



TEXAS REGION 5 AG TRENDS

2019

This document has been compiled from many different news articles and reports. All information contained is directly from these reports. This compilation has been made to aid Texas Migrant Education Program staff to have additional information on trends directly impacting Texas Agriculture. These trends impact the movement of migrant families and youth coming to and from the state.

TEXAS REGION 5 AG TRENDS REVIEW

2019

CONTENTS

TEXAS- WHAT'S GROWING?	
AQUACULTURE	
ALLIGATORS	
BEEF	
COTTON	
FARMERS	
FERAL HOGS	
INTERNATIONAL MARKETS, TARIFFS AND TRADE	
LABOR	
OLIVES	
NURSERY	
PORK	
POULTRY	
RICE	
SHEEP & GOATS	
SOYBEANS	
WATER	
WEATHER AND DISASTERS	

TEXAS REGION 5 AG TRENDS

This document is compiled from many separate sources. No effort has been made to provide one authors voice through the document. Instead the focus is on presenting the articles and reports that summarize the current trends and issues facing the agriculture community in Region 5 of Texas.

TEXAS- WHAT'S GROWING?

AQUACULTURE

Dr. Todd Sink, AgriLife Extension aquaculture and fisheries specialist, College Station, said catfish, a longtime staple for Texas fish production, has experienced a recent decline in pricing and popularity, causing producers to look at other options.

Catfish prices were around 93 cents per pound compared to the high of \$1.35 per pound two years ago. As a result, discerning U.S. consumers are buying less catfish as household wealth and expendable income increase and because other options in the market are perceived as higher quality. Those include salmon, redfish and hybrid striped bass, which are a cross between white and striped bass, he said.

Sink said poor prices and consumer trends have some catfish producers switching at least a portion of production to other species like redfish and hybrid striped bass, which bring higher prices – \$3-\$3.30 per pound and \$3.30-\$3.60 per pound respectively – and are experiencing increased demand.

“It’s fairly clear that consumer tastes are changing from what is perceived as lower-quality fish to higher-end, higher-value fish,” he said. “The cyclical movement on catfish has been downward for a while, so you have a lot of producers looking to diversify with other options that are trending upward in both price and consumer demand.”

Catfish production densities in Texas are around 12,000 pounds of fish per acre compared to 6,500 pounds of hybrid striped bass per acre and up to 8,000 pounds of redfish per acre, Sink said.

Texas is the No. 1 producer of redfish and hybrid striped bass, including around 98 percent of the nation’s redfish production and more than half of hybrid striped bass, Sink said. Established producers continue to expand their capacity to meet demand.

It’s difficult to ascertain redfish and hybrid striped bass production levels because U.S. Department of Agriculture census reports are infrequent, but Sink estimates Texas produces up to 2.7 million pounds of bass and 2.3 million pounds of redfish annually based on their 2013 report and farm expansions since that time.

By comparison, Texas ranks No. 4 in U.S. catfish production with 18.9 million pounds per year.

Several farms are expanding redfish production across Texas with one currently adding 200 acres of production capacity to its operation, which represents a 30 percent increase in overall production, Sink said. Hybrid striped bass production has been expanding at a 3-5 percent rate annually in Texas and southeastern states.

“We don’t expect to see any slowdown in the expansion of both the market and production to meet that market demand over the next five to 10 years,” Sink said. “They’re expanding as they can to supply consumers in a market that is just starting to take off.”

Sink said 90 percent of Texas’ hybrid striped bass production serves demand from high-end restaurants on East and West coasts, while nearly all of the state’s redfish production serves restaurants in large cities such as New Orleans and Houston.

“Producers are getting a premium price for their product, many farms are looking to expand, and some restaurants are operating their own farms just to ensure they can supply their consumer demand,” he said. “Right now they are serving niche markets, so there is room and reason to expand.”¹

Despite much-needed industry advancements, industry growth is still hampered by catfish imported from Vietnam and China.

“When feed costs escalated, our catfish farmers couldn’t pass costs on to the next stop in the supply chain, and it debilitated the industry,” says Avery. “We’re still dealing with the fact that anywhere from 60 to 70 percent of the catfish eaten in the U.S. today are imported.”²

Harvey and Shrimp

Vietnamese fishermen again face large repair bills, devastated industry.

Harvey devastated not only Galveston Bay's marine life but also the tight-knit group of predominantly Vietnamese and Mexican immigrants who ply the normally bountiful waters for a living. It's grueling work that supports a multimillion-dollar seafood industry, puts food on tables and lets Huynh, 57, send his daughters to college.

In a normal year, commercial fishing and seafood processing in the bay would account for more than \$66 million in direct income. But this year, trillions of gallons of freshwater runoff pushed shrimp, fish and crab populations further out into the Gulf and wiped out the prolific local oyster crop.

Even if there were anything left to catch, the Texas Department of State Health Services temporarily closed the bay to commercial fishing, leaving many unemployed for the past month.

The Vietnamese fishermen living along the Texas Gulf Coast are no strangers to hard times. Houston was an official relocation site for refugees from the Vietnam War and its aftermath, and it now boasts the second-largest Vietnamese immigrant population in the U.S.

Many who arrived in the 1970s and '80s settled along the coast and took up jobs catching shrimp, crab and oysters. More than 400,000 died crossing the Atlantic. The survivors rarely discussed the horrors they witnessed.

In Texas, they have survived the Ku Klux Klan and weathered hurricanes and tropical storms. Many still recall how Hurricane Ike destroyed their homes in 2008. They don't divulge too many details

The week after Harvey made landfall, Jannette Diep, executive director of Boat People SOS-Houston, a nonprofit community service group, fielded up to 60 calls a day from fishermen in Anahuac, Galveston, San Leon and Texas City.

She expected questions about government aid. Instead, fishermen and their families overwhelmed her with stories of stress. We can't eat, we can't sleep, they said.

Seeking mental health services remains taboo in the Vietnamese community, Diep said. Yet for hours at a time, immigrants bared all.

¹ Russell, A. (2019). *Texas Aquaculture: Low Catfish Prices Push Producers to Redfish, Bass*. [online] AgFax. Available at: <https://agfax.com/2019/01/21/texas-aquaculture-low-catfish-prices-push-producers-to-redfish-bass/> [Accessed 19 Jul. 2019].

² Robb, B. (2018). *Catfish industry struggles despite research advancements*. [online] Farm Progress. Available at: <https://www.farmprogress.com/livestock/catfish-industry-struggles-despite-research-advancements> [Accessed 19 Jul. 2019].

"I've never seen such defeat on their faces before," Diep said.

Earnings can vary. Primitivo Rojas, 57, who owns an oyster harvesting boat, said he can make about \$5,000 a month during the peak season in the fall. For shrimpers such as Duoc Ngo, 59, late August and mid-September should be prime catching weeks.

Their salvation rests with organizations such as Boat People SOS. One year after Ike, the group secured federal grant money to buy new traps, nets and boat engines. Recovery still took three years, Diep said.

Initial assessments show fishermen are once again in need of new equipment, tools to repair damaged homes and assistance in covering daily living expenses.

The plan is to seek a new federal grant, Diep said. But with recovery efforts underway in Texas, Florida, Puerto Rico and the U.S. Virgin Islands, it's unclear how quickly such funds can be secured, if at all.

Cultural aversion to government debt has dissuaded many from applying for a federal small business loan.

With no crabbing to do, Huynh and his family have been driving into Houston to volunteer with cleanup efforts. "My people have a saying, 'If you worry, you die,'" Huynh said. "All I can do is do good and good times will come."³

Trouble on the Shrimp Farm

A glance at the US consumption data of shrimp indicates there are ample opportunities for investment in this sector. The US imported 1.5 billion lbs of shrimp in 2017, or over 90 percent of total domestic consumption.

Shrimp remains the most popular seafood among Americans, with each person consuming an average of over 4 lbs annually, over 1 lb more than the second most popular – salmon. Yet a closer look shows that behind these tantalizing statistics is an industry marked by low shrimp prices, intense competition against imports, tighter regulations and high mortality rates, to name a few.

Texas is the country's largest producer of farmed shrimp, producing roughly 3.2 million lbs in 2017. Alabama is a distant second, producing a scant 304,572 lbs that year.

"To sum up the Texas shrimp farming industry is to sum up the US industry — it is struggling and facing difficulty at every turn," Granvil Treece, Texas Aquaculture Association board member and aquaculture consultant at Treece and Associates, tells Aquaculture North America (ANA).

"There are only about six or so shrimp producers in Texas that are left. There used to be more, but cheap shrimp imports caused a lot of them to leave shrimp production and move to finfish," Adami says.

In "The Changing US Shrimp Farming Industry 1988 – 2016," Treece, who wrote the report, cited other factors that have been pulling back industry growth. These include low shrimp prices and high feed prices, high mortality rates on most of the farms, post-larval quality and increasing regulations from federal and state governments such as the Environmental Protection Agency, the Texas Commission on Environmental Quality and TPWD.

³ NAJARRO, I. (2017). *Texas Gulf Coast fishing industry struggles*. [online] Morning Ag Clips. Available at: <https://www.morningagclips.com/texas-gulf-coast-fishing-industry-struggles/> [Accessed 7 Aug. 2019].

“A few things have changed in the last few years,” Treece tells ANA. “There have been a few changes in the federal and state regulations of aquaculture. Regulations on all aquaculture, not just shrimp, are getting more cumbersome over time, and there seems to be no reversal of that trend forthcoming.”

“The National Aquaculture Association opposed this and wrote several letters to NOAA, to no avail. The public comment period elicited many negative comments, but NOAA is still requiring this new layer of regulations, which is going to be time-consuming and expensive for farmers who are already struggling to stay afloat.”

Low survival rates, meanwhile, have put farmers on a wait-and-see stance when it comes to the bottom line results. In Texas, the 2017 survival rates of stocked shrimps ranged from 4 to 68 percent. On average, farmers see survival rates of 56 percent, data from TPWD show.

The common practice throughout the country is to grow one crop of larger shrimp to get better price, but late-stage mortality in ponds leads to low survival rates.

One farmer that stands out is Bowers Shrimp Farm because it generally has the best survival rate in the state, says Treece. He says the country’s largest producer of farmed shrimp has found a different formula that’s paying off. “Reed [Bower] has found that two crops of smaller shrimp produce a better survival rate. He puts shrimp into a temperature-controlled biofloc nursery in February and stocks ponds with advanced juveniles as soon as temperatures allow it. He then restocks the nursery for the second crop to be stocked in mid-summer.”

ANA requested the farm owner, Reed Bowers, for comments but he took a raincheck. He was busy putting up a shrimp hatchery.

A confluence of factors has made it imperative for some producers to build their own hatcheries to have access to adequate and quality seeds. They are forced into this “very expensive process in order to survive,” says Treece.

Two farms in Texas have shut down since 2017. “Most small farms make just enough to get by. I know several farmers who want to retire and have put up their farms for sale.”

The lack of awareness among US consumers is also working against the industry. They do not fully understand why locally farmed shrimp is more expensive than shrimp from India, Indonesia, Ecuador and Thailand, the leading exporters to the US.

Treece acknowledged the US government’s assistance “on very rare occasions” to aquaculture producers. One of them was the USDA Trade Adjustment Assistance Program, where he had participated as a business planning specialist. It only lasted a few years and was terminated.

Another was the USDA Marine Shrimp Farming Program at the Oceanic Institute in Hawaii. The program was an integrated multi-state research consortium that developed and transferred “technologies, products, and services necessary for domestic shrimp farming industry to become competitive in the world market.”

The US Congress terminated the program in 2011. What was interesting, Treece says, was what transpired after the program was discontinued. “The Oceanic Institute sold the technology and shrimp bloodlines, paid for by US tax payers, to China,” he says.

He suggested that “some type of tariff” be placed on shrimp from countries that do not have the same level of regulations as US shrimp farmers. The proceeds from the imposed tariff “need to go back to the shrimp farmer

and not the US Government,” he suggested, otherwise those tariffs would only serve to raise shrimp prices for consumers, he said.⁴

The Kobe Beef of Shrimp?

After 18 years and \$35.4 million in development, the founders of NaturalShrimp are convinced shrimp lot No. 180 at the company’s remote Medina County fish-tank complex is their aquaculture pay dirt.

NaturalShrimp is one of the companies trying to prove you don’t need a big body of natural saltwater like the Gulf of Mexico to raise shrimp — that they can grow to commercial proportions in specialized tanks on land. The business’s aim is to deliver fresh shrimp to restaurants and markets far from the sea.

Survival rates at the NaturalShrimp facility are beating expectations and could wind up being well above the 50-percent rate considered notable in the industry. For the first time, workers haven’t had to wade through the tanks with buckets, fishing out floaters.

Investors in the penny-stock company are perking up, with the share price rising 353 percent from Jan. 2 to its Jan. 31 close of 7.7 cents.

But despite the small burst of excitement, Dallas-based NaturalShrimp is just getting started.

The next step is to restock after harvest and add three more 65,000-gallon indoor tanks to the complex. From there, the company will attempt to replicate the process in places far from seawater but a less than a half-day’s drive from metro areas teeming with markets clamoring for chemical-free, never-frozen shrimp.

Or salmon, sea bass, lobster, clams or oysters.

Natural Shrimp’s patent, granted this past Christmas Day — patents are only granted on Tuesdays — covers all aquatic species.

“We know it works — it’s just now ramping up production,” co-owner Gerald Easterling said. “It’s not a concept any more, it’s a reality.”

By “it,” Easterling was referring to a pricey system of pumps, filters and a proprietary device that, after the latest round of tinkering, is in its fifth iteration. It essentially uses selective electrical currents to destroy the bacteria and break up the effluent ammonia that so far have destroyed crop after crop of shrimp — and globally made shrimp farming a shaky proposition.

“It basically sings (shrimp-killing bacteria) and disintegrates it so it’s not able to spread,” said Peter Letizia, CEO of Florida-based F&T Water Solutions, which partnered with NaturalShrimp to develop the technology.

Electrostimulation has been around for more than 100 years, Letizia said, and is commonly used to sterilize surgical equipment. But it’s beginning to expand to commercial agriculture. Letizia also has been working with fruit, vegetable and marijuana growers to test its capabilities as an alternative to pesticides and herbicides.

But the expense and complexity so far has kept the technology from widespread use in food production.

⁴ Gonzalez, R. (2019). *Grim prognosis for US farmed shrimp sector* - <https://www.aquaculturenorthamerica.com>. [online] Aquaculture North America. Available at: <https://www.aquaculturenorthamerica.com/grim-prognosis-for-us-farmed-shrimp-sector-2214/> [Accessed 17 Jul. 2019].

“Trying to just put electricity in water is basically the science, but there is an art behind exactly how do you do it,” he said. “What kind of electrodes do you use? What kind of power source do you use? What kind of spacing? How much volume? There are all those intricacies that take it from a science and make it more like an art.

“NaturalShrimp has it down to where they know exactly how much they can grow a pound of shrimp for, and basically they know how much they can sell it for. So it’s actually a very predictable or predictive market, which is kind of why we like it.”

There’s no doubt of the strong demand for shrimp.

Shrimp is the United States’ top-selling seafood, with the average consumer eating 4.4 pounds of it per year. As ocean stocks have declined from overfishing and pollution, farming it has become a big business, overtaking wild harvesting in 2007.

Traditional shrimp farms are built on coastlines that have a ready supply of saltwater to fill open ponds. Inland shrimp farming has been evolving, but production has mostly been inconsistent and companies have had to stock their ponds at low density due to water treatments that introduce bacteria and cloud the water.

“The reason we’re here, (why) we stayed with it, is we always knew the market and the need,” Easterling said. “What we have here is phenomenal. It answers all the problems in the industry as far as raising aquatic species indoors.”

Texas leads in U.S. shrimp cultivation. But that production has declined, from a 2003 peak of 9 million pounds valued at about \$18 million to between 2.5 million and 2.9 million pounds per year. Texas shrimp farms in 2016 generated revenue of about \$8.3 million.

Aquaculture consultant Granvil Treece said the farms have taken hits from young shrimp not surviving the transport or acclimating to man-made environments. Fewer than half make it to market. Bowers Shrimp Farm, which operates the state’s largest shrimp farm, near Matagorda Bay, had the state’s highest survival rate at 54 percent.

It’s the same for farms around the world. And even when the larvae take, shrimp in all producing countries have frequently succumbed to disease outbreaks. There also are concerns about aquaculture operations damaging estuaries and contaminating natural fisheries with toxic outflows.

A 1999 disease outbreak in Ecuador nearly wiped out that nation’s shrimp farm industry, as well as some 100,000 jobs. Mexico in 2016 suffered devastating losses to disease and premature harvest.

While NaturalShrimp won’t harvest the current tank till mid- to late February, the goal for the 30,000-square-foot facility is 4,000 pounds of shrimp a month. The aim is to produce 7,000 pounds each week once the new tanks are operational, sending truckloads rumbling past neighboring corn, cotton and sunflower fields to buyers like Michael Scott, the corporate chef at Rosewood Texas Raised Wagyu Beef.

Scott first came across the shrimp about a decade ago at a Dallas food show. He has since become a NaturalShrimp shareholder.

“I thought they were Hawaiian blues,” a variety of shrimp, he said. “I walked over, snapped the head off and I bit into the tail raw. ... I said, ‘This is buttery — this is very clean.’ I said this is like the ‘Kobe beef of shrimp.’”

Scott likes that the shrimp aren’t washed with citric acid and sodium for extended shelf life, and haven’t had exposure to water pollutants.

“When I clean these shrimp, we’re not pulling big poop lines out,” he said.⁵

"All aqua-farming companies to date have had no defense against shrimp viral diseases. NaturalShrimp, however, is able to completely eliminate all viral pathogens. Asian aqua-farmers cannot do anything against viral diseases but they have been using antibiotics to prevent bacterial outbreaks. Antibiotics that are used in aqua-farming have dangerous side effects. Recent samples of aqua-farm raised shrimp from India and Thailand tested positive for nitrofurazone, an antibiotic that's a known carcinogen. It was present at levels 29 times higher than those allowed by the FDA. Another antibiotic, chloramphenicol, was detected at levels 150 times the legal limit. It's been banned because of possible severe side effects such as aplastic anemia and leukemia.

"Antibiotic raised shrimp are now being banned from being imported to the U.S. and England because its use can cause the development of antibiotic-resistant bacteria. But even though antibiotic-raised shrimp have been banned, because of the huge volume of shrimp imports, only a small percentage of the imported shrimp can be tested.

"Another problem with imported shrimp is the chemicals that are used prior to shipping them to American and European markets. After being harvested from ponds, or even wild caught, the shrimp are soaked in sodium bisulfite, which slows decomposition, and also slows down melanosis, which causes their shell to blacken. The shrimp are also treated with sodium tripolyphosphate, a re-hydrating agent. Shrimp are 80 percent water, so they tend to dry out during shipping. Both of these chemicals increase the shrimps' sodium level.

"Shrimp is the most widely served seafood in the US and, in fact, is the most traded seafood in the world. According to the Food and Agriculture Organization of the United Nations, the number of fish and crustaceans, such as shrimp, in the world's oceans are steadily declining. There is only a finite amount of fish and shrimp in the oceans and they are being depleted faster than they can be replenished. The amount of ocean-caught seafood leveled off in the 1990s, and the amount of ocean harvested fish has been slowly declining since then.

"Aquaculture will increasingly become the way to meet the demand for fish and crustaceans, as long as a way is found to reliably raise seafood by aquaculture," Mr. Schaefer concludes.⁶

Dangerous Catch

As happens tens of thousands of times each year, a Texas angler walks into a bait shop, fishes a thin cardboard box or plastic bag holding a pound or so of frozen shrimp from the stack in the store's freezer, pays for the bait and heads out for a day of relaxing recreation.

Maybe it's to a beachfront pier or a stretch of bay shoreline where the angler plans to use the shrimp to tempt redfish, drum, whiting or other marine sport fish. Maybe it's to a lake or river, where the shrimp will be used a bait for blue catfish.

As the angler opens the box or bag of bait shrimp, maybe he notices (but probably not) some small printing on the container noting the contents are a product of a country in Asia, Central America or South America. Farm-raised shrimp. No surprise; as much as 90 percent of shrimp sold in this country are non-native species produced in foreign commercial shrimp farms. The frozen foreign shrimp are less expensive than fresh, never-frozen, wild-caught native shrimp, even if not nearly as effective as bait.



⁵ Brezosky, L. (2019). *Updated: Texas-sized shrimp dream at long last proves viable*. [online] ExpressNews.com. Available at: <https://www.expressnews.com/business/local/article/Texas-sized-shrimp-dream-at-long-last-proves-13581032.php> [Accessed 17 Jul. 2019].

⁶ Knopic, P. (2019). *NaturalShrimp: Key To Future Of Shrimp Production*. [online] PR Newswire. Available at: <https://www.prnewswire.com/news-releases/naturalshrimp-key-to-future-of-shrimp-production-300856777.html> [Accessed 18 Jul. 2019].

The angler threads one of the thawed shrimp on a hook, casts it into the water ... unwittingly and certainly unintentionally violating a state law and potentially putting native crustaceans at risk of devastating diseases.

“It’s a situation most fishermen are not aware of, but one that puts fisheries at risk,” Lance Robinson, deputy director of coastal fisheries for Texas Parks and Wildlife Department, said of the sale and use of non-native, farm-raised shrimp as fishing bait. “We’re hoping to educate anglers and bait dealers about that very real risk so they can make informed choices.”

Texas law classifies all Penaeid shrimp (marine shrimp) other than three species native to Gulf of Mexico waters (brown, white and pink shrimp) as “harmful or potentially harmful” and prohibits introducing them or any part of them into state-controlled waters.

Simply casting a hook baited with a non-native shrimp — even one long dead and frozen — into a bay, river or other public waterway is a violation of Texas law and could garner a Class C misdemeanor citation from a Texas game warden. Worse, it threatens to set loose two viruses deadly to shrimp, crawfish and other crustaceans into the ecosystem.

The prohibition on introducing non-native shrimp into Texas waters has two aims: preventing introduction of live alien species of shrimp into Texas marine waters, where they could become invasive species competing with native shrimp, and preventing the introduction of diseases carried by non-native shrimp. Both have the potential to devastate native crustaceans. And the second threat does not require the shrimp to be alive when it hits the water.

Foreign farm-raised shrimp are prone to outbreaks of several virus-caused diseases — a result of crowded and often unsanitary conditions in the aquaculture facilities. Two of the most common are “white spot syndrome virus” and “yellow head virus,” neither of which are native in Texas waters.

The viruses are easily transmitted from infected shrimp to other shrimp and can result in high and often complete mortality of shrimp held in grow-out ponds.

But foreign, non-native shrimp raised in farm operations can be infected with the disease and still live to be harvested and shipped to market.

Humans are immune to the viruses that cause the diseases in shrimp, so the presence of white spot or yellow head virus in shrimp poses no human health threat and does not disqualify shrimp from being sold for human consumption.

But the viruses are virulent to shrimp even after freezing.

“Freezing doesn’t destroy the viruses,” Robinson said. “The risk they pose to live shrimp is still there.”

Bait vendors’ — and anglers’ — attraction to the frozen imported shrimp is understandable. The imported shrimp are much less expensive than wild-caught native shrimp, and they are more reliably available because of the boom in global trade. At least one bait dealer contacted by TPWD said he had an inventory of as much as 10,000 pounds of foreign shrimp; dumping that inventory would be economically ruinous to a small business.

“We heard from a lot of dealers,” Robinson said. Like anglers, most bait dealers have been unaware of the legal and environmental issues involved with using foreign-produced, non-native shrimp for bait.

“The risk is very real,” Robinson said of the threat posed should viruses carried by foreign shrimp be introduced into Texas waters and spread.

That risk is not limited to shrimp.

“The viruses infect crustaceans, and not just shrimp,” Robinson said. “Crawfish are susceptible, too.”

That means any anglers targeting catfish in an East Texas river or stream and using foreign shrimp carrying white spot virus for bait could potentially infect the waterway’s crawfish population. And crawfish are a crucial piece of the finfish forage base as well as whole freshwater ecosystems.

“Every time someone uses those shrimp as bait, it’s a risk,” Robinson said, noting TPWD plans to soon mount an information and education effort on the issue, aiming at anglers and bait dealers.

Robinson recommends anglers look closely at any box or bag of frozen shrimp they consider purchasing for bait. If it has a country of origin label indicating the shrimp are from a foreign country, don’t buy or use it. And if there is labeling, be wary.

“Ask those questions. Where are these shrimp from?” he suggests.

Fresh-dead or even frozen native, wild-caught shrimp are more expensive than the frozen foreign shellfish, but they also are a superior bait. And buying those wild-caught native shrimp supports the Texas commercial shrimpers, bait dealers and businesses who provide them to the state’s two-million or more anglers.

Making certain the shrimp they buy and use as bait are native shrimp might cost anglers a little more, but if it reduced risks to the state’s fisheries (and the angler’s risk of a citation if found using prohibited shrimp), the benefits are well worth that cost.⁷

Shrimp is Stable, for Now

For the 2019 Gulf of Mexico shrimping season, industry members expect the market for their wild product to remain stable for at least the first half of the year while they keep an eye on the effects of farm-raised imports from Asia.

Landings and prices for the last two months of 2018 are not available because of the U.S. government shutdown. But for January through October landings were about 17 percent below averages going back to 2002.

In the first 10 months of 2018, about 83.5 million pounds (headless, shell-on) were landed in Texas, Louisiana, Alabama, Mississippi and off the West Coast of Florida, compared to an average 100.92 million pounds from 2002-17.

“The industry is certainly stable and doing better,” Williams said. “The industry is in a good place. As long as you have someone looking out for it and trying to prevent illegal product from coming in, it will remain stable.”

Williams says the Southern Shrimp Alliance is working closely with federal and state fisheries managers to ensure the U.S. shrimp industry survives by turning back illegal, unregulated and unreported imports. He said the seafood import monitoring program that took effect Jan. 1 establishes a traceability system to determine where products came from, and how they got to the United States from their country of origin.

“We don’t want to stop the imports,” Williams said. “But we want it to be done legally.”⁸

⁷ Tompkins, S. (2019). *That box of frozen shrimp used for bait could be illegal - and deadly*. [online] ExpressNews.com. Available at: <https://www.expressnews.com/sports/outdoors/article/That-box-of-frozen-shrimp-used-for-bait-could-be-13689567.php> [Accessed 17 Jul. 2019].

⁸ Cocking, S. (2019). *Gulf shrimp is stable, but still subject to strength of Asian imports | National Fisherman*. [online] National Fisherman. Available at: <https://www.nationalfisherman.com/gulf-south-atlantic/gulf-shrimp-is-stable-but-still-subject-to-strength-of-asian-imports/> [Accessed 17 Jul. 2019].

On Tuesday, the Fishery Monitoring Branch of National Oceanic and Atmospheric Administration (NOAA) Fisheries' Southeast Fisheries Science Center released shrimp landings data from the Gulf of Mexico for January 2019.

Last month, 2.4 million pounds of shrimp were landed by commercial fishermen in the Gulf of Mexico. This was a significant increase from the 1.9 million pounds of shrimp harvested in January 2018, but still well below the prior seventeen-year historical average for January of 4.0 million pounds.⁹

Labor Woes

[2018] The Texas shrimp industry is facing a shortage of workers due to a federal cap on H-2B immigrant worker visas, and it could cost the industry millions of dollars.

Congress failed this year to renew a cap exemption for returning, foreign workers, which created the shortage in Texas. Andrea Hance, the executive director of the Texas Shrimp Association, said that an estimated 70% of the Brownsville-Port Isabel shrimp fleet will start the season short of workers, [the Brownsville Herald reported](#).

Texas's seafood industry relies heavily on foreign, seasonal labor, and will be short at least 750 workers this year, Hance said. Because of the shortage, the industry will lose \$1 million each day, Hance told [the Associated Press](#).

The H-2B visa program dates back to 1990 as a way to [help non-farm businesses](#) find seasonal workers. There is a cap of 66,000 visas per fiscal year for the whole country. Vox reported that in 2014, most of the workers were [hired by businesses in Texas](#).

"There's been such an increase in demand," Hance told the *Brownsville Herald*. Applications for H-2B visas exceeded 200,000 this year. And for that reason, Hance says the cap isn't going to cut it.¹⁰

It's two weeks in the Shrimp Season and Texas shrimpers are dealing with another worker shortage. Last year about 20% of the Texas Shrimp fleet stayed in Port from a lack of workers. Andrea Hance is Executive Director of the Texas Shrimp Association based in Brownsville. She told *The Texas Standard* that about 8 to 10 percent of the state's shrimp boats are still tied up at docks.

"And those boat owners or captains what happened to them is they don't have enough people to even man the boat, um, so they may only have one other person, well, the boat needs at least three to go out and efficiently operate."

Hance says the Shrimp industry relies on seasonal foreign workers to staff their boats because it's hard to find American workers with the experience and even the desire to do this type of work.

"That U.S. Citizen that has never been on a fishing vessel before that wants off the boat immediately, we have to turn that boat around, travel all the way back to the dock and lift the person off the boat."

According to the Texas Shrimp Association – for the 2017 Shrimping Season, 64 percent of American citizens hired wanted to get off the boat within 2 days.

⁹ Southern Shrimp Alliance. (2019). *Shrimp Landings in 2019 Start Off Above Prior Year Levels - Southern Shrimp Alliance*. [online] Available at: <http://www.shrimppalliance.com/shrimp-landings-in-2019-start-off-above-prior-year-levels/> [Accessed 17 Jul. 2019].

¹⁰ Corbett, E. (2018). *Texas Shrimp Industry Could Lose \$1 Million Each Day Due to Visa Cap*. [online] Fortune. Available at: <https://fortune.com/2018/07/18/texas-shrimp-industry-visa-cap/> [Accessed 17 Jul. 2019].

The industry relies heavily on seasonal, foreign employees, who can legally work on American Shrimp boats if they get an H-2B visa, but for some reason those visas are in short supply this season.¹¹

[2019] Congress has approved an extra 15,000 migrant workers to fill the much-needed demand for people to work the shrimping season, but it looks like there may be a shrimp shortage this year.

Starting in mid-July, the industry has a temporary solution to historic worker shortages, which is a new hurdle for local shrimpers.

Despite having the necessary workers, Congress's solution is a one-time fix meaning, next year they'll be advocating for legislative change.

Experts say they are not anticipating a high production season based on research related to freshwater flow from the Mississippi River, which could mean premature shrimp are flushed into the gulf.

According to the Texas Shrimp Association, the state brings in 40 to 50 million pounds of shrimp with premature shrimp, they expect 20 percent less this year.¹²

Texas shrimpers are optimistic about the upcoming season despite a low catch projection and a recent migrant worker shortage. Andrea Hance, Executive Director of the Texas Shrimp Association says, "We're either going to see a ton of very small shrimp, or not very many shrimp at all."

For the first time in the past three years, the local industry is overcoming a worker shortage. This year congress approves an extra 15,000 migrant workers to fill the much-needed demand.

"We've been using seasonal workers for years. They come from South America and Mexico. They know how to operate a boat. They know how to work on a boat." Says Hance.

Despite having the necessary workers, congress's solution for more workers is a one-time fix. That means that next year they'll be advocating for legislation change.

Hance adds, "We're staying optimistic. We have our workers this year. We're ready, if the shrimp are out there, we are ready to catch them."¹³

The head of the Texas Shrimp Association said it's unclear how much a Trump administration decision allowing another 30,000 foreign seasonal workers into the United States this year will help the state's shrimpers.

The 30,000 extra H-2B visas the government said it will issue are above the usual cap of 66,000 visas per fiscal year — 33,000 the first half and 33,000 the second half. The domestic seafood industry, seasonal hotels, landscaping companies and other businesses rely heavily on the H-2B program to fill positions, though the strong economy is making it harder than usual for employers to find enough workers.

The government's issuance of additional visas is a response to this situation, though Hance said she's not sure Texas shrimpers will benefit since the state's shrimp season doesn't start until mid-July.

¹¹ Smith, C. (2018). *Texas Shrimp Industry Lacks Willing U.S. Workers*. [online] Red River Radio. Available at: <https://www.redriverradio.org/post/texas-shrimp-industry-lacks-willing-us-workers> [Accessed 17 Jul. 2019].

¹² NBC (2019). *Texas could see a shortage of shrimp this year*. [online] KGNS. Available at: <https://www.kgns.tv/content/news/Texas-could-have-a-shortage-of-shrimp-this-year-512176632.html> [Accessed 17 Jul. 2019].

¹³ Cuadros, A. (2019). *A Shortage of Shrimp*. [online] Available at: <https://www.kveo.com/news/a-shortage-of-shrimp/> [Accessed 17 Jul. 2019].

“We still don’t know for sure if 30,000 is going to be enough, especially in our industry because our season falls so late in the year,” she said. “Usually we get the bottom of the barrel, so to speak, the last ones available. We’re just hoping that the 30,000 is going to be enough.”

It’s an improvement over the last two years, when the government raised the cap by only 15,000 visas each year, Hance said. This year, the 66,000 workers allowed in under the normal cap are already spoken for, she noted.

The additional visas will be granted only to returning foreign workers who have had them over the last three fiscal years, many of whom return to the United States for the same jobs each year. Most of the H-2B visa holders who work in the Texas shrimp industry, which includes processing plants as well as boats, are from Mexico and Central America.

Hance said the workers are experienced and prepared for the rigors of spending a month or more at sea aboard a trawler.

“You’re staying away from your family for 30 to 45 days,” she said. “It’s a tough sell.”

Some critics of the H-2B visa program contend that it takes jobs away from Americans, though Hance said finding U.S. citizens willing to crew shrimp boats is next to impossible, and the few that are willing often have no experience. That creates a dangerous situation because commercial fishing is extremely hazardous, she said.

A survey of shrimp fleet owners conducted in the last few years found that 96 percent of inexperienced season workers wanted off the boat in the first week, while 64 percent never finished their first 30-day trip, Hance said. Shrimp boat owners can’t keep crew members at sea against their will, though bringing them back to shore can cost thousands of dollars in lost production and fuel, she said.

“We know these (foreign workers) have experience,” Hance said. “They do their jobs, pay taxes and go back home.”

Texas’ seafood industry is very small and uses less than 1,000 workers total, though a shortage of foreign seasonal workers is crippling, she said.

“It’s costing us \$1 million a day during peak season, the entire industry, all because of a handful of workers,” Hance said.

Acting Homeland Security Secretary Kevin McAleenan said on Monday that the additional visas are only a temporary fix and called on Congress to figure out a permanent solution.

Hance agrees.

“We’ve been fighting for a permanent fix to the program and this is still just another Band-Aid,” she said. “We were hoping for (another) returning worker exemption that would allow the workers to come over without being counted in the cap. We weren’t successful in obtaining permanent legislation, so we’re still fighting the fight on that.”¹⁴

¹⁴ Clark, S. (2019). *Shellfish Industry Eyes Visas*. [online] Brownsville Herald. Available at: https://www.brownsvilleherald.com/news/local/shrimp-industry-eyes-visas-another-seasonal-workers-to-be-allowed/article_59084c84-704a-11e9-b6c4-93cee67a3c3f.html [Accessed 17 Jul. 2019].

Water Woes: The Dead Zone

Just off the coast of Louisiana, where the Mississippi River lets out into the Gulf of Mexico, an enormous algae bloom, fueled by fertilizer from Midwestern farm fields and urban sewage, creates an area so devoid of oxygen it's uninhabitable to most marine life every summer.

Nutrients like nitrogen from fertilizer and phosphorus from sewage act as a catalyst for algae growth. While algae are the base of the food chain for some fish, when these green plumes proliferate beyond what fish are capable of eating, their decomposition consumes much of the oxygen in the water.

This year, historic rains and [flooding in the Midwest have roiled farm fields](#) and overwhelmed sewer systems, flushing a tremendous amount of nutrients into the Mississippi River and into the Gulf, spurring a remarkable amount of algae. While the agricultural runoff from farms — exempted under the Clean Water Act — is the main driver of the Gulf dead zone, Chicago's sewage is the largest single source of phosphorus pollution.

Climate scientists say this issue is only expected to get worse in the future as [a wetter climate in the Midwest](#) — specifically one characterized by heavy rainfall in the winter and spring — creates more runoff.

"From a runoff point of view, it's actually the worst-case scenario to get more heavy rain," said Jim Angel, former Illinois state climatologist. "Those are the ones that really flush out the system. If you have a generally wet period, it doesn't have much of an impact on the system. If you get 2-inch, 4-inch rainfall events on saturated soils, you get the major flushing of the nutrients and get soil erosion as well. You're really sending Illinois farmland down the river."

This week, scientists with the National Oceanic and Atmospheric Administration and several research universities announced that the so-called dead zone in the Gulf of Mexico is projected to be around 7,800 square miles, roughly the size of Massachusetts, the second largest on record behind 2017.

As in past years, the ensuing dead zone is expected to result in widespread die-offs and migration, influencing the region's fishing and shrimping industry.

"The fish that can move leave the area," said Don Scavia, an aquatic ecologist at the University of Michigan and collaborator on the NOAA forecast. "The organisms that live in the sediment — one of the main food supplies for the fish — can't. They die. There's been videography down there showing dead organisms, but most shrimp and fish that can swim completely leave the area. There are implications for that. The energy it costs the shrimp to leave the area tends to make them smaller. They aggregate in areas that make them easier to catch, so there's the threat of overfishing. The fishing fleets have to go farther away to find them." "

Just like climate change, there's no one thing that is going to fix the algae apocalypse," said Josh Mogerman of the Natural Resources Defense Council, a nonprofit with offices in Chicago.¹⁵

Forecasters at the National Oceanic and Atmospheric Administration say the so-called dead zone is the result of agricultural activity, which courses through the Mississippi River Delta and spawns a massive bloom of algae that kills marine life. The buildup happens every summer, but researchers predict this year the dead zone could be as large as 8,766 square miles — roughly the size of the Commonwealth of Massachusetts.

NOAA says higher than average amounts of rainfall along the river's watershed could make this year's dead zone especially aggressive.

¹⁵ Briscoe, T. (2019). There's a giant dead zone in the Gulf of Mexico — thanks in large part to pollution from Chicago. [online] Chicago Tribune. Available at: <https://www.chicagotribune.com/news/breaking/ct-met-dead-zone-gulf-of-mexico-midwest-20190612-story.html> [Accessed 17 Jul. 2019].

And, the agency warns, larger masses of algae could continually form each summer as heavy rainfall becomes the norm over much of the region and Texas, in particular.

NOAA's director of National Centers for Coastal Ocean Science, Steve Thur, said that was also a central finding in a multiagency climate assessment and that the rain could increase the dead zone, known in science speak as a "hypoxic zone."

"The assessment predicts an increase in the frequency of very heavy precipitation events in the Midwest, Great Plains, and Southeast regions, which would impact nutrient input to the northern Gulf of Mexico and the size of the hypoxic zone," Thur said.

The forecast, however, is just that: a forecast. Thur said it's possible the model, which also uses data from the U.S. Geological Survey, could overestimate the mass of the algae bloom in the Gulf, as it did last year. But, while the dead zone was smaller than anticipated last year, it was because the bloom was jilted by an overactive hurricane season.

NOAA expects this year's Atlantic Ocean hurricane season to follow a similar pattern.

NOAA has previously found these dead zones lead to stunted growth in Gulf shrimp. That ecological impact becomes an economic one for shrimpers, who haul in smaller shrimp, which net less money.¹⁶

First came Hurricane Katrina, the 2005 monster storm that devastated her small fishing community in Plaquemines Parish before roaring up the Gulf Coast, killing more than 1,800 people and destroying \$125 billion in property. Five years later, BP's Deepwater Horizon drilling rig exploded 40 miles offshore, spewing nearly 200 million gallons of crude. The fisheries have not fully recovered more than nine years later, nor has her family.

But this year may be worse. A historic slow-moving flood of polluted Mississippi River water loaded with chemicals, pesticides and human waste from 31 states and two Canadian provinces is draining straight into the marshes and bayous of the Gulf of Mexico — the nurseries of Arnesen's fishing grounds — upsetting the delicate balance of salinity and destroying the fragile ecosystem in the process. As the Gulf waters warm this summer, algae feed on the freshwater brew, smothering oxygen-starved marine life.

Fishermen and state government officials agree this long, hot summer may go down in history as one of the most destructive years for Gulf fisheries. The torrent of river water pushing into Gulf estuaries is decimating crab, oyster and shrimp populations. The [brown shrimp catch](#) this spring in Louisiana and Mississippi is already down by an estimated 80%, and oysters are completely wiped out in some of the most productive fishing grounds in the country, according to state and industry officials. The polluted freshwater has also triggered algae blooms, which have led to [beach closures](#) across Mississippi.

[Mississippi](#) and [Louisiana](#) have already started the process of requesting federal disaster assistance for damaged fisheries. But it will likely be a long while before any money reaches the fishermen whose nets are coming up empty. To officially apply for disaster relief, Louisiana state officials say they need more data, which will take months to compile.

"We are seeing impacts across the coast in all sectors of the fishing communities," said Patrick Banks, assistant secretary for the Louisiana Department of Wildlife and Fisheries. "We will continue to collect data to support a disaster declaration."

¹⁶ Andrew Weber, K. (2019). *Coming To A Gulf Of Mexico Near You: A 'Dead Zone' The Size Of Massachusetts*. [online] Houston Public Media. Available at: <https://www.houstonpublicmedia.org/articles/news/texas/2019/06/11/336394/coming-to-a-gulf-of-mexico-near-you-a-dead-zone-the-size-of-massachusetts/> [Accessed 17 Jul. 2019].

It's not just fisheries that are suffering. Dolphins have been dying in huge numbers across the region — nearly 300 this year already, which is three times the number in a normal year, according to federal and state officials. Fishermen report finding dead dolphins floating in water near shore or beached in the marshes, covered in painful skin lesions that scientists have linked to freshwater exposure. One fisherman reported finding a mother dolphin pushing her dead baby along in the water.

“Their skin looks like a Brillo pad,” said Louisiana charter boat captain George Ricks, who heads the Save Louisiana Coalition, a coastal management advocacy organization.

Ricks and many other fishermen blame the unprecedented deluge of freshwater pouring into the Gulf. The Bonnet Carre, a huge spillway that protects New Orleans, has already opened an unprecedented two times this year to divert surging Mississippi River water and is currently pouring more than 100,000 cubic feet per second into Lake Pontchartrain. Being able to close the spillway again depends on rainfall upriver.

The Army Corps of Engineers operates the spillway and says it has no choice but to keep it open to protect property upstream. The Corps argues that some of this flooding can be beneficial to the ecosystem. “The introduction of fresh water during leakage events simulates the natural cycle of overbank flooding and provides numerous ecosystem benefits to the aquatic and terrestrial resources in the spillway,” the [agency notes](#) on its website.

But some marine biologists say the flood of freshwater can be catastrophic for species such as bottlenose dolphins, which are very territorial and are reluctant to leave their spawning grounds even when salinity levels become toxic. Endangered species like Kemp's ridley turtles are also threatened by river water exposure, since they depend on rich Gulf marshlands to grow and develop.

“We are experiencing a Cat 5 aquatic hurricane,” said Dr. Moby Solangi, director of the [Institute for Marine Mammal Studies](#) in Mississippi. Dolphins are particularly vulnerable to incursions of river water, he said. “Every time they open the Bonnet Carre spillway, we see a spike in deaths.”

Solangi's team recently found a stranded dolphin on a Gulfport beach, breathing slowly and covered in freshwater lesions. It died a short time later.

“Dolphins are like the black box found on airplanes,” Solangi said. “They tell you what's happening in the environment. When dolphins are doing well, the environment is doing well.”

By all accounts, the Gulf marine environment is not well. Scientists predict the [annual dead zone](#) — a giant blob of polluted, deoxygenated water linked to algae blooms — will grow to the size of Massachusetts and suffocate even more marine life later in the Gulf this summer.

“The Army Corps of Engineers says we had the most rainfall in 124 years,” said Joe Spraggins, executive director of the Mississippi Department of Marine Resources. “Shrimpers and crabbers are struggling. Oystermen are almost nonexistent. ... It's not going to get better soon.”

“I've had grown men call me on the phone and cry,” said Arnesen, who serves on the board of the [Louisiana Shrimp Association](#) and works on state coastal management issues. “This feels like the height of the BP oil spill.”

But many fishermen who have worked in these areas for generations suspect something else is threatening their future: politics. As part of a plan to save Louisiana's rapidly sinking coastline, state agencies want to pump in more sediment-heavy river water to help rebuild the disappearing land. Fishermen question the efficacy of freshwater diversions and worry about the dangers to fisheries and marine life posed by these projects. They question why [NOAA would grant waivers](#) to Louisiana last year to bypass the Marine Mammal Protection Act and allow the freshwater diversion construction to proceed.

Meanwhile, fishermen know a changing climate is not working in their favor. [Scientists say](#) the Mississippi River is expected to continue to flood in future years as the atmosphere heats up and produces stronger storms and more rainfall. Barry, the storm heading for the coast right now, is the latest to threaten the Gulf ecosystem, but certainly not the last.

All of this worries Acy Cooper, a fourth-generation fisherman and president of the Louisiana Shrimp Association who is leading a delegation of fishermen to Washington this month to plead their case for disaster assistance. He blames the Army Corps for not adequately managing the river and controlling and dredging the river passes that empty into the Gulf, making the effects of freshwater worse.

But his biggest worry is for his family and future generations. He comes from a long line of fishing families who have prospered and persevered in one of the most bountiful fisheries in the world, and he doesn't want to be the last.

"My sons can't make enough to feed their families," he said. "What's going to happen to them?"

Arnesen worries about this as well.

"If we keep operating like this, we're going to kill the estuaries and the oceans, yet they still dismiss us," she said. "Our fish feed America. That should matter to everyone."¹⁷

The enormous "dead zone" in the Gulf of Mexico will take decades to recover even if the flow of farming chemicals that is causing the damage is completely halted, new research has warned.

Intensive agriculture near the Mississippi has led to fertilizers leeching into the river, and ultimately the Gulf of Mexico, via soils and waterways. This has resulted in a huge oxygen-deprived dead zone in the Gulf that is [now at its largest ever extent](#), covering an area greater than the state of New Jersey.

A new study has found that even if runoff of nitrogen, a fertilizer chemical, was fully stemmed, the Gulf would take about 30 years to recover. Even this scenario is "not only considered unrealistic, but also inherently unsustainable", researchers stated in the work, [published in Science](#).

"We have been building up nitrogen for the past 50 years and it will take time to go through the system," said Nandita Basu, associate professor of environmental sciences at Canada's University of Waterloo and the study co-author.

"Money is being spent on the landscape in an ad hoc way. We need to focus better. If we make the right changes it will have an impact, it's just that it'll take a few decades. It's like when you go on a diet – you can't expect results right away."

The ailing Gulf of Mexico is emblematic of a global suffocation of the oceans caused by modern agriculture, sewage and climate change, which is causing waters to warm and hold less oxygen. At least 500 sites experiencing [hypoxia](#), or oxygen deprivation, [have been reported near coasts worldwide](#), up from just 50 in 1950. The true number may, in fact, be much higher, experts believe.

Fertilizers spilling into the oceans promote the growth of algae, which can trigger toxic blooms harmful to fish, shellfish, marine mammals and birds. These outbreaks can discolour water and befoul beaches. It also depletes oxygen in the water, leading to further damage to marine creatures and dwindling supplies for the people who rely upon them for food.

¹⁷ Kistner, R. (2019). *There's An Environmental Disaster Unfolding In The Gulf of Mexico*. [online] Huffington Post. Available at: https://www.huffpost.com/entry/mississippi-louisiana-gulf-coast-environmental-disaster_n_5d262c42e4b0583e482b28ed [Accessed 17 Jul. 2019].

In the US, a [federally led taskforce](#) set a goal of shrinking the Gulf's dead zone to less than 5,000 sq km by 2015. However, the hypoxic area was three times that size by the target year, prompting the deadline to be pushed back to 2035.

There is also an interim goal of cutting nitrogen flow to the Gulf by 20% by 2025, but that too looks in peril.

“That short term 2025 goal, based on the course we're on now, isn't really possible,” said Kim Van Meter, a colleague of Basu's and a fellow co-author. “It would take an immediate change and it takes time for that to happen. The legacy of nitrogen in the system means that it will take decades.”

Nitrogen pollution can be [curbed](#) with a more careful application of fertilizers, the planting of certain grasses, trees and shrubs that can stop the chemicals getting into waterways and reducing the amount of tilling of the soil, to prevent soil erosion and runoff.

Some US farmers are given governmental support in these efforts, although environmentalists argue that funds have been wasted on projects that merely help farms to increase production of crops and meat, rather than tackle pollution.

“This study shows we need a scientific strategy and can't expect instant results, but we know what needs to be done to improve things,” said Denise Breitburg, a marine scientist at the Smithsonian Environmental Research Center who was not involved in the report.¹⁸

The global meat industry, already implicated in driving [global warming](#) and deforestation, has now been blamed for fueling what is expected to be the worst “dead zone” on record in the Gulf of Mexico.

Toxins from manure and fertilizer pouring into waterways are exacerbating huge, harmful algal blooms that create oxygen-deprived stretches of the gulf, the Great Lakes and Chesapeake Bay, according to a new report by [Mighty](#), an environmental group chaired by former congressman Henry Waxman.

Nutrients flowing into streams, rivers and the ocean from agriculture and wastewater stimulate an overgrowth of algae, which then decomposes. This results in [hypoxia](#), or lack of oxygen, in the water, causing marine life either to flee or to die.

Some creatures, such as shrimp, suffer stunted growth. Algal blooms themselves can cause problems, as in Florida last summer when several beaches [were closed](#) after they became coated in foul-smelling green slime.

America's vast appetite for meat is driving much of this harmful pollution, according to Mighty, which blamed a small number of businesses for practices that are “contaminating our water and destroying our landscape” in the heart of the country.

The Mighty report analyzed supply chains of agribusiness and pollution trends and found that a “highly industrialized and centralized factory farm system” was resulting in vast tracts of native grassland in the midwest being converted into soy and corn to feed livestock. Stripped soils can wash away in the rain, bringing fertilisers into waterways.

Arkansas-based Tyson Foods is identified by the report as a “dominant” influence in the pollution, due to its market strength in chicken, beef and pork. Tyson, which supplies the likes of McDonald's and Walmart,

¹⁸ Milman, O. (2018). 'Dead zone' in Gulf of Mexico will take decades to recover from farm pollution. [online] the Guardian. Available at: <https://www.theguardian.com/environment/2018/mar/22/dead-zone-gulf-of-mexico-decades-recover-study> [Accessed 17 Jul. 2019].

slaughters 35m chickens and 125,000 head of cattle every week, requiring five million acres of corn a year for feed, according to the report.

This consumption resulted in Tyson generating 55m tons of manure last year, according to the Environmental Protection Agency (EPA), with 104m tons of pollutants dumped into waterways over the past decade. The Mighty research found that the highest levels of nitrate contamination correlate with clusters of facilities operated by Tyson and Smithfield, another meat supplier.

This pollution has also been linked to drinking water contamination. Last week, a report by [Environmental Working Group](#) found that in 2015 water systems serving seven million Americans in 48 states contained high levels of nitrates. Consuming nitrates has been linked to an increased risk of contracting certain cancers.

The US is an enormous consumer of meat, with the average American chewing through 211lbs in 2015. A [study released earlier](#) this year found that US beef consumption fell by nearly one fifth from 2005 to 2014, possibly due to concerns over health or the environment. A new increase is now expected.

[According](#) to the US Department of Agriculture, beef and pork production is forecast to grow significantly over the next decade, driven by lower feed costs and healthy demand. By 2025, the average American is expected to eat 219lbs of meat a year. Just [3%](#) of Americans follow a vegetarian or vegan diet.

A Tyson spokeswoman said “we don’t agree with the group’s characterization of our company but share its interest in protecting the environment.”

“It’s true the livestock and poultry industry is a major buyer of grain for feed, however, the report fails to note that a large percentage of corn raised in the US is used for biofuel and that a significant portion is used for human consumption,” she added.

“Tyson Foods is focused on continuous improvement. We are constantly looking to improve and lead the industry, so that we can deliver sustainable food to people every day at a scale that matters to the world.”¹⁹

Oysters

Texas oyster reefs are under threat, and so are local fishermen’s livelihoods and way of life.

It’s the first day of Texas oyster season, and Galveston Bay is packed with so many boats that 33-year-old Captain Joaquin Padilla decides to post a video of them on Facebook, adding a side-eye emoji as comment. Padilla has been on the water with his little crew since sunup, steering his boat, the *Miss Kosovare*, in languid circles, dragging his dredge—a chain and metal basket about the size of a basking shark’s mouth—over the oyster reefs below. His is one of about 150 trawlers out this November day, harvesting bivalves from the limited wild reefs on the bottom of Galveston Bay, right in Houston’s backyard.

The fishermen are worried about the future. They know they have a rough season ahead.

They know the state, charged with protecting the threatened, finite resource that is our public reefs, has opened only 14 of the 34 shellfish classification areas along the Texas coast in the aftermath of Hurricane Harvey, which has reduced the oyster population significantly. East Galveston Bay, a huge area where 150 boats typically could work for six months easy, has lost practically every single oyster.

This morning they’ve been fishing what the state calls TX 7, a portion of Galveston Bay that is, for the moment, full of market-sized oysters. But 150 boats on a two-by-two-mile stretch of water, not all of which is covered in

¹⁹ Milman, O. (2017). *Meat industry blamed for largest-ever 'dead zone' in Gulf of Mexico*. [online] the Guardian. Available at: <https://www.theguardian.com/environment/2017/aug/01/meat-industry-dead-zone-gulf-of-mexico-environment-pollution> [Accessed 17 Jul. 2019].

oyster reef, is a lot of boats. How long the open sections will be able to provide three-inch oysters—the legal size for harvestable specimens in public waters during public season, which runs from November 1 to April 30—is anybody’s guess.

For some weeks, the oystermen’s luck holds. Even with fewer areas open, Padilla and his team consistently pull in their daily limit of bags, and with demand peaking over the holidays, money keeps rolling in. Fishing Monday through Friday in TX 7, Padilla is making about \$1,500 a week. Relieved, he gets his three sons iPhones for Christmas and springs for the pricey makeup on his 16-year-old daughter’s wish list.

It doesn’t last. January brings ice storms and freezing weather. The reefs in TX 7 start to show major signs of strain from all the holiday demand.

Once again, they and the rest of the state’s oystermen are caught in an all-too-familiar struggle to harvest legalized bivalves amid a dwindling supply, which has marred each six-month oystering season for the past decade. Well before the season ends, they know, the oysters will run out entirely, the result of various factors, including a litany of natural disasters, only the latest of which was Harvey.

The oystermen believe part of the problem is mismanagement on the part of the state: Texas, they say, is opening and closing the wrong areas, although officials dispute that. Through mid-February, TX 7 remains open, while other areas around Galveston Bay are closed, a decision Padilla disagrees with. “The state should’ve closed TX 7 by Christmas,” he tells us later, “to let those little bitty oysters grow out, but they waited.”

Inevitably, some boats begin eyeballing a closed area in the bay, TX 5. The oystermen maintain that there’s no reason to keep it closed, that there are plenty of good bivalves in those waters.

The pressures are getting to a lot of the guys, Padilla explains. Fishermen are a tightknit, self-policing community, but only to an extent. Sometimes, the need to make a living supersedes the need to follow the rules. Padilla tells his buddies to stay out of the closed sections until the game wardens choose to open them. If they don’t listen, well, they don’t listen.

And for as far back as he can remember, he tells us, there have been oysters in Galveston Bay, “oysters like crazy.”

Sadly, that’s changing. Yes, the Gulf Coast region—composed of Texas, Louisiana, Mississippi, Alabama, and Florida—is the leader of America’s \$217.2 million dollar industry, producing 44 percent of all oysters consumed in the country each year, with the bulk of that production coming from Texas and Louisiana. And the Texas oyster industry itself has a \$50 million impact on the state economy annually. But the resource has declined over time, part of a downward spiral worldwide.

“There are predictions that globally, we’ve lost 85 to 91 percent of oysters around the world,” says Texas A&M University–Corpus Christi marine biology professor Jennifer Pollack, who studies the bivalves in the bays surrounding Corpus Christi, “and 50 to 85 percent of all oyster habitat here in Texas.” When you harvest an oyster, she explains, you’re taking away its habitat with it, which is bad news for bays, wetlands, and even the coast, since reefs act as natural barriers against big storms.

In 1999, a high-water mark for the industry, fishermen harvested 6.13 million pounds of oysters, not including shells, in Galveston Bay, about 95 percent of the 6.4 million pounds harvested in Texas that year. But since Ike hit in 2008, the bay’s production has never topped more than 3.5 million pounds in a year. In 2016 fishermen harvested just 709,408 pounds out of the bay. While overall Texas still had a strong harvest in 2016, providing 3.1 million pounds of oysters to enthusiasts, that’s a far cry from the 1990s and early aughts.

For a cautionary tale about the desolation that could descend upon the Texas coast, consider what’s already happened in New York Harbor and Chesapeake Bay. Both were considered America’s essential oyster hubs until, more than a century ago, they were decimated by overharvesting, disease, and pollution.

New York closed to oyster fishing in 1906, its oyster beds nonexistent. Chesapeake Bay went from producing 20 million bushels of oysters in the late 1800s to having three quarters of its natural oyster reefs disappear by the 1920s. Today in the Chesapeake, oysters are only at 1 percent of their peak historic level, and there’s little hope of

them ever growing there again—except for genetically engineered (and sterile) triploid oysters harvested in man-made cages.

Texas, home to Galveston Bay’s massive reefs, built up over centuries, is one of the last states that still harvest oysters from natural beds. The *Crassostrea virginica*, the bivalve found in our waters (as well as in the Atlantic), has been a bountiful delicacy in the bay since before settlers arrived. The Karankawas supplemented their diet with the plump, briny wonders. By the 1880s, Texas was the only state that shipped oysters by train to other regions, which was when the first oyster houses—or firms, as they were called—were established here.

Our oysters thrive in saltwater estuaries that have a freshwater inflow, and serve the dual purpose of filtering the bay. In fact, oysters are pretty magical. Not only can they change their sex, they can sequester carbon from the atmosphere to help curb air pollution, and even mitigate nitrogen produced by wastewater treatment plants. Natural oyster reefs are like big old family trees, composed of granddaddy and grandma oysters at the base and younger generations attaching themselves on top. Reefs near shore are safe harbors for juvenile shrimp and crabs, and conservationists consider them to be more valuable than sea grass.

A 2017 economic impact study prepared for Galveston County by Martin Associates reported that between seafood processing and commercial fishing, Galveston Bay brings in more than \$66 million in direct personal income and about \$111 million in direct business revenue each year.

Like any other seafood—say, red snapper—the bivalves on public beds are protected by Texas Parks & Wildlife. Size limits allow both to grow. But while snapper can swim, oysters can’t, which makes them even more vulnerable. As Tracy Woody of Jeri’s Seafood in Smith Point, one of the top oyster dealers in the Texas market, puts it: “They can’t just run and hide.”

It’s TPWD’s job to balance the conditions that must be maintained for a healthy population with the needs of the multimillion-dollar Texas oystering industry, and the Texans who’ve made their living fishing oysters for generations.

This task has gotten increasingly difficult over the past decade, as Galveston Bay has faced numerous setbacks—or, as Lance Robinson, deputy division director of the Texas Parks & Wildlife Department’s Coastal Fisheries, describes it, “a series of cumulative impacts.”

Over the past decade, Texas oysters have endured everything from hurricanes to floods to drought.

In 2008 Hurricane Ike dumped so much silt, sediment, and debris into Galveston Bay that the oysters on more than 8,000 acres of reef, roughly half the reefs in the bay, suffocated to death. Seemingly overnight, the bay went from supplying 80 percent of Texas oysters each year to just under a third. While the reefs were easily destroyed by the storm, it has taken years, and more than \$70 million, to rebuild just 1,400 acres of these devastated oyster beds. It will take an estimated \$330 million over decades—yes, decades—to recover.

Then, just two years after Ike, the Deepwater Horizon blowout sent crude oil gushing into the Gulf off the coast of Louisiana. Texas bays came through relatively unscathed, but as Robinson explains, “Every other state in the Gulf was closed from that event *but* Texas, so we had increased pressure and harvest. We also had a drought in that time frame.”

The drought, from 2011 to 2015, was one of the worst in Texas history, resulting in too-salty waters, a calling card for parasites, disease, and oyster drills—small, predatory snails that like to stab oysters in the back and eat them from the inside out.

“It was like pulling dredge on a parking lot,” remembers Misho Ivic of Misho’s Oysters, one of the largest oyster dealers in Texas. “Snails ate everything.”

Meanwhile, oysters that weren’t devoured by predators were being contaminated by red tide and other toxic algae blooms that thrived in warm, salty water. Starting in 2011, Texas Department of State Health Services officials not only delayed the start of the season but closed off sections hit by these algae spores, in an effort to keep people from getting sick. Then came 2015 and 2016, and the massive floods that brought in too much fresh water, *again* destabilizing the oysters.

This time there appeared to be a bright side. Yes, flooding kills oysters, but it also ultimately can help reefs in the long run, cleansing them of predators and disease brought on by high salinity while leaving shells intact. These shells, in turn, attract babies, or spat, providing plenty of hiding spots for them to grow big and market-sized with a lesser chance of predation.

Unfortunately, many didn't stand a chance as, last August, a storm called Harvey arrived, dumping more than 33 trillion gallons of fresh water, most of which ended up in the bays and estuaries. Padilla and his family initially came through the hurricane fine—he spent the days afterward rescuing people stranded in the floods—but the industry lost millions, as populations growing in many of Galveston Bay's reefs were cut in half or worse.

At first some thought the state wouldn't open the bay to oystering season at all. In those first weeks after the hurricane, oystermen, scientists, and wardens hit the water, checking on mortality on public and private reefs. Padilla went out and pulled up some oysters on Prestige Oysters' leases, just to see how the reefs had fared. He and his deckhands sorted through dozens of bivalves, firing the half-open shells of dead ones back into the water. They found only four live ones. But that was only one part of the bay.

By November it became clear that some oysters on public reefs had survived and grown to market size. The good ones were soon scraped off the beds, though.

When you take into account all these stresses, it's not surprising that the quality of the Texas oyster has waned while the price has doubled over the past 20 years. In 2000 dealers paid an estimated \$2.24 per pound for oyster meat at the dock. In 2016 they paid about \$5.50, and as of December of last year, they were paying \$6.20, according to Robinson. Today prices are the highest the industry has seen since Texas Parks & Wildlife first started recording the annual rates back in 1972. Houston-area restaurants have increased prices accordingly: In 2004 longtime local food critic Robb Walsh wrote about enjoying Texas oysters at downtown restaurant Joyce's for \$6.95 a dozen. Today the same plate is \$14.95.

Part of the problem is the oystermen themselves, TPWD's Robinson explains, because when good-sized bivalves aren't available, some have not shied away from bending the rules to fill their sacks. After Ike, many got into the habit of loading up their bags—which typically hold 110 pounds, roughly 250 to 300 oysters—with as much as half their contents composed of dead shell or undersized bivalves.

This practice does damage. Dead shell is crucial for the reefs because it serves as a substrate for the next generation of oysters, while harvesting undersized oysters too early means they can't spawn and repopulate the bay. "Oyster dealers came to the department and said, 'We've got a problem here,'" Robinson says.

Robinson has been with TPWD for 27 years, working out of Galveston Bay for 20 of those as a field biologist and regional director. He says it's quite common for oyster-industry leaders to voice their opinions and push for regulations and change. "It's one of the fisheries in Texas that's the closest to co-management as we see. There is a lot more dialogue. They understand there are issues out there." That doesn't mean all parties always see eye to eye, though.

"Everyone wants more oysters," adds Pollack, the marine biologist at A&M. "I go to wildlife commission and stakeholder meetings. We're all engaged. But it's hard to figure out what the path forward is."

In 2016 stressed oystermen started prospecting in areas they'd never fished before: intertidal reefs, the shallow reefs along the edge of bays that stick up out of the water when it's low tide and are imperative to the health of numerous species and our wetlands. Sixty commercial fishermen at a time might be wading around on those reefs to harvest oysters. The state immediately closed the areas.

"It opened people's eyes," says Pollack. Texas has now restricted fishing on any oyster reef within 300 feet of the shore.

In 2017 the state ramped up regulations even more and increased penalties—a move that's good for the oysters, but *hard, hard, hard*, says Padilla, on fishermen like him. Oystermen now have to pay larger fines if they're caught with a sack containing over 5 percent undersized shell, up to \$500. If it's over 30 percent, everybody on board can face even steeper fines, license suspensions, even jail time.

"The penalty is like driving drunk," says Woody of Jeri's Seafood. "They'll throw you in jail. We're talking about small oysters, and I believe that's a little harsh." But nothing else has worked to curb the problem.

“Nobody wants to get in trouble,” adds Padilla. “You try to do your best.”

“When you’ve got new people, it’s really hard to not get a ticket,” he says.

Back in 2005, state officials announced they were going to put a moratorium on any new oyster licenses in Texas. The idea was to reduce the number of boats drawing on the public reefs each year. But the move backfired. The ban sent people into a last-chance-scenario buying mode during the yearlong window before it went into effect, putting licenses on just about anything that floats—someone even tried to put one on a jet ski. The number of licenses skyrocketed from 350 to 760, the opposite of the new rule’s intended effect.

Today there are still 557 commercial oyster-boat licenses and 465 oyster-boat captain licenses in Texas, numbers that are still too high. Last year the state implemented a license buyback program to alleviate stress on the water, in addition to other measures, including reducing limits from 40 to 30 sacks, closing reefs to commercial harvest on Saturdays, and requiring dealers to return 30 percent by volume of shucked shell from each sack to help rebuild public reefs.

Controversially, Texas has also introduced a new measure requiring boats to be outfitted with vessel monitoring systems (VMS), which use GPS technology to track boats and bust any that fish on closed waters or poach from private leases.

But while these systems could be key to curbing overharvesting in the future, the state currently has no funding to utilize the new tool. That’s right: Texas requires the boats to have VMS, but can’t afford the satellite technology needed to operate it. Instead, the state continues to rely on wardens to hand out citations, but there are only 12 patrolling the waters between Galveston and Chambers counties, and they can’t be everywhere at once.

The oystermen themselves are divided on VMS. Prestige Oysters’ Raz Halili is for it, but his own fisherman, Padilla, doesn’t think it’s the answer. Instead, Padilla says, the state should listen to fishermen’s concerns and take into account their input on what’s fished out, while opening other areas. But what would keep fishermen from overfishing those as well?

“That is the argument,” says Ivic of Misho’s Oysters. “If fishermen respected area 5, the state would open it.”

In fact, this year by mid-January, the state already had evidence of fishing in that exact area even though it hadn’t opened. Scraped reef. Broken shell. The tell-tale signs of dredging and culling.

Texas uses a science-based threshold to determine if an area has enough sustainable market-sized oysters to open. If it falls below a certain mark, the state closes the area until the oysters can grow to adequate size, which could be years.

“Our position is, those oysters belong to everyone in the state of Texas,” says Robinson, “and it’s our goal to manage them in a prudent and sustainable method.”

Some oystermen continue to insist the real problem is that the state is opening the wrong beds. Boats started avoiding Copano Bay this season, Padilla tells us, even though it was open, because nobody wanted to fish there for fear of getting a ticket.

“Why not open other areas that have market-sized oysters?” Halili adds. “What’s the point of keeping them closed? What’s the point of having this system of harsh penalties, if you know there’s an area of market-sized oysters? I don’t understand that.”

Tracy Woody of Jeri’s Seafood says his own lack of trust in the state to protect the resource is the reason why, in 2014, he and his now-deceased father-in-law created Sustainable Texas Oyster Resource Management (STORM), with the goal of preserving it through private enterprise.

While most of Texas’s rich oystering tradition was built upon its 49,000 acres of public beds, since the 19th century, oystermen have also fished on private leases, of which today there are just 43, covering more than 2,300 acres of reef, all located in Galveston Bay. Since the state placed a moratorium on these leases in the 1980s, they are now controlled by just a few people, including Woody and the Halilis, both of whom also own Texas’s largest oyster-processing facilities.

Leaseholders put millions of dollars back into the bay, building up their private reefs, which they typically harvest after the public season is over. For loyal fishermen like Padilla, who leases the *Miss Kosovare* directly from the Halilis and sells only to them, this means a way to make money year-round.

Which is why most oystermen found STORM to be suspect from the beginning. Woody founded the initiative after discovering a bill of sale dating back to 1957 revealing, he maintains, that the state had sold 23,000 acres of submerged land to the Chambers–Liberty Counties Navigation District, including about 2,900 acres of public beds and 452 acres of private beds already leased by his competitors, the Halilis and Ivic among them.

“Parks and Wildlife went and leased to those folks across the bay—the others—land that the state had sold and no longer owned,” Woody argues. “It’s basic property law.”

After informing the Navigation District that it owned this underwater land, he leased it from them with the intention of managing it. He then sent out notifications to the other leaseholders warning them not to trespass on his property.

Not surprisingly, Woody’s competition saw the effort as an attempt to corner the market. “It was half the bay,” says Halili, whose family had spent millions building up private reefs in Chambers County. Lawsuits were filed, and last fall a Galveston district judge sided with the state, dismissing Woody’s claim on the leases (he has said he’ll appeal). Woody continues to insist private enterprise is the solution.

The camaraderie among local oystermen, long a tradition, took a hit.

When fishermen travel, they must cover their personal expenses, and even when they’re not bringing in sacks, they still have to pay for boat leases and maintenance while taking care of costs back home. Many don’t enjoy it.

Back in Galveston Bay, Texas Parks & Wildlife has decided not to open TX 5 at all this season. The agency won’t even start testing it again until fall of 2018, so if another flood comes through, it’s possible all of its market-sized oysters will die. That’s a risk TPWD is willing to take to protect the resource. The fishermen, of course, are disappointed. Galveston Bay is pretty much done for the season.

“We had a guy come up and want to sell his boat and his license,” says Halili. “Done it for most of his life. But it was too difficult with the new regulations and the travel. He’s not interested.”

Although official numbers won’t be out until the end of this month, Padilla thinks this has been the worst season he’s ever seen, and he’s convinced the next two years will be identical, with only a few reefs opening while baby spat grow out in closed areas. He is hopeful, at least, that the oysters are coming back.²⁰

Muscling in on Oyster Farming

Oysters can seem endless in their quantity. Restaurants serve plate after plate of them on the half shell, and in marinas they cluster on bulkheads and moorings like an afterthought. Despite the appearance of abundance, this beloved Texas fishery is in a historic decline.

Dr. Joe Fox, a 40-year veteran of mariculture, thinks the state is overdue for an oyster revolution.

“We used to have hundreds of miles of shell roads and piles of oyster shells three stories high on the shores of Nueces Bay, but production has been sliding and it’s volatile,” said Fox, Harte Research Institute for Gulf of Mexico Studies (HRI) Chair for Marine Resources Development and Professor of Mariculture, Environmental Science, Coastal & Marine System Science.

Destructive fishing practices and a string of natural disasters have led to a steep decline in oyster production in Texas, with the annual harvest plummeting by 41 percent since 2010.

A large percentage of oysters on local restaurant plates come from outside the state – about 90 percent of U.S. seafood is imported.

²⁰ Knapp, G. (2018). *The Texas Oyster Industry Is Now a Shell of Its Former Self*. [online] Houstonia. Available at: <https://www.houstoniamag.com/articles/2018/4/24/texas-oyster-industry> [Accessed 17 Jul. 2019].

Other coastal states have supplemented their production with oyster mariculture to the tune of \$270 million annually.²¹

And now, Texas has a new industry. Oyster farming will be legal in Texas as of September 1 now that Gov. Greg Abbott has signed House Bill 1300 into law. The bill by Coastal Bend Rep. Todd Hunter (R-Corpus Christi), includes Texas in a growing industry that state law historically prohibited. Texas was the only coastal state in the United States that did not allow oyster farming.

Currently, commercial oyster aquaculture rakes in \$173 million a year nationwide, according to NOAA figures. Add in the harvest of wild oysters, and the figure jumps to \$217 million a year.

The Texas portion of that has been shrinking over the years due to hurricanes and years of drought followed by too much rain. In 2008, Hurricane Ike wiped out half the oyster population in Galveston Bay, the state's most profitable oyster fishery. In 2017, Hurricane Harvey just about finished off the industry.

Only allowed to harvest from natural reefs, the Texas oyster industry is also hurt by the short season: November 1-April 30. When waters are warm, wild oysters spawn, which turns the meat mushy and undesirable.

Farmed oysters are a sterile variety called triploids that do not spawn and can be harvested year-round. They are fatter and more consistent in size than wild oysters, too, while still retaining that distinctive Texas Gulf Coast flavor.

The Texas Gulf Coast will reap environmental as well as economic benefits, according to supporters of the bill. Oyster farms will join natural reefs in filtering saltwater, helping prevent coastal erosion and protecting wildlife habitat.

The Texas Parks and Wildlife Department has started developing the rules and regulations for operating oyster farms in the state.

Despite the jumpstart — the governor signed the bill into law even before the Legislature adjourned on Memorial Day — it will most likely take until 2021 before the first farmed oysters are shucked in a restaurant. Once a farm is set up, it takes eight to nine months for the oysters to develop the proper eating size and quality.

Farmed oysters are grown in cages suspended on poles. The cages float in the water and are manually rotated to optimum conditions. The final product is a meaty oyster grown in a teacup-shaped shell.

According to the research center, Texas has about 1.5 million acres of water that could be used. Only about 2,000 acres in production would double the state's current harvest.²²

Fox is hoping to jump-start the industry and support Texas oyster producers, fishermen and restaurants with the launch of a major new program at HRI.

It's not just economic — oysters are traditionally harvested from public fishing grounds by dredging, which destroys the sea bottom as it brings up its catch. Reefs can be lost, and so are the benefits they provide as habitat for popular sportfish, protection for the shoreline, and a natural filtration system for coastal waters. Oyster mariculture takes fishing pressure off these natural reefs with oysters grown in cages so that they can be easily removed and harvested. They still provide environmental benefits without the economic damage to the habitat.

Fox secured funding for three new projects: two oyster hatcheries and a demonstration project. These facilities will conduct research and grow oysters, but more importantly, they will help support and train a new Texas workforce.

The largest of these projects will be the Texas Oyster Resource and Recovery Center in Palacios. Funded by the RESTORE Act and environmental fines paid out after the Deepwater Horizon oil disaster, the center is a

²¹ Texas A&M University-Corpus Christi. (2019). *Turning the Tide on Oyster Mariculture in Texas*. [online] Available at: <https://www.tamucc.edu/news/2019/06/turning-the-tide-on-oyster-mariculture.html#.XS8zfk7mUk> [Accessed 17 Jul. 2019].

²² Freeman, S. (2019). *Texas Muscles in on Oyster Farming*. [online] Corpus Christi Business News. Available at: <https://www.ccbiznews.com/news/texas-muscles-in-on-oyster-farming> [Accessed 17 Jul. 2019].

partnership with Texas A&M AgriLife Research. Researchers will grow oyster larvae to support reef restoration and train a local workforce in oyster cage culture.

HRI will also partner with AgriLife to operate a research oyster hatchery in Flour Bluff funded by the Texas A&M University System Chancellor's Research Initiative, and build a demonstration project of about 180 mariculture cages that will grow oysters in Matagorda Bay with the help of federal fisheries disaster relief money from Hurricane Harvey.

"Texas is way behind the curve, but we have a chance to provide real coastal resilience," Fox said. "This is an economic driver in other coastal states. There's also an extremely large benefit to bays and estuaries. It's a no brainer."²³

To help combat the steep decline of Texas' oyster population, the Nature Conservancy will carry out two oyster reef restoration projects in 2019, using a new approach that aims to benefit both the marine ecosystem and commercial industry.

A 50-acre oyster reef will be built in Galveston Bay, using a \$2.5 million grant from the BP oil spill restoration fund. While a 60-acre, roughly \$5 million reef, will be built in Copano Bay, near Rockport, using different settlement money.

"Right now we're at a critical point where there is a significant amount of funding that is available — billions of dollars will be spent on Gulf restoration over the next 15 years through the BP oil spill mitigation funds," said Lily Verdone, the Director of Freshwater and Marine at the Nature Conservancy's Texas Chapter. "So there's tremendous opportunity to reverse oysters' decline in the Gulf of Mexico."

An estimated 50-85% of the Gulf of Mexico's original oyster reefs have disappeared, according to a recent report by the Nature Conservancy. In addition to the Deepwater Horizon oil spill, other factors like over-fishing and hurricanes have also contributed to the population decline.

"Although historically there were reefs and a lot more diversity in the marine life in these areas of the Gulf, right now we're going out there and pulling up samples and not finding oysters, just mainly a lot of mud," Verdone said.

The two reefs will use a new approach: half of each will be a protected marine area, while the other half will be designated for commercial harvesting.

"The idea is that each site pairs both the habitat and the commercial harvestable reefs together to help restore the Gulf ecosystem, while helping revive Texas' commercial oyster fishery," Verdone said. "This methodology is not just great for Texas, but it can be used and replicated throughout the Gulf."

'Unsung Heroes': Why Protecting Oysters Matters

Though bivalves might not seem like the most exciting sea creature, they have significant impacts on the marine ecosystem and beyond.

"We like to think of oysters as the unsung heroes of our ocean," Verdone said. "They support habitat for diversity of marine life, reduce shoreline erosion, buffer storm waves and sea level rise, and really without oysters our coastal ecosystems break down."

Oysters also improve water quality — one adult oyster can filter around 50 gallons of water a day.

And from a commercial perspective, oysters contribute around \$40 million to the Texas economy annually.

What's Next?

The reefs will be built using limestone boulders to mimic what the historic reefs were like in the area. "The idea is to create some structure in the water where oysters will be able to attach onto and then the reef will develop," Verdone said.

²³ Texas A&M University-Corpus Christi. (2019). *Turning the Tide on Oyster Mariculture in Texas*. [online] Available at: <https://www.tamucc.edu/news/2019/06/turning-the-tide-on-oyster-mariculture.html#.XS8zfd7mUk> [Accessed 17 Jul. 2019].

The portions designated for commercial harvesting will use smaller pieces of limestone to make harvesting easier. The [oyster reef in Copano Bay](#) is already in the pre-construction phase with full construction slated for the winter. The project will then take about six to eight weeks to complete.

Construction for the Galveston reef will begin in mid-2019, and be carried out in conjunction with the National Fish and Wildlife Foundation, Texas Parks and Wildlife, and the Galveston Bay Foundation.

After construction is complete, the reefs will be closed for two years until there are harvestable sized oysters, according to Verdone.

“At the same time it’s open, we’ll have the protected reef that will then allow for more oysters to spread out through the Gulf and create more habitat,” she said.²⁴

While Hurricane Katrina grabbed national headlines for devastating New Orleans, Louisiana, in August 2005, it was actually Hurricane Rita, a few weeks later, that wrecked the Texas coast, dumping all kinds of freshwater on oyster beds.

Salinity levels not only impact the tastes of an oyster. They also matter to their survival. Oysters typically need a salinity level of at least 8 parts per thousand to survive and experience their highest growth rates at a level greater than 20 ppt, according to [The Virginia Oyster Gardening Guide](#).

In 2008, Hurricane Ike buried nearly 8,000 acres of the state’s oyster reefs in Galveston Bay with a suffocating sediment and, in 2010, the Deepwater Horizon oil spill damaged oyster beds off the coasts of Louisiana and Florida, putting more pressure on Texas’ diminished oyster population.

From 2010 until 2014, Texas saw the second worst drought in its history, reducing freshwater inflows into the bay and driving up salinity levels. Salinity levels reached 42 parts per thousand in Galveston Bay, the highest level recorded in 40 years of monitoring by the state. The conditions promoted a better habitat for such oyster predators as the Hays rocksnail, aka “oyster drill,” blamed for killing 80% of young oysters.

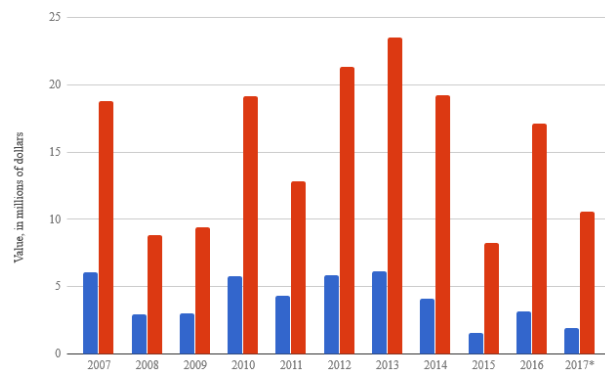
Then 2015 and 2016 brought the opposite problem, record-setting rainfalls and too much freshwater, followed by overfishing and the illegal fishing of undersized oysters.

Texas went from producing 6 million pounds of oyster meat worth nearly \$19m in ex-vessel sales in 2007 to one that accounted for just 1.6m lbs in 2015 worth \$8.3m, according to state records.

Because of their recent struggles, the Texas oyster industry hasn’t been able to fully capitalize on a recent surge in the market, driven largely by the increasing consumption of higher-priced, half-shelled, farmed oysters at bars and restaurants with all kinds of fun names like “Naked Cowboy”, “Fat Bastard” and “Skinny Dipper”.

It used to be that roughly half the oyster market was dominated by half shells, Rheault said. Now it’s more like 60% to 70%, he said.

Texas oyster landings and their ex-vessel value



*2017 values up to June only. Source: Texas’ Parks and Wildlife’s Coastal Fisheries Division

²⁴ Watkins, K. (2018). *How Two New Projects Aim To Boost Texas’ Declining Oyster Population (And Why It Matters)* | Houston Public Media. [online] Houston Public Media. Available at: <https://www.houstonpublicmedia.org/articles/news/energy-environment/2018/12/10/314883/how-two-new-projects-aim-to-boost-texas-declining-oyster-population-and-why-it-matters/> [Accessed 17 Jul 2019]

Oysters have become “merroir”, a play on the French word terroir, used to describe how wine might derive its taste from where its grapes were grown, explained Chris Rubino, a purchasing agent for Elkridge, Maryland-based seafood dealer J.J. McDonnell.

J.J. McDonnell advertises 70 different kind of oysters as available on its [website](#), including many from as far away as New England and Canada, but none on the page are from the gulf.

There is a demand for gulf oysters, Rubino told *Undercurrent*. It’s just not easy to find them right now.

Also like wine, prices for oysters range widely, said Rubino, who noted that some West Coast oysters are going for as much as \$1.50 each.

Raz Halili said he has noticed prices as high as \$75 for a bushel of gulf oysters since Harvey. “I am doing all I can to keep our prices from rising to an extreme,” he said.

A price of about 40 cents per oyster is more the norm in the gulf.²⁵

ALLIGATORS

Charlie Harris and his wife, Jana, have owned and operated the East Texas gator and Wildlife Park for nine years and say the number of gators in East Texas continues to grow.

"As the years go by, there are more and more of them," Harris said.

That's why he said visitors to area's lakes and ponds should always keep their eyes peeled for gators, especially because they are "opportunist eaters."

Harris said that "they will lay around and wait for something to come close enough that they can handle and grab it."

Gators typically won't pursue humans, particularly adults, because of their size. However, if you are close enough, they will bite.

Harris explained that "in water, they can swim up to 25 miles per hour. On land, they can run up to 20 miles per hour. So if you get close enough, and he wants ya, he'll have ya."²⁶

Amos Cooper knows exactly when Texas’ half-million-plus alligators begin their annual springtime mating season.

“The phones start ringing off the hook — people calling to report they saw an alligator in their yard, a ditch, a pond or crossing a road, and wanting someone to do something about it,” said Cooper, Port Arthur-based alligator program leader for Texas Parks and Wildlife Department.

Those phones are ringing, now, Cooper said, with Houston-area TP&W offices getting “10-15 calls a day, and sometimes a lot more,” from worried folks who have spotted one of the tens of thousands of gators crawling across the landscape in search of a new home territory, a mate or both.

Those calls say a lot about Texas’ alligator population and the public’s lack of knowledge about these native reptiles.

²⁵ Huffman, J. (2017). *Texas oyster industry braces for more bad news*. [online] Undercurrent News. Available at: <https://www.undercurrentnews.com/2017/09/12/texas-oyster-industry-braces-for-more-bad-news/> [Accessed 17 Jul. 2019].

²⁶ Tyler Morning Telegraph. (2016). *East Texas alligator population rising*. [online] Available at: https://tylerpaper.com/news/local/east-texas-alligator-population-rising/article_67db16c3-852c-5d98-a591-9021555d6805.html [Accessed 19 Jul. 2019].

“I’m always a little surprised that so many people are shocked when they see an alligator,” said Cooper, who has spent 30 years working with alligators and coordinating the state’s alligator management programs. “They’re not exactly rare in this state.”

No, they aren’t. Only Louisiana and Florida hold more wild alligators than Texas.

Texas’ alligator population, which numbered just a few thousand when they were protected by state and federal laws in the late 1960s, has exploded over the past half-century. The 22 Texas counties with the highest concentrations of alligators (so-called core alligator counties in southeast Texas and along the upper and middle coast) hold at least 500,000 gators, Cooper said.

“And that’s a low-end, conservative estimate,” he said.

Over the past decades, the reptiles have reclaimed much of the native range from which they’d been extirpated. Alligators have been documented in 127 Texas counties, half the counties in the state, Cooper said.

“You’re likely to find alligators anywhere east of Interstate 35,” Cooper said. “If you’ve got water — a river, pond or lake — you’ve probably got gators.”

And Interstate 35 isn’t a boundary for the reptiles. Alligators have been recently documented in the Guadalupe River above Canyon Reservoir, the upper Brazos River system and even farther west, in areas where the reptiles haven’t been seen in a century, if ever.

That range expansion is a function of what Texans are seeing this month. May is the peak of the alligator mating season, a time when lots of alligators are on the move.

During the mating season, adult male alligators become very territorial, staking out a large area of habitat that holds several female gators. Young male gators, and many smaller female gators, are forced to relocate; the dominant males brook no trespassers and will kill (and eat) smaller gators.

This annual scramble of young gators looking to settle in new, unoccupied habitat is what expands the reptiles’ range and finds them in suburban yards, canals, ditches, stock tanks, reservoirs and in the path of oncoming vehicle traffic.

Most alligators shy away from any interaction with humans, especially those encountered in the reptile’s native habitat. And attacks by Texas alligators on humans are almost unheard-of; there have been only a handful of alligator-related injuries and only one death documented in the state.

Texas anglers and others who spend time in alligator habitat during the mating season sometimes encounter male gators that will approach a boat it sees as intruding on its territory. In those instances, Cooper advises simply giving the gator some room.

Hunting opportunities

While most people do their best to avoid alligators, some seek them out. Texas’ thriving, expanding alligator population supports a two-part alligator hunting season, with one of those seasons set during spring.

Since 1984, Texas has held an annual alligator hunting season each September in counties holding the highest gator populations. In the 22 so-called core counties, alligator harvest is regulated through issuance of tags to landowners.

But since 2007, the state has allowed a spring season in all counties outside those 22 core counties. The season, which runs April 1-June 30, allows a person holding a Texas hunting license and hunting on private property to take one alligator per license year, with strict requirements on reporting the take and obtaining a federally required tag from TP&W.

“It’s a way to offer opportunity to use a renewable resource,” Cooper said of the spring season.

The spring season usually sees hunters take about 200 gators from non-core counties, Cooper said. And many of those gators come from areas of the state many would not associate with large gator populations.

“Our alligator population in Texas is excellent,” said Cooper, noting good habitat conditions created by abundant rains. “They’ve been a success story.”²⁷

2015 PETA Investigation

Workers at an East Texas alligator farm “tortured and cruelly killed” animals by cutting into fully conscious alligators and leaving severely injured, but still conscious, animals to suffer and die in ice water bins, according to a [2015] PETA investigation.

Following an investigation into the the Lone Star Alligator Farm late last year, PETA sent a detailed complaint to Chambers County Sheriff Brian Hawthorne in February alleging numerous violations of state animal cruelty laws.

“Obviously, we’ve never received this kind of complaint before,” Hawthorne told the Houston Press. “We are a rural county. Two-thirds of our land is ranches and farms, sort of like that alligator farm.”

First, Hawthorne and his investigators had to get familiar with alligator slaughter. Lone Star Alligator Farm, which last year killed more than 15,000 alligators, according to the annual report of the company that owns half the farm, kills the animals when they reach about one year old. Standard practice is to knock the animal unconscious with a bolt gun to the head, right behind the eyes, sort of like a livestock. Once the animal is unconscious, farm workers slice into the alligator’s neck with a box cutter, severing the animal’s major blood vessels. Then the alligator is hung upside down for several minutes to exsanguinate before its carcass is thrown into an ice bath. The dead alligators stay in ice water bins for about a day before being skinned.

Sheriff Hawthorne says his investigation largely confirmed PETA’s allegations. “I will tell you we found no real contradiction with the PETA complaint,” he said. Among other claims, PETA’s complaint alleged that still-conscious alligators were often killed because workers either misplaced the bolt gun or the device wasn’t working properly.

At one point in their investigation, PETA claims, a bolt gun on the farm wasn’t working properly, so a manager just told workers to slaughter the alligators “by cutting into the animals, just behind the skull, and between adjacent vertebrae, and then turning the knife blade 90 degrees before driving a pithing rod towards the animals’ brains.” PETA investigators claimed they saw workers “stab and cut into approximately 60 fully-conscious alligators behind the base of their skulls.”

Hawthorne says he turned his investigation over to the local district attorney’s office, which recently presented an animal cruelty case to a Chambers County grand jury. On Thursday, that grand jury cleared Lone Star Alligator Farm workers of any wrongdoing.²⁸

²⁷ Tompkins, S. (2016). *There are gators galore in Texas*. [online] ExpressNews.com. Available at: <https://www.expressnews.com/sports/outdoors/article/There-are-gators-galore-in-Texas-7947073.php> [Accessed 7 Aug. 2019].

²⁸ Barajas, M. (2016). *PETA Targets East Texas Alligator Farm*. [online] Houston Press. Available at: <https://www.houstonpress.com/news/peta-targets-east-texas-alligator-farm-7547925> [Accessed 19 Jul. 2019].

BEEF

East Texas Cattle are a Family Heritage

Generally, east Texas is not considered cow country in comparison to the western, northern and southern areas of Texas.

A yearly normal rainfall average of 35 to 60 inches gives east Texas a moist climate which promotes good grazing habitat.

The east Texas economy is supported by cattle, timber, minerals, industry and tourism, with poultry as an important contributor. Cattle ranches vary in size and types of operations, and many have been owned and operated by five and six generations of family.

Julie David is an only child and the fifth generation of her family to raise cattle. The first ancestors were more farmers than ranchers, but that changed through the years. Chance David is from Louisiana, and his ancestors were originally farmers but started ranching in the early 1930s. The Davids have cattle on both sides of the Texas-Louisiana line. They love what they do, and they are good at it.

Since drought has become more of a norm in Texas than an occasional event, Chance and Julie are breeding drought resistance into their cow-calf herds.

Chance purchased an African Watusi bull at a Florida auction and is breeding it to Brahman cows. He is also crossbreeding Texas Longhorns and Brahmans.

“I feel that both the Watusi and Longhorn complement the qualities of the Brahman,” says David. “The crosses exhibit improved heat tolerance and are good browsers.

“They can live and produce on what is in the pasture, regardless of whether it’s grass, weeds or brush. These cattle don’t require as much water as our other cattle. They are excellent cattle for drought areas.”

Four ranches were visited across the center part of east Texas from the Louisiana border to the Trinity River. Although the ranches differ in size and types of beef cattle enterprises, they are all operated by sixth-generation and seventh-generation family.

Other commonalities include detailed record-keeping with a close eye on the bottom line, use of Brahman influence to produce environmentally adapted cattle, good land stewardship and a love for family and the cattle business. Yes. East Texas is cattle country with a deep heritage.²⁹

A Global Agreement

Global Affairs Canada posted a [joint statement](#) announcing that the United States and Canada have agreed to eliminate, no later than May 19, all tariffs the United States imposed on imports of aluminum and steel products from Canada and all tariffs Canada imposed in retaliation.

This would include removal of the 10% tariff Canada imposed, beginning in July of last year, on prepared beef items imported from the United States. Canada is the fourth-largest market for U.S. beef and first quarter exports

²⁹ Fears, R. and Fears, J. (2013). *Cattle are a family heritage in east Texas*. [online] Progressive Cattle. Available at: <https://www.progressivecattle.com/features/regional-features/cattle-are-a-family-heritage-in-east-texas> [Accessed 18 Jul. 2019].

were down 14% in both volume (23,199 mt) and value (\$143.8 million). Canada's imports of the U.S. beef products affected by the 10% duty fell by about \$20 million (or 16%) from July 2018 through March 2019.

"This is also excellent news for the U.S. meat industry, as it will mean restoration of duty-free access for all U.S. red meat to Canada and Mexico," Halstrom added. "Elimination of these duties also removes a major obstacle for the U.S.-Mexico-Canada Agreement, which is a very important trade agreement for U.S. agriculture."³⁰

Harvey Scattered Cattle

[2017] Texas ranchers are scrambling to relocate cattle from massive flooding spawned by Tropical Storm Harvey, with many hauling livestock up to the north of the state while others rush to move the animals to higher ground nearby.

About 1.2 million cattle are located in a 54-county disaster area drenched by Harvey, which made landfall as a hurricane last weekend. With more torrential rain in the forecast, ranchers are expressing worry that some animals could perish despite efforts to save them.

Chuck Kiker, who raises cattle on his farm near Beaumont, about 60 miles (96 km) northeast of Houston, opted to leave his animals in place but was caught off guard by the storm's severity.

"You can't move animals at this point, so you're kind of stuck because of high water everywhere. There's really no place to move them," he said.

Texas Governor Greg Abbott has declared 54 counties a disaster area. About 27 percent of the state's 4.46 million-head beef cow herd is in those 54 counties, according to Texas A&M University livestock economist David Anderson.

Longer-term concerns for the cattle include foot rot from standing in water or muddy fields for long periods and the risk of disease from mosquitoes.³¹

BEES AND HONEY

Many US commercial honeybee colonies are part of migratory beekeeping operations. Some of the beekeepers I work with keep their bees in Texas all year. Some beekeepers only bring their bees out of state for almond pollination or for honey production. But most follow an extensive migration route that includes Texas, the Dakotas and California (and for some beekeepers, indoor wintering sheds in Idaho).

After five months here in Texas, I still get surprised by the accuracy of the saying "everything is bigger in Texas." First of all, it is bigger in terms of beekeeping. In spring, early pollen sources provide the protein for each colony to build up bee numbers early in the season, which allows beekeepers here to divide their colonies more aggressively and still make good honey crops. After spring splitting, the number of colonies in Texas is likely to top 300,000.

³⁰ USMEF (2019). *Mexico and Canada remove retaliatory duties on US products, including beef – Texas and Southwestern Cattle Raisers*. [online] Texas and Southwestern Cattle Raisers. Available at: <http://tskra.org/mexico-and-canada-remove-retaliatory-duties-on-us-products-including-beef/> [Accessed 18 Jul. 2019].

³¹ Waters, T. and Plume, K. (2017). *Harvey's floods scatter cattle in Texas, swamp cotton fields*. [online] Reuters. Available at: <https://www.reuters.com/article/us-storm-harvey-cattle/harveys-floods-scatter-cattle-in-texas-swamp-cotton-fields-idUSKCN1B92QD> [Accessed 18 Jul. 2019].

Here, as in a lot of places, human-induced changes have a huge influence on beekeeping. The Chinese Tallow Tree (introduced as an ornamental in the 1700s and widespread on the Gulf Coast by the 1900s) provides an intense early-summer honey flow, especially in East Texas near the Gulf of Mexico.

With a long warm season when the bees are raising brood, Texas also has a very long “mite season,” during which parasitic *Varroa destructor* mites can reproduce in a honey bee colony. That is a primary concern for beekeepers outside of Asia, Australia, and parts of the tropics. It is especially important to keep an eye on the levels of mite infestation when the mite season extends to include nearly the whole year.³²

Hives on the move

Almond bloom comes nearly all at once in California — a flush of delicate pale blooms that unfold around Valentine's Day.

In early February, drivers along Interstate 5 through California's agricultural center in the San Joaquin Valley might see, interspersed among endless rows of almond trees, thousands of white boxes, each holding a beehive. Behind this postcard image is the underlying story of how these bees got there and why. Each box represents two things. First, a long journey across the country for a colony of honeybees. Second, a unique — and potentially revolutionary — symbiosis between America's migratory beekeeping industry and California's expanding almond industry.

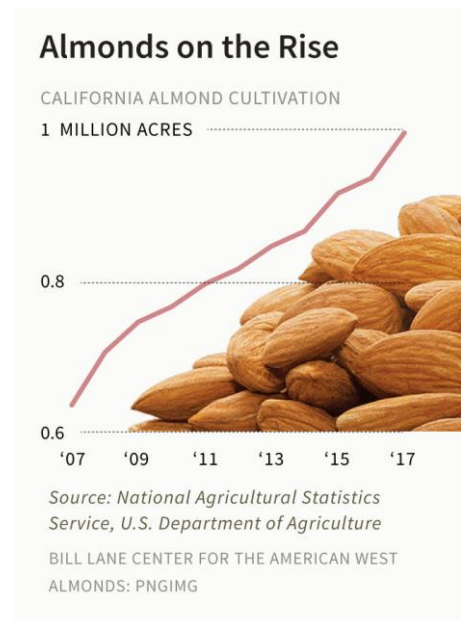
Almonds are California's most important crop, valued at \$5.33 billion in 2015. Their blooming period is the earliest and one of the shortest among California crops. It begins in late January and lasts less than a month.

Every year, the arrival of the bees to pollinate almond flowers in California orchards — primarily in five counties between Los Angeles and the San Francisco Bay Area — marks the start of a brief frenzy of activity. It is the world's largest pollination event.

A recent report published by Scientific American, titled [“The Mind-Boggling Math of Migratory Beekeeping.”](#) details the mechanics of this road-show honeybee business. The nearly yearlong routes they take around the nation begin in Texas or Florida at the beginning of the year. From here, they are loaded into the beds of semi-trucks and moved to California's almond orchards around Valentine's Day. They stay for less than a month, then spend the rest of the spring and summer traveling up the West Coast or toward the Dakotas. Finally, they head South and East to rest before beginning the cycle again.

The time they spend in California is particularly important. Around [85 percent of all commercial colonies in the United States](#) visit California's almonds.

The Scientific American article's subheading takes a particularly pessimistic perspective on the relationship between almonds and bees: “31 billion honeybees plus 810,000 acres of almond trees equals 700 billion almonds—and one looming agricultural crisis.” But experts like Jay Evans and Gordon Wardell, who spent their careers working toward bee development and health, challenge the premise that the almond industry and migratory beekeeping together represent a “looming agricultural crisis.”



³² Aurell, D. (2017). *Everything is Bigger in Texas*. [online] Bee Informed Partnership. Available at: <https://beeinformed.org/2017/10/16/everything-is-bigger-in-texas/> [Accessed 17 Jul. 2019].

They paint a very different picture, arguing that the blooming of millions of almond trees and the transcontinental movement of millions of bees does not put the bees at particular risk; instead, it has made the two industries “kind of co-dependent,” according to Jay Evans, a bee health researcher with the USDA. Because the bees are essential to the success of an almond crop, is in the interests of the almond growers, he said, to ensure the honeybees’ health. And they are trying to do so, Evans said: growers and beekeepers work each other and with the scientific community “to find [agricultural] methods that are safe for honeybees.”

Data indicates that these efforts have been partially succeeded: commercial honeybee populations numbers have not only remained constant, but have actually increased slightly in recent years. This is thanks to, in part, the relationships between the almond grower and the scientific communities, which have produced projects like Seeds for Bees, providing growers with supplemental nutritional forages to plant in their orchards. These supplemental plants are where bees can feed before and after the almond bloom and boost bee health as well as crop yield.

Scientific studies conducted on insecticides and fungicides have also informed almond growers’ efforts to make their orchards attractive and safe for migratory honeybees. The Almond Board’s guidebook, Best Management Practices, compiles this research in a list of safe growing methods which circulates throughout the almond grower community.

Collaboration between the scientific community and almond growers has been the goal of Gordon Wardell, a bee researcher for the U.S. Agency for International Development, the Nature Conservancy, and most recently, [the Wonderful Company](#), a Los Angeles-based agricultural and industrial conglomerate. Operating at the nexus of almond growing and beekeeping, Wardell, affectionately known as “Gordie” by many in almond and honeybee circles, has insisted on autonomy in his work to allow him to make the almond industry the safest crop for bees.

In his former position as the Wonderful Company’s “bee guy,” Wardell found that in many of his projects, growers cooperate willingly, for “why pay \$400 per acre for pollination if they are working against the bees?” This was true in the growers’ response to a misapplication of pesticides that killed 80,000 hives in 2014, when Wardell worked with them to identify the problem and implement safer methods. Wardell has also encouraged growers to take part in Seeds for Bees, urged beekeepers to register their colonies with the county, and pushed both parties to engage with each other.

Wardell’s sole concern about the migratory beekeeping business is the stress that being trucked from coast to coast puts on already vulnerable honeybee colonies. “There is a three percent chance of losing queens every time they put bees on a truck,” he said. And there are other risks, like nutritional stress and exhaustion.

Wardell’s concern stems from the potential threats to bee health on the road. When traveling, the bees are more susceptible to viruses triggered by cold snaps. They are also often worked nearly year round, without a hibernation period. And when there is insufficient natural forage for the bees, they are held in their shipping containers and have to be fed sugar water and protein patties. The impact becomes apparent generations down the road, Wardell said, because the continual need to reorient decreases the number of broods raised by the hive.

“Many beekeepers come back [from almonds] and say their colonies are doing just fine, but many more come back having to spend the rest of the year recovering,” he said. “And they return to California even with this risk each year because it is where the money is” – \$2 billion a year, in fact, a [figure calculated](#) by the University of Minnesota’s Center for Urban Ecology and Sustainability.

Growers of other crops like apple, prunes, and berries are following almond growers’ lead, showing that the cooperative relationship between growers and beekeepers may be contagious. This relationship proves that everyone benefits from practices developed in collaboration among all concerned parties – the growers, the migratory beekeepers, the scientific communities, and perhaps even consumers and citizens. Certainly, the

relationship between a road-show honeybee and a California almond shows what can be achieved with collaboration.³³

And beekeeper Bret Adee is hustling to get his hives ready, working through them on a Central Valley ranch before placing them in orchards.

This third-generation beekeeper works night and day with a crew of more than 35. Adee has been busy staging more than 100 semi truckloads of his honey bee hives in almond orchards over a 200-mile swath of the Central Valley.

When temperatures rise and the blooms open, his bees wake up and go to work. It's his hives' first yearly stop on a 6,500-mile tour across the nation.

But this almond bloom, Adee's scrambling more than usual.

Adee lost more than half of his hives over the winter — 50,000. And he's not alone.

"You know, in September, I thought we had the most awesome bees ever," Adee says. "The bees looked incredibly good."

Like Adee, many beekeepers across the U.S. have lost half their hives — they call one with no live bees inside a "deadout." Some beekeepers lost as many as 80 percent. [That's unusual](#). And many of the hives that did survive aren't strong in numbers.

For decades Adee says if he lost 5 percent he really got nervous. Now a 40 percent loss every few years is more common, he says. But this many lost hives across the country is concerning.

California almond orchards have grown so much over the past 10 years, the bloom requires nearly every commercial hive available in the United States.

Almonds [have grown](#) from 765,000 acres to 1.33 million acres in the last decade. Bees travel from as far as Florida and New York to do the job. Without these hives, there is no harvest.

Almond bloom is just as important to the beekeepers. It's a chance to make [nearly half their yearly income](#), and a place for the bees to work and grow early in the spring while healing up from winter.

This year, many beekeepers have had to tell their orchardists that they won't have enough bees this year to cover their entire contracts. And some orchardists are desperately calling beekeepers. Some report [pollination prices](#) going up.

Experts say honey bees are dealing with many stressors: chemicals, loss of wildflowers, climate change, nutrition and viruses. But this year, a special problem might have taken down the honey bees more than usual.

A tiny parasite called the varroa mite sucks at the bee's body, causing big problems.

Ramesh Sagili, a bee expert with Oregon State University, [predicted these big bee losses](#) because of mites earlier last year.

³³ Wilder, E. (2018). *Bees for Hire: California Almonds Become Migratory Colonies' Biggest Task* | *The Bill Lane Center for the American West*. [online] Stanford University: Agriculture and the West. Available at: <https://west.stanford.edu/news/blogs/and-the-west-blog/2018/bees-for-hire-california-almonds-now-are-migratory-colonies-biggest-task> [Accessed 17 Jul 2019].

"It's a very lethal parasite on honey bees," Sagili says. "It causes significant damage not only to the bee, but to the entire colony. A colony might be decimated in months if this varroa mite isn't taken care of."

He says unusually early and warm spring weather last year made the bees start rearing baby bees early. That gave varroa mites a chance to breed and multiply too.

Varroa mothers crawl into the cells of baby bees and hide there until the bees close the cell up with wax. Then they lay an egg and rear their young on the baby bee.³⁴

The importance of bees to the success of California Almonds is undeniable. What may be less understood is the amount of money, time and manpower beekeepers invest to get these bees healthy and ready to pollinate the crop.

Beekeepers report that inputs are growing steadily each year, as rising demand and pressures on honey bee health challenge them to produce more and more healthy hives.

Losses to Varroa mites and lack of native forage top the list of challenges beekeepers face, forcing them to increase inputs for mite control and supplemental feed to reduce pressures and subsequent overwintering losses to their bee populations.

These are unprecedented times for beekeepers.

"The last 30 years have been the most tumultuous time for beekeepers in almost four centuries," John Miller, a fourth-generation beekeeper said. "In the 1980s we had tracheal mites, and we solved that problem. Now it's Varroa, Varroa, Varroa and everything else."

Rising corn and soybean prices created an incentive to farm land [...] that had been taken out of production for years — land that was often excellent pollinator habitat during the summer.

Acreage once left native as part of the USDA's Conservation Reserve Program has been converted to corn and soybean production. This loss of native forage, and a general loss of bee pasture and wildflowers due to drought and other factors, is forcing beekeepers to increase the level of supplemental protein and sugar feed they provide their colonies. Forage losses have also greatly diminished the honey revenue side for professional beekeepers.

Miller also said the costs for supplemental feeding have exploded in the last decade. Last year, he fed 1.2 million pounds of supplemental feed, including 800,000 pounds to get hives ready for pollination and another 400,000 or so to prepare them for winter.

"In the U.S., beekeepers now feed more calories to their hives than they harvest from their hives in honey. This has never happened before," Miller explained.

He added that hive theft is also becoming a more common concern for professional beekeepers. He relies on the eyes and ears of his almond-growing customers for theft prevention, but losses are inevitable.

In general, beekeepers say that they and almond growers have the same interest: producing and maintaining healthy bee colonies to optimize pollination.

"It's a relationship that's built on trust," Miller stated.

³⁴ King, A. (2019). *From Northwest Hives To California Almonds, Bee Deadout Threatens Crops And Livelihoods*. [online] NW News Network. Available at: <https://www.nwnewsnetwork.org/post/northwest-hives-california-almonds-bee-deadout-threatens-crops-and-livelihoods> [Accessed 17 Jul. 2019].

Beekeepers say that communication between partnering growers and beekeepers is critical.

When orchard management problems such as tank-mixing insecticides led to concerns about bee losses they agree that almond growers almost universally responded to beekeepers' concerns by changing practices and avoiding tank mixes that include insecticides. Growers also agreed that fungicide sprays, only when necessary, would be done late in the afternoon or evening when the bees were done for the day.

"Last year, we started having meetings between beekeepers, almond growers, the Department of Pesticide Regulation, the Almond Board and Project Apis m., and working to educate growers," Park-Burris said. "The industry has responded, and now growers are timing those applications to avoid bees. My growers always bend over backward to accommodate the health of my bees."

In turn, beekeepers make robust efforts every year to meet rising demand for healthy hives for almond pollination.³⁵

When the almond blooms fade, beekeepers will truck their hives across America — from the Northwest and Dakotas to the South and Maine, chasing spring.

In Eric Olson's foggy and frosty Washington state cherry orchard, bloom is still a while off. His crew is busy pruning away the wood that would block light to the fresh fruit.

He's helps manage one of the largest beekeeping businesses in the Northwest.

He says their hives experienced a dramatic loss this year. But it's not as bad as when he lost about 65 percent of them.

"That's when I cried," says Olson, who served 20 years in the Air Force. "I was a pilot, and I spent my time in combat situations. Never in my life was I as low as when we lost 65 percent of those bees."

Still, spokespeople for the [almond industry](#) are saying it's all fine.

"Orchard growers who have long-standing relationships with beekeepers are not experiencing problems," says Bob Curtis, a consultant for the Almond Board of California. "Folks that are having trouble are the ones that don't make the contracts in the fall with beekeepers."

If Northwest growers line up beekeepers early, Olson says he expects there will be enough bees for the region's smaller fruit tree bloom. Still, he's worried for his orchardist friends.

"If I can't get bees in my cherries I'm in trouble," Olson says. "I don't have a crop. What do I do? I don't know."

Surveys later this spring will give a better idea of nationwide bee losses, but that might be too late for orchardists at the end of the pollination line.³⁶

The results of this year's annual [Bee Informed Partnership survey](#), a collaboration by leading research labs released Wednesday, found that winter colony losses were nearly 38%, the highest rate since the survey began 13 years ago and almost 9% higher than the average loss.

³⁵ Curtis, B. (2019). *Beekeepers face challenges in and out of almond bloom*. [online] Farm Progress. Available at: <https://www.farmprogress.com/orchard-crops/beekeepers-face-challenges-and-out-almond-bloom> [Accessed 17 Jul. 2019].

³⁶ King, A. (2019). *From Northwest Hives To California Almonds, Bee Deadout Threatens Crops And Livelihoods*. [online] NW News Network. Available at: <https://www.nwnewsnetwork.org/post/northwest-hives-california-almonds-bee-deadout-threatens-crops-and-livelihoods> [Accessed 17 Jul. 2019].

The panic underscored a fundamental problem with the relationship between almonds and bees: Every year, the almond industry expands while the population of honeybees, beset by a host of afflictions, struggles to keep pace.

“We are one poor weather event or high winter bee loss away from a pollination disaster,” Jeff Pettis, an entomologist who was then head of research at the USDA’s Bee Research Laboratory, said in 2012. And while the disaster Pettis warned of hasn’t struck yet, its likelihood grows each year.

There would be no almond industry without the honeybee, which so far is the only commercially managed pollinator available in sufficient numbers to work California’s almond fields. The industry is in the midst of a boom as Americans eat more almonds than ever. We consume more than [two pounds per person](#) each year in our granola bars, cereals and milk, along with regular old nuts, fueling an \$11 billion market.

It’s not clear that boom is sustainable. Though concern about a bee shortage seemed acute this year, the pollination market for almonds has been tightening for more than a decade. In 2005, fear of a pollinator shortage was so great that the government allowed wholesale importation of honeybees for the first time since 1922.

California’s almond industry spreads over 1.4 million acres of the Central Valley. During bloom, which typically unfolds over three weeks in February, these orchards require the services of some 80% of all the honeybees in the country.

Honeybee colonies, on the other hand, have been dying at high rates. Historically, colonies died mostly during the winter. So when the Bee Informed Partnership started tracking colonies in 2007, it only looked at winter colony losses, which have ranged from 22% to this year’s nearly 38%.

Along the way, researchers realized that beekeepers had started losing a surprising number of bees in the summer, too, a season when all should be going well for bees. They started tracking annual colony losses in 2013, which have ranged between 33% and 45%. The loss for the year ending March 31 was 41%.

The threat to the bees is multifaceted and existential. The varroa mite, an invasive species of external parasite that arrived in Florida in the 1980s, literally sucks the life out of bees and their brood. Herbicides and habitat loss have destroyed the bees’ forage. An array of pesticides, including dicamba and clothianidin, have been found to damage the bees’ health in a variety of ways, weakening their immune systems, for instance, and slowing their reproductive rate.

The process of getting the bees to the almonds adds another stressor. Each January, the sluggish bees are prodded into action much earlier than what would be their normal routine. They are fed substitutes for their natural foods of pollen and nectar so they will quickly repopulate the hive to be ready for almonds. They are then loaded onto trucks and shipped across the country, plopped in an empty field and fed more substitute food while they wait for almonds to bloom.

“We’ve had to bend the natural behavior of honeybees around almonds,” said Charley Nye, who runs the bee research operation at the University of California, Davis.

One reason beekeepers are less inclined to talk about this distortion of nature is that almond pollination has become their biggest single money-maker of the year, accounting for about one-third of their annual income in 2016. No other crop pays as well as almonds, so if a beekeeper misses almond pollination, it could cripple his business.

“They’re not dead, but if they don’t make it to almonds, then from an economic standpoint, they’re as good as dead,” said Gene Brandi, a California beekeeper, back in January when the panic was in full bloom.

The trend lines are clear: Unless something changes, at some point in the near future we won’t have enough bees.

Ultimately, a big part of the solution may be to reevaluate the number of colonies deployed per acre. “Those standards were set many, many, many years ago,” said Bob Curtis, a pollination consultant with the Almond Board of California, and a lot has changed since then.

The Almond Board is undertaking new studies to determine if the stocking rate — the number of colonies per acre — could be adjusted, which would ease the pressure on embattled beekeepers to keep up with the surging almonds.

A lower stocking rate would also ease the stress on the bees themselves, but it wouldn’t stop them from dying in excessive numbers. Reversing that trend will require dramatically different approaches to everything from how we farm to how we use our land — things not likely to change anytime soon. The disaster Pettis warned of remains a very real possibility as honeybees continue to fight for their lives.³⁷

Bee Killing Culprit Found

It's about time for the annual mass migration of honeybees to California, and new research is helping lower the chances the pollinators and their offspring will die while they're visiting the West Coast.

Each winter, professional beekeepers from around the nation stack hive upon hive on trucks destined for the Golden State, where February coaxes forward the sweet-smelling, pink and white blossoms of the Central Valley's almond trees.

Almond growers rent upwards of 1.5 million colonies of honeybees a year, at a cost of around \$300 million. Without the bees, there would be no almonds, and there are nowhere near enough native bees to take up the task of pollinating the trees responsible for more than 80 percent of the world's almonds. The trouble was, bees and larvae were dying while in California, and nobody was sure exactly why. The problem started in adults only, and beekeepers were most worried about loss of queens.

Then in 2014, about 80,000 colonies -- about 5 percent of bees brought in for pollination -- experienced adult bee deaths or a dead and deformed brood. Some entire colonies died.

With support from the Almond Board of California, an industry service agency, bee expert Reed Johnson of The Ohio State University took up the task of figuring out what was happening. Results from his earlier research had shown that some insecticides thought safe for bees were impacting larvae. Building on that, Johnson undertook a new study, newly published in the journal *Insects*, that details how combinations of insecticides and fungicides typically deemed individually "safe" for honeybees turn into lethal cocktails when mixed.

"Fungicides, often needed for crop protection, are routinely used during almond bloom, but in many cases growers were also adding insecticides to the mix. Our research shows that some combinations are deadly to the bees, and the simplest thing is to just take the insecticide out of the equation during almond bloom," he said.

"It just doesn't make any sense to use an insecticide when you have 80 percent of the nation's honeybees sitting there exposed to it."

Many almond growers are rethinking their previous practices and are backing off insecticide use during almond bloom, Johnson said.

³⁷ Embry, P. (2019). *Our Love of Almonds is Seriously Jeopardizing Honeybees*. [online] Huffington Post. Available at: https://www.huffpost.com/entry/honey-bee-census-almonds_n_5d0a8726e4b0f7b7442b3aaa?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xLLmNvbS8&guce_referrer_sig=AQAAAGn_RxskNfgeo3mrGfQfMVHn1UUMsue8E86tmIn4sWUpTFCVhs8rLSQUWYHZEuQrHoq2VYy_O_bGsDCVCC_CerncOrf-WwfOnO1XF6Im_DljsYv5q-gky4mSwnSsLb6GFY09R6UUIFeUSFEjAPgWWzDh3fM3h61SYyUZAL_1fF [Accessed 17 Jul. 2019].

That's good news for bees, and doesn't appear to be harming the crops either, he said, because there are better opportunities to control problematic insects when almonds are not in bloom.

"I was surprised -- even the experts in California were surprised -- that they were using insecticides during pollination," Johnson said.

While these products were considered "bee-safe," that was based on tests with adult bees that hadn't looked into the impact they had on larvae.

"I think it was a situation where it wasn't disallowed. The products were thought to be bee-safe and you've got to spray a fungicide during bloom anyway, so why not put an insecticide in the tank, too?"

Insecticides are fairly inexpensive, but the process of spraying is labor-intensive, so growers choosing to double up may have been looking to maximize their investment, he said.

"The thing is, growers were using these insecticides to control a damaging insect -- the peach twig borer -- during this period, but they have other opportunities to do that before the bees enter the almond orchards or after they are gone," Johnson said.

This research could open the door to more study of fungicide and pesticide use on other bee-dependent crops, including pumpkins and cucumbers, Johnson said.³⁸

Bee Thieves?

Surging almond production means bees are more in demand than ever, proving a lucrative opportunity for thieves who want to make a quick buck.

Orin Johnson, a second-generation beekeeper based in Stanislaus County, California, considers himself the poster child for bee theft. He has had his hives stolen four times over the past 15 years, a haul worth nearly \$25,000 in total.

Johnson, 71, was able to recoup about \$19,000 worth of his bees, but only after enlisting his neighbors to search for the missing hives and help catch the robbers. "Most people think that bees just sit out there, making honey and making you money," Johnson said.

In many ways, bee theft is the perfect inside job. For anyone scanning the colonies housed in the California foothills, a bee thief — often a beekeeper himself to have the knowledge and equipment for moving bees — looks no different from the owner with a bee suit, flatbed truck and forklift.

Thieves need only load up a couple hundred beehives before driving down the road to the next almond farmer for a quick transaction, often making tens of thousands of dollars in the process. One California man in 2017 was caught after stealing thousands of hives worth nearly \$1 million — one of the biggest bee thefts ever. "It's more lucrative than selling drugs," said Kim Flottum, publisher of trade magazine Bee Culture.

That's because honey bees have become serious business in the past five years after a surge in California almond demand drove prices up for pollinating crops. California, the only U.S. state that commercially grows almonds, produced \$5.6 billion worth of the crop in 2017, according to the U.S. Department of Agriculture. The Almond Board of California also found the Golden State in 2017 was responsible for 80% of the nut's total global production.

Without honey bees, which are transported from as far as New York and Florida, to pollinate nearly [1.4 million acres](#) of almond blossoms in February, almond production in the U.S. would come to a halt. "It's the largest

³⁸ Ohio State University. "Culprit found for honeybee deaths in California almond groves: Researchers and industry leaders working to stop insecticide use during bloom." ScienceDaily. ScienceDaily, 4 February 2019. <www.sciencedaily.com/releases/2019/02/190204114625.htm>.

pollination event in the world," said Butte County Deputy Rowdy Freeman, who investigates bee theft in California.

And demand is only getting higher. Almond trees require about two hives for every acre, and California growers have been expanding acreage every year to meet the global appetite for almonds and nut-based milks. However, beekeepers lost about 40% of their colonies just this past winter, according to a survey from the Bee Informed Partnership.

Bees can die from just about anything, including mites, malnutrition, adverse weather — even "colony collapse disorder," when hordes of bees inexplicably abandon their queens and hives. A single misstep can require beekeepers to tally up their losses and start over.

For beekeepers like Johnson, whose father once loaned bees to farmers for \$2 per beehive, surging growth in the almond industry means he can rent his 400 hives for \$200 each, reaping a minimum of \$80,000 for a month's worth of busy bees. Nationwide, pollination income for commercial beekeepers increased 8% to reach \$302 million in 2018, according to the USDA.

However, that top-line figure disguises the amount of labor and capital beekeepers pour into their colonies year-round. Johnson worries that this is attracting amateurs into the industry who are less likely able to keep their colonies and healthy through winter.

"There's a saying for those young beekeepers," Johnson said. "If you want to make a small fortune in beekeeping, start with a large fortune."

In response to the thefts, beekeepers are wising up by sequestering beehives behind locked fences, installing hidden cameras to watch over equipment or tucking GPS trackers into beehives.

Deputy Freeman also said he typically recommends beekeepers mark their hives, so they can be identified if they're stolen. But he admits it's difficult to track thieves once they're gone. Said Freeman: "It's a tough crime to investigate."³⁹

Speaking Up for Bees

A public hearing at the Texas State Capitol on Wednesday brought together dozens of experts and legislators to discuss the declining monarch butterfly and bee populations in the state. Agriculture, tourism, recreation and hunting all rely on the free ecosystem services provided by the insects and other wildlife that make one of every three bites of our food possible.

Mary Reed, chief apiary inspector for the Texas Apiary Inspection Service, ticked off the challenges for commercial beekeepers in the state: foul brood, a fatal spore driven disease; varroa mites; and nosema. Reed said Texas beekeepers reflect the national averages for mites, which is the No. 1 threat to honey bee colonies.

Clint Walker, owner of [Walker Honey Farm](#), said that because of habitat loss, pesticide use, and climate change, it's almost impossible for Texas beekeepers to make a living producing just honey.

It wasn't always so, said Walker, who grew up in McAllen and has been keeping bees for 50 years. Before big freezes hit citrus groves in the 1980s, honey made from orange and grapefruit blossoms was the most prized nectar product. "It's not even on the radar today. ... Orange blossom honey doesn't even gain shelf in the grocery store."

The most productive and profitable honey crop results from the invasive [Chinese tallow](#) tree, labeled a noxious weed by the state of Texas. "It's the mesquite of the Gulf Coast plains," said Walker. "It will take [over] a pasture. It's the No. 1 honey-producing plant in Texas."

³⁹ Min, S. (2019). *Bee thieves find sweet rewards in California's almond groves*. [online] CBS News. Available at: <https://www.cbsnews.com/news/how-almond-production-has-made-a-lucrative-business-of-bees/> [Accessed 17 Jul. 2019].

Walker added that without Chinese tallow, honey production in Texas would be cut in half.

“Texas beekeepers relying on honey production are in peril,” he said, adding that commercial bees are typically not in Texas to produce honey. Most Texas bees start the year in California pollinating almonds, he said. “Our fate’s not even in our own hands,” he said.

Walker also bemoaned the overuse of pesticides and genetically modified crops, specifically cotton. Cotton produces tons of nectar, he said.

“God made cotton to produce honey,” he said. “Now we’ve bred the nectar out of it. Now we don’t attract the beneficial wasps that eat the boll weevil, and we don’t get cotton honey.”

While we often focus on the importance insect pollinators play in our food, Shalene Jha, an associate professor of integrative biology at the University of Texas at Austin, stressed the importance of insect pollinators to crops like cotton. South Texas accounts for about 15 percent of the state’s cotton production, which is the most economically valuable nonfood crop in the world. Texas alone produces 25 percent of U.S. cotton.

In [studies she conducted working with landowners across Texas](#), cross-pollination made possible by insect pollinators – even in self-pollinating crops like cotton – yielded higher boll sizes, increased weight and more profit for farmers.

Cotton bolls were 18 percent heavier when pollinated by insects versus self-pollination, said Jha. “The per-boll increase equals \$118 per acre more in profits,” she said, adding that similar results occurred with melons and blueberries.⁴⁰

Legislating Bees

The Texas Legislature is considering a record number of bills that impact beekeepers and those concerned about bees & pollinators in our state.

- **SB 677**, as amended: Repeals the requirement of an intrastate permit and converts the current free apiary registration to a fee-based beekeeper registration, converts the import permit to a broad interstate transport permit, and exempts beehive removers from paying a fee for registration.
- **HB 2670**: Same as the amended SB 677, except that beehive removers would also pay the registration fee.
- **HB 1723**: Repeals the requirement of an intrastate permit.
- **HB 4212**: Establishes a licensing program for bee removers, including 160 hours of training.
- **HB 2996**: Excludes land in residential subdivisions from being qualified as agricultural land for property tax purposes.
- **HB 136/ SB 2170**: Forms a task force to study pollinator protection.
- **HB 2483**: Bans the use of neonic pesticides in public road right-of-ways.
- **HB 2484**: Creates a Bee Pollinator Task Force, comprised of state agency officials.
- **SB 2691**: Bans the use of neonic pesticides and glyphosate herbicides at school facilities.
- **HB 2108**: Expands the cottage food law in multiple ways, including allowing the sale of honey and honey-based products as a cottage food.

SB 677 originally repealed the requirement for beekeepers to have a permit to transport bees across county lines within Texas. SB 677 now:

1. Repeals the intrastate transport permit and repeals the export permit for moving bees out of Texas.

⁴⁰ Maeckle, M. (2019). *Public hearing in Austin: “Texas beekeepers relying on honey production are in peril”*. [online] Texas Butterfly Ranch. Available at: <https://texasbutterflyranch.com/2018/07/21/public-hearing-in-austin-texas-beekeepers-relying-on-honey-production-are-in-peril/> [Accessed 17 Jul. 2019].

2. Converts the import permit into a “interstate transport permit” that allows individuals to bring bees into Texas if they have an inspection in the state they are coming from *or* if they have had an inspection by the Texas apiary inspector anytime within the last 12 months.
3. Expands the definition of “beekeeper” to cover anyone who “owns, leases, possesses, controls, or manages one or more colonies of bees for any personal or commercial purpose.”
4. Creates beekeeper registration and empowers Texas Apiary Inspection Service to charge a fee for it.

The most troubling provision in HB 2670/ SB 677 is the beekeeper registration. On the surface, it is voluntary. But some people must register their apiaries in order to qualify for ag valuation – and SB 677 transforms it from a free registration of the apiary into registration of the individual with a fee to be set by Texas Apiary Inspection Service (TAIS).

More troubling is that this provision lays the groundwork for mandatory registration of all beekeepers.

FARFA is also concerned by the illogical changes to the import permit. Under current law, an individual who brings bees into Texas must get an import permit and an inspection by the apiary inspector in the state that he/she is coming from. This is fairly standard for most major beekeeping states. Under SB 677/ HB 2670, the import permit is converted into an “interstate transport” permit, and the bees must either be inspected by the apiary inspector in the state they are coming from *or* have been inspected by the Texas apiary inspector anytime within the last 12 months.

This simply doesn’t make sense from a disease control standpoint. A 12-month-old inspection, after the hives have been moved through multiple states all over the country, is meaningless. When FARFA [surveyed over 500 beekeepers](#) last February, the majority of them wanted to see **stricter** requirements on importers; SB 677/ HB 2670 goes in the opposite direction. We have also heard from beekeepers who contend that there is no serious disease concern; if that is accurate, the whole permit should simply be abolished. A real analysis of the disease risks is needed – not creating a permit regime that still requires permits and fees, yet provides no real disease prevention mechanism.

[HB 4212](#) establishes a licensing regime for bee hive removers. The bill:

1. Creates required training for bee removal work, which includes 80 hours of classroom training and 80 hours “practical” training.
2. Creates an occupational license for bee removers.
3. Requires bee removers to carry specific amounts of insurance.

While some regulation of bee removers may be appropriate, this bill goes much too far and is overly burdensome.

[HB 2996](#) excludes land in “residential subdivisions” from ag valuation under 1-d-1. This bill has broad implications for beekeepers as well as small farmers of all types, particularly the “market farmers” who already have significant trouble getting fair property tax treatment.

The bill sponsor is trying to address the problem of people with high-dollar properties who simply put a cow out on their land or some other token effort and get a major tax break. The underlying problem is the way the counties manage property tax assessments – granting ag valuation to such properties, while denying it to real working farms! Unfortunately, most working farmers can’t afford an attorney to challenge the county assessor, while the high-dollar property owners can ... hence, the unequal treatment.

Foreign Invader or Beneficial Plant? Chinese Tallow

Driving through [Texas] you might notice the bright fall foliage of the Chinese tallow tree (*Sapium sebiferum*). If you stop to watch the colorful leaves descend to the ground, you will see why the tree is commonly called the Popcorn tree. The unusual wax-coated seeds nestled at the ends of the branches are white and look like popcorn.

In the early 1900s, the Foreign Plant Introduction Division of the U.S. Department of Agriculture promoted tallow tree planting in Gulf Coast states to establish a local soap industry. The plants have tremendous reproductive potential. A single, mature tree produces up to 100,000 seeds. Chinese tallow is very invasive.⁴¹

Chinese tallow is a prolific invader and destroys wildlife habitat and grazing land. A fast-growing weedy tree with milky sap, it reaches a height of 30 feet. Also called chicken tree and popcorn tree, the plant is found in fields, wetlands, upland forests, rights-of-ways and pastureland from the Texas Rio Grande Valley to North Carolina's northern boundary.

Because of Chinese tallow, less than 1 percent of the original Texas coastal prairie remains and less than 500 of the original 2.2 million acres still exist in Louisiana.

"Chinese tallow will completely cover a pasture within five years from the time it first appears," said David Mitchell of M&M Air Services in Beaumont. "This plant produces up to 100,000 seeds each year and, as a result, spreads very rapidly.

"It cannot be controlled mechanically because of the huge seed supply in the soil and the plant's ability to sprout from its roots."

Chinese tallow is a hardy tree, able to survive full sunlight and shade, flooding, drought, saline soils and, in most cases, fire. Insects do not feed on this plant and it seems not to have any natural enemies. Because of this environmental tolerance and its bright yellow, orange or red foliage in the fall, the plant is considered an excellent ornamental. In some areas, it has been declared a nuisance plant and no longer can be sold.

As reported by the United States Department of the Interior, "Chinese tallow has been cultivated as a seed-oil crop in China for at least 14 centuries. Candles, soap, cloth dressing and fuel are made from the tallow. The kernels produce oil called stillingia which is used in machine oils, lamp oil, varnishes and paints.

"It also can be converted to charcoal, ethanol and methanol. Potentially, oil from the seeds can be a substitute for petroleum."

The plant was introduced into several different areas of the United States for different reasons. It is reported that Chinese tallow was imported by Benjamin Franklin in 1772 and into South Carolina in the late 1700s as an ornamental. The United States Department of Agriculture introduced it into the Gulf of Mexico's coastal regions in the 1900s to help establish local soap industries.

Chinese tallow trees are a significant problem to ranchers primarily because they cause a decrease in forage. The plant also can have a toxic effect on cattle. One percent of an animal's weight of green plant material can produce a strong purgative effect on bowels of cattle within 12 to 14 hours after consumption.⁴²

⁴¹ Godwin, P. and Stroud, J. (2016). *Too Much of a Good Thing*. [online] Intranet.ces.ncsu.edu. Available at: <https://intranet.ces.ncsu.edu/2016/12/too-much-of-a-good-thing/> [Accessed 19 Jul. 2019].

⁴² Fears, R. (2015). *Foreign Invasion: Chinese Tallow*. [online] The Eagle. Available at: https://www.theeagle.com/landandlivestockpost/foreign-invasion-chinese-tallow-is-just-another-problem-weed/article_a54d8b06-c822-5ef9-8b2c-54ee3fbc84db.html [Accessed 19 Jul. 2019].

The Texas Department of Agriculture lists Chinese Tallow as one of the 24 most invasive plants, and includes Chinese Tallow in a list of Noxious and Invasive Plants which are illegal to sell, distribute or import into Texas.⁴³

It seems that in the southern U.S., Chinese tallow has become invasive like Kudzu, privet, mimosa, Japanese honeysuckle, chinaberry and wisteria. States including Florida, Louisiana, Mississippi and Texas have declared tallow trees a noxious weed. It has caused large-scale ecosystem modification throughout the southeastern U.S. by replacing native vegetation. It quickly becomes the dominant plant in disturbed vacant lots, abandoned agricultural land, natural wet prairies, and bottomland forests. Once established, Chinese tallow is virtually impossible to eliminate.

The nectar from Chinese tallow tree is non-toxic, and has become a major honey plant for some beekeepers. The honey is of high quality and is produced copiously during the month of June, on the Gulf Coast.⁴⁴ In the Gulf coast states, beekeepers migrate with their honey bees to good tallow locations near the sea.⁴⁵

Robo-Bees

Walmart has taken the first step to ensuring foods such as apples, pumpkins and almonds remain on shelves in the event of a bee extinction.

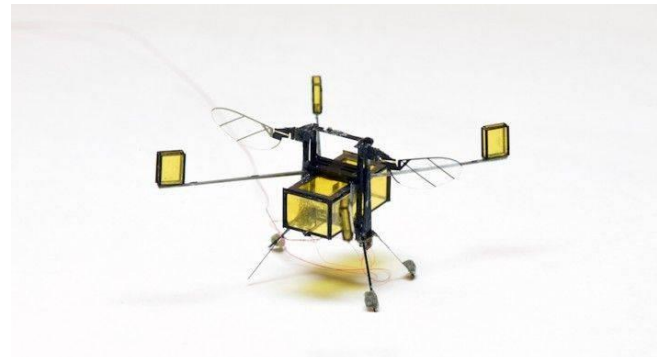
Earlier this month, [Walmart filed a patent](#) for a "Pollination Drone" that would be capable of pollinating flowers and crops the same way a bee would. The drone would be fitted with cameras and sensors to identify pollen in one flower before taking it to another.

The robo-bees would also have "sticky bristles" that can extract the pollen and keep it held until the Pollination Drone arrives at another flower.

"In recent years, the amount of pollinators (e.g. ants, bees, beetles, butterflies wasps, etc.) has been in steady decline, which leads to reduced fertility and biodiversity of the crops and reduced crop production," the patent reads.

"While there have been attempts to fertilize crops by pollinating the crops via crop dusting, blanket spraying of pollen onto crops from an airplane flying above ground is non-targeted, and a significant percentage of the pollen may not reach its intended targeted crops due to the speed of the moving airplane and intervening wind," the statement continued.

Harvard has previously built its own robot bee, which looks similar to a hobby drone. In 2013, the university launched the device, which could only fly and hover. Now, the bee-sized drone can swim underwater and stick to surfaces.



Harvard's John A. Paulson School of Engineering and Applied Sciences has been working on a robo-bee for the past five years. Harvard School of Engineering and Applied Sciences

⁴³ Bee Culture. (2017). *CATCH THE BUZZ – Chinese Tallow subject to Integrated Pest Management Control with imported beetle. Major Honey Plant in South.* [online] Available at: <https://www.beeculture.com/catch-buzz-chinese-tallow-subject-integrated-pest-management-control-imported-beetle-major-honey-plant-south/> [Accessed 19 Jul. 2019].

⁴⁴ Godwin, P. and Stroud, J. (2016). *Too Much of a Good Thing.* [online] Intranet.ces.ncsu.edu. Available at: <https://intranet.ces.ncsu.edu/2016/12/too-much-of-a-good-thing/> [Accessed 19 Jul. 2019].

⁴⁵ Bee Culture. (2017). *CATCH THE BUZZ – Chinese Tallow subject to Integrated Pest Management Control with imported beetle. Major Honey Plant in South.* [online] Available at: <https://www.beeculture.com/catch-buzz-chinese-tallow-subject-integrated-pest-management-control-imported-beetle-major-honey-plant-south/> [Accessed 19 Jul. 2019].

Last year, Japanese researchers made a breakthrough—mistakenly—when they created an ionic liquid gel capable of grabbing pollen. Together with horse hair, the \$100 bee robot they designed was able to transport pollen from one flower to another.

The gel was a failed attempt to create electrically conducting liquids almost a decade earlier. It was left in a drawer, and after eight years, the researchers found the gel had not dried out.⁴⁶

Have you heard this news? Scientists in Japan have built a [pollinator bot](#), a remote-controlled drone, that can go from flower to flower, brushing against the flower's stamen with a horsehair paintbrush that's covered in a sticky ionic liquid gel, both lifting off pollen from each flower as well as depositing some of that pollen on to the next. It's a little hard to ["drive"](#), but put Artificial Intelligence (AI) in the driver's seat and this may be the future of pollination.

But, hold on, hold on.... Let's pump the brakes for a second here, folks. Is it even feasible at this point that these drones could take over the role of the honeybee in the pollination process?

Breaking down the numbers

Bee Estimates

Almond Grove Estimates

- Avg. acreage: 40 acres
- Trees / Acre: 120 trees
- **Total Trees: 4,800 trees**

- Hives / Acre: 2 hives
- Frames / Hive: 8 frames
- Bees / Frame: 1,500 bees
- Bees / Hive: 12,000 bees
- Foragers / Hive: 4,000 bees
- **Foraging Bees / Acre: 8,000 bees**

[Thanks to Joe Traynor's excellent analysis which inspired this post](#), we know about half of the foraging bees per acre (~4,000 bees) will be actively pollinating at one time. The other half will be back in the hive (or on their way back) to offload their pollen and fuel up for the next trip.

The bees end up visiting each flower multiple times during their daily foraging period, from around 10:00am to 2:00pm. The extra trips to the flowers, dropping off extra pollen, stimulates the growth of the pollen grain that did end up pollinating the flower.

Each tree has about 20,000 flowers. With 40 bees to pollinate each tree at the rate of about 10 flowers per minute, they'll be able to pollinate about 96,000 flowers during a workday. Which equates to visiting each flower 4 to 5 times.

⁴⁶ Hetherington, J. (2018). *RoboCrop: Walmart is making robotic bees*. [online] Newsweek. Available at: <https://www.newsweek.com/can-robotic-bees-replace-real-thing-walmart-files-patent-pollination-drone-845861> [Accessed 18 Jul. 2019].

Comparing the costs

<i>Bees</i>		<i>Drone Equipment</i>	
Hives / Acre	2 hives	Drone	\$50
Hives / Avg. Grove (40 Acres)	80 hives	Horsehair brush	\$10
Cost / Hive	\$180	Ionic gel	\$20
Cost for 80 Hives	\$14,400	Set-up labor (4 hrs @ \$20/hr)	\$80
Time Spent Pollinating	21 days	Cost for 1 Drone	\$160
Cost per Day	\$686	Cost for 46 Drones	\$7,360

Now, until AI can replace a manual operator, a remote-controlled drone needs a human to control it. Let's say a person controlling a drone is super focused and can pollinate 5 trees, lush with almond bloom, trying their best to get all the flowers nestled within the branches, in a day, at \$15/hr.

To get the pollination job done in the same amount of time using drones, it would cost over \$100,000--**more than 8 times as much as the cost of renting bees!**

So, beekeepers of the world, sit back and relax for now. When it comes to pollination, the honeybee is key.⁴⁷

BLUEBERRIES

The data is in! We're eating more blueberries today than just a few years ago. In fact, there's a 50% increase in consumption per cap in the last ten years. This is a global trend. Demand is high and prices for fresh, processed, and juice markets are just plain exciting. Besides a growing fresh market, blueberries are finding their way into juices, jellies, and other processed products.⁴⁸

Blueberries were first established in East Texas as a test plot on the small farm of Mr. Herbert K. Durand at Buna, Texas in 1967. Dr. Hollis Bowen, a Texas A & M University pomologist with a fresh PhD out of Rutgers, speculated that east Texas should be a fine place to test rabbiteye blueberries (*Vaccinium ashei* Reade), a species indigenous to Florida and parts of Alabama and Georgia. In their natural range, rabbiteyes prefer alluvial floodplain sites, a low soil pH and good humic content.

East Texas is blessed with acid sandy loam soils, nearby sources of irrigation water and ready access to a number of organic soil amendments (pine bark, straw, chips, hay, etc.). The requirements to grow rabbiteyes and East Texas attributes looked like a logical union.

⁴⁷ Riggs, G. (2018). *Will pollinator drones replace honeybees?*. [online] The Bee Corp. Available at: <https://www.thebeecorp.com/thebeeword/will-pollinator-drones-replace-honeybees> [Accessed 18 Jul. 2019].

⁴⁸ Texas A&M AgriLife Extension Serv (2015). *Growing Blueberries in the South*. [online] Texas A&M. Available at: https://aggie-horticulture.tamu.edu/fruit-nut/files/2015/04/blueberries_2015.pdf [Accessed 17 Jul. 2019].

As a result of field trial production data, good promotion and news releases, East Texas blueberry acreage grew. Since the mid-1980's, late spring frosts have emerged as the single most important constraint to high yields.

Commercial fields in East Texas are based primarily on five varieties: Climax, Premier, Brightwell, Tifblue and Powderblue. Blueberries are an exciting alternative crop for East Texans. The economic picture has improved greatly in the last few years due to increased demand for both fresh and processed product.⁴⁹

The best blueberry for Texas is the rabbiteye blueberry (*Vaccinium ashei*). It is grown commercially in East Texas, where the humid woodlands are typical of native rabbiteye blueberry habitat. A single rabbiteye blueberry plant can produce 15 pounds of berries per year, and the berries are easily marketed. With proper management, commercial blueberry plantings in Texas can yield from 5,000 to 9,000 pounds per acre per year.

Their popularity is growing because of the fruit's high concentration of antioxidants, which are thought to help prevent cancer and heart disease. Rabbiteyes are an excellent choice for organic or Earth-Kind® orchards, because they have few serious pests, need little fertilization, and are native to the southeastern United States.

Blueberries may be harvested by hand or by machine. Most of the fruit grown in Texas is picked by hand and sold for fresh consumption. A successful strategy in many areas is pick-your-own blueberry marketing.

In most Texas locations, the harvest season extends from May through July, depending on the varieties grown.⁵⁰

Though they expect to market more volume in the coming weeks, with good-quality fruit, growers and marketers say larger crops in other states and offshore have also pressured the market this year.

Historically, market prices for blueberries in March and early April have been "fantastic," said Gunnar Avinelis, CEO of Agricare, which manages blueberry farms in California and in Oregon. He started harvest on his covered berries about two weeks ago. With Mexico staying in the market longer, prices have not been as good as in the past, he said. This year, in particular, we're starting to see the impact of Mexico's increasing volume in their later varieties," he added.

Not only is Mexico shipping more volume, he said, but its varieties have gotten better. It's a trend he said he's observed in other South American producers as well, noting that Peru and Chile also have become bigger players in recent years.⁵¹

COTTON

Cotton Blown Away by Harvey

[2017] Texas leads U.S. states in cattle and cotton production. An estimated \$150 million worth of cotton has been lost as the storms ripped the bolls off plants and left white fiber strewn across fields. Texas Gulf Coast export terminals that handle about a quarter of U.S. wheat exports also remained shuttered.

⁴⁹ Texas A&M AgriLife Extension Service (2015). *Growing Blueberries in the South*. [online] Texas A&M. Available at: https://aggie-horticulture.tamu.edu/fruit-nut/files/2015/04/blueberries_2015.pdf [Accessed 17 Jul. 2019].

⁵⁰ Nesbit, M., Kamas, J. and Stein, L. (n.d.). *Texas Fruit and Nut Production: Blueberries -Are blueberries easy to grow?*. [online] Texas A&M AgriLife Extension Service. Available at: <https://agrilifeextension.tamu.edu/library/farming/texas-fruit-and-nut-production-blueberries/> [Accessed 7 Aug. 2019].

⁵¹ Fresh Plaza. (2019). *Blueberry harvest starts slowly in US as volumes recover*. [online] Available at: <https://www.freshplaza.com/article/9099723/blueberry-harvest-starts-slowly-in-us-as-volumes-recover/> [Accessed 17 Jul. 2019].

On cotton farms, more than 300,000 bales have likely been lost, between cotton yet to be harvested and bales sitting on fields awaiting ginning, according to John Robinson, an agricultural economist at Texas A&M University.

The loss, though a small part of the total U.S. cotton crop of about 20 million bales a year, was devastating for individual farmers.

“The cotton that was where the hurricane hit was affected by the winds, it was blown right off the plant. Some of those fields are obliterated,” Robinson said.

“Some of the cotton will still be on the plant but strung out like someone papered your field with toilet paper,” he said.

South Texas and Coastal Bend cotton farmers were expecting a record crop this year. Thirteen of the counties in the disaster area are major cotton producers.

“The South Texas Cotton and Grain Association has preliminary crop losses projected at \$150 million. That’s just devastating to all of farmers down there,” Texas Agriculture Commissioner Sid Miller said in a statement.

Monday’s Intercontinental Commodity Exchange benchmark cotton price spiked 2.5 percent as a portion of the unharvested crop in Texas was destroyed or damaged by rain and high winds, traders said.

“The cooperative’s growers still have a lot of cotton in the field, maybe like 50 percent still out there. A lot of that will be lost because of the wind and rain,” said Jimmy Roppolo, general manager of United Agricultural Cooperative Inc in El Campo, Texas.

“It was the best cotton crop we ever raised. We really needed it this year to make up for other years,” Roppolo said.⁵²

DAIRY

A rusted, padlocked gate marks the entry to a once modern and bustling dairy barn.

The facility in the heart of Northeast Texas dairy country that once collected milk from hundreds of Holstein cows, is now a depository for knickknacks, scrap wood and metal, tools and idle equipment.

Surrounding county roads are littered with similar remnants – abandoned dairy barns, empty drip sheds, exposed concrete slabs and silent stalls – from the region’s past as Texas’ top milk producing area.

Texas milk production continues to rise, said Dr. Ellen Jordan, Texas A&M AgriLife Extension Service state dairy specialist, Dallas. Dairy facilities increased production 9 percent in 2017, to more than 12 billion pounds of milk.

It’s likely Texas will become a top-five milk producing state in the nation this year, she said, but where that milk is produced shifted dramatically over the past four decades.

⁵² Waters, T. and Plume, K. (2017). *Harvey's floods scatter cattle in Texas, swamp cotton fields*. [online] Reuters. Available at: <https://www.reuters.com/article/us-storm-harvey-cattle/harveys-floods-scatter-cattle-in-texas-swamp-cotton-fields-idUSKCN1B92QD> [Accessed 18 Jul. 2019].

In 1980, almost 25 percent of the state's milk was produced in Northeast Texas. Hopkins County was the dairy capital of the state and produced 16 percent of the state's 3.5 billion pounds of milk that year, or 560 million pounds, according to U.S. Department of Agriculture Agriculture Marketing Service.

By 1990, production in Hopkins County had risen to 925.6 million pounds, but was surpassed by Erath County in Central Texas with almost 1 billion pounds produced. Central and Northeast Texas produced 57 percent of the state's milk by that time.

Production in Northeast Texas rapidly declined over the next two decades as milk production moved west to a region that accounted for less than 1 percent of production in 1980 – the Panhandle.

“There were several factors that initiated the move to Central Texas and eventually the Panhandle over the past two decades,” Jordan said. “Rainfall, animal welfare, quality of life for producers, the economics of production and other factors all contributed to the move from East Texas.”

East Texas weather, including up to 50 inches of annual rainfall, heat and humidity, presented several challenges for dairies, she said.

Rain caused problems with mud and waste management, she said.

“Dealing with multiple heavy rain events poses real problems for producers in East Texas,” she said. “Producers would have to battle mud and need additional lagoon space for waste catchment to prevent runoff and possible environmental impacts. Weather was the No. 1 issue for production quality and quantity and animal welfare.”

Heat and humidity reduce herd production significantly, including milk pounds and fertility rates, she said. It's easier to cool cows in the summer and warm them in the winter in areas where humidity levels are low.⁵³

“What's happened is east Texas had a lot of grass that they grew, and we had very small farms there,” she says. “They also had 50 inches of rainfall, which the cows didn't care for that at times because of course it could get muddy. In July and August, it was droughty, so then there wasn't any grass.”⁵⁴

“The Panhandle receives around 20 inches of rainfall each year,” she said. “There are increased costs associated with humidity and the amount of rainfall in East Texas compared to what producers would deal with in drier regions of the state. Happy, healthy cows produce more milk and moving them to an environment that is better suited for them made sense.”

Quality of life for cows was an important factor in the shift, and so was quality of life for dairy producers, she said. More than 95 percent of Texas dairies are family owned and operated.

Dairy production is a year-round, around-the-clock venture, Jordan said. Dairy farmers wanted to get big enough to hire managers and enough workers so they could attend family events and take vacations as with other vocations, but expansion was costlier in East and Central Texas.

Higher land values and suburban sprawl contributed to the economic decision to move west, Jordan said. Dairy operations that hoped to expand needed additional space and finding contiguous parcels meant paying premium prices for land.

⁵³ Russell, A. (2019). *Texas Dairy Production Has Shifted From The Northeast To The Panhandle, But Why?*. [online] Texas A&M Today. Available at: <https://today.tamu.edu/2018/02/06/texas-dairy-production-has-shifted-from-the-northeast-to-the-panhandle-but-why/> [Accessed 18 Jul. 2019].

⁵⁴ Rice, J. (2018). *In the Lone Star State, Milk Is Worth \$2 Billion. How Moving West Jump-Started Texas Dairy*. [online] KUT. Available at: <https://www.kut.org/post/lone-star-state-milk-worth-2-billion-how-moving-west-jump-started-texas-dairy> [Accessed 18 Jul. 2019].

Landowners also faced the increased demand to sell as encroaching development placed a premium price on their land holdings, she said.

“As a result, you saw a lot of dairy producers sell out entirely and either retire or take up beef or poultry production,” she said. “There were also many producers who retired and the next generation were not interested in continuing in the dairy business.”

For example, in the first half of the 20th Century, there were 200 dairies in operation in Dallas County, Jordan said. Today, there are none.

The Panhandle was a good option because of rainfall amounts and land availability, but it also provided a steady supply of high-quality feed because of the well-established feedlot industry in the region, Jordan said.

Cottonseed, a waste product that ended up in landfills in the 1970s, emerged as a high-quality feed option for dairy producers as well, she said.

“Dairy cows like cottonseed,” she said. “Converting a waste product into a valuable food source was a win for cotton and dairy producers. Nutrition and high-quality feed is critical for milk production.”

The combination of economic, logistical and environmental factors helped the Panhandle emerge as an ideal location for dairy producers. Since the 1980s, milk production in the region boomed from less than 1 percent to more than 68 percent in 2017.⁵⁵

Since dairy moved west, Jordan says that urban sprawl has stretched out in east Texas.

“There is still a dairy industry there, it just has shrunk in size,” she says. “And the same goes for Central Texas.”

Jordan says that, in the dairy business, they’re always looking for a place where they’re welcome, where there’s space available, and where the cows are happy.⁵⁶

FARMERS

When Timothy Gertson finally finished downloading nearly eighty pages of forms from the Texas Department of Agriculture, filling them out the old-fashioned way—by hand—and submitting them, he was one step closer to obtaining a shiny badge of agricultural prestige: a certification for producing organic field corn. “I’m not going to lie,” Gertson says. “It’s pretty intense.”

Gertson comes from five generations of farmers.

Agriculture is in his blood. Yet even for a man with years of experience under his belt, the shift from conventional to organic agriculture was a veritable obstacle course. And he’s only growing one crop.

⁵⁵ Russell, A. (2019). *Texas Dairy Production Has Shifted From The Northeast To The Panhandle, But Why?*. [online] Texas A&M Today. Available at: <https://today.tamu.edu/2018/02/06/texas-dairy-production-has-shifted-from-the-northeast-to-the-panhandle-but-why/> [Accessed 18 Jul. 2019].

⁵⁶ Rice, J. (2018). *In the Lone Star State, Milk Is Worth \$2 Billion. How Moving West Jump-Started Texas Dairy*. [online] KUT. Available at: <https://www.kut.org/post/lone-star-state-milk-worth-2-billion-how-moving-west-jump-started-texas-dairy> [Accessed 18 Jul. 2019].

Organic farming is an entirely different beast, one that comes with a bushel of bureaucratic and natural barriers. Along with the paperwork, there are fees, which can range from a few hundreds of dollars to a few thousand. The application asks for a detailed catalog of all substances used on the land during a three-year period and a “written Organic System Plan describing the practices and substances to be used.” These measures must be taken into account before the first seed hits the soil.

And from there the real work begins. According to the National Organic Program, the regulatory entity within the U.S. Department of Agriculture, the transition period for farmers switching to certified organic produce lasts 36 months, and it’s only after that period that they can market their produce as organic. But only if the crop can survive through the complicated process of replenishing nutrients in the soil.

Last month, seemingly acknowledging the difficulties, the USDA’s Secretary of Agriculture announced a plan to help farmers in the transition process by “expanding a crop insurance option to allow producers to purchase insurance coverage that better reflects their product’s actual value.” But crop insurance is still sold through private agencies, and the yields for organic produce can be as low as one-third of conventional produce during those three years of transition and after. So the lengthy and costly process isn’t an immediately rewarding investment, which suggests that only veteran farmers with other options, like Gertson, are able to take such risks.

The USDA boasts organics as a \$39 billion industry, so there is no debate as to whether the market exists. Stores like Walmart and Costco sell organic produce. You can even buy organic chicken nuggets. For established farmers like Gertson, organic agriculture offers a high demand and equally high premium. “This was purely a business decision for me,” he says. “The price I was offered and contracted for this organic corn [is] exactly three times the price.”

But some of the challenges Gertson observes transcend organics and apply to the industry as a whole, which has changed dramatically since his family started farming. Agriculture can’t guarantee a farmer a paycheck like other jobs, and that uncertainty is unsettling for many young people entering the workforce. Gertson admits he is lucky that his cousin joined him to start their business, but the 31-year-old knows this is an anomaly in his generation. The business is often a family affair; the Texas Department of Agriculture says 98.6 percent of the state’s ranches and farms are run by families or family partnerships. So Gertson’s path to agriculture isn’t uncommon. But neither is the dwindling interest in farming among his generation of siblings and cousins: out of thirteen in his generation, only he and his cousin carried on as farmers.

Meanwhile, the average age of Texas farmers in 2015 was 58—almost two generations ahead of the current working class. “That’s a huge concern of mine—the age,” Gertson says. “That’s a huge concern of the entire industry nationwide.” So with an aging workforce whose children largely aren’t willing to continue farming, the industry is forced to ask itself how to move forward. One of the biggest questions, one that Gertson has already tackled, is the choice between organic and conventional farming. These two practices are often viewed as the only options, but the solution to the future of agriculture might not be in such black-and-white terms. Farmers who’ve been in the practice for some time are saying we can have our cake (or fruits and veggies) and eat it too with sustainable agriculture.

The USDA refers to sustainable agriculture as “an integrated system of plant and animal production practices having a site-specific application that will, over the long term: satisfy human food and fiber needs; enhance environmental quality and the natural resource base [sic] upon which the agricultural economy depends; make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls; sustain the economic viability of farm operations; and enhance the quality of life for farmers and society as a whole.”

Sustainable agriculture does encompass organic farming, but it’s not exclusive to that. The main difference is that sustainable farming is just as much about the practice as it is about the farmer. Or rather, the “quality of life,” meaning that farmers can count on their next paycheck. Sustainable agriculture is not only a solution to keep farmers in the business and consistently producing food, but it’s also a way to market agriculture as a viable career choice for college grads and the emerging workforce. Sustainable farming is a realistic way to draw in outsiders and make agriculture a desirable career again.

And a huge part of sustainability requires keeping pace with changing practices of agriculture and incorporating developing technologies, something that a younger generation will certainly identify with.

“Agriculture is like the new Silicon Valley,” Gertson says. “I have companies calling me all the time who have this new app or invention or new precision ag hardware that they want me to try.” Gertson frequently flies his drone over his 1,500-acre plot of rice, which reduces the number of hours he has to physically spend in the field. He isn’t completely removed from typical farm labor, though: Gertson still wears his rubber boots, gripping his shovel firmly as he works. But when he comes home later, he’ll pull up Farmworks, a software on his laptop with field mapping, drainage design, and GPS survey capability. “Young people don’t think of ag as like this awesome tech world,” Gertson says. “But it is.” Soon we may start imagining farmers with iPads instead of pitchforks.

The future of farming requires equal if not more attention and resources put toward sustainable farming as opposed to conventional or organic. “There is absolutely no way that the world could be fed on organic agriculture. It can’t be done,” Gertson says. Gertson isn’t a pessimist; he just knows the trade. After all, agriculture exists partly as a consumer trend. We don’t really need organic produce, but it sure is nice to have. And, like most luxury goods, there are always going to be people who will pay for it.

Time, unfortunately, is not a luxury. The world’s population is growing faster than ever, and food security remains a challenge. So there must be a compromise. The antiquated agrarian system of wide pastures, intensive tillage, and an affinity for pesticides cannot persist. Similarly, the champions of organic agriculture, whose stubbornness lacks practicality at times, have to recognize the urgency of the situation. Farming itself is a process of give and take, a process filled with much uncertainty but also an immense trust in the land. And in the same way we respect the earth and its bounty, we must care for our farmers and their livelihoods to ensure that they can continue their role as stewards of the environment and gatekeepers of a sustainable future.⁵⁷

While the number of farms in Texas rose over a five-year span, the state lost about 200,000 acres of farmland, according to a new federal report released [in 2014].

Texas leads the nation with 248,810 farms, up from 247,437 operations in 2007, the U.S. Department of Agriculture’s preliminary 2012 Census of Agriculture report said. Farmland covers about 130.2 million acres in Texas, a negligible drop from about 130.4 million acres in 2007.

The number of farms across the U.S. is declining even as the value of their crops and livestock has increased over the past five years, the report said.

The survey, taken every five years, shows there were a total of 2.1 million farms in the United States in 2012, down a little more than 4 percent from 2007. That follows a long-term trend of declining numbers of farms.

Also, farmers are getting older - the average age was 58.3 years. But Agriculture Secretary Tom Vilsack pointed to a bright spot: a small rise in the number of farmers between 25 and 34 years old. In Texas, the average age is 60.1 years, up from 58.9 years in 2007. A younger generation of Texan farmers helped with the age statistic, with 9,301 people ages 24 to 34 farming or ranching in 2012 compared to 9,246 in 2007.

Vilsack said the boost in the number of younger farmers is partly due to increased interest and government support for locally grown foods and a thriving export market. Many younger farmers work at smaller operations, where the boom in the farm economy and a rising consumer interest in where food is grown have helped them.

Though still in the throes of a multiyear drought during which ranchers sold millions of heads of cattle, Texas also led the U.S. in livestock sales with \$18 billion. It was also in the top 10 in total agriculture sales - third with \$25.4 billion - and in crop sales, \$7.4 billion, good for eighth place.

According to the census, a third of farmers across the U.S. were older than 65 in 2012.

More women are taking to the land in Texas, too, with 38,451 farming in 2012, a jump of 3,440. Male farmers declined by 2,067.

The amount of farmland in the United States also shrunk over the time period, from 922 million to 915 million acres. At the same time, farms grew larger - the average farm grew from 418 to 434 acres.

⁵⁷ Mody, P. (2016). *The Future of Farming*. [online] Texas Monthly. Available at: <https://www.texasmonthly.com/articles/the-future-of-farming/> [Accessed 19 Jul. 2019].

Most Texas farms are small, with 88 percent having sales of less than \$50,000 in 2012. The average size of farms or ranches across the state in 2012 was 523 acres, down slightly from 527 acres in 2007.⁵⁸

FERAL HOGS

It's no secret that Texas has a problem with its feral hog population. Regardless of the measures taken, at present, there seems to be no dent in their uptick, and the damage they're causing is outrageously expensive. Landowners throughout the state have been looking to wildlife and game officials for potential solutions, in addition to lawmakers for new or revised legislation. But where did this problem originate? What exactly are the origins of the feral hogs in Texas? The answers might surprise you.

These hogs aren't native to the Lone Star State. In all honesty, they're not even native to the U.S. Members of the Texas Agricultural Extension Service compiled a report entitled, "Feral Hogs in Texas," in which they revealed that they were originally brought over to North America as a food source by explorers such as LaSalle, Cortes, and De Soto. The report stated, "They have been in Texas since the 1680s and were important livestock to the early settlers, who usually allowed their animals to roam free. When confronted by war and economic hard times, settlers often had to abandon their homesteads on short notice, leaving their animals to fend for themselves. Thus, many free-ranging domesticated hogs became feral over time."

They thrive in almost any type of climate in which they're found. They've proven to be highly adaptable creatures which have continued to expand their Texas territory since their introduction, going well beyond our state borders ever since.⁵⁹

Even though hunters and trappers are killing approximately 30 percent of the hog population in Texas annually, hog numbers are still growing by about 20 percent each year. Biologists and wildlife managers estimate that 70 percent of the hogs in the state will have to be killed annually just to maintain current population levels and even more must be taken to actually reduce their numbers.

You read that right: **7 out of every 10 hogs** in the state must be killed just to keep their numbers where they are now.

So why are wild hog populations experiencing such explosive growth in this portion of the United States?

The main reason is that hogs breed almost as fast as rabbits. They become sexually mature before they are a year old and can produce as many as three litters of 6 to 8 piglets every year.

Another reason they are difficult to control is because feral pigs are very intelligent and resilient animals. They quickly respond to [hunting and trapping pressure](#) by changing their habits or just leaving the area for greener pastures when things get too hot.

Since they are known to roam over extremely long distances in search of food, this makes long-term hog control measures difficult and complicated.

Landowners and biologists have been relatively successful in controlling feral hog populations in small areas. However, these are usually short term successes that only last until a new hog sounder moves in and the cycle starts over again.

While wild hogs are fun to hunt and provide some very tasty table fare, they cause all sorts of problems. Their diet normally consists of things like roots, acorns, tubers, and other plants, they will eat literally anything they can find or catch. Crops, snakes, insects, ground-nesting birds, and even deer fawns are not safe from a hungry hog.

Wild pigs are a textbook example of an invasive species and are causing significant damage to native wildlife and ecosystems in Texas. In addition to competing directly with deer for food, they damage vegetation that quail and turkey need to thrive. They also are carriers of a number of nasty diseases and there have even been cases of drinking water sources being contaminated by droppings from feral hogs.

⁵⁸ Blaney, B. (2014). *More farms in Texas; Farmers' Ages Rise*. [online] Lubbock Online. Available at: <https://www.lubbockonline.com/agriculture/2014-02-21/more-farms-texas-farmers-ages-rise> [Accessed 19 Jul. 2019].

⁵⁹ Sault, Spring (2019). *Where Did Texas Feral Hogs Come From? Their Surprising Origins*. Texas Hill Country. <https://texashillcountry.com/texas-feral-hog-origins/>

[Hog hunting](#) and trapping are already going full bore in Texas. Right now, these operations are taking less than half the number of hogs necessary to stop their explosive population growth and it is doubtful this can be achieved by those with trapping and hunting alone.

Poison has been touted as one potential way to turn things around in the war on feral hogs. However, the use of a feral hog poison on a large scale is [a very hotly contested idea](#).

Among other issues, researchers have struggled to find a poison that will quickly and reliably kill hogs without harming other wildlife. For instance, proponents of hog poison experienced a [big setback](#) when nearly 200 birds died after consuming sodium nitrite poison intended for hogs during field testing in northern Texas.⁶⁰

A fact-checking publication known for its work in political reporting recently turned its attention to feral hog population data in the U.S. and Texas.

PolitiFact, a fact-checking site mostly known for holding politicians accountable for misleading statements on matters of policy and things like pork barrel spending, recently shifted its attention to a truth-seeking mission involving actual pork.

Specifically, [PolitiFact took issue](#) with an article posted by Southwest FarmPress claiming Texas was home to an “estimated 50 percent to 75 percent of all feral swine in the nation.”

PolitiFact wasn’t buying it: “Really all of that for Texas by its lonesome? We wondered.”

If this kind of stuff interest you – and for many predator hunters knowing as much as possible about the critters they hunt is time well spent — PolitiFact's digging ends up also offering a concise snapshot into feral pig populations, both in Texas and nationally.

South Carolina hog expert Jack Mayer, Ph. D confirmed in a 2014 research paper that Texas was in fact home to the most wild hogs.

“According to the paper, 99 percent of U.S. wild pigs live in 10 states: Alabama, Arkansas, California, Florida, Georgia, Louisiana, Mississippi, Oklahoma, South Carolina and Texas. ‘As an individual state, Texas had the largest numbers,’ the paper says, accounting for 30 percent (1.8 million) up to 41 percent (3.4 million) of the nation’s total depending on which estimates are chosen. States with the next-most feral hogs, the paper suggests, were Georgia and Florida.”

⁶⁰ TTAG Contributor. (2019) More Hunters Wanted: Texas is Losing the Fight Against Feral Hogs. The Truth About Guns. <https://www.thetruthaboutguns.com/hunters-wanted-texas-is-losing-the-war-on-feral-hogs/>

Meanwhile, a September 2017 Q&A with Texas A&M professor emeritus Billy Higginbotham offered these answers:

'(In Texas) we estimate 2.6 million head based on several population studies.' Another Higginbotham answer says a Texas A&M AgriLife Extension survey of landowners made in 2010 'estimated that we are removing approximately 761,000 pigs from our 2.6 million population annually, which accounts for only 29 percent of the population. We estimate that in Texas we need to be removing 66 percent of the wild pigs annually just to hold the population steady.'⁶¹

There are estimated to be more than 2 million feral hogs in Texas and state Agriculture Commissioner Sid Miller has found what he believes is a new solution to end the war. However, it isn't going over well with everyone.

Unlike Miller's passed legislation for hunters to shoot hogs from helicopters, his newest rule change, classifying a warfarin-based hog lure, "Kaput Feral Hog Lure," as a state-limited-use pesticide used to poison hogs, doesn't have hunters very happy.

"This solution is long overdue. Wild hogs have caused extensive damage to Texas lands and loss of income for many, many years," Commissioner Miller said in a [press release](#). "With the introduction of this first hog lure, the 'Hog Apocalypse' may finally be on the horizon."

What Is Kaput Feral Hog Lure?

Kaput Feral Hog Lure is the first toxicant to be listed specifically for use in controlling the feral hog population. The Texas Department of Agriculture (TDA) says the pesticide "represents a new weapon in the long-standing war on the destructive feral hog population," according to *The Washington Post*.

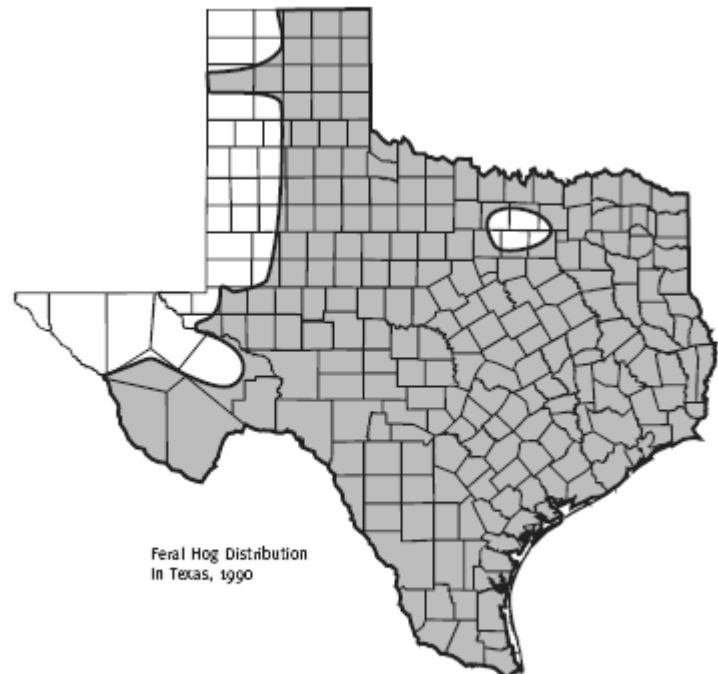
The newly passed rule change isn't off the cuff. Extensive testing of warfarin in Texas has been conducted since 2008. Kaput Feral Hog Lure manufacturer, Sciometrics Ltd., Corp., has manufactured rodent-management products for 15 years. The TDA reports the approval of warfarin for hog control came after more than 10 years of research.

The Environmental Protection Agency (EPA) approved Kaput Feral Hog Lure due to its low toxicity. Still, the TDA imposed the stricter regulations of making it limited use only, making the product available to only licensed applicators or someone under direct supervision of license applicators.

Is Poisoning The Best Solution To Hog Control?

This is a tricky question, and the answers vary depending on who you ask.

The TDA will say absolutely. According to [The Washington Post](#), feral hogs cause about \$50 million in damage per year. They're also notorious for uprooting crops and "entire city parks" and trampling across highways, along with a long list of other problematic situations.



Feral hog distribution, Texas. Photo: Texas Parks and Wildlife

⁶¹ Hatfield, A. (2019). *Is Texas Really Home to Over Half of the Country's Feral Pigs?* | *Grand View Outdoors*. [online] Grand View Outdoors. Available at: <https://www.grandviewoutdoors.com/predator-hunting/hogs/is-texas-really-home-to-over-half-of-the-countrys-feral-pigs> [Accessed 19 Jul. 2019].

“They’re so prolific, you can’t hardly keep them in check,” Miller told [the American-Statesman](#). “This is going to be the hog apocalypse, if you like: If you want them gone, this will get them gone.”

Hunters generally agree in wanting the destruction of feral hogs erased, but the immediate backlash shows how they feel about the new rule. The Texas Hog Hunters Association has taken a public stand against Miller’s chemical war. *The Washington Post* reports in less than two full days, the organization had [more than 3,000 signatures petitioning the new rule](#). The petition sits at just under 10,000 at the time of this writing.

“We don’t think poison is the way to go,” Eydin Hansen, the vice president of the Texas Hog Hunters Association, [told CBSNews.com](#). “If a hog is poisoned, do I want to feed it to my family? I can tell you, I don’t.”

The warfarin-based pesticide will kill hogs, but is it worth it? Warfarin has been used to poison hogs in the past. Australia introduced the idea to the world to address its overpopulation issues, according to *The Washington Post*. After several years of use, Australia banned the act due to “extreme suffering.”

The Post reports warfarin is deadly enough it could indeed create the “hog apocalypse” Miller promises. The newspaper writes an experiment in 1987 using poison on hogs in the Sunny Corner State Forest wiped out 99 percent of the population in just a few months.

The actual poisoning death is being called inhumane by many. Multiple outlets report internal and external bleeding are common during the week-long process. One autopsy revealed a pig’s liver and stomach infused, according to *The Post*. The poisoned pigs’ muscles are also very identifiable, appearing a bright blue due to dye in the poison.

The largest question surrounding poisoning feral hogs is how will the poison be kept from other animals. EPA regulations require hogs to be fed the poison from bins with 10-pound lids. That’s the only plan to keep other animals from ingesting the toxicant. It’s one that Tyler Campbell, a former researcher with the U.S. Agriculture Department, said won’t work.

Campbell mentioned seeing raccoons lift much more weight than 10 pounds during his research, according to *The Washington Post*. Others, including state wildlife veterinarian Jim LaCour, have similar concerns. [LaCour told the Times-Picayune](#) even if hogs are the only animals that can eat the poison from the bins, they’ll surely drop crumbs on the ground.

“We do have very serious concerns about non-target species,” LaCour told the newspaper.

Even if animals don’t ingest the poison itself, it’s likely birds and predators will feast on hogs’ poisoned meat after they die. These concerns, however, are all minimal to Miller. *The Post* reports he said wildlife or pets “would have to ingest extremely large quantities over the course of several days” before getting sick.⁶²

Texans no longer need a license to kill wild hogs. On May 31, Governor Gregg Abbott signed a bill to allow people to kill feral hogs without a license.

The bill that Sen. Brian Hughes of Mineola authored received a large amount of support. The bill allows any landowner, landowner’s agent or lessee to take a feral hog without a hunting license.

The bill unanimously passed the Texas Senate on April 11 before making it through the House with almost unanimous support and moved on to the Governor on May 17 before being signed into law on May 31.



⁶² Miller, B. (2017). *Hog Apocalypse: Is Poisoning Hogs The Way To Go In Texas?*. [online] Grand View Outdoors. Available at: <https://www.grandviewoutdoors.com/predator-hunting/hog-apocalypse-poisoning-hogs-way-go-texas> [Accessed 19 Jul. 2019].

Joe Paddock, a hog hunting guide in Chandler, told [CBS19](#) that he believes hog hunting is very important, but he has reservations about opening it up to anyone with a gun.

"I don't see the doing away with hog hunting licenses is going to help a whole lot but maybe create more problems in the long run, with people that don't have no education, no training or anything with firearms going out in the woods," Paddock said.

Paddock said he will keep buying a license to support Texas state programs, even though it's not required.

A growing problem

The impact of the wild pig herd on Texas is widespread. Not only are they a menace to agriculture and the environment, but they are also a detriment to communities. The wild pig population in Texas ranges between 3 to 5 million pigs and can be found in about 90% of the counties in the state.

Brandon Gunn, executive vice president of the Texas Pork Producers Association, said Texas can't control the wild pig population with the resources they have now.

"We need help. We need more resources, access to more effective baits, and we need the government to provide more funding and support in the fight against feral hogs," Gunn said.⁶³

A Threat to Agriculture

The impact of the wild pig herd on Texas agriculture is widespread. From a livestock standpoint, wild pigs are a major predator of sheep and goats. But when it comes to the state's livestock herd, Tomecek worries most about wild pigs spreading disease.

"We know pigs can vector 21 some odd diseases we are aware of – communicable to all livestock animals," he says. "If I'm a livestock producer, I have to worry about biosecurity all the time. Producers have to vaccinate for diseases they would not normally have to vaccinate for because of this wild pig problem."

Gunn says there is great potential for introduction of these diseases into herds considering the number of small farms all over the state that don't have the resources to house their animals inside well-protected, completely enclosed modern barns.

Research has shown that up to 70% of the feral hog population would have to be removed each year just to prevent population growth," Gunn says. "As the population continues to grow exponentially, the concerns only increase as well."

Some farmers have quit producing grains and now produce cotton because wild pigs won't eat it, Tomecek says. Wild pigs eat seed corn at night, destroying fields. The damages to small grain operations in Texas is so high that many are having a hard time staying in farming because of it.

"From a food security standpoint, that reduces the total number of food America is producing when that land starts being used for non-food production," he says.

In addition, hay producers fight wild pig damage, too. Tomecek says farmers must think long and hard about what a hay field is truly worth when they have to fight off wild pigs.

"Imagine you are a hay farmer and you cut hay close to the ground, rake it and bale it. If pigs root around, you may not be able to see it, but I can assure you when you drive an implement straight into the ground because you can't see the divets, it can cause thousands of dollars of damage to implements," he says.

⁶³ Awtrey, J. (2019). *Governor signs East Texas senator's bill allowing feral hog kills without license*. [online] KLTV. Available at: <https://www.kltv.com/2019/06/03/governor-signs-east-texas-senators-bill-allowing-feral-hog-kills-without-license/> [Accessed 19 Jul. 2019].

Being from Texas, Tomecek always considers what could happen if Texas has a dry year.

“Hay may not be there to feed my livestock if we lose acres of hay production to wild pigs,” he says.⁶⁴

Hidden inside covered trailers or hauled in plain sight under the cover of darkness, wild pigs are on the move. Even trussed in car trunks, stuffed in dog boxes, stretched across back seats, or openly sold on Facebook, wild pigs often march to a man-made beat. Bottom line: The spread of 6.3 million wild pigs across the United States is assisted by rubber tires.

Illegal transport is a major cause of increased wild pig presence, an advance which contributes to an annual multi-billion dollar bill. Wild pigs cause up to \$2.5 billion in damage to the U.S. economy each year and \$1 billion of the total is exclusive to agriculture. Based on anecdotes and observation, wildlife personnel have long suspected illegal transport as a major catalyst of wild pig dispersal. Through advances in genetic technology, intuition is being confirmed with hard evidence: The most reproductively capable large animal in North America is hitching a human ride.

Wild pig expansion over the past 30 years has jumped from 19 states in 1985 to 39 states in 2016.

Prolific breeding (combined with exceptional intelligence and phenomenal adaptability) requires the annual culling of 50 percent to 75 percent of a pig population to keep numbers in check, a control rate that’s often impossible to achieve.

Wild pig presence translates to habitat loss for other animals, including deer: “We’re talking about cockroaches on hooves. We want to educate the public and remove the hunting incentive. When hogs show up, deer leave.”

Hot on the trail of wild pig movement, [Bronson Strickland](#) is cooperating with scientists using genetic testing to prove that adjacent populations are often unrelated. Strickland, a wildlife biologist and wildlife management specialist with [Mississippi State University Extension](#), says illegal releases occur under the radar, but technology is revealing the physical proof of unrelated sounders stretching from Florida to California.

Still in the rudimentary stages of testing, genetic technology is documenting the unnatural spread of pigs, according to Strickland: “We’re beginning to see concrete proof of what we’ve believed for a long time. Populations don’t just spring up overnight.

Natural colonization of wild pigs is a slow spread that resembles rose petal layering as adjacent populations overlap. “Scientifically, when a group of pigs has unique genetics, it tells me they shouldn’t be in that location unless illegal transport is involved,” he says.

Who are the people physically trapping, transporting and releasing the pigs? Strickland points to a small group of outlaw hunters: “I’m not lumping anybody in because it’s a very small group engaging in illegal releases. These people want pigs in every county like we have deer in every county. It’s totally destructive.”

Yet, a few outlaws can ramp up an entire population of wild pigs. “They sneak pigs into a new area and those pigs quickly out-compete many of the native wildlife species we cherish,” he adds.

With no obvious signature, the outlaws typically move at night or use covered trailers.

Nationwide, more states are employing genetic profiles to monitor wild pig outbreaks. IDNR uses a genetic database to store wild pig DNA. As Backs and his team of wildlife specialists get farther down the wild pig removal trail, they’ll be able to detect whether new sounders originate in Indiana or out of state. In some cases, they may be able to trace new arrivals to a specific point of origin.

64 Shike, J. (2018) Deadly Terrorist Threatens the Lone Star State’s Domestic Pig Herd. *Pork Business*. Available at: <https://www.porkbusiness.com/article/deadly-terrorist-threatens-lone-star-states-domestic-pig-herd>.

Again, 6.3 million wild pigs and possibly \$2.5 billion in damage (\$1 billion directly to agriculture) attest to the dire consequences of illegal wild pig transport. “Pigs don’t fly and we know how they’re getting here.”⁶⁵

INTERNATIONAL MARKETS, TARIFFS AND TRADE

“Using the trade deficit as a metric for how well we are doing in trade is really silly,” said Katheryn Russ, a research associate at the Dallas Fed’s Institute for Globalization and Monetary Policy, pointing out that the quickest way to reduce a trade deficit is to have a recession.

Trade deficits or surpluses simply reflect an accounting measure — which can create misperceptions, the Tax Foundation’s Erica York explained.

Here’s an extreme example: A Texas business loads \$100 million of grain sorghum on a cargo ship that leaves the U.S. for China. The ship then sinks halfway through the trip, leaving the company at a total loss. The U.S. would still show a \$100 million trade surplus.

Or consider the issue in more personal, albeit simplistic, terms: Your average Texan — happily — runs an ever-growing trade deficit with Whataburger.

More important than the trade balance, experts said, is that increased trade makes a country’s economy more productive. The U.S. has seen both exports and imports keep growing over time, thanks to decreased trade barriers, better technology and other factors.

Is Trump correct that NAFTA is the ‘worst trade deal ever made’? NAFTA is an easy bugaboo, in part because experts agree that status-quo-changing deals can be painful for workers in some segments of the economy. But there’s no denying its importance to places like Texas, which counts Mexico as its biggest trading partner by a wide margin.

More broadly, a multitude of other economic factors make it difficult to assign specific praise or blame to NAFTA.

“NAFTA has neither been the enormous success that its supporters believe, nor the disaster that its detractors claim,” Russell Green and Tony Payan wrote last year in a report on the deal for Rice University’s Baker Institute for Public Policy.⁶⁶

Tariffs are taxes borne by U.S. businesses, which are then forced to choose whether to absorb that hit, tackle the costly task of reworking supply lines or pass the burden on to customers.

Though Trump has sought to shield consumers from the brunt of his global trade war — which has dinged many manufacturers, while also causing farmers harm via retaliatory tariffs — economic studies and government data show that many wallets are already lighter.

Americans took on \$69 billion in added costs because of the tariffs Trump imposed last year, according to a recent study by four experts, including the World Bank’s top economist.

⁶⁵ Bennett, C. (2018). Pigs Don't Fly: Feral Hog Spread Is A Man-Made Mess. [online] AgWeb. Available at: <https://www.agweb.com/article/pigs-dont-fly-feral-hog-spread-is-a-man-made-mess-NAA-chris-bennett> [Accessed 19 Jul. 2019].

⁶⁶ Benning, T. (2018). *Trump's tariffs threaten Texas. But even critics say he has some good points on trade.* [online] Dallas News. Available at: <https://www.dallasnews.com/business/trade/2018/08/03/trumps-tariffs-threaten-texas-even-critics-say-points-trade> [Accessed 19 Jul. 2019].

An increase to a 25% tariff on such a wide swath of Chinese goods would intensify the impact, particularly in a trade-heavy state like Texas, and Trump has threatened to go even further by expanding tariffs to the \$325 billion in Chinese imports that aren't currently covered by levies.

Indeed, few experts dispute the need to challenge China over unfair trading practices. But the question is in what manner and at what cost? Even as the worst doom-and-gloom predictions over Trump's tariffs so far haven't materialized, many experts insist the risks are all too real.

"There are a lot of threats out there to the Texas and American economy," said U.S. Sen. John Cornyn of Texas, a Republican who likened the tariffs employed by Trump to an "unguided missile." "Trade wars would be on that list."

While Cornyn and other GOPers in Congress have done little legislatively to rein in Trump on trade, they've urged their fellow Republican to cut a deal with China and other trading partners.

Lone Star State lawmakers in both parties tend to agree on that point, given Texas' reliance on trade. Texas companies [already paid \\$1.1 billion in added tariffs due to the trade war just through last October](#), per one study, while the state's farmers [have been hammered by retaliatory duties](#).⁶⁷

Luis Ribera, director of the Center for North American Studies at the Department of Agricultural Economics at Texas A&M University AgriLife Extension says Texas growers and livestock producers rely heavily on trade. He says about one-third of Texas farm income is derived from exports. NAFTA countries account for six or seven percent of the total.

"Our markets overseas are very important," he says "especially now when we have low commodity prices."

Ribera says that despite the importance of trade to Texas farmers, NAFTA negotiations are currently not focusing on agricultural issues. He says that other overseas markets, including China and other parts of Asia, are important and lucrative destinations for Texas crops.

"There are a lot of people [in Asia], but they didn't have money to buy agricultural products," Ribera says. "Now that they have grown and they have more money available to purchase not only grain-based products, but also more protein...that's a big positive impact."

Ribera says Brazil is also an interesting market, that Texas has not yet penetrated.⁶⁸

South Texas farmer Bobby Nedbalek figures America's growing trade conflict is the ultimate poker game.

And while he makes clear he likes the dealer in chief — explaining that he's glad President Donald Trump "is there in the game for us" — he can't help but look with trepidation at his latest hand in the wake of extraordinary antes made Friday by the U.S. and China.

Among the dueling tariffs imposed on a combined \$68 billion in goods was retaliation that Beijing aimed at cotton and grain sorghum — cash crops for Nedbalek and many other Texas farmers.

"I don't think there has ever been a time when there is so much money on the line," said the 77-year-old, who sees nearly all the harvest from his 6,000-acre operation exported to China.

⁶⁷ Benning, T. (2019). 'Unguided missile': How Trump's latest China tariffs hit Texas consumers and businesses. [online] Dallas News. Available at: <https://www.dallasnews.com/business/trade/2019/05/09/unguided-missile-trumps-latest-china-tariffs-hit-texas-consumers-businesses> [Accessed 7 Aug. 2019].

⁶⁸ Brisbin, S. (2018). *For Texas Farmers, Access To Overseas Markets Is Critical*. [online] KUT. Available at: <https://www.kut.org/post/texas-farmers-access-overseas-markets-critical> [Accessed 18 Jul. 2019].

Texas is now all-in on the president's trade war — whether the state likes it or not.

Payback from China and other countries for Trump's trade actions now covers billions of dollars in Texas exports, according to data collected by the U.S. Census Bureau. That hit, focused on the ag and energy industries, appears to be greater than what's being felt in any other U.S. state.

No corner of the Texas economy is likely to go untouched.

The bullish outlook belies clamors of concern emanating from Texas.

Politicians [from Gov. Greg Abbott on down](#) — both Republican and Democrat — have warned about economic pain. The state's vast business community, from corporate titans to family-owned outfits, has likewise launched frantic lobbying efforts to sway the White House.

Retaliation from China on \$34 billion worth of U.S. goods, meanwhile, had a significant impact even before it was officially implemented.

Those tariffs take aim at U.S. agricultural mainstays like cotton, grain sorghum, soybeans and wheat by raising the prices on those goods in China. That ends up reducing demand, driving down commodity prices and [leaving American farmers effectively holding the bill](#).

"It's happening already," said Russell Boening, president of the Texas Farm Bureau. "The prices reacted right away when the threats were being lobbed back and forth."

Many Texas farmers are trying to stay optimistic, especially since Trump has promised to protect a community he talks about with near-reverence.

Wade Cowan is an eighth-generation Texas farmer who now has three crops targeted on his 1,500-acre operation outside Lubbock. He's avoiding the "doom and gloom" for now. That's in part because his sales season isn't until later in the year. Still, if the trade skirmish drags on — and he emphasizes "if" — "this could affect things pretty dramatically," he said.

So many factors come into play. Nedbalek, the South Texan, pointed to grain sorghum.

In some ways, the fact that China's new tariff on that crop is just 25 percent is a relief, he said. Earlier in the year, Beijing imposed and then eventually removed a crippling 178 percent levy on the product, which is popular in China as animal feed.

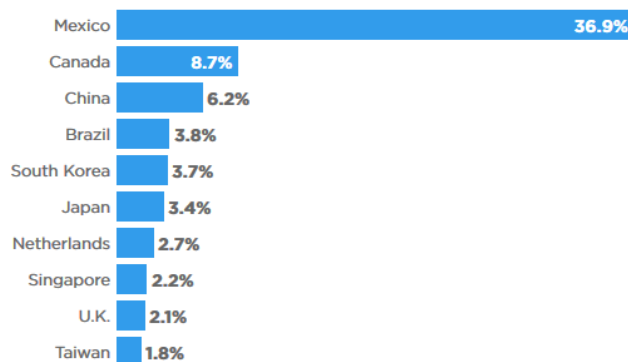
"That made us feel real special," Nedbalek said with a laugh.

But margins are always thin, particularly given the whims of Mother Nature. Last year was a bumper crop, causing many farmers to load up on expenses. Now a drought in many parts of Texas has wrecked this year's yield — "the worst time in the world to have a bad crop," he said.

"We're really vulnerable," Nedbalek said, explaining that low market prices, driven in

Who are Texas' biggest trading partners?

Mexico is Texas' biggest trading partner, measuring by the percentage of the state's exports last year.



SOURCE: U.S. Census Bureau

large part by the tariffs, will make it "really hard for the numbers to work."

From farm to factory — and everywhere in between — the question has now become how long will Trump's trade tiff last. Especially when it comes to China.

But some damage may not be reversed with ease.

Nedbalek noted that the U.S. ag industry has spent years cultivating markets in China, calling the country a "great friend to South Texas agriculture." He worries that once Texas loses its part of that market, it may not come back in the same way.

Such an outcome would be felt well beyond the fields. All kinds of industries connected to agriculture, from tire shops to fast-food restaurants to fuel suppliers, "will feel the economic pinch from agriculture being in this real tight spot," he said.

"Unfortunately, it's like when you pray, 'I want patience, but I want it right now,'" Nedbalek said. "We're at that place now."⁶⁹

Former U.S. trade ambassador Ron Kirk on Tuesday lamented what he called President Donald Trump's "tariff foolishness," explaining that farmers in Texas and beyond "pay the price" for such an approach on trade.

"Agriculture is the tip of the spear in these tariff wars," the former Dallas mayor said at an event hosted at the Newseum by Axios. "Because no matter the country, whether it was China over steel or Britain over cars, they tend to retaliate against agriculture."

Kirk's concern is backed up by federal trade data.

Texas farmers are now bracing for the effects, via reduced commodity prices, from retaliation that China and other trading partners have launched in response to Trump's trade escalation. That payback covers key crops like grain sorghum, cotton, soybeans and rice.

House Agriculture Committee Chairman Mike Conaway, R-Midland, cited the ongoing trade conflict as an example of "turmoil" that has unsettled farmers these days. U.S. Agriculture Secretary Sonny Perdue also made clear that farmers bear the brunt of any trade retaliations.

"They are some of the best patriots in America," Perdue said, conceding that Trump has made his job "more challenging" of late. "But they can't pay the bills with patriotism."

The agriculture chief added that many farmers and ranchers "understand some of the reasons that the president has taken this on."

"China has not played by the rules for a long time," he said.

But Perdue is also working on a mitigation plan to protect farmers if Trump's trade war stretches on for months or longer. He plans to reveal that strategy by Labor Day, at which point the "major harvest through the heartland really begins."

⁶⁹ Benning, T. (2018). *'So much money on the line': No corner of Texas untouched as Trump's tariffs set off trade war with China*. [online] Dallas News. Available at: <https://www.dallasnews.com/business/trade/2018/07/06/much-money-line-no-corner-texas-untouched-after-latest-tariffs-trumps-trade-war> [Accessed 7 Aug. 2019].

"Farmers would rather have trade than aid," Perdue said. "But when they make plans ... and are disrupted by trade actions that they had nothing to do with, we feel like it's only appropriate for mitigation."⁷⁰

Wayne Cleveland of the Texas Sorghum Producers started Wednesday "wondering if we're going to have a commodity at the end of all this."

The grain was on China's list of 106 U.S. products targeted for hefty new tariffs - a retaliatory response to the Trump administration's crackdown on what it views as unfair trade practices. China's latest round of 25 percent tariffs hits rural Texas and America hard, as it includes beef, cotton, wheat, and sorghum as well as corn and soybeans.

Sorghum is a popular feed for Chinese pork and duck meat producers that want to avoid genetically modified organisms, GMOs, that are commonly found in U.S. produced corn. U.S. sorghum producers were already subject to an anti-dumping investigation.

Sorghum exports to China have soared — from \$0 in 2011-2012 to nearly \$1.5 billion in 2015-2016 — making it an even more important market than Mexico.

"We were a market that was groomed by China," Cleveland said.

South Texas sorghum grower Bobby Nedbalek said it appeared China might be buying as much as it could to avoid a feed shortage.

"It's my understanding that there's like 15 or so boatloads of grain sorghum that are destined for China," he said. "The bottom line is that at this point they're going to load all those ships, I think, before they impose any kind of tariff."

Sorghum wasn't alone. China's proposed hit list was a nightmare to the U.S. soybean industry, as farmers last year exported \$12 billion worth of the product to China, making it the biggest U.S. agricultural export.

"We export about 90 percent of our cotton and the majority is produced in Texas. We export close to 50 percent of our soybeans and China is, I believe, our No. 1 market. Beef, the same thing. It's more important for pork but beef is still important," said Texas A&M University agricultural economist Luis Ribera.

"Soybean farmers lost \$1.72 billion in value for our crop this morning alone," American Soybean Association President John Heisdorffer, an Iowa farmer, said in a statement. "That's real money lost for farmers, and it is entirely preventable."

Plains Cotton Growers spokesman Steve Verett said China last year reported purchase of \$980 million of U.S. cotton lint, one of the listed products.

"It is unsettling to see American-produced beef listed as a target for retaliation," said Kent Bacus, director of international trade and market access for the National Cattlemen's Beef Association, which fought years before regaining access to Chinese consumers in 2016. "This is a battle between two governments, and the unfortunate casualties will be America's cattlemen and women and our consumers in China."

Texas farmer Wesley Spurlock, chairman of the National Corn Growers Association, noted that agriculture is one industry with a positive trade balance.

⁷⁰ Benning, T. (2018). *Texas farmers 'pay the price' for Trump's 'tariff foolishness,' says ex-trade czar Ron Kirk*. [online] Dallas News. Available at: <https://www.dallasnews.com/business/trade/2018/07/17/texas-farmers-pay-price-trumps-tariff-foolishness-says-ex-trade-czar-ron-kirk> [Accessed 18 Jul. 2019].

“Instead of new protectionist policies, our nation’s focus should be on growing market access and promoting expanded trade from our most competitive industries,” he said. “We need to be measured, professional and business-like in our approach to keeping the trade doors open with China. Equally important, we need the president to understand the implications that these trade actions have for America’s farm families.”

In the meantime, Cleveland said, growers will struggle with planting decisions and doubling down on efforts to get adequate safeguards in the upcoming farm bill.

“This is the reason we need a safety net,” he said. “We’ve become a political football.”⁷¹

Farm Belt states are great for business. The “I” states — [Iowa](#), [Illinois](#), [Indiana](#) — along with [Nebraska](#), [Kansas](#), [Minnesota](#), [Missouri](#), [California](#), [Texas](#) and others, are powerhouse food producers. U.S. agriculture typically harvests enough for our own consumption and about 20% more for export.

But the farm economy — never a sure thing — is challenged this year like at no other time in recent history, at least since the mid-1980s. Ironically, the problem this time is agriculture’s amazing productivity in the U.S. and other developed nations. Five straight years of bumper crops have resulted in excess supply, depressing commodity prices and eroding the savings and equity on the balance books.

Add to this extreme weather this spring that has produced massive flooding and significantly delayed most planting, which will mean lower yields this fall. Eventually, this may raise commodity prices, but in the short term it creates a “double whammy”: less to sell at lower prices, resulting in drastically reduced income.

Then there are the [ongoing trade issues and tariffs](#) with China, Mexico, Canada and Japan, our top trading partners. Farmers should get some relief from the June 30 cease-fire between the U.S. and China that has stopped additional tariffs on Chinese goods indefinitely. But trade is still a concern.

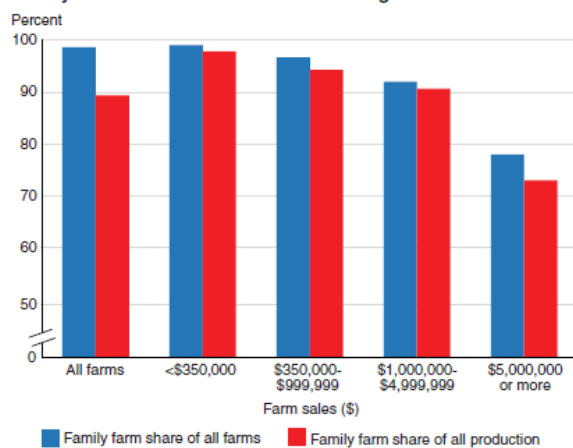
Another complication: China’s pork producers are suffering from an outbreak of African Swine Fever that may cut their production in half. U.S. farmers export soybeans to China as feed, but with significantly lower pork production, China won’t need as much.

Finally, there are critical shortages of farm labor due to Washington’s inability to deal with basic immigration reform. Put it all together and farmers are facing a “perfect storm” that is driving many to financial disaster even with federal aid.

About 98% of U.S. farms are family owned, so these matters hit home. Net farm income has fallen 50% since 2013, from \$140 billion to \$70 billion.

Working capital has decreased about 75% since 2012, from \$165 billion to \$38 billion. Farm debt has steadily increased about 30% since the early 1990s now more than \$400 billion. Farm bankruptcies are up, as are Chapter 12 filings.

Family farms continue to dominate U.S. agriculture



Note: Farm sales are measured as gross cash farm income. On a family farm, the majority of the farm business is owned by the principal operator and people related to the principal operator. Source: USDA, National Agricultural Statistics Service and Economic Research Service, 2015 Agricultural Resource Management Survey.

⁷¹ Brezosky, L. (2018). *China’s tariff list takes aim at Texas farmers and ranchers*. [online] Houston Chronicle. Available at: <https://www.chron.com/business/article/China-s-tariff-list-takes-aim-at-Texas-farmers-12810538.php> [Accessed 18 Jul. 2019].

Weather is beyond our control. But our trade and immigration policies are not. What farmers want most is trade, not aid. Trade uncertainties — whether driven by disputes on tariffs, as we are seeing now, or from unpredictable approvals of genetically modified crops in certain foreign countries — affect planting as well as grain marketing decisions. Fair and open global trade in agriculture can't come soon enough for U.S. farmers, ranchers and agribusinesses.

Ditto immigration reform. The lack of an adequate agricultural labor force has dramatically impacted farmers. There are not enough workers to pick fruits and vegetables, or help milk cows, or keep the livestock packing plant lines running efficiently.

Most farmers and ranchers have been supportive of the [president's trade policies](#), especially with China. But there can be long-term ramifications from the most recent trade disputes. Faced with steeply higher prices, importing countries often seek other sources of supply. That can cost U.S. farmers important markets developed over decades. Chinese buyers looking to Brazil and Argentina for soybean supplies — causing an 85% year-on-year drop in U.S. farmers' soy exports to China as of March 2019 — is case in point and hopefully reversible before it's too late. Trade policy veterans know well: the hardest market to get is the one you had and lost.

On immigration, farmers see themselves as collateral damage to the incessant partisan feuding and deadlock in Congress, where some seem to care more about scoring political points than actually solving problems and looking out for the interests of America's key industries.

Farming has always been tough, but most farmers are resilient. For the rest of us, it's important to have an appreciation of what it takes for America's 2 million farmers to feed the other 330+ million of us. Understand that whether you prefer modern, mainstream farming (about 98% of U.S. acres), or organic (about 2%), or other methods such as hydroponic, U.S. farmers provide the most abundant, safe and affordable food in the world.

Farmers are the original stewards of the environment. They rely on healthy soil, clean water and ample biodiversity. And they have every incentive to improve the sustainability of their land and business — for their livelihood and our food supply — this season and every one that follows.⁷²

At least 11,000 Texas farmers believe they have suffered because of tariffs and trade disputes erupting amid President Donald Trump's get-tough stance with China, which buys about half the cotton grown statewide, according to the Waco-based Texas Farm Bureau and the U.S. Department of Agriculture.

USDA spokeswoman Brenda Carlson said in an email response to questions that the USDA-Farm Production and Conservation Business Center in Texas had processed about 11,000 applications through Thursday. Farmers and ranchers statewide had received direct assistance totaling \$72 million, Carlson said.

But applications received during the 35-day government shutdown, when applications were accepted in-person but not online, may remain in the processing stage, she said.

Texas Farm Bureau spokesman Gene Hall said farmers and ranchers have mixed feelings about the Trump administration, tariffs and the best approach to dealing with China.

“China is a very bad actor, involved in currency manipulation, cheating on subsidies and abusing World Trade Organization rules,” Hall said. “There is a lot of support for taking aggressive action against that country. But a trade war could not have come at a worst possible time. It is being felt most acutely in the Midwest, but we're

⁷² Thatcher, M. (2019). *Farm states slammed by double whammy of US-China trade war and immigration woes*. [online] CNBC. Available at: <https://www.cnbc.com/2019/07/10/farm-states-slammed-by-us-china-trade-war-and-immigration-woes.html> [Accessed 18 Jul. 2019].

having problems here, too. These market assistance payments are helpful, but no one considers them a long-term solution.”

“Looking at this from both sides, China’s economy is not doing well, and our commodity prices are low,” Ribera said. “China is a country that needs quality food, and we have it. Citizens there spend 25 percent of their income on food. Truce or not, China needs our agricultural products. They’re buying soybeans from Brazil, and they are a lot more expensive. I would hope that common sense would play out, but when politics get involved, you never know.”

He said U.S. farmers indeed are facing hard times. Commodity prices have fallen as economies have softened outside the United States, and exports comprise a third of farm income. Meanwhile, rising prices for inputs including fertilizer and machinery, for example, hang around longer than falling revenues.

“China is involved in things I would not call playing fair,” Ribera said. “Something needed to be done, but I would hope this would be something we could sit down and renegotiate terms instead of applying tariffs.”⁷³

China Halts ALL Agricultural Imports from the U.S.

In retribution for the announced 10 percent tariff on approximately \$300 in imports from China, not already subject to duties, China has ceased importing all agricultural products and has rescinded waivers of tariffs on ordered soybeans, effective August 3rd. China also effectively devalued their currency to break the barrier of Rmb 7 to the U.S. dollar precipitating a broad and profound market sell-off amounting to losses of 3.0 percent on the S&P and 3.5 percent on the NASDAQ by close of trading on August 5th adding to the declines on August 2nd and 3rd.⁷⁴

LABOR

If it weren’t for people allowed into the United States under temporary work permits, Bill Carson doubts he’d be in business in Travis County.

The owner of Native Texas Nursery — a 40-acre tree and plant farm in East Austin — says he has trouble hiring U.S. citizens for the physically demanding, outdoor labor.

“And in an urban environment like Austin, (finding employees with agricultural skills) is even worse, because you have people who haven’t grown up on a farm,” Carson said.

He is among the members of the local and state business community — including owners of construction companies, high-tech executives and restaurateurs — who say they worry about the Trump administration’s crackdown on certain categories of immigrants previously exempt from deportation and how it could affect an already stretched Texas workforce.

The administration says it plans to end protections for about 200,000 Salvadorans who have lived in the U.S. for at least the past 17 years. An estimated 36,000 of them reside in Texas, according to the Center for American Progress.

Salvadorans were granted temporary protected status, or TPS, after a pair of earthquakes in El Salvador in 2001, but the policy change means many now could be subject to deportation when it takes effect in September 2019.

⁷³ Copeland, M. (2019). *11,000 Texas Farmers Sign Up for Tariff Relief*. [online] Waco Tribune. Available at: https://www.wacotrib.com/news/farm_and_ranch/texas-farmers-sign-up-for-tariff-relief/article_d2013caf-2260-526e-9ee0-0e83d63748ee.html [Accessed 18 Jul. 2019].

⁷⁴ Shane, S. (2019). *News of the Poultry Industry*. [online] Chick news.com. Available at: <http://www.chick-news.com/news.aspx> [Accessed 8 Aug. 2019].

Meanwhile, an estimated 700,000 young unauthorized immigrants — including about 113,000 in Texas — are awaiting the outcome of negotiations in Washington regarding the Deferred Action for Childhood Arrivals program, known as DACA, that has provided them with work permits and protection from deportation. The numbers are from the U.S. Citizenship and Immigration Services.

Carson said the broad landscaping sector definitely will feel the “ripple effect” of the actions on its ability to hire.

“The people (with temporary protected status) who are now threatened with deportation, well, maybe they have some kids who work in the landscape industry,” Carson said. “Every one of these programs, there is a ripple effect if you remove it.”

Immigrants who have put down roots in Texas — and in some cases started their own businesses — say the end of the programs could be devastating for families.

Many members of the Hispanic immigrant community — even if they aren’t subject to deportation themselves — say they have been rattled by the Trump administration’s actions and are mulling what to do if loved ones are forced out of the country.

Advocates for ending the temporary protection program point out that it was never intended to grant permanent residency. As for DACA — which has provided amnesty for undocumented people brought to the U.S. illegally when they were children — opponents say extending it will encourage more violations of immigration laws.

But Barragan and other local and statewide employers consider the potential deportation of tens of thousands of productive people who have been working in the U.S. legally and paying taxes to be shortsighted, particularly at a time when the labor market is extremely tight.

“Five years ago, you could put a (help-wanted) sign up front and get four or five dozen applicants,” said Barragan, who immigrated from Mexico 30 years ago and is a board member of the Greater Austin Hispanic Chamber of Commerce. “Right now, you put up a sign, you have to hang the sign for six months.”

He said a further tightening of the labor force will slow growth and hurt the overall economy, a view also held by leaders of dozens of major U.S. companies.

Elimination of DACA could reduce gross domestic product in Texas by nearly \$6.3 billion annually, according to the Center for American Progress, which also has predicted a \$1.8 billion annual blow to the state’s economy when the TPS program protecting Salvadorans is ended.

“We have to continue the (DACA) program — it is too vital to our state and our businesses not to,” said Chris Wallace, president of the Texas Association of Business. “We simply have to have the workforce.”

The timing is particularly inopportune, Stan Marek, owner of a construction company in Austin, said, because there already is a post-Hurricane Harvey labor shortage.

“People graduating high school have other opportunities, and we don’t have people from other states coming to do the work,” he said.

Texas is considered by many potential workers to be unwelcoming, Marek said, citing the Legislature’s approval of a so-called sanctuary cities ban last year, which prohibits police and sheriff’s departments from declining to participate in federal immigration enforcement.

Meanwhile, construction work is backing up, Marek said, and “there are thousands of houses that people won’t be able to fix.”

Elsa Caballero, president of the Service Employees International Union in Texas — which represents janitors, food service workers, hospital employees and county/municipal employees across the state — said the White House’s actions also will hurt the housing market because about 30 percent of TPS recipients are homeowners and now face deportation.

In addition, Caballero said she’s concerned some employers could take advantage of a worker’s impending departure by lowering wages. “There are a lot more violations and less people willing to report it,” she said.⁷⁵

What’s the biggest threat to the rolling Texas economy?

Look beyond the tariff talk, trade uncertainties and political conflicts, and focus on the labor shortage. According to employers, it’s already taking a toll, especially in mid-skills jobs.

One Texas company said it would [lose about \\$2 million in revenue](#) this year because it can’t find enough workers. Another said there’s [a desperate need for more work visas](#), a nod to the immigrants who helped power Texas’ growth for decades. A third company said it [could triple sales](#) with a handful of new skilled staffers.

These comments and more were found in the recent Texas [business outlook surveys](#) by the Federal Reserve Bank of Dallas. In May, just over 7 in 10 respondents said they were trying to hire — and a whopping 83% of them reported problems finding qualified candidates

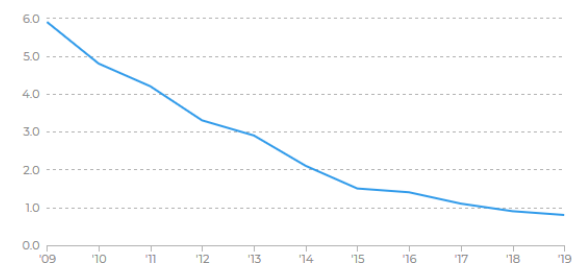
Unemployment in Texas [was 3.5% in May](#), the lowest since the government began tracking the data in the 1970s. The jobless rate nationwide was almost as low, and in 34 states, it was [less than 4%](#). That dims the allure of the Lone Star State because most migrants come to Texas for the work. If jobs are just as plentiful where they’re at, it’s a harder sell for Texas employers.

As unemployment has dropped steadily, the number of job openings nationwide has continued to climb. In April, private employers had almost 7.2 million openings, according to the U.S. Bureau of Labor Statistics. In April 2009, when the Great Recession was still underway, companies had 2.2 million openings.

During the recession, there were nearly 6 unemployed persons for every job opening. In April, that metric was down to 0.8 persons per opening, according to BLS data.

How tight is the labor market?

Number of unemployed persons per job opening in the month of April:



SOURCE: U.S. Bureau of Labor Statistics

Mitchell Schnurman/DMN

⁷⁵ Flores, N. (2018). *Texas employers worry immigration crackdown may cause worker shortage*. [online] The Statesman. Available at: <https://www.statesman.com/BUSINESS/20180112/Texas-employers-worry-immigration-crackdown-may-cause-worker-shortage> [Accessed 17 Jul. 2019].

Companies are trying a number of things. Half or more are increasing wages and ramping up their recruiting, including paying recruiting bonuses and utilizing staffing agencies, according to the Dallas Fed surveys. A third of respondents are offering more training and increasing variable pay, such as bonuses. Some are even cutting education and other requirements for new hires.

Still, the worker shortage persists, and the aging population poses another looming threat. In Texas, the average age of a plumber is about 52 and a trim carpenter 50, said Phil Crone, executive director of the Dallas Builders Association.

One possible solution?

“We need a guest worker program with responsible protections for the country and a chance for employers to fill their jobs,” Crone said.

Other rising expenses, including property taxes, have also pushed up local home costs. That threatens the Texas jobs machine, too.

“We’re losing one of our top attractions — our affordability,” Crone said.⁷⁶

Immigration checkpoints are keeping undocumented immigrants in South Texas while farmers in other parts of the state are desperate for labor.

For the last two years, Bernie Thiel has watched yellow squash rot in his farm fields outside of Lubbock. The crops weren’t diseased, and they weren’t ravaged by pests or pelted by hail, he said. There just wasn’t anyone to pick them. Though Thiel has consistently lowered the acreage he plants to squash — from 160 acres seven years ago to 60 acres now — his aging immigrant workforce just can’t keep up anymore. And there’s no one to replace them.

“It’s very, very frustrating because we can move this product. The demand is there,” Thiel told the *Observer*. “The labor is just not available.”

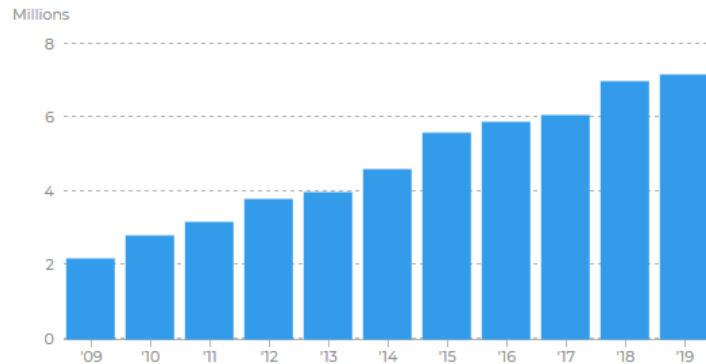
Along with squash, Thiel also grows other labor-intensive crops, such as zucchini, tomatoes and okra, which must be hand-picked. He has 35 employees working six or seven days a week. It’s hard, backbreaking work that most Americans aren’t willing to do. That’s why he, like many farmers, largely relies on immigrant labor to get the work done.

But there’s a problem: Between [50 and 70 percent](#) of immigrant farmworkers are in the country illegally. Texas is home to an [estimated](#) 1.6 million undocumented immigrants, and many of those who are available to work on farms live in the Rio Grande Valley, near the Texas-Mexico border. Though large populations of immigrants are clustered in Houston and other urban areas of the state, many already work in non-agricultural industries.

The Valley, however, has a surplus of undocumented labor — Hidalgo County alone has an undocumented population of approximately 100,000, [according](#) to the Migration Policy Institute. But to get to Thiel’s Panhandle

Job openings keep climbing

Job openings at private employers in the month of April:



SOURCE: U.S. Bureau of Labor Statistics

Mitchell Schnurman/DMN

⁷⁶ Schnurman, M. (2019). *Lots of help wanted: How the labor shortage is slowing the Texas economy*. [online] Dallas News. Available at: <https://www.dallasnews.com/opinion/commentary/2019/06/30/help-wanted-labor-shortage-slowing-texas-economy> [Accessed 17 Jul. 2019].

farm, workers would have to travel on a major highway, past immigration checkpoints, and risk being deported. That's a chance many of them aren't willing to take.

Thiel said most of his current workers are beneficiaries of the Reagan-era Immigration Reform and Control Act, which granted amnesty to immigrants who entered the country before 1982. But the workers are getting old (some of them are in their 70s and 80s), and they don't move as quickly as they used to. Thiel said he's advertised for domestic workers but has had little luck. If he can't find more labor soon, "I may just bow out and ride off into the sunset."

The pressure to find adequate labor is increasingly being felt across agricultural industries, Texas producers say. In July, Erath County dairy operator Sonja Koke testified to the U.S. House Agriculture Committee that she was struggling to hire year-round help for her 200-cow dairy. "Every day, we try to get people to come work for us," she said. Proponents of the horse and beef cattle industries have also bemoaned worker shortages.

Several factors, including relatively low pay and sometimes dangerous work conditions, contribute to farm labor shortages statewide. But especially outside of the Rio Grande Valley, they can also be tied to enhanced immigration enforcement by federal, state and local authorities. In June, [the Associated Press reported](#) deportation fears were driving labor shortages in several Texas industries, including agriculture, which has an annual economic impact of \$100 billion here. Those fears are exacerbated by the "show me your papers" or "[sanctuary cities](#)" bill that was signed into law this year.

For undocumented workers who dare to travel outside the Valley for farmwork, the stakes are high. If caught by immigration authorities, they could be separated from their families and sent back to their home countries where they have fewer economic opportunities and may face violence, said Daniela Dwyer, managing attorney for Texas RioGrande Legal Aid's farmworker program.

"I have heard of workers deciding not to migrate out of the Valley to migratory jobs they used to take," she said, giving the example of one "migratory stream" that once saw immigrants harvesting crops through Texas and into the Midwest. That stream, and others like it, are in jeopardy. "I have heard of some people, especially because they're concerned about the checkpoints leading out of the Valley, deciding not to migrate."

The H-2A visa program, which allows employers to hire foreign nationals for temporary agricultural jobs, is designed to alleviate such labor shortages. But some of the growers interviewed by the *Observer* said the program's requirements — that employers provide transportation to the jobsite and nearby housing — are too expensive, and the paperwork that comes with participating in the federal program is a hassle. Despite the fact that Texas has more agricultural production than almost any other state, it doesn't even break the top 10 in [certified H-2A workers](#).

[In 2017] U.S. Representative Robert Goodlatte, a Virginia Republican, proposed a bill that would create a new visa program, called the H-2C, that would allow workers to stay in the U.S. for longer but would not require employers to provide transportation and shelter. The bill [was] met by opposition from both pro- and anti-immigrant groups. Immigration hawks feared that allowing laborers to work in the country for longer than a year might encourage them to overstay their welcome, while farmworker advocates said the bill would further erode workers' rights.⁷⁷

Could Robo-Farms solve Labor Shortages?

Brandon Alexander grew up on farms, acres and acres of wheat and other broad acre crops in Texas and Oklahoma. So, it's not entirely surprising that he applied his other expertise—based on a robotics degree from the

⁷⁷ Collins, C. (2017). *Immigrant Workers in Texas Could Fill Farm Vacancies, but They're Trapped in the Valley*. [online] The Texas Observer. Available at: <https://www.texasobserver.org/immigrant-workers-texas-fill-farm-vacancies-theyre-trapped-valley/> [Accessed 17 Jul. 2019].

University of Texas and work at Google X—to some of the biggest issues facing modern farmers: water use, labor shortages and total yield.

Iron Ox, which Alexander co-founded with Jon Binney, uses two robots and a cloud-based “brain” to grow lettuce, tomatoes, basil and more in a hydroponic system in its first production farm in San Carlos, California—a facility they claim is the first indoor, fully autonomous robot farm. The company, which started in 2015, is now growing 8,000 square feet of produce, and plans to begin selling to chefs and restaurants later this year, then local grocery stores in 2019. Eventually, the startup wants to open farms across the country, offering local produce year-round.

Are robots the future of farming?

Let’s start with the problem. What problem are you trying to solve with Iron Ox?

There are three macro problems that we’re trying to solve at the same time. One is access to fresh produce. Right now the average travel distance for strawberries, tomatoes, a head of lettuce, is 2,000 miles. And that’s because farming, right now, is highly centralized to just a handful of counties in the entire United States. What we want to do is decentralize farming, so we can grow close to the consumer.

The other big issue facing agriculture today is labor scarcity. The average age of a farmer is 58 years old. We’re finding that newer generations, not just in the United States but across the globe, are not taking up agriculture. There’s a multibillion-dollar loss right now because there’s not enough people to do the work.

One of the big things that we’re concerned about too is food deserts and how you can sustainably provide fresh produce to everybody. And that’s one of the reasons we selected hydroponics for our growing, because it not only can reduce the carbon dioxide emissions by growing locally, but we can also use 90 percent less water.

How did you hit on the combination of hydroponics and robotics?

I actually come from a pretty large farming family. We spent months just talking to farmers and just understanding the landscape—outdoor farms, indoor farms, all different approaches. Hydroponics, aquaponics, vertical farms, we tried to take a broad look at everything before we selected our approach. There’s been a significant amount of technology improvement on outdoor farms, even in the past five years. Cheaper sensors, cloud computing, more robust machine learning algorithms, so on. Fresh produce hasn’t really seen the same level of technology that a lot of broad acre processed crops have, like corn, soybeans, wheat, and so on. So that’s really where we felt there was a real opportunity to innovate.

Greenhouses, indoor farms, they can help grow locally, but they’re still very labor-intensive processes. What we tried to do was reimagine the farm, taking all the learning from the past, but also combining it with state-of-the-art robotics and machine learning. To really redesign the process around robotics. Hydroponics allows us to grow year round, but the robotics allows us to constantly monitor our produce for a more consistent product. So, it shouldn’t matter what time of the year, it should always be this peak quality produce, as if it was—and it will be—harvested that morning.

Can you dig a bit into the tech in the system? What else are you doing that’s innovative?

We have two different robots. A large mobile robot, Angus, is constantly navigating through our farm looking for what’s going on at a macro level. And then we have this robotic arm with a stereo camera, kind of like your eyes. The depth image allows it to see each head of lettuce, or each crop, in full 3D.

We’re using computer vision based on machine learning to recognize warning signs of powdery mildew, or aphids, or [tipburn](#), and then our cloud-based brain can actually take data from the farm, like ph level and temperature sensing, and make a decision on what the issue is and the corrective action to be taken.

Hydroponics has been around. We’re big believers in it from a sustainability perspective, but we had to customize our setup to be robot friendly.

So what are some of your biggest remaining challenges?

Can we grow great produce? And that's where our head of growing, Nicole Bergelin, and her team have been fantastic. Yes, the robots are great, but ultimately, we're a farm, and it's about the produce. One thing we do is internal blind taste testing of our produce. We buy off the counter from great grocery stores, and then we compare it to ours. We always make sure that we're capturing qualitative data of, not just taste, but appearance, texture, crispness, bitterness, sweetness, all these different attributes.

When Nicole took over, there was a significant improvement in our yield and quality. And a big part of that was, she gave every head of lettuce, every kale, every basil, tons of attention per day. So we've been working with her on how we can encode her knowledge and what she's looking for into our robots to do a lot of monitoring for her.

Your food isn't for sale yet, right? What has to happen to make that possible?

We've been talking with chefs, understanding their needs, but we haven't been pitching to them or selling to them yet. Now that we've launched our robotic farm, we're going to start inviting chefs, of local restaurants and so on, to visit our farm and try out the produce for themselves, with the goal of selling later this year. In 2019, we expect to expand to grocery stores.

Robots are cool and all, but what makes using them on a farm so important?

In some ways, this just has to happen if we're going to feed the growing population. There's labor scarcity, but at the same time we're noticing a plateauing of yields in our outdoor farms. One of the reasons we took this more radical approach is because we felt, if we're going to do something to increase the world's food production, we had to take a more drastic path to do it. It can't just be an incremental improvement.⁷⁸

OLIVES

[2017] For nearly a year, Randy Brazil and his wife Monica and their partners were riding a wave of success.

The couple spent years quietly investing in their olive orchard in Devers and last year made their big splash with a marketing strategy and competition win that brought them almost instant notoriety with their company, Southeast Texas Olive Oil.

But that wave of joy soon became as much as five feet of water in the orchard in some spots, and a couple of feet or more in their pasture and home when the hurricane hit. They could only watch helpless as Hurricane Harvey washed away their dream.

It's a super high-density orchard where the trees are lined in rows that are 12-14 feet from the next row with trees that are about five feet apart from each other in the row.

"This orchard is set up to do mechanical harvesting," he said.

There are about 650-680 trees per acre and they have around 34,000 trees.

They buy the cuttings to plant new trees from a nursery in California and it takes about five years before the trees begin to bear olive fruit.

A bad winter last year already meant little fruit were bearing on the trees when Harvey hit.

"What little bit we would have harvested, we lost during the flood," he said.

Few Texas olive farmers were harvesting this year because of the bad winter, but this was a devastating blow to lose all of the fruit.

"This is the first year that we didn't produce any olives or oil," he said disappointed.

⁷⁸ Hurst, N. (2018). *This Robotic Farming System Could Be the Answer to Labor Shortages*. [online] Smithsonian. Available at: <https://www.smithsonianmag.com/innovation/robotic-farming-system-could-be-answer-labor-shortages-180970575/> [Accessed 17 Jul. 2019].

There are hoses that are wound through the trees for irrigation, but are largely unnecessary with the soil in this part of Texas.

"We spend more time fighting to keep water off of the trees than on them," he said. "We haven't watered our trees in four years."

Brazil said the trees should have to work for their water.

"This is a clay gumbo type of soil and it retains water so you really don't want it to be sitting in water for any length of time because it can develop a root fungus that's hard to get rid of," he said.

To keep the orchard pristine, it takes about two days to mow.

Harvest time can be exciting.

To ensure the highest quality of oil, the olives are pressed within a half hour to hour or so of being picked.

The harvesting is done now with an Oxbo 6420 Super High Density Olive Harvester that basically straddles over the trees and drives at about four miles per hour using a bow rod picking system that removes the olives with minimal tree damage and delivers them to dual dump bins. The bins are then transported on the property just minutes away to an awaiting Texas Mobile Mill where the mobile olive processing unit mills the olives on-site saving transportation and storage costs.

"The quicker you get it milled, the better the oil," Brazil said.

Brazil has put together a plan now and is headed back in the right direction and anxious to get back to his speaking engagements and taste testing parties that brought them so much success in the past.

"I'm still learning every day more about olive ranching. The farming is easy to me. It's the marketing that's the hardest for me," he said.

To compensate, he attends as many conferences as he can.

Success has been sweet with the Southeast Texas Olive Oil knocking out more than 900 teams to win the coveted 2017 Silver Award in the New York International Olive Oil Competition.

The olive oil can now be found in the high-end Spec's stores and many others locally.⁷⁹

Oil comes naturally to Texas; some claim it's in Texans' blood. If you've grown up in East Texas or the Permian Basin, talking about that black ooze from the earth is as natural as breathing.

But in the last couple of years, talk has emerged about a different variety of oil—that golden green oil that comes from olives. With Texas's range of microclimates, this ancient Mediterranean fruit is taking root here to a degree that has California noticing. Texas now ranks as the second-largest producer of olive oil in the United States. In the Houston area, a risk-taking group of growers is turning their hayfields and cattle pastures into olive groves.

In his weathered boots, spurs, and pearl-snap denim shirt, Randy Brazil looks more like a cowboy than an East Texas olive grower. Instead of mounting the horse waiting in his corral, Brazil and his wife, Monica, who run [Southeast Texas Olive](#), stroll to the barn, grab a bottle of their award-winning oil and pose with the trophy that proves it. In 2017, extra virgin olive oil from their property competed among entries from 26 countries, winning second place in the New York International Olive Oil Competition. Partnering with fourth-generation farmers Rhonda and Steve Devilliers and their son and daughter-in-law Culley and Melissa Devilliers, the Brazils have turned their former neighbor's 40 acres of Arbequina olive trees into an operation that produced 11,660 bottles in 2015, their first harvest. This is not Tuscany. This is Devers, Texas, 56 minutes from downtown Houston.

There's no shortage of water for the Liberty County farm. A creek runs nearby, and with a turn of the tap, 34,000 Arbequina trees can be drip-irrigated from the ranch's pond. Orchard trees have been planted atop rows of three

⁷⁹ Taylor, D. (2017). *Olive farm survives Harvey ravages*. [online] Houston Chronicle. Available at: <https://www.chron.com/neighborhood/dayton/news/article/Olive-farm-survives-Harvey-ravages-12267254.php> [Accessed 8 Aug. 2019].

foot-high berms to tolerate the prevalence of water and to mix the gumbo clay soil. Three harvest seasons into Brazil-Devilliers' management, these Arbequina are thriving, producing an extra virgin olive oil that's 100% certified organic.

"Olives can grow in the worst soil in the world," says Randy Brazil. "In the Middle East, you have rocky soil and 1,000-year-old trees in Israel still producing oil. Climate is key. If you have a 6 to 8 pH and keep the feet dry," he says, you can grow in East Texas gumbo clay without a problem.

To help with the harvesting, the Southeast Texas Olive partners rely on an Oxbo harvester owned by [Texana Brands](#) and a Texas Mobile Olive Mill owned by [Lone Star Olive Ranch](#). Both were designed to kick-start the Texas olive oil industry for orchard owners who can't capitalize heavy equipment or hand-pick their crop. As the massive Oxbo harvester moves over the olive trees, fruit drops in a bin below, the crated fruit is either milled on site in the mobile mill or moved to a chilled truck.

The Texas Mobile Olive Mill operated by Lone Star Olive Ranch's Christine McCabe and Cathy Bernell is a trailer-mounted, all-in-one milling facility for the field that can move from orchard to orchard within days and process olives to oil in the middle of the night. Since 2016, they've serviced 17 orchards in Texas, plus some in California.

McCabe and Bernell's venture started 10 years ago when they purchased their 80-acre Madison County farm with the idea of becoming olive oil producers. People thought they were crazy. Olive trees had never been planted 100 miles north of Houston. No one knew what the weather would do, or if the soil would be right. It would be at least three years until the first crop if any. The partners had just come from running a cattle ranching operation. "We determined we were not ranchers," McCabe says. "We needed to be farmers, instead."

With 50 acres under cultivation, McCabe and Bernell have decided to hand-harvest. "It produces a better fruit," says McCabe, "which produces a better oil. It is more expensive to hand-harvest, but the process is much more delicate than mechanical harvesting, so we're not bruising the fruit."

Picking olives by hand "sounds really sexy," says McCabe, "but it's not." Harvest time is September, or sometimes even August. It's hot. To beat the heat, picking starts at sunrise. "We're subject to bees and wasps and snakes and spiders and rain. Folks come out and volunteer; they last an hour, then they're gone." So she's developed a crew to get the job done. The fruit has to be picked before it heats up in the sun and starts to break down. Then, it has to be crushed and processed within 24 hours. In their fourth year of production, 2016, they picked and processed for almost four weeks and yielded three tons per acre. Three months later, during a mild winter, the temperature suddenly dropped from 75° to 15°. The freeze lasted four days, affecting every tree and killing 15 acres of saplings. "It was a very long process of recovery and hard pruning," says Bernell, "taking back all the dead wood on the trees. It took nutritional management, trying to get them back into good health; a very long window of time to see if any survived."

McCabe and Bernell were thrilled when, eight months later, their hard work yielded one ton per acre in a harvest that only took 10 days. By 2018, the orchard had fully recovered. "Year after year they said it couldn't be done," McCabe says of the naysayers, "but year after year we're proving that it can be done."

Just 30 miles from the coast, the orchard at Southeast Texas Olive faces different challenges. "The Gulf breeze keeps us from hard freezes in the winter, and from it being too hot in the spring," says Randy Brazil. But in August 2017, Monica and Randy found themselves standing in water. Hurricane Harvey flooded their home and four feet of water stood in their fields for days. They had just planted 7,000 trees; they lost 4,000. 2019 will be their first harvest in two years. "Mother Nature, she can be so cruel," says Brazil, who has income from working at the nearby Covestro plant for over 30 years and from working as a cowboy in the community, running 7,000 head of cattle on his ranch.

“A lot of people who do this, do this while they are doctors or lawyers or have an air conditioning business, but this is what we do,” says Michael Paz, who runs Texana Olive Ranch in Cotulla with his wife, Mary Rose, and his brother-in-law, Stephen Coffman, Jr. The farm has been in the family for 125 years. Cattle grazed and watermelon grew until activity slowed down and mesquite took over. Then, a well came in a few years ago, and “we made the ballsy decision of planting an olive orchard in South Texas,” says Paz.

To make it as full-time olive growers, they learned the business from those who were already doing it. They invested in the Oxbo harvester, built a mill in Cotulla, purchased a production facility in Kyle, and gradually established 150 acres of Arbequina, Arbosana, and Koroneiki olive trees. They’ve learned about other growers’ experiences from traveling to orchards in Australia, and from working their Oxbo harvester during Texas and California harvests. Since their first planting in 2012, the family has planted 200,000 trees in alternate years and formed some basic management practices that allow them to consistently produce the industry standard of three tons an acre per year.

“We farm olives. We make olive oil,” says Paz. “Lots of capital investment, lots of time investment, truly lots of blood, sweat, and tears; we’re in it too far now.”

Even if it takes two generations to turn a profit, for this group of Texas olive growers the rewards come in special forms and often unrecognized signs: recovery from disaster, improving the farm, having your olive oil grade better than USDA standards, or simply seeing, in late summer, the olive limbs so heavy with fruit that they bend low to the ground.

“I love it,” says McCabe. And moments like that are worth their weight in gold.⁸⁰

NURSERY

The Texas horticulture business is blooming. The green industry's economic impact in Texas exceeds \$15 billion according to Texas AgriLife.

The nursery industry can be very competitive because there are so many nurseries in East Texas and Deep East Texas, but it's also a very close-knit group.

Family owned wholesale and retail nurseries trade business and information to help the industry continue to grow.⁸¹

For today’s nursery and greenhouse growers, it’s not enough to simply produce beautiful plants and flowers, in peak condition, at the right time and cost-effectively. Growers must also deal with uncontrollable weather conditions, insect and disease issues, and labor challenges. They must also meet increasing consumer and buyer demands.

In 2016, demand and pricing held generally steady for greenhouse growers. Some areas were impacted by drought conditions and watering bans, but overall the [...] green industry had a good year. The nursery industry saw improved revenues and profits over the prior year, and as housing markets recover and the general economy improves, the industry should also experience economic improvement. Energy costs remained moderate, helping keep production costs in line, but some growers are facing increasing costs to accommodate buyers’ expectations.

Big box chains continue to be the primary sales outlet for both greenhouse and nursery producers. Growers who sell to them often must enter into vendor-managed inventory (VMI) arrangements. These major retailers are increasingly demanding more services from vendors, such as management of their store-level inventory – including watering the plants – which is raising the cost to producers. Suppliers must be very efficient and

⁸⁰ Walden, J. (2019). *A Green Gusher In the Lone Star State*. [online] Edible Communities. Available at: <https://www.ediblecommunities.com/edible-communities/olive-oil-takes-root-in-texas/> [Accessed 8 Aug. 2019].

⁸¹ McCollum, D. (2018). *East Texas plant industry blooming*. [online] <https://www.ktre.com>. Available at: <https://www.ktre.com/story/37849272/east-texas-plant-industry-blooming/> [Accessed 19 Jul. 2019].

manage tight margins in order to survive. Meanwhile, the increase of merchandisers at box stores and VMI have improved the quality of plant material at those stores, which has traditionally been a differentiator for independent garden centers.

Many innovative and high-end garden center retailers are surviving and even thriving in today's market, but it's certainly more challenging. It's no longer enough to simply offer good plants to maintain a customer base. To attract and satisfy demanding retail consumers, retailers must offer an experience compelling enough to pull them away from the chains.

In today's consumer-oriented culture, many retailers, including several big box store chains, such as Home Depot, Lowe's and Walmart, are increasingly asking about growers' use of pest controls, particularly neonicotinoids, or "neonics," and their effect on pollinators. This is forcing many growers to look at alternative pest control methods.

There is a small but increasing number of "controlled environment agriculture" operations growing produce. This includes new and high-tech rooftop structures, vertical farms, hydroponics and other types of facilities that are increasingly producing vegetables, such as baby greens, tomatoes and other high-value crops. While this is still a niche industry, there are already some large producers in this new market segment.⁸²

Rising Housing, Rising Hopes

One of the continuing bright spots in the coming year [2018] is the housing market, a prime influencer of derived demand for green industry products and services.

Even though housing starts have more than doubled from their recession-inflicted bottom, overall starts are currently about 1.2 million units, which is about half of pre-recession levels.

Residential investment and housing starts are usually the best leading indicator for the green industry economy, so this suggests that green industry sectors will continue to grow in 2017. In fact, a recent econometric forecast of historic personal consumption expenditures on plant sales indicates that, holding all other things constant, the market for ornamental crops will continue to rise through 2019.

The most successful nursery and greenhouse firms in 2017 will be those that are well-positioned with their customers in the marketplace, not overleveraged and clearly articulate their value proposition. We will likely see continued structural changes across the industry supply chain as we morph into the more compact and efficient industry of the next decade. This will not only mean further consolidation in the industry, but deeper, more strategic relationships among those left from the transition. The next decade of the green industry will not look the same as the last decade.⁸³

Nurseries navigate a new landscape as consumer demand evolves

Americans love their pets. A lot.

In 2017, they spent nearly \$70 billion on their animal companions, and that number's expected to rise to \$100 billion by the end of the decade, according to the American Pet Products Association.

⁸² Laughton, C. (2016). *A Changing Landscape for Greenhouse and Nursery Growers*. [online] Farm Credit East. Available at: <https://www.farmcrediteast.com/knowledge-exchange/blog/todays-harvest/greenhouse-nursery-outlook> [Accessed 19 Jul. 2019].

⁸³ Hall, PhD, C. (2017). *Greenhouse and Nursery Outlook*. [online] Farmcrediteast.com. Available at: <https://www.farmcrediteast.com/News/media-center/press-releases/20170201FebruaryKEP/GreenIndustry17?nvctx=%7BF100E92A-C3D5-43F6-8DA9-5EC36D2CDCBB%7D> [Accessed 7 Aug. 2019].

They also, it seems, love their smartphones, spending \$84 billion last year and updating their phones an average of every 21 months, according to Statista.

But their plants? That's a bit of a different story.

“We spend a lot on pets. That annual growth rate has never decreased since 1994, even during the Great Recession,” said Charlie Hall, professor and Ellison Chair in the Department of Horticultural Sciences at Texas A&M University. “That's not the same for plants.”

Instead, plant and gardening spending took a big hit during the Great Recession, even if participation didn't drop off as much. According to the National Gardening Survey, lawn and garden spending hit a five-year low in 2014, though it has been on a slow rise ever since. The recession played a big role in driving down that spending, but in Hall's view there's more going on than that.

For one, gardening has fallen down on the list of the most enjoyable leisure activities, according to Hall. In addition, product shortages — the result of fewer plantings during the recession — gave consumers fewer options. While new plant varieties are always coming on the market in an effort to draw new consumers, selling plants on their aesthetics alone isn't cutting it anymore.

“With new varieties, there is some level of excitement that is created with the consumer, but we have enough plants in the pipeline to last decades,” said Hall. “We need another, more powerful value proposition than just that plants are pretty. We need to focus on the functional benefits, the environmental services they provide and the health and well-being that we don't emphasize enough. If the industry were to start emphasizing those more, then we'd see a shift.”

The somewhat-softened demand in the nursery industry of a few years ago stemmed in part from the very real impacts of the Great Recession on the industry as a whole. People may have stayed closer to home during those years, but their discretionary spending on all kinds of goods, not just plants, dropped off.

The crumpled housing market did little to help stimulate new demand for landscaping materials. Nurseries in Oregon found themselves destroying product — literally burning plants — that they couldn't sell. Sales plummeted from an all-time high of nearly \$1 billion in 2006 to just about \$640 million in 2011, according to the Oregon Department of Agriculture.

Looking to avoid a similar fate in the future, the nurseries that survived the recession — as many as 40 percent of growers left the industry at the time — backed off their plantings. In turn, that's led in some cases to shortages of certain plants at a time when consumer demand began ticking up in the past few years.

“Demand changes all the time,” said Andrea Krahmer, a relationship manager with Northwest Farm Credit Services. “We do get reports that (producers) are happy with the level of demand that they're seeing right now. Operations are feeling quite a bit more comfortable.”

Hall noted that growers who did curtail their plantings during the recession have now had long enough to get production back up and running, and they're doing it in a more efficient way.

“I always say, never waste a good recession,” said Hall. “From a market standpoint, there are always efficiencies gained during downturns.”

The housing market has also regained momentum. Building permits for both single-family and multifamily construction bottomed out at just over 500,000 in 2009 and were back up to more than 1.2 million last year.

“What's good for housing is good for us,” Hall said.

Despite the optimistic run in the current environment, plenty of challenges still dot the road ahead for the nursery industry when it comes to consumer demand. As with almost every aspect of the industry, the need for labor poses a constant difficulty. When it comes to demand, labor plays a role because it's required to create the supply to feed the ramping-up demand.

"In the last couple years we've been hearing from growers who say, 'Market conditions tell me I should be expanding, but the labor is the thing that is holding me back,'" said Craig Regelbrugge, senior vice president with AmericanHort, a national trade association that represents the horticulture industry. "Anyone you talk to will say, 'I could hire 50 people tomorrow, but they're not there.'"

One positive side effect of the labor shortage, he added, is that it may be buffering the industry from over-producing and thus setting it up for an unwanted surplus in the not-too-distant future.

Demographic shifts are also playing a role in demand for plants and plant materials. As the Baby Boomers retire and move into smaller homes and planned communities, demand from them has tapered. The suburban settlement patterns of the post-World War II area, which found people living in homes on large lots in need of landscaping, are fading as more people head to the cities and live in areas of higher density.

Millennials seem to be taking their time embracing the larger world of plants, too, as they delay marriage and homeownership later than earlier generations did. That's not to say that they're not into plants at all, noted Behe.

"They don't connect with the industry in traditional ways like gardening and plants in the yard," she said. "They think more about plants and plant projects. They are very connected to things like the environment and where their food is coming from."

Those kinds of shifts in the market are in part a challenge for the industry, but also an opportunity. On top of immigration reform, managing labor issues and keeping plant supply at optimal levels, how the nursery industry shares its stories and markets itself will have a huge impact on stimulating demand from consumers.

That includes playing up the role of plants in ways that have been farther down the list of benefits for years. For example, plants can be used for screening and noise reduction in those more densely-packed residential settings. Regelbrugge believes there's huge opportunity in the world of green infrastructure, where cities are using plants for pollution mitigation, stormwater runoff, green roofs and other applications. The planning community has so far driven that trend, but the nursery industry should be jumping on board with it as well.

"These things have the potential to create and drive major demand," Regelbrugge said. "From a policy perspective, our industry would be wise and better off to be engaging in this."

Tapping into more youthful trends will help capture the millennial generation and stimulate future demand from them, as well.

"They get it. Their eyes light up. You give them a 4-inch annual and you would have thought I paid their tuition," Hall said. "They start taking selfies with it."

That may sound funny, but it's true. According to Behe, smart retailers are already targeting the younger set — Urban Outfitters, which specializes largely in clothing, has a plant shop that offers succulents and other plants for smaller living spaces — but others in the industry need to do so, too.

"Millennials are not going to open an email. They're on Snapchat and Instagram," she said. "We just have to update our game. I still see growers struggling with that because it's not in their nature."

Future demand will also come from longer-term efforts to simply share more about the nursery industry and the benefits of plants in general.

The National Initiative for Consumer Horticulture has launched a campaign called #PlantsDoThat to show how beneficial plants and gardens can be, including the fact that consumer horticulture contributes \$196 billion to the U.S. economy. The campaign also touts these additional benefits:

- office plants reduce employee sick time by 14 percent,
- trails and greenways increase home values
- the return on investment for landscape upgrades is nearly 110 percent.

“People are willing to pay for the thing they want to buy. People afford the things they want,” Hall said. “We’ve got to tap into those feelings. We should all be storytellers and talking about these benefits to society in our own circles of influence.”⁸⁴

The Nursery Management Conference 2019, will take place October 1-3, 2019 at the Hilton Fort Worth in Fort Worth, Texas. This new educational conference, sponsored by *Nursery Management* magazine, will bring owners, executives and managers from nursery operations across North America together to discuss the issues affecting the horticulture industry today, and the impact they will have in the years ahead.

“With growers facing continued labor shortages, the need for more automation, input price increases and rising distribution costs, the time is crucial for another face-to-face event,” says Jim Gilbride, Group Publisher.⁸⁵

PORK

On May 17, the Office of the U.S. Trade Representative (USTR) posted this announcement regarding removal of Section 232 tariffs on steel and aluminum imports from Mexico and Canada and removal of those countries’ retaliatory duties on U.S. goods:

Today, the United States announced an agreement with Canada and Mexico to remove the Section 232 tariffs for steel and aluminum imports from those countries and for the removal of all retaliatory tariffs imposed on American goods by those countries. The agreement provides for aggressive monitoring and a mechanism to prevent surges in imports of steel and aluminum. If surges in imports of specific steel and aluminum products occur, the United States may re-impose Section 232 tariffs on those products. Any retaliation by Canada and Mexico would then be limited to steel and aluminum products. This agreement is great news for American farmers that have been subject to retaliatory tariffs from Canada and Mexico. At the same time, the Agreement will continue to protect America’s steel and aluminum industries.

The Mexican government also issued a statement saying that it is “committed to eliminating all tariffs imposed in retaliation for the measures taken by the Government of the United States,” which would mean restoring duty-free access to Mexico for U.S. pork. In June of last year Mexico began imposing a 10% retaliatory duty on imports of

⁸⁴ Bell, J. (2018). *Where plant demand is headed*. [online] Digger Magazine. Available at: <http://www.diggermagazine.com/where-plant-demand-is-headed/> [Accessed 17 Jul. 2019].

⁸⁵ Castelli, G. (2019). *Nursery Management Conference to bring industry professionals together*. [online] Nursery Management. Available at: <https://www.nurserymag.com/article/nursery-management-conference-2019-ft-worth-texas/> [Accessed 17 Jul. 2019].

U.S. pork cuts, a 15% duty on U.S. pork sausages and a 20% duty on some U.S. processed hams. The duty rate for U.S. pork cuts increased to 20% in July 2018.

“Mexico’s retaliatory duties on U.S. pork have absolutely hammered the U.S. industry, and removal of these duties is tremendous news for the entire U.S. supply chain,” said USMEF President and CEO Dan Halstrom.

Mexico is the leading volume market for U.S. pork, and exports in the first quarter of 2019 were down 13% from a year ago to 177,420 metric tons (mt). Value declined 29% to \$261.9 million as U.S. producers and exporters bore the cost of the retaliatory duties. When factoring in the lost value due to lower prices for key items often exported to Mexico, such as bone-in hams and picnics, from every hog produced in the United States, industry losses have exceeded \$1 billion since June 2018.⁸⁶

POULTRY

Texas’ poultry industry contributes more than \$3 billion to the state’s economy with broiler production accounting for more than \$2 billion in cash receipts.⁸⁷

An estimated 472 million eggs were laid in Texas in July of 2017, according to USDA’s National Agricultural Statistics Service (NASS).

That’s five percent more eggs than were produced in Texas this time [2016]. Egg production this month is down two percent over May.

There are more chickens laying those eggs.

The report indicates there were 21.3 million layers in June, which is four percent higher than last year. It is slightly lower than the May report.

Egg production per 100 layers in Texas averaged 2,211 eggs this month. That’s up 15 eggs from July 2016. It’s down 41 eggs from May.

United States egg production totaled 8.58 billion eggs during June. That’s three percent more than this time last year. The number includes 7.47 billion table eggs, 1.03 billion broiler-type hatching eggs and 73.0 million egg-type hatching eggs.

On average, the number of layers nationally is 370 million. That’s up one percent over 2016 reports.

Egg production nationally per 100 layers was 2,316 eggs, which is also up one percent.

NASS reports there were 49 million egg-type chicks hatched across the nation in June. That’s 15 percent lower than last year.

The hatch of broiler-type chicks nationally was two percent higher compared to last year at 802 million.

Leading U.S. breeders placed 8.59 broiler-type pullet chicks for future domestic hatchery supply flocks in June, which is up one percent over June 2016.⁸⁸

⁸⁶ USMEF (2019). *Mexico and Canada remove retaliatory duties on US products, including beef – Texas and Southwestern Cattle Raisers*. [online] Texas and Southwestern Cattle Raisers. Available at: <http://tscra.org/mexico-and-canada-remove-retaliatory-duties-on-us-products-including-beef/> [Accessed 18 Jul. 2019].

⁸⁷ Fannin, B. (2018). *Texas A&M AgriLife breaks ground on new poultry biosafety research facility | AgriLife Today*. [online] AgriLife Today. Available at: <https://today.agrilife.org/2018/10/23/texas-am-agrilife-to-break-ground-on-new-poultry-biosafety-research-facility/> [Accessed 8 Aug. 2019].

⁸⁸ Domel, J. (2017). *Texas egg production on the rise*. [online] Texas Farm Bureau. Available at: <http://texasfarmbureau.org/texas-egg-production-rise/> [Accessed 8 Aug. 2019].

Valuable Fertilizer

Producers can find value in evaluating fertilizer input costs and comparing traditional nitrogen sources like urea and ammonium nitrate with popular non-traditional sources such as poultry litter, according to Texas A&M AgriLife Extension Service experts.

Poultry litter is a popular alternative fertilizer for East Texas farmers, said Dr. Vanessa Corriher-Olson AgriLife Extension forage specialist, Overton.

But producers should evaluate the nutrient value and timing of nitrogen availability to plants to ensure they are getting the most out of fertilizer whether using urea, ammonium nitrate or poultry litter.

“Litter is a viable option for nitrogen, phosphorous and potassium, but there are some things to keep in mind when considering poultry litter as a fertilizer for forage or hay production,” she said.

First, producers should test their soils as prescribed to determine what nutrients are needed to optimize grazing or hay production, she said. The test should be a guide for producers’ decision on fertilizer applications.

“If the soil test says you don’t need phosphorous then there is no value in it,” she said. “You’re paying for something you don’t need.”

Corriher-Olson said nutrient concentrations in litter are highly variable based on whether the birds are broilers, pullets or layers, and even vary from farm-to-farm and house-to-house or how and how often they are cleaned, when compared to urea or ammonium nitrate.

To evaluate the value of each litter source, one needs to determine the price per pound of nitrogen, phosphorus, and potassium from traditional fertilizer sources, Banta said. Based on May 2017 market prices, the per-pound cost of nitrogen is 46 cents. Phosphorous is 52 cents and potassium is 29 cents.

Using these values and the average pounds of nitrogen, phosphorus, and potassium per ton of litter, from above, we can calculate the potential value of each litter source. Broiler litter would have a potential value of \$70.70.

- The value of nitrogen per ton of broiler litter: 60 pounds x \$0.46 = \$27.60
- The value of phosphorus per ton of broiler litter: 55 pounds x \$0.52 = \$28.60
- The value of potassium per ton of broiler litter: 50 pounds x \$0.29 = \$14.50
- The total value per ton of broiler litter: \$27.60 + \$28.60 + \$14.50 = \$70.70

“If a producer could purchase broiler litter for less than \$70.70 it would be a good buy compared to the same nutrients from traditional fertilizer sources,” Banta said.

Layer litter would have a potential value of \$56, and pullet litter would be worth \$44.41 per ton.

“These values will vary depending on traditional fertilizer prices and the actual nutrient content of your litter source,” he said.

Additionally, if soil tests indicate phosphorus is not needed, the value of broiler litter in our example would be \$42.10.

“You want to know the potential value of the nutrients,” he said. “If the potential value is equal or greater than the cost of the litter then it’s a good buy.”⁸⁹

Labor Issues

EGG-NEWS has commented previously on the relationship between acceptable housing for legal migrant workers and their productivity and tenure. Faced with competition from industry and progressively higher labor rates and the imperative to train and retain employees, many egg farmers are evaluating alternatives to their traditional recruiting and retention programs. This is especially the case in the Southwest where employers require legal workers from Mexico and Central America.

Unlike seasonal harvests, egg production provides year-round employment and demands a high level of training in stockmanship and a commitment to welfare and acceptable procedures. The H-2A program requires employers to provide housing meeting minimum standards as laid down by the Department of Labor.

Based on personal experience in a number of nations and observing the situation in the U.S., egg producers should seriously consider providing acceptable housing for documented workers and their families. With the conversion from conventional cages to aviary systems, labor requirements are at least double and sometimes three-fold compared to conventional cages creating a demand for additional workers. Selection and then training including supervision is an expensive component of the cost of labor. Motivated employees deserve both job security and domestic stability in return for service and commitment. Providing homes of a suitable standard will generate loyalty to an employer and will contribute to a stable workforce which can be relied on to adhere to company procedures.

It is a matter of judicial record that in past years, producers such as the DeCoster family exploited workers and provided “captive” groups of employees with substandard accommodation. His companies used disused and obsolete trailers for housing subjecting workers to unsanitary and unhygienic conditions resulting in intervention by state and Federal authorities in addition to adverse judgments and settlements in civil lawsuits.

Along with investments and installations to satisfy structural biosecurity and environmental compliance, developers of new complexes should consider the erection of housing for workers as an integral component of capital cost as they now or should do with biosecurity.⁹⁰

RICE

For much of the world’s population, especially in Asia, rice is the most widely eaten staple food. Forty percent of humans—mostly in populous, less developed countries—depend on rice as their major source of calories and energy. Hundreds of varieties of rice are grown in a variety of climates and terrains across the globe. Throughout history, rice has fed cities and armies, supported empires and rural populations, and commanded mythical and

⁸⁹ Russell, A. (2017). *Texas: Finding Value in Poultry Litter as a Fertilizer*. [online] AgFax. Available at: <https://agfax.com/2017/05/29/texas-finding-value-in-poultry-litter-as-a-fertilizer/> [Accessed 8 Aug. 2019].

⁹⁰ Shane, S.(2019). *H-2A and Other Documented Employees Require Adequate Housing*. [online] Egg News. Available at: <http://www.egg-news.com/Commentary.aspx> [Accessed 8 Aug. 2019].

religious significance. In many cultures, rice has been a symbol of fertility (that's why we throw rice at weddings) and in several Asian languages, the greeting "How are you?" translates literally as "Have you had rice?"⁹¹

Nearly 85% of the rice we eat in the USA is grown by American farmers. Each year, 18 billion pounds of rice are grown and harvested by local farmers in Arkansas, California, Louisiana, Mississippi, Missouri and Texas. The U.S. rice industry is unique in its ability to produce all types of rice—long, medium and short grain, as well as aromatic and specialty varieties.

The upper Texas coast is home to most of the state's rice production and milling industry. The Texas Rice Belt plays an important environmental, as well as agricultural, role in the coastal prairie. Texas produces mostly long grain rice, which cooks up as separate, fluffy grains. Versatile long grain rice is often used for recipes requiring rice grains with a distinct shape and texture.

Rice was first cultivated in Texas primarily for home or local consumption, using pioneer farming methods. Oxen were used to plow small plots, which were planted by hand. The crop depended on rainfall. Commercial production began in earnest in the 1880s—helped along by the railroad, affordable land, immigration from Louisiana and other grain-producing areas and the introduction of modern rice milling. A significant event occurred in 1904, when seed rice from Japan was introduced. The Houston Chamber of Commerce and the Southern Pacific Railroad invited Japanese farmers to Texas to advise local rice producers. The Japanese farmers arrived with seed, a gift from the emperor of Japan. This event was a turning point in the establishment of the Texas rice industry.⁹²

The commercial rice industry in Texas always depended heavily on international markets; it thrived until there were major market slumps after World War I and later during the Great Depression of the 1930s. World War II brought a resurgence, and the world's demand for rice continues.

Today, Texas is the fifth largest rice-producing state, after Arkansas, Mississippi, Louisiana and California. The current major rice-producing counties in Texas are Colorado, Wharton and Matagorda, which generate around 60 percent of the Texas rice crop. According to the USA Rice Federation, Texas rice production and processing adds \$200 million per year to the state's economy.

Due to water availability issues, Texas has seen a decrease in rice acres in recent years and now produces about 140,000 acres. Rice production and processing both play important roles, contributing more than \$140 million to the state's economy each year and accounting for thousands of real wage jobs in the state.

Rice production is unique in its ability to supplement wildlife habitats. Winter-flooded rice fields cover vital freshwater wetland functions in the Upper Texas Gulf Coast ecosystem. Texas rice fields offer forage and roosting habitats for resident, wintering and migrating waterfowl and shorebirds, as well as other wetland-dependent wildlife species.⁹³

Where do they get the water?

Traditionally, Texas rice farmers have irrigated their fields with water from one of the Texas rivers that traverses the state northwest to southeast and empties into the Gulf of Mexico—the Brazos and Colorado Rivers in particular. This is accomplished by a complex network of canals and pumps, along with the use of reservoirs and wells.

Since they were established, the Highland Lakes reserves have been adequate for all purposes, and LCRA has released water from the lakes downriver every year. That is, until 2012. As the multiyear Texas drought has

⁹¹ Pack, M. (2016). *Rice in Texas*. [online] Edibleaustin.com. Available at: <http://www.edibleaustin.com/index.php/food-2/1588-rice-in-texas> [Accessed 18 Jul. 2019].

⁹² Think Rice. (2019). *Where Is Rice Grown?*. [online] Available at: <https://www.thinkrice.com/on-the-farm/where-is-rice-grown/> [Accessed 18 Jul. 2019].

⁹³ Think Rice. (2019). *Where Is Rice Grown?*. [online] Available at: <https://www.thinkrice.com/on-the-farm/where-is-rice-grown/> [Accessed 18 Jul. 2019].

become increasingly serious, the water level of the lakes has dropped to a frightening 34 percent of normal capacity, while the water demands of ever-growing cities have increased exponentially (for example, Austin's water use tripled between 1970 and 2010).

In 2012, 2013 and now 2014, LCRA has declined to release water downriver for irrigation. Similar scenarios are playing out on the Brazos and other Texas rivers. This has set up heated and emotional conflicts of interest between upriver cities and downstream rice farmers. It's a textbook example of the competing demands in a state that traditionally has been agricultural and is becoming increasingly urban and industrialized.

The drought and lack of irrigation water for three years running have had serious effects on the state's rice industry. Not only has the impact been far-reaching for farmers and their employees, but for related businesses such as equipment vendors and rice mills as well.

So what are the long-term prospects for rice in Texas? Is this crop—fundamental to the development of the state for more than a century—going to just fade away from lack of water? There aren't any easy answers, but Dr. Ted Wilson, director of the Texas A&M AgriLife Research and Extension Center in Beaumont and a world authority on rice production and research, thinks otherwise.

In a panel about rice at the Foodways Texas Symposium this past March at Texas A&M University, Wilson was cautiously optimistic that the industry could weather this drought crisis. "But there will have to be many changes in the way we grow rice," he said. Research projects around the world are breeding strains of rice that require less water and developing new methods to grow them. Texas rice-growing counties are slowly developing downstream reservoirs to store irrigation water. Perhaps in the future, water desalination processes will become financially viable. Also, as Gertson has pointed out, rice farmers are a tenacious lot. "If and when water does become available again, there will be folks left here to utilize it for rice production."⁹⁴

Hoping for a Grain of Relief in 2017

Rice prices have declined for several years, averaging about 10 cents a pound last year [2016], because of competition from huge rice producers like Vietnam and Thailand as well as increases in agricultural productivity that have boosted supplies. Over the past few decades, hundreds of rice farmers in Southeast Texas have given up the crop entirely.

But in mid-July, the Texas rice industry — which is worth about \$100 million per year to farmers — was granted a reprieve: a [deal to allow U.S. rice sales to China](#). The industry estimates that China soon could buy 250,000 tons of U.S. rice per year, out of the 9 million tons it produces, which could boost prices significantly.

Although trade between the two countries had been liberalized when China entered the world trade organization in 2001, trade in rice remained off the table. An agreement to allow exports has been in the making for nearly a decade, with talks launched by George W. Bush, continued under Barack Obama and ultimately concluded under President Donald Trump. The deal sets complex safety standards to prevent pests from entering China with rice imported from America, which, if met, opens a market of more than 1 billion rice eaters to U.S. farmers.

For the Stoesser farm, selling to China could mean a slightly bigger financial cushion in a business that can see a year's income decimated by floods or drought or both.

"If we could get to 16 cents instead of 10 cents a pound, it would take a lot of risk out," Stoesser said. "Trade is the answer to our problems."

The last few decades have left the Stoessers feeling isolated.

⁹⁴ Pack, M. (2016). *Rice in Texas*. [online] Edibleaustin.com. Available at: <http://www.edibleaustin.com/index.php/food-2/1588-rice-in-texas> [Accessed 18 Jul. 2019].

The flat, humid counties east of Houston used to be full of rice fields — in 1968, [70 square miles](#) of Liberty County were planted with the crop.

The rest of Texas' rice industry, however, has shrunk to 187,000 acres from more than 600,000 in the 1950s. In Liberty County, the 70 square miles of rice fields is now eight.

"I hate to say it, but when I was in high school, there were 70 farmers," Neal said. Now there are just three in Liberty County — Neal, his father and his brother, Grant.

[Several reasons are behind the decline,](#)

including the encroachment of suburban housing developments, which raised land prices to the point where it made more sense to sell than keep farming. Today, Texas accounts for about 6 percent of U.S. rice production, far behind the leader, Arkansas, which accounts for about half.

But Texas rice farmers have a few things working in their favor. New seed varieties allowed them to nearly double the yield per acre, with the assistance of experts from Texas A&M's field offices. And federal crop subsidy programs have kept them afloat through thin years, paying out [\\$1.8 billion to Texas rice farmers](#) between 1995 and 2014, according to a database maintained by the Environmental Working Group, an advocacy organization that opposes farm subsidies.

Meanwhile, the rice industry has tried to expand its market by boosting Americans' rice consumption. Stoesser runs the Texas Rice Council, which collects payments from the state's rice farmers for joint marketing efforts, such as one that produced a bumper sticker on his Yukon SUV. "Eat Rice," it reads. "Potatoes make your butt big."

In one regard, they've made progress. Americans now eat 26 pounds of rice per year on average, which is nearly triple their consumption in the 1970s. But that increase is driven largely by immigrant communities that favor jasmine and basmati varieties, mostly imported from Thailand, India and Pakistan, over American medium and long grain rice.

Back in 2005, Greg Yielding took a trip to China.

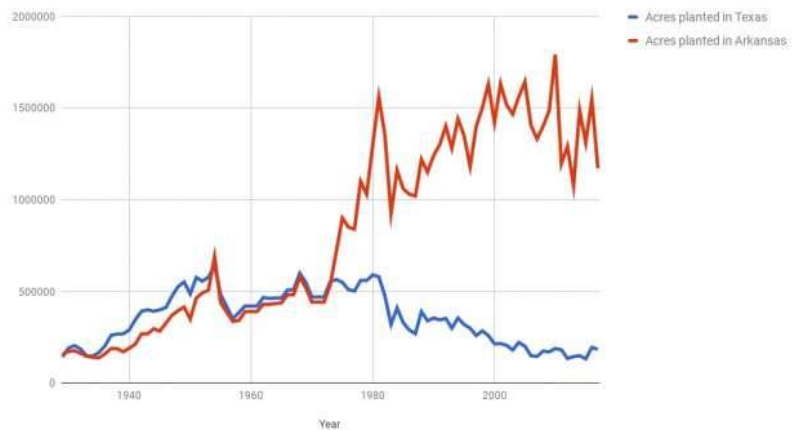
Nothing terribly official for the executive director of the Arkansas Rice Growers Association - just a few visits with people like the U.S. Department of Agriculture's representative in China and the office of [COFCO](#), China's state-owned food importer. At that point, the prospect of selling rice to China seemed like a hopeless quest — "The ultimate example of selling ice to the Eskimos," as one [California official put it](#).

But Yielding heard differently. Chinese supermarket executives, he said, thought they could market American rice as a high-end, safer alternative to their own crops, which had suffered waves of contamination. On successive visits, funded by grants from the USDA, Yielding engaged a market research company to have young women hand out samples of U.S. rice at luxury supermarkets in big cities.

"I couldn't tell you that there was something better about it, but they tried it, they liked the taste of it, they liked the cooking quality," said Yielding, who soon started working for the U.S. Rice Producers Association, a Houston-based trade group. "I just kept making contacts and finding out that the Chinese wanted to buy U.S. rice."

And at the time, China was about to undergo a much larger shift.

The rise of Arkansas and the fall of Texas' rice farmers



For decades, in the name of national security, China had maintained a goal of producing 95 percent of its grain domestically. Around 2012, rocked by food safety scandals, China backed off that target, allowing it to slip to 85 percent. The U.S. went from exporting about \$100 million in grain and feed from the U.S. in 2007 to a peak of \$4.9 billion in 2015.

"That 10 percent is big for agricultural exporters," said Luis Ribera, an agricultural trade expert at Texas A&M.

Rice, however, was still barred entirely, since the two countries hadn't agreed on a common food safety protocol. So, a few years ago, the USDA started facilitating trips by Chinese scientists to visit U.S. farms and rice mills. Ray Stoesser helped shepherd them around in Arkansas.

"The Chinese were optimistic about what they saw," he said, extolling the quality and sanitation of U.S. facilities.

The [Rice Producers Association](#), of which Stoesser is a member, wasn't the only group working for market access — the [U.S.A Rice Federation](#), a coalition of farmers and millers, was sponsoring exchanges as well. Rice mills remove the tough husk from rice grains to make it edible. The millers were particularly keen on the Chinese market, since all the rice going there would be milled in the U.S., in contrast to the largely unmilled "rough" rice that goes to Mexico and South America.

Two years ago, USA Rice's executive director, Betsy Ward, said she thought U.S. negotiators had a deal with China. But they could never get it signed by the Chinese, which Ward thinks may have had to do with the Obama administration having other trade priorities — such as the massive [Trans Pacific Partnership](#), which pointedly didn't include China.

After Trump's agriculture secretary, Sonny Perdue, took office, Ward said her group met with him four times about getting the rice agreement done. Only a few weeks after Perdue visited China to celebrate a deal allowing exports of beef, the rice deal was finally signed.

It was a relief, after more than a decade of work. But the road forward may not be easy.

"It's a very complex agreement and gives them room to find problems when they decide they want to," Ward said.

Whatever the Chinese demand, the Stoesser family stands ready to satisfy it. And the local economy in Liberty County has a stake in their success as well: More acres of rice planted mean more seed and fertilizer ordered, more storage used, more people employed (the Stoesser farm employs about 20).

But even China may not be enough, if trade deals with other countries go south. Ray Stoesser is exasperated over the failure of successive White Houses to allow rice exports to Cuba, which was the largest buyer of Texas rice before trade was embargoed in the 1960s. The Trump administration recently rolled back the small steps that Obama had taken to liberalize trade.

"That's a no-brainer," Stoesser said. "If we can trade with China, why can't we trade with Cuba?"

And now, there's a new worry: The reopening of negotiations with Mexico and Canada over NAFTA. If Trump chose to put tariffs on Mexican manufactured goods, as he's threatened, Mexico could retaliate by limiting its imports of U.S. agricultural products — like rice.

"We've got to have that," Stoesser said, of NAFTA. "I don't see Trump taking that away. If he did ..." he trails off, and looks out the window of the truck, as the fields roll by, one freshly tilled under.

"Get a whiff of this dirt," he said. "It just smells good."⁹⁵

Bumper Crop in 2018

Texas rice farmers are seeing near-record yields of good quality grain and many are considering a second harvest, according to Texas A&M AgriLife Research experts.

Producers in the state's rice-growing coastal region who were able to take advantage of planting windows before late March avoided heavy spring rains that caused delays for other growers. Delays into April exposed late-planted rice to hot spells that may have hurt yields.

The U.S. Department of Agriculture reported Texas green yields were 9,000-11,000 pounds per acre with good quality. There were also reports of market uncertainty and falling prices related to ongoing trade disputes with China and negotiations with Mexico and Canada regarding the North American Free Trade Agreement.

M.O. Way, AgriLife Research entomologist, Beaumont, said about 190,000 acres of rice were planted this season and half the acreage was planted in hybrid varieties. Way said good growing conditions have many farmers considering growing a ratoon crop, that is to allow another crop to grow from the stubble left after harvest.

"Main crop yields and quality are excellent in general," he said. "I estimate early harvested fields, which are usually the highest yielding, averaged about 8,000 pounds per acre wet with some fields over 10,000 pounds per acre wet."

Way said there was plenty of water for rice fields in 2018, but there were a few problems, including rice water weevil, stink bugs and injury to some fields from a new herbicide. Damages from birds and wild pigs were a problem, and producers noted increased wild pig activity.

Producers controlled pests for the most part, and other crop damage was limited, Way said. But heat damage to later-maturing fields was reported as high nighttime temperatures caused some panicle blanking.

Way also said increased rice acreage and good yields have caused problems with storage of rice post-harvest because there are not enough facilities to accommodate the crop.

Rice Sales on Hold, For Now

China needs rice imports, U.S. farmers are anxious to sell more rice and it might not be long before the countries are doing business after more than 20 years of haggling over details of opening up trade.

While there's no guarantee, farmers and millers are increasingly optimistic because the Chinese ban has been lifted, a handful of U.S. rice mills have been cleared for export, and China is looking to make the Trump administration happy with commodity purchases.

It was in December that China took a major step toward making that happen, changing its customs regs and officially lifting its ban on U.S. rice. Separately, China has now officially cleared seven of the 34 U.S. rice mills that USDA's Animal and Plant Health Inspection Service (APHIS) has asked China to certify under the country's sanitary and phytosanitary regulations, U.S. industry and government officials tell *Agri-Pulse*. The remaining mills are still under Chinese consideration, sources say.

⁹⁵ DePillis, L. (2017). *Texas rice farmers hope China deal brings more than a grain of relief*. [online] HoustonChronicle.com. Available at: <https://www.houstonchronicle.com/business/article/Texas-rice-farmers-hope-China-deal-brings-more-11721801.php> [Accessed 18 Jul. 2019].

While the ban has been lifted and seven U.S. mills have been certified, there is one obstacle left that is preventing rice from flowing from American farms to buyers in Beijing and Shanghai: the U.S.-China trade war.

China slapped a 25 percent tariff on U.S. rice last year in retaliation to U.S. tariffs that were meant to punish the country for intellectual property theft and other trade affronts.

The tariff – enacted when the Chinese ban was still in place – is a major barrier, but it isn't absolute. China also continues to levy a 25 percent tariff on U.S. soybeans, but that hasn't stopped the Chinese government from buying about 10 million metric tons of U.S. soybeans over the past two and a half months.

Trump thanked Liu for the message that China was going to buy more soybeans “and other product that they've just committed to us prior to the signing of the deal,” but never specified what that other commodity would be.

A source involved in the negotiations that led up to the Trump-Liu meeting told *Agri-Pulse* the “other things” were definitely agricultural commodities and could possibly be rice.

If it is rice, that would be a major boon for the U.S. rice sector that depends heavily on exports. The U.S. exports about half the rice it produces.

Perhaps even more important to the U.S. rice sector than a “good faith” purchase would be an end to the trade war and the Chinese tariffs that have impacted just about every U.S. farm sector. China consumes about 144 million tons of rice every year and is the world's largest rice importing country. China imports about 5 million tons of rice, according to USDA data, so even a small fraction of that market would mean a lot to U.S. farmers and millers.

One thing U.S. negotiators are demanding is that China live up to pledges it made when it joined the World Trade Organization, and that includes buying a lot of U.S. rice. China, as one condition for its acceptance into the WTO, agreed to buy at least 2.7 million tons of U.S. rice each year.

And there's no reason that shouldn't start right now, said one U.S. rice industry representative, who asked not to be named because of the sensitivity of the ongoing trade talks.

“Now that you have the technical ability, the next step is the political approval to import rice,” the official said. “The importers will have to get the political nod that it's okay to do this.”⁹⁶

First Sale

A California producer has struck a deal to make the first-ever sale of U.S. rice to buyers in China.

It's been about seven months since China officially opened its market to U.S. rice, ending 20 years of haggling over details such as phytosanitary protocols, but bureaucracy and Chinese tariffs have been blamed for delaying purchases.

“This sale marks a turning point for the U.S. rice industry and its relationship with China as it is the first ever of U.S. rice to a private importer and is truly historic as it sets the stage for continued regular trade with China for U.S. grown rice.” said USA Rice President and CEO Betsy Ward.

⁹⁶ Tomson, B. (2019). *US rice sales to China on hold, but maybe not much longer*. [online] Agri-pulse.com. Available at: <https://www.agri-pulse.com/articles/11920-us-rice-sales-to-china-on-hold-but-maybe-not-much-longer> [Accessed 18 Jul. 2019].

Sun Valley reached the deal with Chinese buyers during the U.S.-sponsored World Rice Summit trade show in Guangzhou, China, according to USA Rice. The summit's funding came from USDA's new Agricultural Trade Promotion program, a segment of the Trump administration's trade assistance package.

"It is truly an honor and a privilege to blaze this trail of trading history - American rice in China," LaGrande said.

Sun Valley and the Chinese buyer – privately owned Shenzen Yintuo – worked out a deal that allowed the purchase despite the tariff now being levied by China as part of the ongoing trade war with the U.S., LaGrande said.

The Chinese buyers will be selling the U.S. rice to retailers and food service companies in China, LaGrande said.

"This is not a one-off sale," said LaGrande, who added he expects to make more sales soon to Shenzen Yintuo.

China consumes about 144 million tons of rice every year and is the world's largest rice importing country. China imports about 5 million tons of rice, according to USDA data.

China represent a major opportunity for the U.S. rice sector, which relies heavily on trade. USA Rice says it will hold two more seminars in China this summer in Shanghai and Shenzhen.⁹⁷

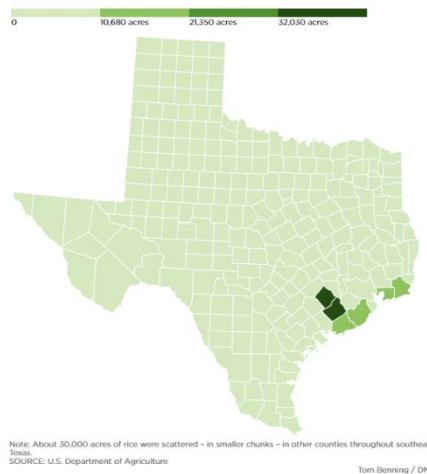
Regulatory Storm, Not Harvey, Ripped Up Rice

Hurricane Harvey's winds ripped through John Gaulding's rice farm near the southeast Texas hamlet of Hamshire. Rainwater inundated one field for two days, while flooding kept another wide swath submerged for almost a week.

When Mother Nature backed down, a regulatory thicket was waiting.

Texas' rice crop

About 190,000 acres of rice were planted in Texas in 2016. The state's rice belt is clustered in the coastal and near-coastal counties that are east and west of Houston.



Vague guidance from the U.S. Food and Drug Administration left the impression that Texas' entire rice crop might be out of commission due to contamination concerns. That meant Gaulding and other rice farmers reeling from Harvey had their livelihood in the balance.

And even though the FDA later clarified its stance to stress that there was no outright ban on Texas rice, the episode resulted in frustration that's lasted weeks beyond the storm.

"It was just a stressful situation," said Gaulding, a 71-year-old who's been through 47 rice crops. "Something that we didn't have to go through."

The confusion illustrates the challenge the government faces in responding to massive disasters that cut through communities in ways that aren't always obvious.

Texas' rice industry, all things considered, weathered Harvey OK.

More than 80 percent of the crop was harvested before the storm made landfall in late August, and some of the rest was salvageable. So most growers avoided the dire losses suffered by cotton farmers and others.

⁹⁷ Tomson, B. (2019). *US makes first rice sale to Chinese buyers*. [online] Agri-pulse.com. Available at: <https://www.agri-pulse.com/articles/12382-us-makes-first-rice-sale-to-chinese-buyers-usa-rice> [Accessed 18 Jul. 2019].

But the difference between profit and loss can depend on the slightest of variables.

The FDA guidance forced some farmers to submit crops for testing, adding delays to a disrupted harvest. Some mills aren't accepting untested rice, despite no signs of contamination. And organic rice farmers, thanks to other factors, had to sweat the impact on that prized certification.

"It was looking to be a relatively good year," said Charlie Reneau, who farms about 1,800 acres of rice near Beaumont. "Then Harvey shows up and wrecks it for us."

Rice is an important, albeit smaller, part of Texas's agricultural portfolio.

Around 190,000 acres of rice were planted last year in the Lone Star State, making it the fifth-biggest producer in the U.S. That activity, worth tens of millions of dollars, is clustered in the coastal and near-coastal counties around Houston that endured Harvey's wrath.

Rice is actually well-suited to survive such a storm, experts said. The plant thrives on water. It can go underwater for some time without ill effects. And hulls, or husks, provide time-tested natural protection.

The plant, however, is not invincible.

More than 50 inches of rain overwhelmed some parts of Texas, preventing some farmers from finishing the homestretch of their harvest. Some rice went overripe, shattering the grain. Other rice went underwater too long, causing fresh sprouts to ruin the grain.

"These guys ... it will likely knock out any chance of them making a profit," said L.G. Raun, a rice farmer in El Campo, about an hour southwest of Houston.

And there was also a regulatory storm in Harvey's wake.

The FDA provided initial crop safety guidance that addressed potential contamination by pollutants or fungal activity. But many in the industry took the vague notice to mean that any rice crops flooded by Harvey were unfit for consumption.

'Didn't mean to send panic'

That could've jeopardized unharvested rice.

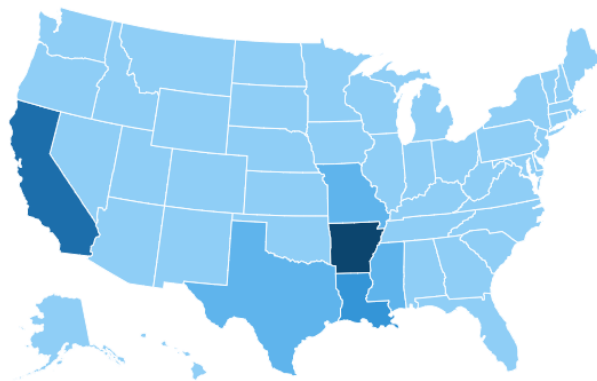
And the second crop, known as a "ratoon," that was yet to come. And maybe "just rice, period," said Dwight Roberts of the U.S. Rice Producers Association.

"They told us they didn't mean to send panic through the rice farmers," said Roberts, whose group operates out of Houston. "That's certainly what it was. I was getting 100 calls a day."

Meanwhile, organic rice farmers in Texas faced another challenge.

Texas is one of America's few rice states

Six states accounted for nearly all of the 3.1 million acres of rice planted in 2016. Texas tied for fifth among that group, tallying about 190,000 acres of rice last year.



SOURCE: U.S. Department of Agriculture

Tom Benning / DMN

The potential for mosquito-borne diseases in Harvey's wake caused officials to spray the Houston area with insecticide. That kind of activity could've nullified organic certifications — run by the state — that take substantial time and effort to accomplish.

"It would've been devastating," said Ted Wilson, a rice expert at the Texas A&M AgriLife Research Center in Beaumont.

The organic issue proved simple enough to sort out. Officials at the Texas Department of Agriculture and the U.S. Department of Agriculture determined that the one-time mosquito response wouldn't ruin the rice's organic status.

Farmers, experts, lawmakers and others also reached out to the FDA to clarify broader concerns.

They pointed out that there wasn't any evidence of contamination in Texas. They offered that rice goes underwater every year, hurricane or not. They noted that rice must be milled and then cooked before being consumed.

No ban on rice

And FDA Commissioner Scott Gottlieb in mid-September issued a lengthy clarification that said, in part, that the agency "has not issued a ban on rice or any other food crops."

An FDA spokeswoman this week added that the agency has "been working with rice companies to be responsive to their individual situations to evaluate the food safety impact of the product and to answer questions regarding testing and reconditioning of rice crops."

The follow-up was "more reasonable," since it zeroed in on proximity to chemical plants or other hazards, said Roberts, the U.S. Rice Producers Association president. And Wilson, the rice expert, said he wasn't aware of any fields in Texas that would face those kinds of problems.

But the revised guidance hasn't solved everything.

Some rice mills in Texas decided they wouldn't take any rice without a test showing that the crop was in the clear. That created a jam for farmers like Gaulding, the Hamshire farmer who said the location of his fields gave him no reason to believe that his rice had been compromised.

He, like some others, sent a sample to the Texas state chemist.

The tests, which were free, showed no contamination. That's apparently been true for all the samples provided in Harvey's wake, said Wilson, the A&M rice expert. But the tests took time. And as the days went by, more and more grains were susceptible to over-ripening and other issues.

Gaulding, who eventually got his crop harvested, said he would "be able to recover somewhat." But others weren't as lucky.⁹⁸

Trouble with Tariffs

The U.S. rice industry could suffer from retaliatory tariffs in response to proposed steel and aluminum import tariffs, according to a study released last week by economists at the University of Arkansas (UofA) System

⁹⁸ Benning, T. (2017). *In Harvey's wake, Texas rice farmers had to combat flooding — and the government / Harvey / Dallas News*. [online] Dallas News. Available at: <https://www.dallasnews.com/news/harvey/2017/10/12/harveys-wake-texas-rice-farmers-combat-flooding-government> [Accessed 7 Aug. 2019].

Division of Agriculture.

The UofA analysis estimates the impact on U.S. rice if trading partners Canada, South Korea, Mexico, Turkey, Japan, Taiwan, and the European Union retaliate in response to a 25 percent tariff on steel imports and a 10 percent tariff on aluminum imports recently announced by President Donald Trump.

Within days of the President's announcement, the EU published a list of imports from the United States, including rice, which could be subject to retaliation. The EU has not moved beyond refining this list (still including rice) while top officials of the EU Commission explore with their U.S. counterparts possible exemption of the EU as a whole or for certain steel and aluminum products from the EU. The United States exported 58,000 metric tons of rice to the EU last year, valued at \$42 million.

"We estimate total U.S. rice production and exports drop 1.3 percent and 3 percent, respectively, and domestic consumption increases marginally, as a result of the implementation of import tariffs on U.S. rice," stated the economic analysis report.

According to the report, while lower rice prices could benefit consumers by \$66 million, lower prices could also negatively affect U.S. rice producers to the tune of \$118 million.⁹⁹

SHEEP & GOATS

[2018] The market for sheep and goat meat, wool and mohair continues to grow, according to a Texas A&M AgriLife Extension Service expert.

Fleece production is beginning to see larger profits due to the demand, Dr. Reid Redden, AgriLife Extension state sheep and goat specialist, said.

"It used to be that wool prices would barely cover the shearing cost, but now producers are seeing profits range from \$25 to \$50 per fleece," Redden told AgriLife Today.

While wool and mohair demand is high, it's nothing compared to the demand for lamb and goat meat, Redden said.

"The lamb and goat markets have really been gaining momentum the last five years," he said. "Producers can't keep up with the demand for lamb."

Redden noted the demand for lamb comes primarily from ethnic markets, but it has also become a trendy meat option for millennials. The demand for lamb, Redden said, is much larger than what the United States can supply, so lamb is imported from Australia and New Zealand.

Texas remains the top producer of goat meat, with 35 percent of the national supply. The Lone Star State also ranks first in sheep production and mohair production but falls behind other states in wool.

"There's been a big transition in the last 10 years in the meat market, and now that demands for quality wool and mohair are helping those markets, we're really seeing profitability opportunities that warrant inclusion of sheep and/or goats into beef cattle operations," Redden said. "There are more challenges in production, but the market for Texas producers is strong and all the trends are positive."¹⁰⁰

⁹⁹ USA Rice. (2019). *U.S. Rice Industry Stands to Lose from Trump Tariffs* | USA Rice Federation. [online] Available at: [https://www.usarice.com/news-and-events/publications/usa-rice-daily/article/usa-rice-daily/2018/03/19/uofa-arkansas-stands-to-lose-more-than-4k-jobs-\\$383-million-from-trump-tariffs](https://www.usarice.com/news-and-events/publications/usa-rice-daily/article/usa-rice-daily/2018/03/19/uofa-arkansas-stands-to-lose-more-than-4k-jobs-$383-million-from-trump-tariffs) [Accessed 18 Jul. 2019].

¹⁰⁰ Texas Farm Bureau. (2018). *Sheep, goat demand on the rise - Texas Farm Bureau*. [online] Available at: <http://texasfarmbureau.org/sheep-goat-demand-rise/> [Accessed 8 Aug. 2019].

[2019] Markets for goat and sheep meat and fiber continue to be relatively strong despite softening prices and lower inventories, according to a Texas A&M AgriLife Extension Service expert.

Bill Thompson, AgriLife Extension economist, San Angelo, said production data from the sheep and goat fiber and meat markets reveal mixed signals about their place among Texas livestock.

Sheep and goat numbers are down, but prices remain high relative to their respective five-year averages and demand for meat, hair and wool continues to grow.

SHEEP

Sheep inventories are down in the U.S. and in Texas, according to U.S. Department of Agriculture data, as markets for lamb meat and wool continue to perform well, Thompson said. Lamb prices are down slightly, but consumers in traditional ethnic markets and emerging markets continue an upward demand trend.

“Whether you’re talking about chops or ground meat, most large grocers have lamb on hand because of its popularity,” he said.

Wool prices have dipped some since record highs of around \$7 per pound in 2018, but remain very strong at more than \$6.50 per pound, Thompson said. Production of wool also dipped slightly.

Thompson said the dip in sheep inventories for meat and wool and the subsequent dip in prices are surprising because of price strength and consumer demand.

“We would expect wool production and sheep numbers to come back because wool prices are so strong,” he said. “The decreases are not big, but they are still decreases. You would think the market would take account of the strong prices and grow the production side of the market.”

Thompson said the Rambouillet market dropped significantly, and they were replaced with hair sheep. Labor costs associated with shearing Rambouillets and better parasite tolerance in hair sheep likely contributed to the change, he said.

GOATS

Texas continues to be the top producer of goats by a large margin, Thompson said. Texas’ goat herd as of Jan. 1 was estimated at 740,000 and is larger than the next 10 states combined, which have a total of 631,000 goats.

But the state’s inventory of meat and mohair goats fell 3 percent from 2018, he said. The total U.S. inventory fell 1 percent to just over 2 million animals.

U.S. mohair production was up 2 percent to 755,000 pounds in 2018, Thompson said, with 62 percent of production coming from Texas.

“The goat markets were banner for the last few years, but inventories keep dropping,” Thompson said. “Imports and the value of the dollar may have something to do with that, but there is still room for producers to pencil out pretty good profits.”

One possible deterrent for goat producers, especially those new to the industry, could be the animals’ propensity for escape, property damage and general “mischievousness,” he said.

Predation also continues to be a top concern for sheep and goat producers, Thompson said. Producers south and west of San Angelo have faced challenging losses by incorporating management practices, including the use of guardian dogs.

“It’s been tough, but producers are getting better results with guardian dogs,” he said. “They will have a huge impact on the industry, but it’s just taking time for producers to learn how to train them and use them effectively.”

Despite weakening price trends and lower inventories, Thompson said he expects demand for sheep and goat meat and their respective fibers to continue an upward trend.

“There is high demand for wool and mohair for clothing, especially high-end, high-quality natural fabrics,” he said. “Consumers want natural. They want environmentally friendly and sustainable along with quality. The market for meats continues to grow as well as traditional consumers are wanting more while new consumers are trying those meats and making them trendy.”¹⁰¹

SOYBEANS

Growers in Texas worry America’s contentious trade war with China could have negative effects on the state’s fragile soybean market if it goes on for too long.

Daniel Berglund, chairman of the Texas Soybean Association in Lubbock, said it’s too early to tell how deeply Texas farmers could be hurt by China’s decision this week to stop buying American soybeans.

He applauded the Trump administration’s effort to level a trade imbalance between the two nations by imposing tariffs on Chinese goods.

“China has been getting away with unfair trade for a long time,” Berglund said. “Our concern is how long it will take. The urgency to get negotiations underway is there.

“We’ve spent millions on developing markets and ... can now be on the verge of losing out to other suppliers.”

Make no mistake about it: [cotton and wheat are king in Texas](#); soybeans aren’t among the state’s top 10 crops, in terms of acres planted or bushels sold.

Still, Texas growers in recent years have planted more soybean acres to open additional revenue streams.

Last year, Texas farmers planted 140,000 acres of soybeans, and production that year averaged 4.7 million bushels, according to the U.S. Department of Agriculture. Yields in Texas have consistently averaged about 34 bushels per acre the last three years.

While elevators in the Midwestern states are stocked with unsold soybeans, inventories in Texas largely have been shipped to customers in Mexico.

“They’ve (Mexico) always been a natural market for us, even when China has been the big buyer,” Garcia said.

¹⁰¹ Russell, A. (2019). *Texas sheep, goat prices, inventories down slightly amid strong market*. [online] Farm Progress. Available at: <https://www.farmprogress.com/crops/texas-sheep-goat-prices-inventories-down-slightly-amid-strong-market> [Accessed 8 Aug. 2019].

Soybeans on Friday traded for \$8.72 a bushel, down roughly \$2 in value from a year ago.¹⁰²

The U.S. corn and soybean crops conditions barely changed from a week ago, according to the USDA's weekly Crop Progress Report released Monday.

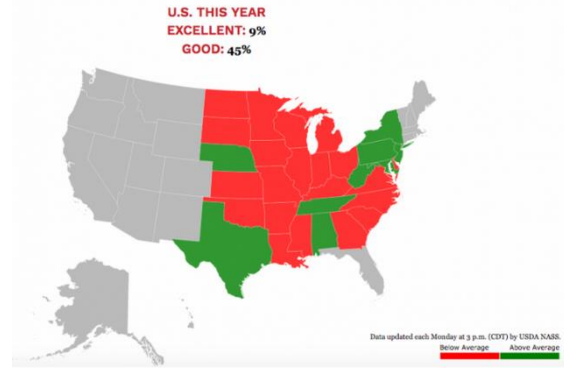
The data came in about the same as the trade expected

The nation's crop is rated 54% good/excellent, equal to a week ago.

Also, 57% of the soybean crop is blooming vs. a 79% five-year average.

The USDA pegged the amount of soybeans setting pods at 21%, well below a five-year average of 45%.¹⁰³

2019 SOYBEAN CROP-CONDITION



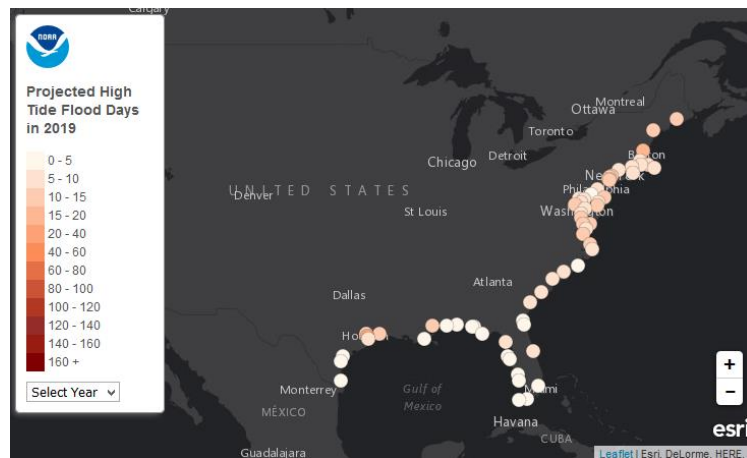
WATER

A new government report says the Texas coast is increasingly at risk of flooding, even when there's not a rain cloud in sight.

Sea level rise is projected to cause more flooding from high tides in Texas and across the U.S., according to the [report](#) from the National Oceanic and Atmospheric Administration.

The analysis points both to future risk and present-day problems.

“Really the future is now in terms of sea level rise impacts,” William Sweet, a NOAA oceanographer, [told NPR](#). “The ocean is at the brim. It’s clogging storm water systems and it’s spilling into streets.”



The East Coast has felt the impacts more than Texas so far, with high tides there flooding roads and farms. But NOAA's report notes that high tide flooding is increasingly rapidly in Texas as well.

NOAA researchers expect the western Gulf of Mexico – i.e. the Texas and Louisiana coasts – to see 10 to 20 days of coastal high tide flooding annually by 2030, and anywhere from 65 to 165 days by 2050. The report says those areas will likely see a median of six days of high tide flooding in 2019, a 130% increase from 2000. (The western Gulf saw eight such days in 2018, a year when no hurricanes made landfall in the area.)

“Annual flood records are expected to be broken again next year and for years and decades to come,” the NOAA report summary reads. “Projecting out to 2030 and 2050 provides vital information for communities who are already taking adaptation steps to address coastal flooding impacts and those who are beginning to assess future flood risk in their communities.”¹⁰⁴

¹⁰² Ramirez, C. (2019). [online] Caller Times. Available at: <https://www.caller.com/story/news/2019/05/31/texas-soybean-farmers-back-trump-china-tariffs/1303928001/> [Accessed 8 Aug. 2019].

¹⁰³ McGinnis, M. (2019). *For Two Weeks, Soybean Crop Shows No Progress, USDA Says*. [online] Successful Farming. Available at: <https://www.agriculture.com/news/crops/for-two-weeks-soybean-crop-shows-no-progress-usda-says> [Accessed 8 Aug. 2019].

¹⁰⁴ Bubenik, T. (2019). “Sunny Day” Flooding To Increasingly Threaten Texas Coast | *Houston Public Media*. [online] Houston Public Media. Available at: <https://www.houstonpublicmedia.org/articles/news/energy-environment/2019/07/10/339073/sunny-day-flooding-to-increasingly-threaten-texas-coast/> [Accessed 17 Jul. 2019].

Even in the best of times, water in Texas has always been an ornery and mercurial resource. It falls from the sky in torrents in the sodden eastern counties along the Gulf of Mexico and falls sometimes not at all in the parched counties to the west where, in a good year, a foot or less of rain might make it to the ground.

And those good years have always been punctuated by bad ones. It's almost a maxim that the climatological history of Texas is in a constant cycle of drought and flood, with periods of just plain hardship in between.

But now, most scientists agree, climate change is making those cycles more severe, the droughts drier and the storms more vicious. And Texas' antiquated laws are potentially priming the state for a water crisis.

What isn't changing with the climate is how Texas deals with water, particularly groundwater, which is being pumped relentlessly under a system of rules that were first laid down in 1904. It allows landowners to pump it to their hearts' content, even if it drains every drop of water under neighboring property. It's known as the "Rule of Capture."

It stands in contrast to how the state, and many others in the West, regulate the use of surface water, which is legally considered a public resource and rights to it are granted on a first-come, first-serve basis.

That approach, many experts say, helped the state survive massive droughts in the past, but the state fails to recognize groundwater's related role.

The heart of the problem is that Texas views the looming water crisis less as a single problem, but as 100 different regional problems best addressed on a local level. Though they are linked in countless ways, one often replenishing the other, groundwater and surface water in Texas are viewed as entirely separate resources and are legally disconnected. State Rep. Lyle Larson, a San Antonio Republican who chairs the House Natural Resource Committee, puts it this way: "Texas has abdicated a global view of water." Noted water expert Robert Gulley, who has been working on water issues both inside and outside state government for decades, is even more blunt. "Texas," he says, "has repealed the laws of hydrology."

With global warming exacerbating both extreme weather and drought, the laws of nature are becoming even less friendly to a state that ignores them.

At least one study, conducted by scientists at the World Weather Attribution Project, posited that last year's Hurricane Harvey, which dumped up to 40 inches of rain along the Gulf Coast and caused some 80 deaths and \$200 billion of destruction in its wake, was made three times more likely because of the effects of a changing climate. The drought that ravaged Texas and much of the West from 2011-13, causing more than \$7.5 billion in crop and livestock losses in Texas alone, was at least in part the perfectly predictable result of adding roughly 1 degree Celsius to the temperatures in that region as a result of our profligate use of fossil fuels and our release of other greenhouse gases, actions that will continue to alter the climate for centuries, said the state meteorologist, John Nielsen-Gammon, in an interview at the height of that drought.

The escalating costs of those climate change-related damages loom over cities and states nationwide, but Texas' crisis is closing in fast. Its population is expected to double from 24 million in 2010 to more than 54 million by 2050 according to the state demographer, putting exponentially more stress on its water supply.

State officials, among them Robert Mace, senior scientist and deputy executive director of the Texas Water Development Board, the state agency charged with developing the evolving Texas State Water Plan, freely acknowledge that Texas is ill-prepared for another storm like Harvey. Chillingly, they concede that Texas currently does not have the resources to make it through a major drought, like the historic decade-long drought that devastated Texas in the 1950s, the so-called Drought of Record, without serious, perhaps even deadly, consequences.

The system for allocating surface water as a public resource—"First in time, first in right" is the way it is essentially distilled—is hardly perfect, most experts say, noting that the state's waterways are over-allocated. There are more entities and people with legitimate claims to the water than there is water, even in good years. But the system has provided a paradigm for allocation of surface water, which, though contentious, has survived through a couple of deep droughts in the past two decades.

Groundwater, in contrast, is viewed not only as wholly separate from surface water, but as first and foremost a property right. Under a system abandoned elsewhere in the West more than a century ago because it was found

be unworkable—though it still remains the law in some states in the East—in Texas the view is that a landowner controls everything above his land and below from the sky to the center of the earth, and that includes groundwater. The Rule of Capture has led to a long list of tales of how once-lush springs, like the once-world-famous Comanche Springs in the desert at Fort Stockton, simply dried up because of over-pumping. In its simplest formulation, the law can be boiled down to: “Whoever has the biggest pump wins.”

This system has put Texas at odds with its neighboring states, particularly those that share the overdrawn Ogallala Aquifer. Drive west into New Mexico through the little town of State Line, Texas, and you’ll be met with a stunning image. While Texas’ emerald-green fields glitter in the relentless sun, their thirsty plants slaked by massive pivot irrigation systems, New Mexico is as parched and unforgiving as it was when Coronado first stumbled through here almost 480 years ago.

Those states that share the aquifer view Texas’s race to the bottom of the Ogallala with a jaundiced eye, especially since they have taken steps to limit withdrawals. New Mexico and Colorado, for example, use a first-in-time system, similar to the one applied to surface water in Texas. Oklahoma, taking its cue from a system developed more than 100 years ago in California, and recognizing that groundwater and surface water are linked in innumerable ways, has adopted a correlative rights system in which ownership of a piece of land entitles you to a percentage of the water in an aquifer, but you don’t have an absolute right to ownership of the groundwater or the right to pump it without limits. Nebraska uses a similar system, but adds the caveat that the water must be used for beneficial purposes.

It’s not that Texas lacks the authority to regulate groundwater. In 1917, after two deep and destructive droughts, voters amended the state constitution to state in no uncertain terms that “the preservation and conservation of...natural resources of the State are each and all hereby declared public rights and duties; and the Legislature shall pass all such laws as may be appropriate thereto.”

Indeed, over the years, some halting steps have been taken to circumscribe the Rule of Capture. That authority, however, has been delegated to some 100 local groundwater districts, each defending parochial interests, and each mindful that in Texas, political survival often depends on recognizing that individual property rights are paramount.

Those local authorities most often, for example, set permits based less on the conditions of underlying groundwater than on the landowner’s historical usage, as long as the water is used for a beneficial purpose, a remarkably elastic term. Indeed, that decentralized, sometimes maddeningly chaotic system, has led to some bizarre and perverse incentives not to preserve water but to use it, even in dry times, and has in the recent past been used to justify catfish farms in the dry scree outside of San Antonio and to test plots of rice in the arid basin outside of Fort Stockton.

But for a number of reasons—perhaps because Texans are by nature and history a stiff-necked and individualistic bunch, or that the courts have increasingly in recent years been unwilling to legislate from the bench, or because, as many have quipped, the Texas legislature has been unwilling to legislate from Austin—the Rule of Capture remains the dominant feature of Texas water law.

As Texas Supreme Court Justice Nathan Hecht put it in his concurrence to a 1999 case that reluctantly again upheld the Rule of Capture, “Not much groundwater regulation is going on.”

WEATHER AND DISASTERS

From the heat wave currently sweeping the Midwest to the oncoming ravages of hurricane season in the south, extreme and volatile weather impacts every state in the nation. But some states are more at risk than others as global warming changes the entire landscape of the country.

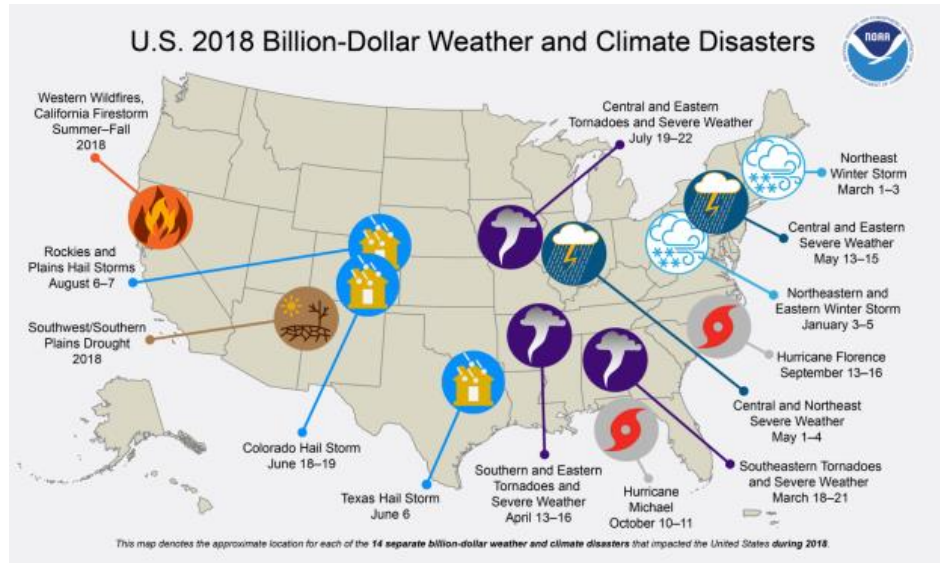
In 2018 the United States experienced 14 disasters that cost the economy as much or more than \$1 billion dollars each. But the total cost of these hurricanes, wildfires, floods and other disasters that struck the U.S. last year is about \$91 billion, [according to the](#) U.S. National Oceanic and Atmospheric Administration, which tracks U.S. weather and climate events that have great economic and societal impacts.

Some studies speculate that a [warming climate](#) may be making these disasters more frequent and more intense, and the areas they hit will change over time. The trend has people in the U.S. wondering which state is the safest place to live and work.

“As natural and man-made hazards become increasingly complex and difficult to predict, the need for forward-leaning action is greater than ever before,” Michael Hart, news desk manager of FEMA’s Office of External Affairs, told CNBC via email.

Natural disasters are also taking a toll on the U.S. economy, and it is spurring migration shifts.

The catastrophes of 2018 weren’t an anomaly: Over each of the past three years, an average of 15 billion-dollar disasters have occurred, while the average for 1980–2018 was just 6.2 events per year. The number of billion-dollar disasters is [clearly trending upward](#), writes Adam B. Smith, a climate scientist with the NOAA. Since 1980 weather and climate disasters have cost the US \$1.6 trillion in damages, the agency reports.



One state really stands head and shoulders above the rest, and that would be [Texas](#),” says Smith. Over NOAA’s 40 years of analysis, the Lone Star State has experienced more than 100 separate \$1 billion disasters, from the Houston floods and hurricanes of 2017 to flooding and even winter storms, which are more usually associated with the Eastern Seaboard.

Texas has the highest frequency of extreme weather events over the period of analysis, and it also has the highest inflation-adjusted costs related to extreme weather. The government estimate of more than \$250 billion in damage is a conservative one, Smith says. The real number is likely much higher.

“Texas takes an all-hazards approach to disaster management and preparedness, whether it is hurricanes, tornadoes, floods, extreme heat or cold,” Chuck Phinney, chief of staff for the Texas Division of Emergency Management, told CNBC. That means the basic plan for dealing with disasters is the same no matter what comes: Local jurisdictions lead the emergency response push, with the state organization providing support for response and recovery.

“Other than using the private sector and nonprofit organizations in our response efforts, we do not work directly with businesses,” he writes. “However, one of our objectives following a disaster is to restore critical infrastructure as quickly as possible so that businesses can open. Because disasters begin and end locally, we suggest that businesses work with the local emergency managers.”¹⁰⁵

When Hurricane Harvey made landfall on the Texas coast, it brought with it winds in excess of 130 to 150 mph and 51.88 inches of rainfall, setting a new record for the continental US. In the wake of this devastation, the Texas

¹⁰⁵ Eschner, K. (2019). *The most dangerous places to live in America that are prone to natural disasters*. [online] CNBC. Available at: <https://www.cnbc.com/2019/07/10/billion-dollar-natural-disasters-rising-these-states-better-prepare.html> [Accessed 18 Jul. 2019].

agriculture industry is turning their attention to recovery efforts and measuring the impact this record-breaking storm will have on the future.

Rebuilding what has been destroyed or washed away will require a significant effort from the agriculture sector in Texas. Not only are they rebuilding their homes and the homes of their friends and family, but they are also faced with the possibilities of building shelters for thousands of livestock, and fixing structural issues caused by Hurricane Harvey in standing structures.

One positive sign amid the recovery effort is that beef prices are not expected to spike in the short-term. Unfortunately, ranchers themselves will still experience a heavy financial burden. The same applies to many [commercial crop farmers](#), especially those that lost rice and cotton crops due to extreme flooding and strong winds.

As Texas agriculture looks to [bounce back](#) in the aftermath of the historic hurricane, many farmers and ranchers are focused on discovering what remains of their livestock, reestablishing fence lines, and accounting for farm equipment.¹⁰⁶

Cost of Coastal Protection

After centuries of fighting back water in a low-lying nation, the Dutch have become the world leaders in flood control. And their expertise is helping Texas design what would become the nation's most ambitious — and expensive — coastal barrier.

The dunes in Noordwijk are part of a world-renowned storm defense system that covers the entirety of the Netherlands' coastline — much of it hefty enough to protect against a monster, 10,000-year storm. The system has become a beacon for Texas as it looks to guard the eastern flank of the low-lying Houston-Galveston region — home to millions of people and the nation's largest petrochemical complex — from hurricanes. Despite its vulnerability to deadly storm surges, the upper Texas coast has no comprehensive storm protection system.

“The Dutch have faced storm surge and flooding as an existential threat to their country for centuries,” said Texas Land Commissioner George P. Bush, who heads the General Land Office, the state agency that oversees the coast.

As a result, most Dutch citizens don't question sizable government spending on flood control or complain about paying higher taxes — about \$119 annually per household — to maintain a system that has protected them from the sea for generations. It's a mentality that stands in stark contrast to the United States, where many elected officials are staunch champions of smaller government and lower taxes.

If completed, Texas' coastal barrier would become just the second coastal protection system in the United States, after New Orleans' revamped levee system, and the largest that the Army Corps has constructed in its 200-year history — so large it would be visible from space.

Selling the Texas project to members of Congress from inland states that don't face similar threats will be difficult, Bush acknowledges.

Then there is the question of which local entity would pay to maintain the coastal barrier. Once the Army Corps is done with a project, it typically hands over the keys and walks away.

The first time Dutch flood control experts visit Galveston Island, they are always shocked to see homes and businesses perched next to the water — no levees, dunes or gates of any significance to guard them.

¹⁰⁶ Bentoli. (2018). *Texas Agriculture: Industry Evaluates Hurricane Harvey Recovery Efforts*. [online] Available at: <https://www.bentoli.com/texas-agriculture-hurricane-harvey/> [Accessed 18 Jul. 2019].

“In the United States, it’s like, ‘I want to have a view, I want to see the sea from my house, so I’m going to build on the beach,’” said Jeroen Aerts, director of the Institute for Environmental Studies at Vrije Universiteit Amsterdam. “It’s completely different in the Netherlands.”

Many Dutch officials say that mindset reveals the biggest differences between the countries: Americans are more self-reliant — and their properties are most often insured — so federal and state government focus on emergency response and cleaning up after a natural disaster much more than preventing the damage.

But with so much at stake on the Texas coast — millions of lives, billions of dollars worth of property, and many of the nation’s biggest fuel and chemical producers — some state officials have pushed to break that mold.

“Sea level is rising, the storms are getting larger, and the clock is ticking,” wrote Jim Blackburn, co-director of Rice University’s Severe Storm Prediction, Education and Evacuation from Disasters Center, in a recent white paper.

Over the years, Blackburn also has hammered that the impact of a worst-case storm on the industrial complex — in addition to economic calamity — could lead to one of the biggest environmental disasters in U.S. history. Storm modeling shows that a major surge could impact thousands of industrial storage tanks near the Houston Ship Channel that hold crude oil and hazardous chemicals; if even one ruptured, scientists say, the toxins could inflict irreparable harm on Galveston Bay, one of the region’s most productive estuaries and a national ecological treasure.

Merrell, an A&M Galveston oceanographer has spent the past decade warning of a coming disaster and trying to convince the government that he has a solution. In early 2009, just a few months after Hurricane Ike devastated the Houston-Galveston region, Merrell introduced the Ike Dike.

The plan, which consisted of beachfront earthen levees topped with sand dunes along the entire lengths of Galveston Island and Bolivar Peninsula, plus two huge storm surge barrier gates between the landmasses and another gate system on the far end of Galveston Island near San Luis Pass. He included a “ring” levee around the city of Galveston to protect it from incoming and outgoing surges.

Merrell argued that his beachfront system was superior to one further inland — a concept that had been proposed by Rice University researchers — because it would protect everyone.

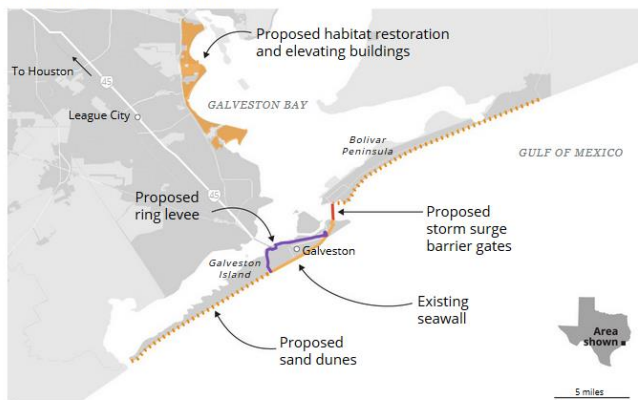
Locals loved the concept, but politicians were not so convinced, at least at first.

In [2015](#), the Army Corps and Texas General Land Office launched a study to find the best solution. Last October, the agencies proposed a plan that would build 17-foot-tall levees on the backsides of the main roadways on Galveston and Bolivar and install 39 vertical storm surge gates in the waterway between them — plus a single large gate over the deepest part of the pass where ships travel. But after receiving some 6,000 public comments expressing outrage that thousands of homes and businesses would be stranded on the ocean side of the levees, the agencies have revised the plan to look a whole lot like Merrell’s Ike Dike.

“They’re going to end up with our original concept,” Merrell said in a recent interview. “It was the right concept. I’m more and more convinced of that, and, of course, the Dutch helped us do it.”

How the government wants to guard the Houston area from hurricanes

The U.S. Army Corps of Engineers and the Texas General Land Office have proposed a major public works project to protect the Houston-Galveston region against hurricanes. It has evolved in recent months, but its major components now include sand dunes along Galveston Island and Bolivar Peninsula; massive storm surge barrier gates between the two landmasses; habitat restoration and elevating buildings; and a “ring” levee around the city of Galveston to protect it from incoming and outgoing storm surge.



Source: Coastal Texas Protection and Restoration Feasibility Study, Texas General Land Office
Credit: Connie Hanzhang Jin

The overarching vision follows the Dutch approach of blocking storm surges right at the coast with a combination of hard and soft infrastructure.

But the plan remains controversial. The Galveston business community says the proposed ring levee would hinder cargo and passenger loading at the Port of Galveston, a key destination for major cruise ships. And environmentalists worry that a gate system between Galveston and Bolivar to block storm surges — the most important, expensive and complex component of the plan by far — would hinder an exchange of saltwater and freshwater between Galveston Bay and the Gulf of Mexico that is crucial for marine life [and the fishing industry].

Army Corps leadership has given the Galveston District unprecedented leeway as it designs such an extraordinary project. Typically, districts are only given \$3 million and three years to complete plans; the Galveston District has \$20 million and five years.

While the government is finally moving ahead with a plan after many years of foot-dragging and debate, Merrell says he still sees a lack of political will to turn the plan into reality.

“I don’t know if we’ll find it or not,” he said. “In the Netherlands, they have political will to protect — it’s part of their culture — and we really don’t. We’d rather pay the money afterwards. ... To protect is a much harder thing for our political system to deal with.”

Blueprints for the project aren’t expected to be finalized until 2021. After that, it will get in line with dozens of other projects across the country awaiting funding.

The original version of the coastwide project, which includes extensive beach nourishment wetland restoration and other natural storm surge barrier absorbers on the lower Texas coast, was estimated to cost between \$23 billion and \$32 billion, with the Houston-Galveston coastal barrier system making up as much as \$20 billion of that.

Even in a best-case scenario, the project won’t be completed until 2035. Burks-Copes said it will likely take far longer than that.

“This will be the largest engineering system built in this century,” she said, noting that the Army Corps’ entire [annual budget](#) is only about \$5 billion. “In all likelihood, we’ll probably receive incremental funding, and we’ll have to build this component by component.”

Even if the Texas coastal barrier comes to fruition, some fear the Army Corps’ plan may not be enough to protect lives and property from a worst-case hurricane.

While the agency runs hundreds of storm models to settle on the best design, Blackburn, co-director of Rice’s disaster center, contended in his recent white paper that the plan has a major flaw: It’s designed to withstand an average, rather than an extreme, storm.

“It is worrisome that the U.S. Army Corps of Engineers would recommend a project costing \$14 billion to \$20 billion that does not protect the region from a larger storm that is certainly foreseeable,” he wrote.

As far as the eye-popping price tag of the project — [equivalent](#) to the estimated cost of NASA’s planned moon landing — Burks-Copes emphasized that Harvey and Ike each inflicted tens of billions of dollars in damage. That means this project would pay for itself in one storm, she said.

Another concern: Texas — unlike the Netherlands — faces hurricanes, and some experts say that means the Army Corps needs to build the barriers even higher than the Dutch did to get the same level of protection.

preliminary modeling shows the dunes would likely protect against only a 100-year storm.

Aerts, the Vrije Universiteit Amsterdam professor, said designing for a 100-year storm is probably fine for Texas as long as it sufficiently accounts for climate change and allows for adaptation if weather patterns change more rapidly than initially predicted — something Burks-Copes said the agency is doing.

That can be difficult in a country where climate change denial has gained traction among those in power, but Aerts said that he's learned one thing about Americans after working in the United States for more than 20 years.

"A lot of people are skeptical about climate change," he said, "but if things have to be done, then things get done."¹⁰⁷

Critics say the plan is easy to sell because the details are vague and it's a simple idea. "Draw a line on a map along the coast in front of Galveston Bay and all of your problems are solved," says Phil Bedient, a civil engineering professor and founder of Rice University's Severe Storm Prediction, Education, and Evacuation from Disaster Center. "But his plan won't be enough."

Opponents say the Ike Dike won't even keep a storm surge from flooding Galveston, as happened during Hurricane Ike. "With Ike Dike they can still flood from the backside, with water going up the Trinity River and then coming back down. We need multiple lines of defense and we need a plan for if things go wrong, if water overtops the barriers, if dikes break and a gate doesn't work — we need options," Bedient says.

Environmentalists maintain the Ike Dike could screw up Galveston Bay itself, which would affect the wildlife living in and around it, potentially altering the entire estuary system, from the rivers to the coast.

One thing the two sides agree upon: Something needs to be done. When the perfect storm finally hits just to the south of Galveston — where Ike was originally slated to make landfall — feeds off Galveston Bay and then roars up the Houston Ship Channel, it will cut a swath of devastation through the entire coastal region, covering Galveston, Clear Lake and half of Houston with water. It will unleash hundreds of gallons of oil and other chemicals and toxins into the flood waters, creating the worst environmental and natural disaster ever seen in the United States.

The upper Texas coast has been hit by a significant hurricane every 15 years, on average, since 1900, but while these storms have prompted discussion of more storm surge protection, few projects have been built. "Typically, government doesn't do anything until people die," says Bill King, the former mayor of Kemah, a former Houston mayoral candidate and a longtime proponent of storm surge protection. "Every year we're playing Russian roulette with this, but it's hard to get support for an eventuality that may happen next year, or seven years from now."

The other question is what Galveston Bay will be like after the coastal spine is built. Whooping cranes, sea turtles, shrimp, oysters, fish and bottlenose dolphins are all dependent on the health of Galveston Bay. If the bay's salinity shifts or its water level drops, that affects the lives of everything in and around the bay. An enormous gate that changes how the water flows in and out of the bay might just cause a few changes to the bay system, Brandt Mannchen, a longtime member of the Houston Sierra Club, says.

Mannchen is skeptical of the Ike Dike. If Merrell's barrier gate is planted on the Bolivar Roads Pass, it may reduce the amount of water flowing by 40 percent or more, according to a TAMU-Galveston interim report issued in 2015. If the amount of water flowing in and out of the bay changes, the salinity of the bay is expected to drop, according to a Delft University of Technology study from 2011.

¹⁰⁷ Collier, K. (2019). *Can the "masters of the flood" help Texas protect its coast from hurricanes?*. [online] The Texas Tribune. Available at: <https://www.texastribune.org/2019/07/15/can-masters-flood-help-texas-protect-its-coast-hurricanes/> [Accessed 18 Jul. 2019].

Changing both the amount of water and the rate at which the bay waters move alters the way sediment is deposited around the bay system, and could transform how the delicate ecosystems of the bay, the marshes, the wetlands, the river and the bayou systems that link up to the bay all work together. “You’re talking about a massive change to the ecosystem of Galveston Bay, and nobody is looking at the environmental implications of this,” Mannchen says. “We think this whole thing is incredibly premature.”

Bob Stokes, president of the Galveston Bay Foundation, has also been hesitant about the Ike Dike. “I asked Bill Merrell for some clear idea what this would mean for Galveston Bay, since that’s what we’re working to protect, and he couldn’t tell me, because a lot of that work hasn’t been done yet; those questions are only beginning to be asked,” Stokes says. “It’s far too early to make the Ike Dike the main plan. There’s so much we don’t know.”

But Congress also may allow the U.S. Army Corps of Engineers to skip the environmental review and to expedite the entire process so that the details get overlooked. Projects get built faster this way, but not always wisely. “It looks harmless,” Blackburn says. “It looks like a positive thing, but there could be consequences to changing Galveston Bay in such a fundamental way, and they may not even get looked at if Congress just signs off after the next big storm. None of these projects are without impact; none of these ideas are without consequences.”¹⁰⁸

¹⁰⁸ Wray, D. (2016). *The Ike Dike is Gaining Support, But Will It Really Save Us?*. [online] Houston Press. Available at: <https://www.houstonpress.com/news/the-ike-dike-is-gaining-support-but-will-it-really-save-us-8888737> [Accessed 18 Jul. 2019].

WORKS CITED

- Andrew Weber, K. (2019). *Coming To A Gulf Of Mexico Near You: A 'Dead Zone' The Size Of Massachusetts*. [online] Houston Public Media. Available at: <https://www.houstonpublicmedia.org/articles/news/texas/2019/06/11/336394/coming-to-a-gulf-of-mexico-near-you-a-dead-zone-the-size-of-massachusetts/> [Accessed 17 Jul. 2019].
- Aurell, D. (2017). *Everything is Bigger in Texas*. [online] Bee Informed Partnership. Available at: <https://beeinformed.org/2017/10/16/everything-is-bigger-in-texas/> [Accessed 17 Jul. 2019].
- Awtrey, J. (2019). *Governor signs East Texas senator's bill allowing feral hog kills without license*. [online] KLTV. Available at: <https://www.kltv.com/2019/06/03/governor-signs-east-texas-senators-bill-allowing-feral-hog-kills-without-license/> [Accessed 19 Jul. 2019].
- Barajas, M. (2016). *PETA Targets East Texas Alligator Farm*. [online] Houston Press. Available at: <https://www.houstonpress.com/news/peta-targets-east-texas-alligator-farm-7547925> [Accessed 19 Jul. 2019].
- Bee Culture. (2017). *CATCH THE BUZZ – Chinese Tallow subject to Integrated Pest Management Control with imported beetle. Major Honey Plant in South.* [online] Available at: <https://www.beeculture.com/catch-buzz-chinese-tallow-subject-integrated-pest-management-control-imported-beetle-major-honey-plant-south/> [Accessed 19 Jul. 2019].
- Bell, J. (2018). *Where plant demand is headed*. [online] Digger Magazine. Available at: <http://www.diggermagazine.com/where-plant-demand-is-headed/> [Accessed 17 Jul. 2019].
- Bennett, C. (2018). *Pigs Don't Fly: Feral Hog Spread Is A Man-Made Mess*. [online] AgWeb. Available at: <https://www.agweb.com/article/pigs-dont-fly-feral-hog-spread-is-a-man-made-mess-NAA-chris-bennett> [Accessed 19 Jul. 2019].
- Benning, T. (2017). *In Harvey's wake, Texas rice farmers had to combat flooding — and the government | Harvey | Dallas News*. [online] Dallas News. Available at: <https://www.dallasnews.com/news/harvey/2017/10/12/harveys-wake-texas-rice-farmers-combat-flooding-government> [Accessed 7 Aug. 2019].
- Benning, T. (2018). *'So much money on the line': No corner of Texas untouched as Trump's tariffs set off trade war with China*. [online] Dallas News. Available at: <https://www.dallasnews.com/business/trade/2018/07/06/much-money-line-no-corner-texas-untouched-after-latest-tariffs-trumps-trade-war> [Accessed 7 Aug. 2019].
- Benning, T. (2018). *Texas farmers 'pay the price' for Trump's 'tariff foolishness,' says ex-trade czar Ron Kirk*. [online] Dallas News. Available at: <https://www.dallasnews.com/business/trade/2018/07/17/texas-farmers-pay-price-trumps-tariff-foolishness-says-ex-trade-czar-ron-kirk> [Accessed 18 Jul. 2019].
- Benning, T. (2018). *Trump's tariffs threaten Texas. But even critics say he has some good points on trade*. [online] Dallas News. Available at: <https://www.dallasnews.com/business/trade/2018/08/03/trumps-tariffs-threaten-texas-even-critics-say-points-trade> [Accessed 19 Jul. 2019].
- Benning, T. (2019). *'Unguided missile': How Trump's latest China tariffs hit Texas consumers and businesses*. [online] Dallas News. Available at: <https://www.dallasnews.com/business/trade/2019/05/09/unguided-missile-trumps-latest-china-tariffs-hit-texas-consumers-businesses> [Accessed 7 Aug. 2019].
- Bentoli. (2018). *Texas Agriculture: Industry Evaluates Hurricane Harvey Recovery Efforts*. [online] Available at: <https://www.bentoli.com/texas-agriculture-hurricane-harvey/> [Accessed 18 Jul. 2019].
- Blaney, B. (2014). *More farms in Texas; Farmers' Ages Rise*. [online] Lubbock Online. Available at: <https://www.lubbockonline.com/agriculture/2014-02-21/more-farms-texas-farmers-ages-rise> [Accessed 19 Jul. 2019].
- Brezosky, L. (2018). *China's tariff list takes aim at Texas farmers and ranchers*. [online] Houston Chronicle. Available at: <https://www.chron.com/business/article/China-s-tariff-list-takes-aim-at-Texas-farmers-12810538.php> [Accessed 18 Jul. 2019].
- Brezosky, L. (2019). *Updated: Texas-sized shrimp dream at long last proves viable*. [online] ExpressNews.com. Available at: <https://www.expressnews.com/business/local/article/Texas-sized-shrimp-dream-at-long-last-proves-13581032.php> [Accessed 17 Jul. 2019].
- Brisbin, S. (2018). *For Texas Farmers, Access To Overseas Markets Is Critical*. [online] KUT. Available at: <https://www.kut.org/post/texas-farmers-access-overseas-markets-critical> [Accessed 18 Jul. 2019].
- Briscoe, T. (2019). *There's a giant dead zone in the Gulf of Mexico — thanks in large part to pollution from Chicago*. [online] Chicago Tribune. Available at: <https://www.chicagotribune.com/news/breaking/ct-met-dead-zone-gulf-of-mexico-midwest-20190612-story.html> [Accessed 17 Jul. 2019].
- Bubenik, T. (2019). *"Sunny Day" Flooding To Increasingly Threaten Texas Coast | Houston Public Media*. [online] Houston Public Media. Available at: <https://www.houstonpublicmedia.org/articles/news/energy-environment/2019/07/10/339073/sunny-day-flooding-to-increasingly-threaten-texas-coast/> [Accessed 17 Jul. 2019].
- Castelli, G. (2019). *Nursery Management Conference to bring industry professionals together*. [online] Nursery Management. Available at: <https://www.nurserymag.com/article/nursery-management-conference-2019-ft-worth-texas/> [Accessed 17 Jul. 2019].
- Clark, S. (2019). *Shellfish Industry Eyes Visas*. [online] Brownsville Herald. Available at: https://www.brownsvilleherald.com/news/local/shrimp-industry-eyes-visas-another-seasonal-workers-to-be-allowed/article_59084c84-704a-11e9-b6c4-93cee67a3c3f.html [Accessed 17 Jul. 2019].
- Cocking, S. (2019). *Gulf shrimp is stable, but still subject to strength of Asian imports | National Fisherman*. [online] National Fisherman. Available at: <https://www.nationalfisherman.com/gulf-south-atlantic/gulf-shrimp-is-stable-but-still-subject-to-strength-of-asian-imports/> [Accessed 17 Jul. 2019].
- Collier, K. (2019). *Can the "masters of the flood" help Texas protect its coast from hurricanes?*. [online] The Texas Tribune. Available at: <https://www.texastribune.org/2019/07/15/can-masters-flood-help-texas-protect-its-coast-hurricanes/> [Accessed 18 Jul. 2019].
- Collins, C. (2017). *Immigrant Workers in Texas Could Fill Farm Vacancies, but They're Trapped in the Valley*. [online] The Texas Observer. Available at: <https://www.texasobserver.org/immigrant-workers-texas-fill-farm-vacancies-theyre-trapped-valley/> [Accessed 17 Jul. 2019].
- Copeland, M. (2019). *11,000 Texas Farmers Sign Up for Tariff Relief*. [online] Waco Tribune. Available at: https://www.wacotrib.com/news/farm_and_ranch/texas-farmers-sign-up-for-tariff-relief/article_d2013caf-2260-526e-9ee0-0e83d63748ee.html [Accessed 18 Jul. 2019].
- Corbett, E. (2018). *Texas Shrimp Industry Could Lose \$1 Million Each Day Due to Visa Cap*. [online] Fortune. Available at: <https://fortune.com/2018/07/18/texas-shrimp-industry-visa-cap/> [Accessed 17 Jul. 2019].
- Cuadros, A. (2019). *A Shortage of Shrimp*. [online] Available at: <https://www.kveo.com/news/a-shortage-of-shrimp/> [Accessed 17 Jul. 2019].
- Curtis, B. (2019). *Beekeepers face challenges in and out of almond bloom*. [online] Farm Progress. Available at: <https://www.farmprogress.com/orchard-crops/beekeepers-face-challenges-and-out-almond-bloom> [Accessed 17 Jul. 2019].
- DePillis, L. (2017). *Texas rice farmers hope China deal brings more than a grain of relief*. [online] HoustonChronicle.com. Available at: <https://www.houstonchronicle.com/business/article/Texas-rice-farmers-hope-China-deal-brings-more-11721801.php> [Accessed 18 Jul. 2019].
- Domel, J. (2017). *Texas egg production on the rise*. [online] Texas Farm Bureau. Available at: <http://texasfarmbureau.org/texas-egg-production-rise/> [Accessed 8 Aug. 2019].

Embry, P. (2019). *Our Love of Almonds is Seriously Jeopardizing Honeybees*. [online] Huffington Post. Available at: https://www.huffpost.com/entry/honey-bee-census-almonds_n_5d0a8726e4b0f7b7442b3aaa?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2x1LmNvbS8&guce_referrer_sig=AQAAAGn_RxskNfgeo3mrGfQfMVHn1UUMsue8E86tmIn4sWUpTFCVhs8rLSQUnWYHZEuQrHoq2Vy_O_bGsDCVCC_CerncOrf-WwfOnO1XF6lm_DljjsYy5q-gky4mSwnSsLb6GFY09R6UUIFeUSIEjAPgWWzDh3fM3h61SYyUZAI_1fIF [Accessed 17 Jul. 2019].

Eschner, K. (2019). *The most dangerous places to live in America that are prone to natural disasters*. [online] CNBC. Available at: <https://www.cnbc.com/2019/07/10/billion-dollar-natural-disasters-rising-these-states-better-prepare.html> [Accessed 18 Jul. 2019].

Fannin, B. (2018). *Texas A&M AgriLife breaks ground on new poultry biosafety research facility | AgriLife Today*. [online] AgriLife Today. Available at: <https://today.agrilife.org/2018/10/23/texas-am-agrilife-to-break-ground-on-new-poultry-biosafety-research-facility/> [Accessed 8 Aug. 2019].

Fears, R. (2015). *Foreign Invasion: Chinese Tallow*. [online] The Eagle. Available at: https://www.theeagle.com/landandlivestockpost/foreign-invasion-chinese-tallow-is-just-another-problem-weed/article_a54d8b06-c822-5ef9-8b2c-54ee3fbc84db.html [Accessed 19 Jul. 2019].

Fears, R. and Fears, J. (2013). *Cattle are a family heritage in east Texas*. [online] Progressive Cattle. Available at: <https://www.progressivecattle.com/features/regional-features/cattle-are-a-family-heritage-in-east-texas> [Accessed 18 Jul. 2019].

Flores, N. (2018). *Texas employers worry immigration crackdown may cause worker shortage*. [online] The Statesman. Available at: <https://www.statesman.com/BUSINESS/20180112/Texas-employers-worry-immigration-crackdown-may-cause-worker-shortage> [Accessed 17 Jul. 2019].

Freeman, S. (2019). *Texas Muscles in on Oyster Farming*. [online] Corpus Christi Business News. Available at: <https://www.ccbiznews.com/news/texas-muscles-in-on-oyster-farming> [Accessed 17 Jul. 2019].

Fresh Plaza. (2019). *Blueberry harvest starts slowly in US as volumes recover*. [online] Available at: <https://www.freshplaza.com/article/9099723/blueberry-harvest-starts-slowly-in-us-as-volumes-recover/> [Accessed 17 Jul. 2019].

Godwin, P. and Stroud, J. (2016). *Too Much of a Good Thing*. [online] Intranet.ces.ncsu.edu. Available at: <https://intranet.ces.ncsu.edu/2016/12/too-much-of-a-good-thing/> [Accessed 19 Jul. 2019].

Gonzalez, R. (2019). *Grim prognosis for US farmed shrimp sector - https://www.aquaculturenorthamerica.com*. [online] Aquaculture North America. Available at: <https://www.aquaculturenorthamerica.com/grim-prognosis-for-us-farmed-shrimp-sector-2214/> [Accessed 17 Jul. 2019].

Hall, PhD, C. (2017). *Greenhouse and Nursery Outlook*. [online] Farmcrediteast.com. Available at: <https://www.farmcrediteast.com/News/media-center/press-releases/20170201FebruaryKEP/GreenIndustry17?nvctx=%7BF100E92A-C3D5-43F6-8DA9-5EC36D2CDCBB%7D> [Accessed 7 Aug. 2019].

Hatfield, A. (2019). *Is Texas Really Home to Over Half of the Country's Feral Pigs? | Grand View Outdoors*. [online] Grand View Outdoors. Available at: <https://www.grandviewoutdoors.com/predator-hunting/hogs/is-texas-really-home-to-over-half-of-the-countrys-feral-pigs> [Accessed 19 Jul. 2019].

Hetherington, J. (2018). *RoboCrop: Walmart is making robotic bees*. [online] Newsweek. Available at: <https://www.newsweek.com/can-robotic-bees-replace-real-thing-walmart-files-patent-pollination-drone-845861> [Accessed 18 Jul. 2019].

Huffman, J. (2017). *Texas oyster industry braces for more bad news*. [online] Undercurrent News. Available at: <https://www.undercurrentnews.com/2017/09/12/texas-oyster-industry-braces-for-more-bad-news/> [Accessed 17 Jul. 2019].

Hurst, N. (2018). *This Robotic Farming System Could Be the Answer to Labor Shortages*. [online] Smithsonian. Available at: <https://www.smithsonianmag.com/innovation/robotic-farming-system-could-be-answer-labor-shortages-180970575/> [Accessed 17 Jul. 2019].

King, A. (2019). *From Northwest Hives To California Almonds, Bee Deadout Threatens Crops And Livelihoods*. [online] NW News Network. Available at: <https://www.nwnewsnetwork.org/post/northwest-hives-california-almonds-bee-deadout-threatens-crops-and-livelihoods> [Accessed 17 Jul. 2019].

Kistner, R. (2019). *There's An Environmental Disaster Unfolding In The Gulf of Mexico*. [online] Huffington Post. Available at: https://www.huffpost.com/entry/mississippi-louisiana-gulf-coast-environmental-disaster_n_5d262c42e4b0583e482b28ed [Accessed 17 Jul. 2019].

Knapp, G. (2018). *The Texas Oyster Industry Is Now a Shell of Its Former Self*. [online] Houstonia. Available at: <https://www.houstoniamag.com/articles/2018/4/24/texas-oyster-industry> [Accessed 17 Jul. 2019].

Knopic, P. (2019). *Natural Shrimp: Key To Future Of Shrimp Production*. [online] PR Newswire. Available at: <https://www.prnewswire.com/news-releases/naturalshrimp-key-to-future-of-shrimp-production-300856777.html> [Accessed 18 Jul. 2019].

Laughton, C. (2016). *A Changing Landscape for Greenhouse and Nursery Growers*. [online] Farm Credit East. Available at: <https://www.farmcrediteast.com/knowledge-exchange/blog/todays-harvest/greenhouse-nursery-outlook> [Accessed 19 Jul. 2019].

Maeckle, M. (2019). *Public hearing in Austin: "Texas beekeepers relying on honey production are in peril"*. [online] Texas Butterfly Ranch. Available at: <https://texasbutterflyranch.com/2018/07/21/public-hearing-in-austin-texas-beekeepers-relying-on-honey-production-are-in-peril/> [Accessed 17 Jul. 2019].

McCullum, D. (2018). *East Texas plant industry blooming*. [online] <https://www.ktre.com>. Available at: <https://www.ktre.com/story/37849272/east-texas-plant-industry-blooming/> [Accessed 19 Jul. 2019].

McGinnis, M. (2019). *For Two Weeks, Soybean Crop Shows No Progress, USDA Says*. [online] Successful Farming. Available at: <https://www.agriculture.com/news/crops/for-two-weeks-soybean-crop-shows-no-progress-usda-says> [Accessed 8 Aug. 2019].

Miller, B. (2017). *Hog Apocalypse: Is Poisoning Hogs The Way To Go In Texas?*. [online] Grand View Outdoors. Available at: <https://www.grandviewoutdoors.com/predator-hunting/hog-apocalypse-poisoning-hogs-way-go-texas> [Accessed 19 Jul. 2019].

Milman, O. (2017). *Meat industry blamed for largest-ever 'dead zone' in Gulf of Mexico*. [online] the Guardian. Available at: <https://www.theguardian.com/environment/2017/aug/01/meat-industry-dead-zone-gulf-of-mexico-environment-pollution> [Accessed 17 Jul. 2019].

Milman, O. (2018). *'Dead zone' in Gulf of Mexico will take decades to recover from farm pollution*. [online] the Guardian. Available at: <https://www.theguardian.com/environment/2018/mar/22/dead-zone-gulf-of-mexico-decades-recover-study> [Accessed 17 Jul. 2019].

Min, S. (2019). *Bee thieves find sweet rewards in California's almond groves*. [online] CBS News. Available at: <https://www.cbsnews.com/news/how-almond-production-has-made-a-lucrative-business-of-bees/> [Accessed 17 Jul. 2019].

Mody, P. (2016). *The Future of Farming*. [online] Texas Monthly. Available at: <https://www.texasmonthly.com/articles/the-future-of-farming/> [Accessed 19 Jul. 2019].

NAJARRO, I. (2017). *Texas Gulf Coast fishing industry struggles*. [online] Morning Ag Clips. Available at: <https://www.morningagclips.com/texas-gulf-coast-fishing-industry-struggles/> [Accessed 7 Aug. 2019].

NBC (2019). *Texas could see a shortage of shrimp this year*. [online] KGNS. Available at: <https://www.kgns.tv/content/news/Texas-could-have-a-shortage-of-shrimp-this-year-512176632.html> [Accessed 17 Jul. 2019].

Nesbit, M., Kamas, J. and Stein, L. (n.d.). *Texas Fruit and Nut Production: Blueberries -Are blueberries easy to grow?*. [online] Texas A&M AgriLife Extension Service. Available at: <https://agrilifeextension.tamu.edu/library/farming/texas-fruit-and-nut-production-blueberries/> [Accessed 7 Aug. 2019].

Ohio State University. "Culprit found for honeybee deaths in California almond groves: Researchers and industry leaders working to stop insecticide use during bloom." ScienceDaily. ScienceDaily, 4 February 2019. <www.sciencedaily.com/releases/2019/02/190204114625.htm>.

Pack, M. (2016). *Rice in Texas*. [online] Edibleaustin.com. Available at: <http://www.edibleaustin.com/index.php/food-2/1588-rice-in-texas> [Accessed 18 Jul. 2019].

Ramirez, C. (2019). [online] Caller Times. Available at: <https://www.caller.com/story/news/2019/05/31/texas-soybean-farmers-back-trump-china-tariffs/1303928001/> [Accessed 8 Aug. 2019].

Rice, J. (2018). *In the Lone Star State, Milk Is Worth \$2 Billion. How Moving West Jump-Started Texas Dairy*. [online] KUT. Available at: <https://www.kut.org/post/lone-star-state-milk-worth-2-billion-how-moving-west-jump-started-texas-dairy> [Accessed 18 Jul. 2019].

Riggs, G. (2018). *Will pollinator drones replace honeybees?*. [online] The Bee Corp. Available at: <https://www.thebeecorp.com/thebeeword/will-pollinator-drones-replace-honeybees> [Accessed 18 Jul. 2019].

Robb, B. (2018). *Catfish industry struggles despite research advancements*. [online] Farm Progress. Available at: <https://www.farmprogress.com/livestock/catfish-industry-struggles-despite-research-advancements> [Accessed 19 Jul. 2019].

Russell, A. (2017). *Texas: Finding Value in Poultry Litter as a Fertilizer*. [online] AgFax. Available at: <https://agfax.com/2017/05/29/texas-finding-value-in-poultry-litter-as-a-fertilizer/> [Accessed 8 Aug. 2019].

Russell, A. (2019). *Texas Aquaculture: Low Catfish Prices Push Producers to Redfish, Bass*. [online] AgFax. Available at: <https://agfax.com/2019/01/21/texas-aquaculture-low-catfish-prices-push-producers-to-redfish-bass/> [Accessed 19 Jul. 2019].

Russell, A. (2019). *Texas Dairy Production Has Shifted From The Northeast To The Panhandle, But Why?*. [online] Texas A&M Today. Available at: <https://today.tamu.edu/2018/02/06/texas-dairy-production-has-shifted-from-the-northeast-to-the-panhandle-but-why/> [Accessed 18 Jul. 2019].

Russell, A. (2019). *Texas sheep, goat prices, inventories down slightly amid strong market*. [online] Farm Progress. Available at: <https://www.farmprogress.com/crops/texas-sheep-goat-prices-inventories-down-slightly-amid-strong-market> [Accessed 8 Aug. 2019].

Sault, S. (2019). Where Did Texas Feral Hogs Come From? Their Surprising Origins. Texas Hill Country. <https://texashillcountry.com/texas-feral-hog-origins/>

Schnurman, M. (2019). *Lots of help wanted: How the labor shortage is slowing the Texas economy*. [online] Dallas News. Available at: <https://www.dallasnews.com/opinion/commentary/2019/06/30/help-wanted-labor-shortage-slowing-texas-economy> [Accessed 17 Jul. 2019].

Shane, S. (2019). *News of the Poultry Industry*. [online] Chick-news.com. Available at: <http://www.chick-news.com/news.aspx> [Accessed 8 Aug. 2019].

Shane, S.(2019). *H-2A and Other Documented Employees Require Adequate Housing*. [online] Egg News. Available at: <http://www.egg-news.com/Commentary.aspx> [Accessed 8 Aug. 2019].

Shike, J. (2018) Deadly Terrorist Threatens the Lone Star State's Domestic Pig Herd. *Pork Business*. Available at: <https://www.porkbusiness.com/article/deadly-terrorist-threatens-lone-star-states-domestic-pig-herd>.

Smith, C. (2018). *Texas Shrimp Industry Lacks Willing U.S. Workers*. [online] Red River Radio. Available at: <https://www.redriverradio.org/post/texas-shrimp-industry-lacks-willing-us-workers> [Accessed 17 Jul. 2019].

Southern Shrimp Alliance. (2019). *Shrimp Landings in 2019 Start Off Above Prior Year Levels - Southern Shrimp Alliance*. [online] Available at: <http://www.shrimpalliance.com/shrimp-landings-in-2019-start-off-above-prior-year-levels/> [Accessed 17 Jul. 2019].

Taylor, D. (2017). *Olive farm survives Harvey ravages*. [online] Houston Chronicle. Available at: <https://www.chron.com/neighborhood/dayton/news/article/Olive-farm-survives-Harvey-ravages-12267254.php> [Accessed 8 Aug. 2019].

Texas A&M AgriLife Extension Servic (2015). *Growing Blueberries in the South*. [online] Texas A&M. Available at: https://aggie-horticulture.tamu.edu/fruit-nut/files/2015/04/blueberries_2015.pdf [Accessed 17 Jul. 2019].

Texas A&M University-Corpus Christi. (2019). *Turning the Tide on Oyster Mariculture in Texas*. [online] Available at: <https://www.tamucc.edu/news/2019/06/turning-the-tide-on-oyster-mariculture.html#.XS8zfk7mUk> [Accessed 17 Jul. 2019].

Texas A&M University-Corpus Christi. (2019). *Turning the Tide on Oyster Mariculture in Texas*. [online] Available at: <https://www.tamucc.edu/news/2019/06/turning-the-tide-on-oyster-mariculture.html#.XS8zfk7mUk> [Accessed 17 Jul. 2019].

Texas Farm Bureau. (2018). *Sheep, goat demand on the rise - Texas Farm Bureau*. [online] Available at: <http://texasfarmbureau.org/sheep-goat-demand-rise/> [Accessed 8 Aug. 2019].

Thatcher, M. (2019). *Farm states slammed by double whammy of US-China trade war and immigration woes*. [online] CNBC. Available at: <https://www.cnb.com/2019/07/10/farm-states-slammed-by-us-china-trade-war-and-immigration-woes.html> [Accessed 18 Jul. 2019].

Think Rice. (2019). *Where Is Rice Grown?*. [online] Available at: <https://www.thinkrice.com/on-the-farm/where-is-rice-grown/> [Accessed 18 Jul. 2019].

Tompkins, S. (2016). *There are gators galore in Texas*. [online] ExpressNews.com. Available at: <https://www.expressnews.com/sports/outdoors/article/There-are-gators-galore-in-Texas-7947073.php> [Accessed 7 Aug. 2019].

Tompkins, S. (2019). *That box of frozen shrimp used for bait could be illegal - and deadly*. [online] ExpressNews.com. Available at: <https://www.expressnews.com/sports/outdoors/article/That-box-of-frozen-shrimp-used-for-bait-could-be-13689567.php> [Accessed 17 Jul. 2019].

Tomson, B. (2019). *US makes first rice sale to Chinese buyers*. [online] Agri-pulse.com. Available at: <https://www.agri-pulse.com/articles/12382-us-makes-first-rice-sale-to-chinese-buyers-usa-rice> [Accessed 18 Jul. 2019].

Tomson, B. (2019). *US rice sales to China on hold, but maybe not much longer*. [online] Agri-pulse.com. Available at: <https://www.agri-pulse.com/articles/11920-us-rice-sales-to-china-on-hold-but-maybe-not-much-longer> [Accessed 18 Jul. 2019].

TTAG Contributor. (2019) More Hunters Wanted: Texas is Losing the Fight Against Feral Hogs. The Truth About Guns. <https://www.thetruthaboutguns.com/hunters-wanted-texas-is-losing-the-war-on-feral-hogs/>

Tyler Morning Telegraph. (2016). *East Texas alligator population rising*. [online] Available at: https://tylerpaper.com/news/local/east-texas-alligator-population-rising/article_67db16c3-852c-5d98-a591-9021555d6805.html [Accessed 19 Jul. 2019].

USA Rice. (2019). *U.S. Rice Industry Stands to Lose from Trump Tariffs | USA Rice Federation*. [online] Available at: [https://www.usarice.com/news-and-events/publications/usa-rice-daily/article/usa-rice-daily/2018/03/19/uofa-arkansas-stands-to-lose-more-than-4k-jobs-\\$383-million-from-trump-tariffs](https://www.usarice.com/news-and-events/publications/usa-rice-daily/article/usa-rice-daily/2018/03/19/uofa-arkansas-stands-to-lose-more-than-4k-jobs-$383-million-from-trump-tariffs) [Accessed 18 Jul. 2019].

USMEF (2019). *Mexico and Canada remove retaliatory duties on US products, including beef – Texas and Southwestern Cattle Raisers*. [online] Texas and Southwestern Cattle Raisers. Available at: <http://tskra.org/mexico-and-canada-remove-retaliatory-duties-on-us-products-including-beef/> [Accessed 18 Jul. 2019].

Walden, J. (2019). *A Green Gusher In the Lone Star State*. [online] Edible Communities. Available at: <https://www.ediblecommunities.com/edible-communities/olive-oil-takes-root-in-texas/> [Accessed 8 Aug. 2019].

Waters, T. and Plume, K. (2017). *Harvey's floods scatter cattle in Texas, swamp cotton fields*. [online] Reuters. Available at: <https://www.reuters.com/article/us-storm-harvey-cattle/harveys-floods-scatter-cattle-in-texas-swamp-cotton-fields-idUSKCN1B92QD> [Accessed 18 Jul. 2019].

Watkins, K. (2018). *How Two New Projects Aim To Boost Texas' Declining Oyster Population (And Why It Matters) | Houston Public Media*. [online] Houston Public Media. Available at: <https://www.houstonpublicmedia.org/articles/news/energy-environment/2018/12/10/314883/how-two-new-projects-aim-to-boost-texas-declining-oyster-population-and-why-it-matters/> [Accessed 17 Jul. 2019].

Wilder, E. (2018). *Bees for Hire: California Almonds Become Migratory Colonies' Biggest Task | The Bill Lane Center for the American West*. [online] Stanford University: Agriculture and the West. Available at: <https://west.stanford.edu/news/blogs/and-the-west-blog/2018/bees-for-hire-california-almonds-now-are-migratory-colonies-biggest-task> [Accessed 17 Jul. 2019].

Wray, D. (2016). *The Ike Dike is Gaining Support, But Will It Really Save Us?*. [online] Houston Press. Available at: <https://www.houstonpress.com/news/the-ike-dike-is-gaining-support-but-will-it-really-save-us-8888737> [Accessed 18 Jul. 2019].