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Economic Viability of Industrial Hemp in the United States: A Review of State Pilot Programs

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Abstract

After a hiatus of almost 45 years, the Agricultural Act of 2014, Public Law 113-79 (the 2014 Farm Bill) reintroduced industrial hemp production in the United States through State pilot programs. U.S. industrial hemp acreage reported by State pilot programs increased from 0 in 2013 to over 90,000 acres in 2018, the largest U.S. hemp acreage since the 146,200 acres grown in 1943. While the U.S. hemp industry grew rapidly and commercial hemp production was legalized again by the 2018 Farm Bill, the industry's long-term economic viability is uncertain. This study documents outcomes and lessons learned from the State pilot programs and examines legal, agronomic, and economic challenges that may affect the transition from the pilot programs to economically viable commercial production. Competition with alternative crops for acreage, global competitiveness, market transparency, and the ability to manage regulatory and market risks will determine patterns of development in the emerging U.S. hemp industry.

Keywords: hemp, cannabidiol, CBD, pilot program, infant industry, Farm Bill

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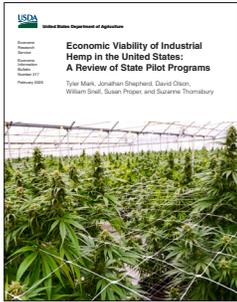
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Errata

On August 10, 2020, Appendix B tables were updated to reflect that the reported 2018 greenhouse areas for Montana, Vermont, and West Virginia were not available (N/A) and the 2017 greenhouse area for Minnesota was also not available (N/A). Vermont processor numbers in 2016 were updated to 1 (grain), 3 (CBD), and 4 (total). Values in the associated charts and text were correct and are unchanged.



Economic Viability of Industrial Hemp in the United States: A Review of State Pilot Programs

Tyler Mark, Jonathan Shepherd, David Olson, William Snell, Susan Proper, and Suzanne Thornsberry

What is the Issue?

After a hiatus of almost 45 years, the Agricultural Act of 2014, Public Law 113-79 (the 2014 Farm Bill) reintroduced industrial hemp production in the United States through State pilot programs. Beginning in 2014, States with laws that allowed growth or cultivation of industrial hemp could establish a pilot program or conduct research on the crop. Production beyond the pilot programs was legalized in the Agricultural Improvement Act of 2018, Public Law 115-334 (the 2018 Farm Bill). This study documents outcomes and lessons learned from the State pilot programs and examines legal, agronomic, and economic challenges that may affect the transition from the pilot programs to economically viable commercial production.

What Did the Study Find?

Under the pilot programs, United States industrial hemp acreage reported by States increased from zero in 2013 to over 90,000 acres in 2018, the largest U.S. hemp acreage since the 146,200 acres planted in 1943.

The State pilot programs restarted production of a crop that had not been grown in the United States for decades. Some challenges became apparent:

- establishing State legislation that allowed hemp to be grown or cultivated;
- acquiring critical production inputs (e.g., seeds, insecticides, herbicides) and credit;
- inconsistency between State requirements; and
- lack of basic data and information for decision-making.

The 2018 Farm Bill addressed many of the challenges identified in the pilot programs or authorized subsequent regulations to address them.

The pattern of establishment and expansion of industrial hemp was influenced by existing infrastructure, public sector support, relative profitability of alternative enterprises, and ultimately market development and economic returns. After the pilot programs, acreage continued to expand with 146,065 acres of hemp reported as planted to the U.S. Department of Agriculture's (USDA) Farm Service Agency in 2019.

ERS is a primary source of economic research and analysis from the U.S. Department of Agriculture, providing timely information on economic and policy issues related to agriculture, food, the environment, and rural America.

By December 2019, hemp could be grown legally in every State except Idaho, Mississippi, and South Dakota. As with other crops, it is not likely that hemp will be economically viable in every State. Even if barriers to entry are low, growers are not likely to plant or process hemp if more profitable options exist. States that moved quickly to establish pilot programs were not leading producers of competing major field crops.

Long-run economic viability will be affected by factors including

- competition from other domestic crops for acreage,
- global competitors in hemp and hemp products,
- market information and transparency, and
- the regulatory environment.

How Was the Study Conducted?

This study is based on a collection of the available data drawn from State pilot program annual reports, website information, USDA's Farm Service Agency, unstructured discussions with State staff, and third-party information. Study results provide a detailed synthesis of the pilot programs established by the 2014 Farm Bill and identify lessons learned including factors that will affect economic viability of the industry moving towards commercial production. There is no systematic comprehensive data source regarding the emerging United States hemp industry or requirement to report a consistent set of data for the pilot programs. States collected data at various times and levels of aggregation. For example, some States report hemp data by intended end use (i.e., grain, fiber, cannabidiol (CBD) or other extracts) while others do not report data. Some States categorize applicants separately as processors or growers while other States report only total applicants. To provide the most complete information available on each pilot program, we have not tried to consolidate information about licensing and applications when categories are inconsistent. Since the data are from various sources, and reporting categories and definitions vary, caution should be used in adding State data from multiple sources to reach national or regional statistics.

Economic Viability of Industrial Hemp in the United States: A Review of State Pilot Programs

Introduction

After a hiatus of almost 45 years, the Agricultural Act of 2014, Public Law 113-79 (the 2014 Farm Bill) reintroduced industrial hemp production in the United States.¹ The 2014 Farm Bill allowed State departments of agriculture and institutions of higher education to legally grow and cultivate hemp for purposes of research or to license growers in their State for these activities. States with laws that allowed growth or cultivation of industrial hemp could now establish a pilot program and conduct research on the crop. Although some States had small university-based hemp research projects on specific agronomic topics, most of the pilot programs licensed individual producers to grow hemp under the supervision of the State agriculture department or a university to explore general issues of agronomic and economic viability.² Commercial production of hemp outside of the pilot programs was not allowed. Hemp is a versatile plant with a number of potential end-uses, including food from hemp seed, fiber from hemp stalks, and oil from the flowers and seeds. State pilot programs varied in the uses approved.

¹Section 7606, entitled “Legitimacy of Hemp Research,” defines industrial hemp as “the plant *Cannabis sativa* L. and any part of such plant, whether growing or not, with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis.” Delta-9 tetrahydrocannabinol (THC) is the psychoactive ingredient in marijuana. Including that definition of industrial hemp as the legal definition in 7 U.S.C. 5940 was a critical step in allowing hemp production to restart in the United States. This was the first time in decades that hemp was legally defined as a crop different from marijuana (see Appendix A: A Brief History of U.S. Hemp Before the 2014 Farm Bill).

²In this report, the term “pilot program” refers to the entire set of industrial hemp-related activities conducted within a State under auspices of either the State department of agriculture or a university.

The earliest pilot programs, established in 2014 and 2015, were not necessarily the largest by 2018. While Colorado, Kentucky, and Oregon licensed individual growers and expanded their programs quickly, some other early pilot programs remained small experimental projects. For example, Indiana reported 5 acres of hemp planted in 2015 and reported only 16 acres in 2018. Other pilot programs established after 2015, notably Montana, were able to expand quickly and became some of the largest U. S. hemp producers.⁶ Beginning in 2015, USDA's Farm Service Agency began collecting data on hemp acreage planted.⁷ However, similar to other crops, not every grower participates in Farm Service Agency programs and so, as expected, reported acreage planted is lower than the totals reported by State pilot programs (Figure 2). Some advocacy groups also collected data. Beginning in 2016, Vote Hemp published an annual hemp crop report that included estimates of acreage grown.⁸

Some States licensed greenhouse space as well as field acreage in the pilot programs. By 2018, 13 States reported only field production while 9 additional States were showing both field and greenhouse growers. Like field acreage, greenhouse plantings grew rapidly between 2014 and 2018. Colorado, Massachusetts, Minnesota, Nevada, New York, Pennsylvania, and Oklahoma all reported greenhouse production of more than 10,000 square feet (0.23 acres) by the 2018 crop year. Colorado alone had nearly 5 million square feet (approximately 114 acres) of greenhouse hemp. Some of the greenhouse space is used for growing seedlings, clones, and seeds, rather than for growing plants for harvest. USDA added hemp to the organic certification program in 2016, in response to stakeholder demand, which was a popular option in some States (Dingha et al., 2019).⁹

Nationally, the number of producers reported to have approved hemp licenses increased from 292 in 2014 to 3,852 in 2018, although many of these producers were small (Figure 3). Because of various legal and logistical issues, not all the licensed producers planted hemp or planted as many acres as they had licensed. However, the number of approved licenses more than doubled between 2017 and 2018.

Information about the number of hemp processors is even more difficult to ascertain. Some States with pilot programs did not have a separate application or license requirement for processors, so the data on nationwide processor numbers are limited and do not reflect the extent of the pilot programs.¹⁰ Based on the data that are available, there was an increase in processor applications between 2014 and 2018. There were 823 processors reported by State pilot programs in 2018, however, this does not capture missing data, size of operations, or if the processors were active. In some cases, growers may also license themselves as processors if they plan to process the hemp beyond its first stage or produce an end-use hemp product.¹¹

⁶Reported planted acreage in Montana expanded from 550 in 2017 to 22,000 in 2018.

⁷During the pilot programs, USDA, Farm Service Agency data include only data reported by Agency customers and are a simple total of reported acres.

⁸Vote Hemp reports planted acreage for States where data are available, and estimates planted area for other States at 70% of licensed hemp acreage.

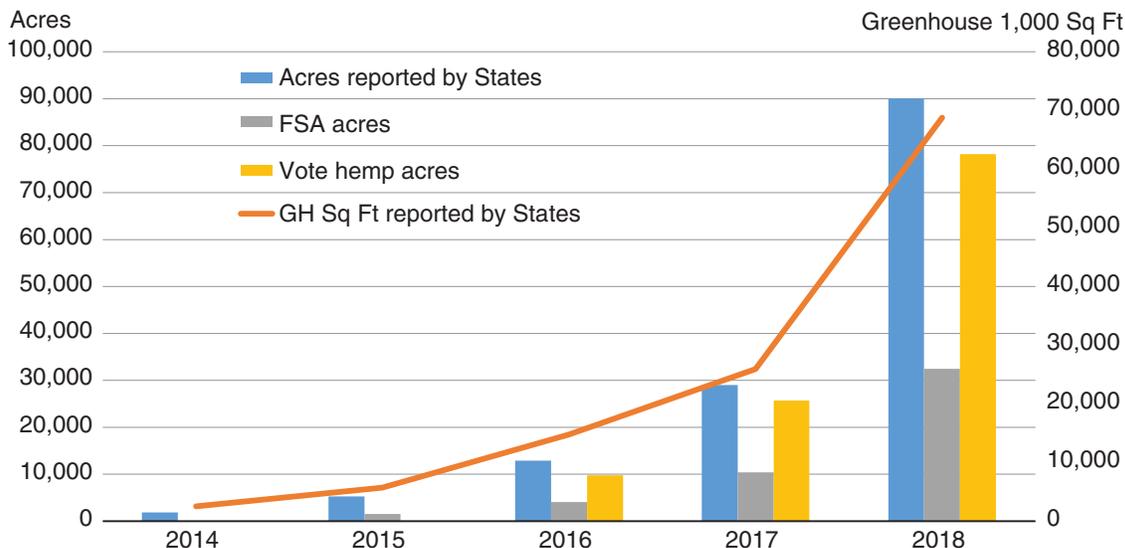
⁹Organic hemp is subject to the National Organic Program regulations at 7 CFR Part 205 National Organic Program. As of mid-November 2019, Program data indicate 15 or more certified organic operations in 5 States (Wisconsin, Colorado, New York, California, and New York) that included hemp in their certification.

¹⁰For example, data on processors from Colorado are not available, and Tennessee did not require processors to have a license after 2016.

¹¹Some States issued processing licenses at no additional cost if an applicant paid for a grower license, whether the grower had any intention of processing on any meaningful scale. Some States required additional licenses for activities such as transportation of hemp or hemp products.

Figure 2

Reported U.S. hemp acreage and greenhouse area, 2014-2018

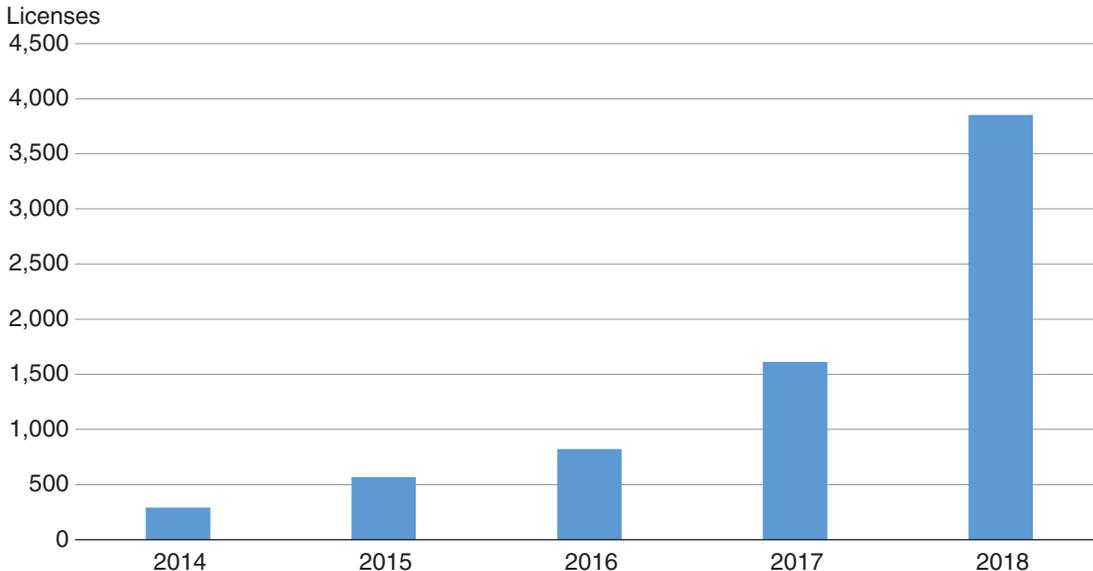


Note: FSA = Farm Service Agency. GH Sq Ft = Greenhouse square feet. Not all States reported data on the same basis. Reported acreage may include planted, harvested, and/or licensed or approved acreage. Not all States reported greenhouse data. Farm Service Agency data include only data reported by Agency customers and are a simple total of reported acres.

Source: USDA, Economic Research Service calculations based on data reported by State pilot program, USDA, Farm Service Agency, and Vote Hemp.

Figure 3

Approved U.S. producer hemp licenses, 2014-2018



Source: USDA, Economic Research Service calculations based on data reported by State pilot programs.

Table 1 provides detailed information on the status of the pilot program in each State as of 2018. By 2018, Colorado, Kentucky, Montana, and Oregon were the only States reporting more than 5,000 acres of hemp planted. Most other States still had relatively small programs, even though pilot programs had been authorized since 2014.

Table 1
Hemp Acreage and Participation Reported by State Pilot Programs, 2018

State	2018 Area by Type and Intended Use		Number of Processors		2018 Range of Fees	Number of Approved Applicants		Number of Employees in State's Program ²	
	Grain	Fiber	Grain	Fiber		Registrants ¹	Registrations ¹	FT	PT (FTE)
Colorado	CBD	30,950			\$500 application plus \$5/acre and/or \$3.00/1,000 sq ft	835		FT	3.5
	Total acres	4,788,523	Total	95		1,075		PT (FTE)	0
Hawaii	Grain	2	Information not available		Grower application fee \$500+\$250 grower license fee+\$40/hour for inspection+laboratory testing costs plus \$2/acre + \$.33/sq ft	Approved ³	10	FT	1
	Fiber							PT	
	CBD							(FTE)	
	GH SQ FT	1,000						0	
Illinois	Grain		Information not available		No fees for 2018; fees beginning 2019 University ⁴	Approved	3	FT	N/A
	Fiber							PT	
	CBD							(FTE)	
	Total acres	1						3	
Indiana	Grain	5	Grain	1	No fees for 2018; fees beginning 2020	Approved	11	FT	2
	Fiber	11	Fiber	0				PT (FTE)	
	CBD		CBD	0				1	
	Total acres	16							
Kentucky	Grain	2,337	Grain	18	\$100 Grower application + \$400 per address + \$250 for secondary THC5 test (if required); Processor fees \$500-\$3,000; Broker/Handler/Seed Dealer \$500; Site modification fee \$750	Approved	210	FT	3
	Fiber	335	Fiber	25				PT (FTE)	
	CBD	4,028	CBD	49				14	
	GH SQ FT	750,812							
	Total acres	6,700							
Cert seed acres	2,875								

Table 1

Hemp Acreage and Participation Reported by State Pilot Programs, 2018—continued

State	2018 Area by Type and Intended Use		Number of Processors		2018 Range of Fees	Number of Approved Applicants		Number of Employees in State's Program ²		
	Grain	Fiber	Grain	Fiber		Approved	PT (FTE)	FT	PT (FTE)	
Maine	CBD		No record for Maine; growers and processors use same application		\$100 application per non-contiguous location + \$500 license + \$50/acre	Approved		FT	0	
	Total acres	550						PT (FTE)	0.65	
Massachusetts	Grain		Grain	0	\$100 application fee + \$300 grower fee + \$150 for second THC test if applicable	Approved	14	FT	4	
	Fiber		Fiber	0				PT (FTE)	1	
	CBD		CBD	9						
	Total acres	21	Total	9						
	GH SQ FT	15,050								
Minnesota	Grain	623	Grain	2	\$37 application fee + \$550 grower participation fee + \$250 for THC testing beyond 1st test if required + \$100/location fee; \$350 each for processor, broker/handler, or seed dealer license	Approved	65	FT	2	
	Fiber	14	Fiber	0				PT (FTE)	0	
	CBD	72	CBD	6						
	Total acres	709								
	GH SQ FT	55,000								
Montana	Grain		Grain	0	\$450 application + \$250 per THC test; Seed dealer \$55 (standard for all seed dealers in MT)	Approved	58	FT	1	
	Fiber		Fiber	1				PT (FTE)	0	
	CBD		CBD	2						
	Total acres	22,000								
	Cert seed acres	22,000								
Nevada	Grain		Information not available	Information not available	Information not available		PT (FTE)	FT	3	
	Fiber									0
	CBD									
	GH SQ FT	176,912								
	Total	1,523								

Table 1

Hemp Acreage and Participation Reported by State Pilot Programs, 2018—continued

State	2018 Area by Type and Intended Use		Number of Processors			2018 Range of Fees	Number of Approved Applicants		Number of Employees in State's Program ²					
	Grain	Fiber	Grain	Fiber	CBD		Approved	University	FT	PT (FTE)				
New York			0	14	22	\$500 grower fee; \$500 processor fee	Approved University	104	2	2	3			
	Total	720												
North Carolina	GH	SQ FT												
	Grain	NR	Grain			\$250 application + \$250 grower participation fee + \$59 for 1st inspection + \$150 for 2nd inspection + \$2/acre for 49-500 acres and/or \$2/1,000 sq ft	Approved University	450	20	10	0			
	Fiber	NR	Fiber											
	CBD	NR	CBD		300									
	Total	3,184	Total											
North Dakota	Grain		Grain		0	\$150 for either grower or processor + \$25/ac	Approved University	27	2	1	0			
	Fiber		Fiber		5									
	CBD		CBD		0									
	Total	2,800	Total											
Oklahoma	Grain		Information not available			\$500 application fee + \$5/acre + \$500/location fee + \$.33/sqft (if applicable) + \$35/hr inspection fee + actual cost of THC testing; \$100 seed dealer license fee	Approved	28	PT	N/A	N/A			
	Fiber													
	CBD													
	GH	SQ FT												
	Total	63,000												
	Cert seed acres	447												
Oregon	Grain		Grain			\$1,300 grower participation fee + actual cost of THC testing; \$1,300 processor fees; \$120 seed dealer fee	Approved	584	FT	2	5			
	Fiber		Fiber											
	CBD		CBD											
	Total	11,754	Total		212									

Table 1

Hemp Acreage and Participation Reported by State Pilot Programs, 2018—continued

State	2018 Area by Type and Intended Use		Number of Processors				2018 Range of Fees	Number of Approved Applicants		Number of Employees in State's Program ²	
	Grain	Fiber	Grain	Fiber	CBD	Total		Approved	University	FT	PT (FTE)
Pennsylvania			1	0	2	3	\$250 application + \$2,000 participation fee + \$150 each for 1st and 2nd THC test if applicable + \$100 site modification fee	Approved	University	35	2
		585								3	1
		18,000									
		11									
South Carolina			0	1	1	2	\$50 app + \$400 permit for growers; \$100 app + \$3,000 license for processors	Approved		20	N/A
											N/A
		1,600									
Tennessee			Information not available				Grower application fee \$250 + \$35/hr for field inspections + \$175 THC testing + \$2/acre; processor fee \$250 University	Approved	3	226	0
										PT	2
		1,034								(FTE)	
Vermont			1	2	20		\$25 application fee + \$120 for 1st THC testing + Seed dealer fees based on tonnage	Approved	University	461	0
										1	1.5
		3,290									
Virginia			0	20	0	20	\$45	Approved	University	85	0
										85	0
		135									

Table 1

Hemp Acreage and Participation Reported by State Pilot Programs, 2018—continued

State	2018 Area by Type and Intended Use		Number of Processors		2018 Range of Fees	Number of Approved Applicants		Number of Employees in State's Program ²				
	Grain	Fiber	Grain	Fiber		Approved	University	FT	PT (FTE)			
Washington	CBD		0	9	\$450 each for grower or processor/marketer application; \$800 for combination (grower/processor/marketer license) application +\$300 licensee fee (for all) +\$200 inspection+ mileage fee + time fee. THC testing \$200-\$2,000	11		0	0			
	Total	142		0								
	Grain											
	Fiber											
West Virginia	Grain				\$100+\$/ac + inspection \$35/hr plus driving time; \$150 per THC test per sample	46	Approved	2	2			
	Fiber						University	1	1	1		
	CBD											
	Total	155										
Wisconsin	Grain		Grain	small #	Application fee: 0-30 acres=\$150; 31-199acres=\$5/acre; 200ac+=\$1,000 + \$350 grower participation fee + \$250 each for 1st and second THC test; \$100 processor fee; \$50 site modification fee (plus any acreages fee changes); change of farm manager fee = \$15 (to cover cost on new background check)	247	Approved	0	0			
	Fiber		Fiber	small #								
	CBD		CBD	100								
	Total	1,700	Total	100+								
	GH											
	SQ											
	FT											
	NA											

Note: CBD = cannabidiol; PT = part time; FT = full time; FTE = full time equivalent; GH = greenhouse; SQ FT = square feet; THC = tetrahydrocannabinol; NA = Not available.

¹Colorado used the terminology "registrants" to refer to the individuals or entities who applied to grow hemp and "registrations" to refer to sites (i.e. land areas) covered by the license. There could be multiple registrations for each registrant.

²States defined staff participation differently. In some cases, only a portion of a "full-time" employee was assigned to the hemp pilot program. In other cases, multiple "part-time" employees were assigned to the hemp pilot program and were aggregated to a full time equivalent (FTE) reported number.

³Approved is the number of licenses approved.

⁴University is the number of universities with approved licenses.

⁵THC is delta-9 tetrahydrocannabinol.

Source: USDA, Economic Research Service calculations based on data reported by State pilot programs. Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports.

Support and Management

States adopted a variety of approaches to support and manage their hemp pilot programs (Table 2). All States with pilot programs ultimately charged fees to cover at least a proportion of program costs, although fee schedules varied widely, and some States did not begin charging until 2018 or 2019. Some States charged a single fee per application, while others charged by per planted or intended planted acre. Fees often varied significantly between producers, processors, and brokers, as some (but not all) States included different categories of licensees.

Table 2

State pilot program support and management characteristics

	Program Similarities	Program Differences
Support	Fees to Cover Program Costs	Fee Schedule
	Small Staff	University Extension
Management	THC Testing Required	THC Sampling, Testing Procedures, and Costs
	Background Checks	Stakeholder Engagement
	GPS Field Locations	Seed Source Requirements
	Annual Reports	Detail of Data Collected

Note: THC = delta-9 tetrahydrocannabinol. GPS = Global Positioning System.

Source: USDA, Economic Research Service compilation.

Most States had fewer than five people to implement and oversee the pilot programs. Even by 2018 as the number of applications increased, program support staff remained small (Table 3). Partly because of the plethora of optimistic speculative market analysis for hemp, many potential growers were new to agricultural production. Existing staff with expertise in addressing stakeholder needs for conventional crops were not as familiar with the rapidly changing economic, agronomic, and legal issues involved with growing hemp and reliable consistent information was not readily available. Most States did not necessarily have the resources to expand staff numbers and capabilities, even as hemp production rapidly increased. At levels of production in the thousands of acres per State at most, the cost for additional staff dedicated to industrial hemp may be difficult to justify. However, this creates challenges in supporting a new industry with elevated regulatory and reporting standards. Additional support was provided by university Extension services in some States, while others did not have these resources available during the pilot programs.¹²

Table 3

Average staff responsibility for hemp pilot program in States with reported data

	Coverage per Staff Person		
	Average	Minimum	Maximum
Production			
Field Acres (n=17)	2,479	4.2	22,000
Greenhouse Square Ft (n=8)	203,514	1,000	1,368,149
Processor Number (n=13)	12.6	0.5	30.3

Source: USDA, Economic Research Service calculations based on data reported by State pilot programs, 2018.

¹²University extension programs have been developing additional resources as interest in hemp grows. For example, Cornell is offering a Plant and Soil Science degree in hemp and Vermont is offering a medical degree in hemp. Indiana and Kentucky both have recently hired a dedicated staff person and Oregon has a global hemp center. Oregon and Kentucky both have hemp work groups.

Management of the pilot program components varied widely. In the pilot programs, product testing was required by all States to help producers show that the THC (delta-9 tetrahydrocannabinol) content met the legal definition of industrial hemp. Hemp is unlike other crops because of the requirements for background checks, coordination with law enforcement, and THC sampling and testing. THC content can vary widely depending on which part of the plant is selected for testing and when in the plant life cycle it is tested. For example, THC is concentrated in the flowering portion of a hemp plant. In some cases, States provided the testing with or without a separate fee. Other States required certified testing by third parties. Testing methods, standards, and costs varied widely which added uncertainty and could lead incentives for growing and/or processing hemp to vary between States.

The Hemp Industry Association established voluntary process control standards for hemp producers and for verifying THC content in 2019, but the guidelines were not in place during the pilot programs (U.S. Hemp Authority, 2019). The American Society for Testing and Materials has a cannabis standards committee, but the standards themselves were still under development and not available for the pilot programs (ASTM, 2017).

Most States required background checks for producers and required producers to provide Global Positioning System location information on their hemp fields and submit to audits or spot checks of the crop.¹³ Some States established advisory boards or commissions to promote industrial hemp. Engaging stakeholders through boards or commissions provided useful input and could supplement State support staff, but also required time and resources to convene and manage. All States produced annual reports, although the level of data collected, detail provided, and accessibility varied widely.¹⁴

Challenges

Overall, the hemp pilot programs were successful in restarting production of a crop that had not been grown in the United States for decades. However, some challenges became apparent: establishing State legislation that allowed hemp to be grown or cultivated; acquiring critical production inputs (e. g. seeds, insecticides, herbicides) and credit; inconsistency between State requirements; and lack of basic data and information for decision-making.

A few States had strong political consensus to pass hemp legislation on the first attempt, but in other cases hemp legislation failed repeatedly, typically because of law enforcement concerns or lack of public support. Colorado and Kentucky are two examples of States that included law enforcement stakeholders early when establishing their pilot programs. This allowed an early basis for dialogue and shared knowledge. The State pilot programs were very responsive to law enforcement concerns, and staff were available to answer questions about legal rights to grow and/or process hemp. After 2014, most States used Kentucky or Colorado's legislation and administrative procedures as a template, with local variations.

¹³These requirements are not unique to hemp. Field locations and spot checks are typical requirements by State departments of agriculture and USDA agencies to demonstrate program eligibility and environmental compliance for other existing field crops. Coordination with law enforcement and background checks are unique requirements for hemp.

¹⁴Some, but not all, reports are accessible through State websites. For more information, see Executive Summary on how this report was conducted.

Access to adequate quantities of viable seed was a challenge for many pilot programs because of legal challenges for procurement, availability of appropriate strains, and lack of transparent, reliable identification about seed characteristics. There is no systematic source of data on the origin of hemp seed planted in the United States. (Federal Register, 2019b). During the pilot programs, viable hemp seeds were still subject to U.S. Drug Enforcement Agency (DEA) permitting requirements. Marijuana and hemp are the same species of plant, *Cannabis sativa L.*, and cannot be distinguished by visual inspection or smell. State legislatures had to balance promoting a new crop with law enforcement concerns.¹⁵ This issue was not resolved until 2016 though a “Statement of Principles” on industrial hemp from the U.S. Drug Enforcement Agency, the U.S. Department of Agriculture, and the U.S. Food and Drug Administration (Federal Register, 2016). Imported seeds were still subject to DEA restrictions until 2018 when industrial hemp was legally removed from the definition of marijuana in the Controlled Substances Act.¹⁶

With multiple end-uses for hemp, some strains are better suited for particular products.¹⁷ For example, strains developed for cannabidiol (CBD) oil use produce shorter plants that are not well suited for fiber end products, while strains bred for fiber use produce tall plants that are poorly suited for CBD oil or grain. There are significant information gaps about the characteristics of various cultivars. Commercial plant breeding programs have mainly focused on hemp fiber, seed, or grain production over the past 50 years. Hybrid strains developed outside a commercial plant breeding program may not produce consistent results and mainly focus on high THC marijuana. During the pilot programs, there was relatively little agronomy research to develop varieties with consistently high CBD and low THC content optimal for oil production. As hemp product markets develop, a profit incentive may form to develop strains high in CBD oil and plant breeders will likely respond in time.

Even when strains are available for a specific end use, it can be hard for a grower to distinguish between them without consistent, standardized identification and/or clear labelling. Some companies did offer strains claiming high CBD content, but there was no centralized certification organization to verify those claims during the pilot phase. At times, producers found out that the strain selected did not meet CBD content or other performance claims only after planting the seed or testing for THC. In particular, seeds sold as all female for CBD production sometimes turned out to not be female or testing was so limited that claims could not be verified or lacked meaning.¹⁸ Since 2016, Colorado and Montana have had State programs for certifying hemp strains (Colorado Department of Agriculture, 2018; Montana Department of Agriculture, 2019a). Voluntary standards groups, particularly the American Society for Testing and Materials, are starting to address certification and testing issues.

¹⁵In 2014, U.S. Customs confiscated Italian hemp seed shipments destined for Kentucky because they were considered viable cannabis seeds without the U.S. Drug Enforcement Agency permit required by the Controlled Substances Import and Export Act. Kentucky sued in court to get the seeds back. (Kentucky Department of Agriculture vs. DEA, U.S. Customs and Border Protection, U.S. Justice Department, and Eric Holder, May 2014.) In April 2019, USDA’s Agricultural Marketing Service and Animal and Plant Health Inspection Service issued a joint statement detailing requirements for hemp seed imports (USDA AMS, 2019b).

¹⁶U.S. Drug Enforcement Agency and U.S. Food and Drug Administration regulatory authorities were not changed by the 2014 Farm Bill definition of industrial hemp.

¹⁷For discussion of hemp products, see Appendix C: Uses of Hemp.

¹⁸Only female flowers produce the cannabinoids used for CBD oil.

During the period of the pilot programs, there were no pesticides registered with the Environmental Protection Agency for use on cannabis, either for hemp or marijuana. As of 2019, there were still no pesticides recognized as safe for use on hemp under the Federal Insecticide, Fungicide, and Rodenticide Act. Some pesticide manufacturers applied to add hemp to the authorized uses for existing pesticide registrations in cases where the Environmental Protection Agency previously determined the residues will be safe under any reasonably foreseeable circumstances and established tolerance exemptions for those residues in or on all raw agricultural or food commodities (Federal Register 2019a).¹⁹ The Colorado Department of Agriculture has a list of pesticides approved for use on cannabis in that State, which has been available since 2016 (Colorado Department of Agriculture, 2016). Montana has similar guidance on pesticides for use on hemp (Montana Department of Agriculture, 2018).

Likewise, as of November 2019, there were no herbicides explicitly registered for use on hemp. Hemp for fiber is grown in high-density plantings that will typically shade out weeds. However, hemp for oil extracts or grain is grown in rows with wider spacing where weeds can become a problem. In parts of the Midwest where hemp was grown during WWII, volunteer hemp (i.e., ditch weed) is itself a relatively common weed. One study in Kentucky evaluated current herbicides for suitability for hemp, but more research is required in different areas with different cultivars of hemp to produce definitive results (Maxwell, 2016). In areas where hemp or marijuana was grown historically, there may be wild plants or illegal plantings that can crossbreed with planted hemp, causing problems with seed quality and THC content.

During the pilot program, access to credit markets was a challenge for many hemp producers and processors. Traditional banks were reluctant to lend on the crop itself as they saw it as too risky. Producers who did secure financing often had to rely on equity in their operations in contrast to having the hemp crop stand as collateral for a loan. Many processors rely on venture capital for their business as other sources can find the financial and regulatory risks outside of their guidelines for lending.²⁰

Variability between industrial hemp regulations across States made it challenging for processors to operate in multiple States during the pilot programs. Interstate commerce was particularly problematic, given different State hemp laws and testing procedures. For example, inconsistent testing rules for THC content can result in a crop that tests as “hemp” in one State being confiscated as “marijuana” as it travels to another State.

¹⁹As of 8/23/19 the Environmental Protection Agency had received ten applications. In December 2019, the Environmental Protection Agency approved adding hemp to the use sites of 10 pesticides. Nine of the products are biopesticides and one is a conventional pesticide.

²⁰The Secure and Fair Enforcement Banking Act of 2019 (H. R. 1595), passed by the House on September 25, 2019, generally prohibits a federal banking regulator from penalizing a depository institution for providing banking services to a legitimate marijuana-related business. On December 3, 2019 the Federal Reserve Board, the Federal Deposit Insurance Corporation, FinCEN, the Office of the Comptroller of the Currency and the Conference of State Bank Supervisors issued a statement clarifying the legal status of hemp growth and production and the relevant requirements under the Bank Secrecy Act. The statement emphasizes that banks are no longer required to file suspicious activity reports for customers solely because they are engaged in the growth or cultivation of hemp and following applicable laws and regulations. In addition, USDA, Farm Service Agency issued Notice FLP-807 on October 31, 2019 with Guidance on Making Direct and Guaranteed Loans to Hemp Producers.

An ongoing challenge for the hemp industry is the collection and sharing of basic data and information foundational to making informed production, processing, and marketing decisions. The absence of data on the size and location of growers, buyers, and competitors in this fast-developing industry was a significant challenge during the pilot programs. The programs themselves became a data source as States produced annual reports of their hemp pilot programs. The economic information that was documented focused on fees assessed by State programs on growers and processors and employment levels of the pilot programs, although detail and clarity vary significantly from State to State. Advocacy organizations also collected and published information on the growing hemp industry.²¹ The USDA, Farm Service Agency began collecting data on planted hemp acres with the 2015 crop year.²²

Beyond basic data, most agronomic and economic research on hemp is in its infancy, with more information currently published in the grey literature than peer reviewed.²³ While the grey literature can be widely accessible, it is often difficult to distinguish quality or applicability beyond a single circumstance. In the pilot programs, there was little objective information on regulatory status for CBD oil or economics available which created ongoing challenges for decision-making.

Lessons Learned

For industrial hemp, the 2014 Farm Bill was a landmark piece of legislation that reintroduced a crop that was last grown commercially in the United States in the 1950s, independent of legal issues. In most States, hemp had not been produced commercially in more than 100 years because of limited demand for food, fiber, and textile uses. The pilot programs demonstrated that, like many new industries, the pattern of establishment and expansion of industrial hemp is influenced by existing infrastructure, public sector support, relative profitability of alternative enterprises, and ultimately market development and economic returns.

Existing Infrastructure

It is not surprising that pilot program acreage was concentrated in relatively few States. As with other crops, it is likely that hemp will not be economically viable in every State. Hemp production in the pilot programs ramped up quickly in States where existing infrastructure and/or knowledge made barriers to entry relatively lower. Although 23 pilot programs reported acreage and greenhouse plantings by 2018, the emerging industry continued to be concentrated where hemp had been grown previously or in States with established medical marijuana production. Production developed more rapidly in States that had proven agronomically suited to hemp in the past, particularly Kentucky. In 1917, long before legal restrictions on growing cannabis, the USDA Yearbook reported that nearly all the hemp produced in the United States was grown in Kentucky. Kentucky continued as the major hemp producing State prior to World War II and had the advantage of many tobacco barns that were suitable for drying hemp (Oliver and Hopkins, 1951). In addition, former tobacco growers

²¹For example, Vote Hemp published data on acres beginning in 2016 (Vote Hemp, 2019).

²²During the pilot programs, growers participating in FSA programs were required to report information on their crops, including hemp. The USDA, Agricultural Marketing Service interim rule, published in October 2019, requires all hemp growers to report data to FSA on field acreage, greenhouse or indoor square footage, and intended end-use (e. g. fiber, CBD, grain, or seed) of all hemp planted.

²³Grey literature are materials and research produced by organizations outside of the traditional peer-reviewed commercial or academic publishing and distribution channels. See Appendix D: Literature Review for more information.

in Kentucky and other States had institutional knowledge associated with high-value/labor-intensive field crops and experience using migrant labor and equipment.²⁴

The pilot programs also developed more rapidly in States where they could benefit from the expertise of cannabis producers, particularly Colorado, Montana, and Oregon. States with medical marijuana already had laws and regulations in place that could be modified to address industrial hemp and experience from growing cannabis could be transferred to growing hemp. Colorado passed legislation in 2016 allowing hemp to be tested for THC content by commercial marijuana retailers (Justia US Law, 2016), which has made such testing particularly convenient and inexpensive, further contributing to the viability of Colorado's hemp industry. Colorado was among the first States to legalize medical marijuana sales and production. In the longer term, competition for investment capital and acreage between hemp and marijuana may ultimately be more of an issue.

Public Sector Support

Public sector support is one avenue to help overcome barriers to entry where they do exist. Pilot programs that were able to plant for the 2014 crop year had strong State government support for hemp production, and existing university research. Companies involved in legal hemp or cannabis production in Canada invested in processors in Colorado and Kentucky, contributing to the size of the pilot programs in these States and the longer term economic viability of commercial production. Various State governments have also invested in promoting hemp, which may contribute to economic viability. This has especially been the case in Kentucky and the Pacific Northwest with investment in research and development of new uses and products.

Other States that did not have historic hemp production have provided significant funding to help promote recent production within the State. For example, in 2017, the State of New York announced \$10 million in grant funding to support the hemp industry. This funding was split into two \$5 million components with the first to support research and production of hemp and the second to provide capital grants that eligible companies can use to advance hemp processing within the State.

Relative Enterprise Profitability

Even if barriers to entry are low, growers are not likely to plant or process hemp if more profitable options exist. States that moved quickly to establish pilot programs were not leading producers of competing major field crops, such as wheat, corn, cotton, or soybeans. Agronomic and/or economic limitations on these alternatives may encourage producers towards faster consideration of hemp production. In contrast, the Corn Belt States that did produce hemp during WWII, including Illinois and Minnesota, had much smaller and later pilot programs while Iowa did not have a pilot program at all.

Conventional field crops, both major and minor, exhibit relatively low switching costs, allowing producers to move between crops planted from one year to the next based on several factors, including seed and fertilizer costs, land rental prices, labor costs, and the expected value of production. Switching from established field crops into a new minor crop-like hemp is unlikely in the short run because of the difficulty of achieving economies of scale for input supplies, harvesting and

²⁴Hemp may also be a good fit for hops or vegetable growers. For example, Oregon has been identified as a location where hemp could be used to spread the costs of existing infrastructure used for harvest and drying of hops (Nesin, 2019). Tennessee identified vegetable grower experience with migrant labor as an advantage for growers in that State.

planting equipment, and processing. Production variability over time in minor crops is often greater as growers are opportunistic in these markets and use them to fill gaps.²⁵

Specialty and minor crops are often agronomically suited to a limited geographic area or economically viable in only a few States. Typically, regional production has centered around a limited number of processing plants or contracting companies.²⁶ Many specialty or minor crops have no cash or “spot” market and are only grown by growers who have contracts (formal or informal) with processing companies. Growing a specialty or minor crop without a contracted buyer can be financially risky if there is not an established alternative cash market.²⁷ Producers selling their commodity into a thin market can be disadvantaged from a lack of price transparency needed for decision-making and risk reduction, and from a lack of alternative buyers. Although still early, the emerging hemp industry has somewhat followed the pattern of established field crops, where economic viability is concentrated in a region near the contracting and processing companies, and where the revenue per acre is competitive with alternative crops. International cannabis and hemp companies have made significant investments in processing facilities in several States.

Outside of the historic production areas, States primarily focused on intensive greenhouse operations for hemp, specializing in CBD oil production or other hemp extracts. CBD oil is harvested mainly from the flowering portion of the hemp, so short varieties specialized for greenhouse growing are preferred to taller varieties developed for fiber uses. Some of the greenhouse production is for growing seedlings, clones, and seeds, rather than for growing the plants from seed to harvest. The agronomic and economic viability of greenhouse-grown hemp offers possibilities to expand the industry geographically, because of the widespread availability of commercial greenhouses and greenhouse equipment for specialty crops.

Market Development

Ultimately, the relative profitability of hemp and hemp products will shift as these industries develop and mature. As an industry originates, there are typically relatively few producers or consumers with high startup costs including initial investments and research (i.e., infant industry). Production and pricing uncertainty and risk are high and rapid turn-over is often observed. The early pilot program years represented such a phase for U.S. hemp. As an industry transitions into the growth stage, there is an influx of consumers who expand demand even as producers continue to expand supply, with potential to add more volatility in the markets. There can be periods with both increasing supplies and rising prices that attract new producers. Prices can then fall rapidly as capacity expands. Prices of hemp products are likely to change if commercial production increases under the 2018 Farm Bill. The growth stage is eventually followed by a period of market consolidation and maturity where

²⁵For example, U.S. production of mustard and safflower (two minor crops) has been highly variable, dropping when soybean and wheat prices are high or stocks from the previous year are ample, and has never expanded outside a few States.

²⁶For example, U.S. sesame growers reported about 140,000 acres to the USDA, Farm Service Agency in 2019 (as of December 2, 2019), which makes the crop a similar size to industrial hemp in 2019. Sesame is produced in the United States under contract to one or two companies each year and is primarily grown in Texas and Oklahoma, where the potential yield is highest and therefore revenue per acre can be competitive with wheat and cotton. Although sesame can be grown in other States, the revenue per acre compared to other crops is not necessarily competitive. Companies that contract for sesame do not offer contracts in every State.

²⁷For example, crambe (a minor oilseed) production in the United States dropped to zero when there were no longer any processors to purchase the crop.

industry leaders emerge, and the expansion rate of the industry slows. Prices tend to stabilize and the more typical inverse relationship between increasing supplies and decreasing price is observed.

Hemp product markets are at different stages of development. Oil extracts are attracting heightened interest from potential producers and investors compared with other hemp products, and CBD oil is currently estimated to generate much higher profits per acre than other hemp products. Regulatory status of CBD oil and other extracts is still evolving, which adds to the market uncertainty. A CBD product called Epidiolex is licensed by the U. S. Food and Drug Administration as a drug (Devinsky et al., 2014). This means that CBD oil cannot legally be sold as a dietary supplement, per the Federal Food, Drug and Cosmetic Act. The U.S. Food and Drug Administration has issued warning notices to companies attempting to sell CBD oil as a nutritional supplement or making claims about its efficacy for treating a variety of diseases.²⁸

During the pilot programs, the market for fiber was uncertain. There have been large-scale investments in fiber processing facilities, but buyers are not available in all regions and transportation costs limited profitability for fiber where margins were thin. The equipment used for processing hemp fiber is unique within the fiber industry and there are few, if any, domestic equipment producers. U.S. fiber processors must engineer their equipment or import from Europe or China.

Competing suppliers of imported fiber are readily available. The United States was importing hemp fiber, in both raw and processed forms, for some end uses even when domestic production was not allowed (Figure 4). It is not yet known if U.S. fiber will be able to compete with imports in the long run or if additional end uses will expand demand for hemp fiber as supplies increase. Since 2014 fiber imports have shifted towards processed forms with Europe emerging as a major supplier to the United States (Figure 5).

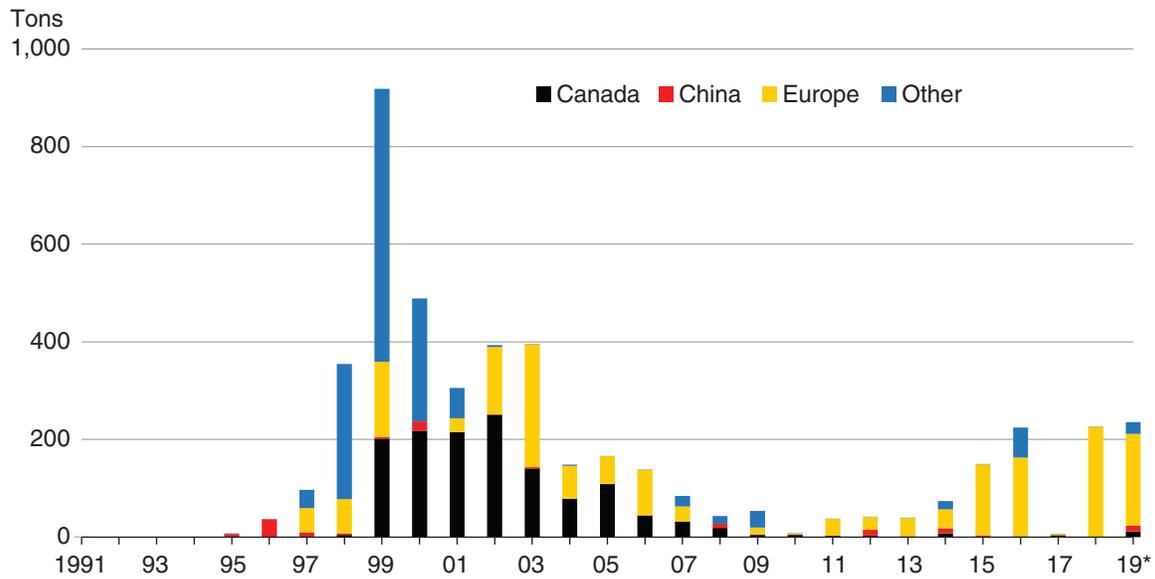
As a joint product with oil production, changes in domestic and international fiber output will be influenced by the growing demand for CBD oil. Some producers may have planned to grow hemp for CBD oil or other extracts and also profit from selling the residual fiber, much as cotton producers sell both the cotton lint and the cotton seed. But negative returns to fiber could offset profits from oil, and there were few examples of dual use reported as markets developed during the pilot programs.

Economic Returns

While the pilot programs provided experience in growing and processing hemp and alternative hemp products, information on economic returns remains difficult to ascertain. Even during the pilot programs, producers, processors, and lawmakers struggled to find sound information on the economic returns to hemp production. The pilot programs themselves became a source of information, but systematic data collection on production, prices, or sales was not required.

²⁸The U.S. Food and Drug Administration is evaluating the regulatory frameworks that apply to certain cannabis-derived products that are intended for non-drug uses, including whether and/or how the U.S. Food and Drug Administration might consider updating its regulations, as well as whether potential legislation might be appropriate (U.S. Food and Drug Administration, 2019).

Figure 4
U.S. imports of raw hemp, 1991-2019

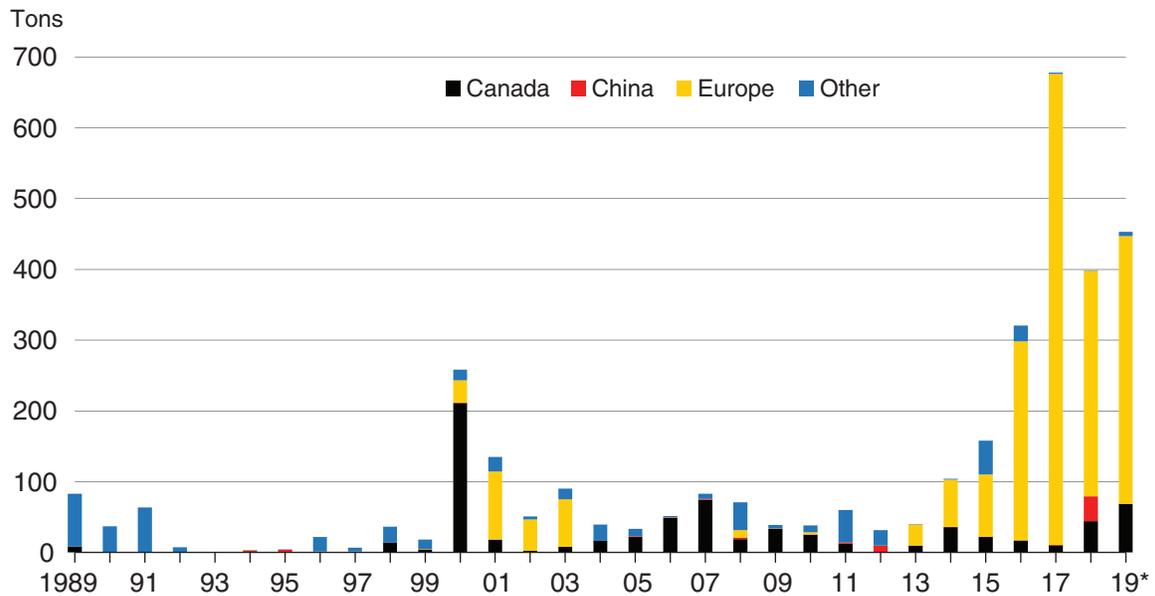


Note: HS code 5302100000 True hemp (*Cannabis sativa* L.), raw or processed but not spun; tow and waste of true hemp (including yarn waste and garnetted stock).

*2019 is a partial year, January-September.

Source: USDA, Economic Research Service calculations using data from U.S. Department of Commerce, Bureau of Census.

Figure 5
U.S. imports of processed hemp, 1989-2019



Note: HS code 5302900000 True hemp, processed, not spun, tow and yarn waste other.

*2019 is a partial year, January-September.

Source: USDA, Economic Research Service calculations using data from U.S. Department of Commerce, Bureau of Census.

There were no enterprise budgets available in 2014 when the first pilot programs began and, as of late 2019, still no publicly reported price information. Transparent, accurate price reporting and forecasting are critical for well-functioning markets. They are often provided as a public good through a government source. Without such basic data being available, there is no benchmark for privately negotiated prices, which may or may not be reputable or available to all growers. During the pilot programs, there was no Federal data collection on hemp production, other than the USDA, Farm Service Agency acreage reporting beginning in 2015. As the State programs developed, some information slowly became more available. As of 2019, budgets were available for Kentucky, New York, Tennessee, Pennsylvania, and North Dakota for hemp production. The available budgets reflect projections under limited assumptions and much market uncertainty and should be used with caution for investment decisions.

Hemp production budgets from the University of Kentucky show modest returns for grain, negative returns for fiber, and large returns above variable costs for CBD oil (Shepherd and Mark, 2019). Typically, the producer plants a hemp strain suitable for producing either oil extracts or fiber, making a mid-season transition in output product difficult if not impossible as a viable market strategy. These budgets are specific to Kentucky but can be modified for other States. Even within Kentucky, every line of the budget can be tailored to be specific for a particular operation. Prices are highly variable and subject to continuous change along with future technology developments in the genetics, production tools, and processing techniques.

Tennessee, Pennsylvania, North Dakota, and New York also have production budgets available in 2019, but these budgets were not available for most of the pilot phase. The University of Tennessee has a production budget for CBD oil that shows a positive return per acre based on the assumptions used (Cui and Smith, 2019). The budget assumes that the price received is \$1.50 per percent CBD per pound of material and notes that labor costs included are likely lower than what some researchers are observing. University of Tennessee budgets for other hemp products are currently not available.

Pennsylvania State University has budgets for grain and fiber that show potentially modest returns per acre compared with conventional crops (Harper et al., 2019). These budgets highlight variability in returns, the potential erosion of profits through transportation expenses to processors, and the importance of the initial planting decision to grow for either seed or fiber. The Pennsylvania State University hemp budgets explicitly include the need to till the soil for weed control because of the lack of approved pesticides and incorporate the cost of a cover crop to minimize erosion caused by this tillage.

Moving Beyond the Pilot Programs

The U.S. hemp industry is developing quickly after a long hiatus. The Agricultural Improvement Act of 2018 (Public Law 115-334) (the 2018 Farm Bill) addressed many of the challenges identified in the pilot programs or authorized forthcoming regulations to address them. Acreage expanded rapidly between 2018 and 2019 with the USDA, Farm Service Agency reporting 146,065 planted acres in 2019; acreage estimates from private advocacy organization sources such as Vote Hemp showed a similar magnitude of increase in licensed and harvested acres.²⁹ Some major agricultural States that had not previously grown hemp under the pilot programs, including Arizona, Arkansas, California, Florida, Georgia, Kansas, and Nebraska, began production in 2019. With the recently released USDA, Agricultural Marketing Service interim regulations, the 2020 crop may be larger still. While production is expanding, the industrial hemp industry still faces challenges in transitioning from the pilot programs to a mature industry with economically viable, sustainable commercial production.

2018 Farm Bill

The 2018 Farm Bill made further amendments to U.S. narcotics control laws to define hemp and hemp products, added hemp to crop insurance laws, authorized USDA to develop regulations to produce commercial hemp, and legalized the production of hemp outside the pilot projects.³⁰

Here are relevant sections of the Farm Bill:

- Section 12619 removes hemp from the Controlled Substances Act definition of marijuana. Removing hemp from the Controlled Substances Act and further defining hemp to include derivative products were critical steps in allowing commercial production of hemp outside of carefully defined pilot programs.
- Section 7129 of the 2018 Farm Bill adds hemp to the list of alternative crops regulated by USDA.
- Section 7501 adds hemp as a critical agricultural material, which allows USDA to fund hemp research, within the requirements set by the farm bills and the (then) forthcoming AMS regulations (USDA, National Institute of Food and Agriculture, 2019).³¹
- Section 10113 has an additional, expanded definition of hemp as “the plant *Cannabis sativa* L. and any part of that plant, including the seeds thereof and all derivatives, extracts, cannabinoids, isomers, acids, salts, and salts of isomers, whether growing or not, with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis.” The reference to “derivatives, extracts, cannabinoids” is particularly relevant for the CBD sector.
- Section 10114 addresses interstate commerce of hemp.

²⁹Some estimates are as high as 500,000 acres licensed for 2019 (Vote Hemp) or as much as 1,000,000 acres projected to be planted by 2022 (New Frontier).

³⁰For the full text of these sections of the 2018 Farm Bill, as well as relevant earlier legislation, please see Appendix E: Selected Legislation Relevant to Hemp.

³¹USDA published its interim final rule establishing a domestic hemp production program on October 31, 2019.

- Section 10113 amended the Agricultural Marketing Act of 1946 by adding subtitle G (sections 297A through 297D of the Agricultural Marketing Act).
- Section 297B of the Agricultural Marketing Act requires the Secretary of Agriculture (Secretary) to evaluate and approve or disapprove State or Tribal plans regulating the production of hemp.
- Section 297C of the Agricultural Marketing Act requires the Secretary to establish a Federal plan for producers in States and territories of Indian Tribes not covered by plans approved under section 297B.
- Lastly, section 297D of the Agricultural Marketing Act requires the Secretary to promulgate regulations and guidelines relating to the production of hemp, including sections 297B and 297C, in consultation with the U.S. Attorney General.

No State or Tribal production plans could be approved until the 2018 Farm Bill implementing regulations were published and effective (USDA, AMS, 2019a). Some States and Tribes submitted production plans to the USDA prior to the interim rule in order to have them ready for review as soon as the Agricultural Marketing Service regulations were available; for example, Montana and Kentucky rapidly made their plans public (Montana Department of Agriculture, 2019b; Ag News 2018).³² Until the Agricultural Marketing Service regulations were published, and State and Tribal plans in conformance with those regulations are approved by the U.S. Department of Agriculture, hemp production is still subject to the requirements in the 2014 Farm Bill. The 2014 Farm Bill provisions remain in effect for 12 months after the interim rule was published. Under the 2018 Farm Bill, to be approved, a State or Tribal production plan is required to include the following:

- a system to maintain relevant information regarding land on which hemp is produced in the State or territory of the Indian Tribe, including a legal description of the land, for a period of not less than 3 calendar years;
- a procedure for testing THC levels of hemp produced in the State or territory of the Indian Tribe;
- a procedure for the effective disposal of plants that are produced in violation of the THC thresholds, and products derived from those plants;
- a procedure to comply with the enforcement procedures required by the Farm Bill;
- a procedure for conducting annual inspections of, at a minimum, a random sample of hemp producers to verify that hemp is not produced in violation of Farm Bill requirements;
- a procedure for submitting required information to USDA in a timely way (including acreage planted, harvested, and disposed); and
- a certification that the State or Indian Tribe has the resources and personnel to carry out the practices and procedures described.

³²Twenty draft production plans were received by the USDA, Agricultural Marketing Service for subsequent review prior to interim regulation being released in October 2019. On December 27, 2019 USDA announced that 3 State and 3 Tribal plans had been approved. The USDA, Agricultural Marketing Service maintains updates on the status of State and Tribal hemp production plans for USDA approval on their website.

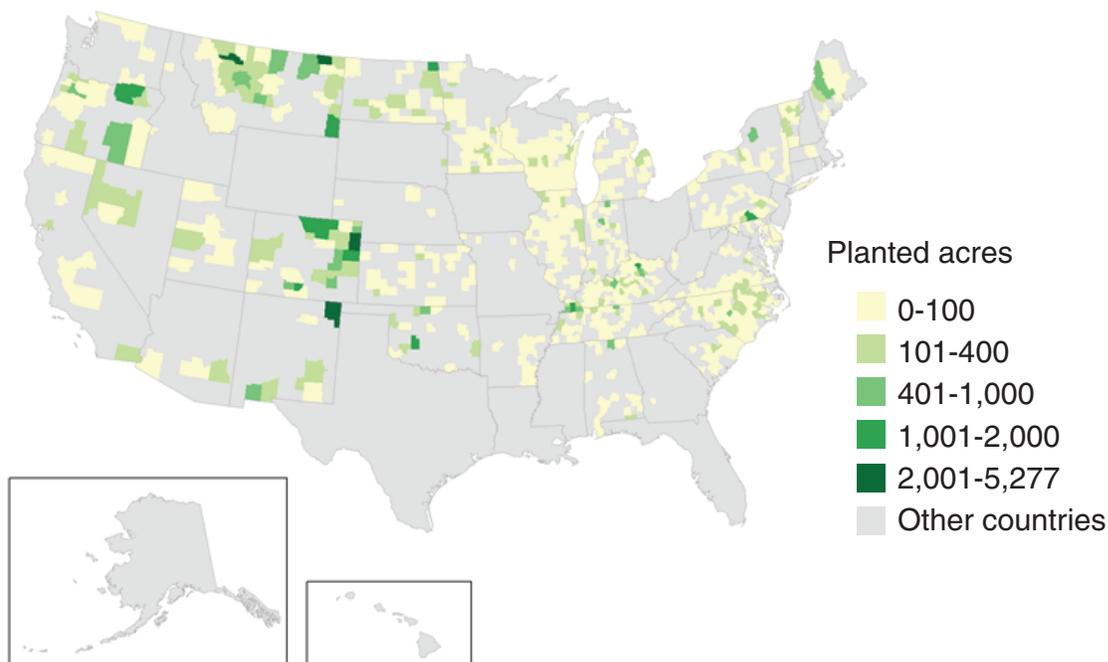
Hemp Beyond 2018

Moving beyond the pilot programs in 2018, interest in hemp production grew rapidly in 2019 (Figure 6). For example, the number of approved producer applications in Kentucky increased from 210 in 2018 to 978 in 2019. Hemp acreage reported to the USDA, Farm Service Agency increased from 32,464 acres in 2018 to 146,065 in 2019.³³ By mid-2019, 47 States had passed legislation to allow some form of hemp production. Only Idaho, Mississippi, and South Dakota did not have legislation in place. While not every State with legislation was ready to submit a production plan to the USDA under the 2018 Farm Bill, producers could still grow hemp under provisions of the 2014 Farm Bill for 12 months after the new regulations were issued.

Hemp production may expand even more rapidly in 2020 as the regulatory environment becomes more stable and if farmers face depressed market outlook for other commodities. On October 31, 2019, the USDA, Agricultural Marketing Service released for comment an interim rule for the Establishment of a Domestic Hemp Program (Federal Register, 2019b). After reviewing and evaluating the comments, the USDA will draft and publish a final rule within 2 years. Under the interim rule, hemp producers must operate under an approved plan: either the USDA or a USDA-approved State or Tribe plan. The USDA, Agricultural Marketing Service rule includes provisions for maintaining information on the land where hemp is produced, testing the levels of THC, disposing of plants not meeting necessary requirements, licensing requirements, and ensuring compliance. The USDA has also made public procedures for sampling and testing hemp material.

Figure 6

Industrial hemp production density at the county level, 2019



Data as of December 2019.

Source: U.S. Department of Agriculture, Farm Service Agency.

³³To provide context, crops with similar acreage reported to FSA in 2019 (as of December 2, 2019) include safflower (142,090 acres), sweet potatoes (145,439 acres), flue-cured tobacco (149,157 acres), and Extra Long Staple (ELS) cotton (161,021 acres).

Global Context for Hemp

While the reintroduction of hemp production in the United States is relatively recent, hemp production has already been legal in other parts of the world. Global production was small and relatively stable until the recent worldwide interest in CBD oil. Hemp competes for acreage with locally and regionally important food and feed crops, but is still not currently considered a major crop in any country or region of the world.³⁴ There is some demand for hemp as a sustainable natural fiber, hemp seeds and protein as a food ingredient, and hemp extracts for cosmetics and food, but CBD oil has been the primary source of demand growth.

Canada, Europe, and China are major foreign hemp-producing regions and potentially formidable competitors for an emerging U.S. industry because they have several decades or more of additional agronomic and marketing experience.³⁵ Canada and the European Union also have decades of regulatory stability and investor knowledge of the industry. Along with the United States, Canadian and European Union hemp industries face competition from low-cost suppliers in Eastern Europe and China. Those regions could potentially expand exports quickly if the demand for CBD oil proves to be long lasting and local regulatory regimes are supportive.

Canada

Canada is perhaps the most relevant analog for the U.S. hemp industry and may prove to be a tough competitor moving forward. Canada's modern hemp industry has developed following a similar legislative and policy path as the U.S. industry, but it began 20 years earlier. In 1994, the Canadian government offered experimental research licenses for hemp production. In 1998, commercial production became legal in Canada with grower licenses and other regulatory provisions covering production, processing, transporting, delivery, sale, and trade provided by Health Canada.

During early years of commercial production, the Canadian hemp industry experienced considerable production volatility. Acreage and prices fluctuated widely during the 1990s once research licenses were available. Planted acres in Canada were often far less than licensed acres. Early hemp growers and processors found that the market demand was unknown, and expansion was not as fast as initially predicted. Markets were affected by speculative demand, competition from other crops, and changes in U.S. import rules for hemp-related products.³⁶

Like growers in the U.S. pilot programs, many Canadian growers took risks in growing a crop without a contracted buyer. Those who grew hemp without a contract sometimes found no established market for their output, resulting in price declines and reduced acreage the following year. An early hemp contracting company in Canada shut down after only a few years, leaving additional producers with no buyer for their crop. Canada was able to benefit in the longer run from steady

³⁴Hemp has been cultivated for thousands of years, primarily in Asia and Europe, for food and textile uses. It was traditionally a competitor to flax, cotton, jute, sisal, abaca, and other natural fibers. As natural and synthetic alternative fibers became widely available after WWII, hemp production shrunk worldwide. International treaties on narcotics contributed to the decline. Hemp can be grown in many different regions, but a longer growing season is needed for grain use rather than fiber or straw use.

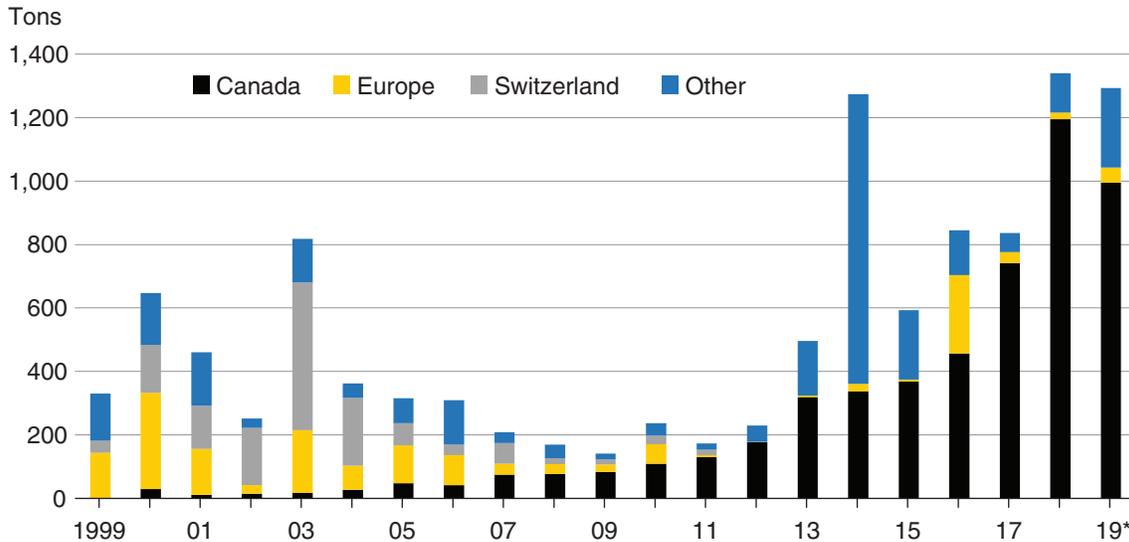
³⁵Other hemp-producing countries include Chile, Brazil, South Korea, Russia, Ukraine, and the Philippines.

³⁶In the early 2000s, the U.S. Drug Enforcement Agency published several rules banning hemp food imports with any level of THC, which disrupted imports from Canada for several years until the courts eventually resolved the issue in favor of allowing such imports (Johnson, 2018).

demand from the United States for hemp food grain, textiles, and cosmetic oils, and there are now established brands that use Canadian hemp. Current Canadian hemp production is mostly for grain and CBD as producers struggle to find profitable markets for fiber.

Canadian hemp acreage has been trending upward since 2008 with improved processing technology, research, and government financial support (Government of Alberta, 2012; 2015). There are an increasing number of Canadian businesses developing hemp products and overall growing demand including domestic and foreign demand for organic hemp for food, as well as demand for CBD oil. Canada is a major international supplier of hemp oil for the U.S. market (Figure 7).

Figure 7
U.S. imports of hemp oil, 1999-2019



Note: HS code 1515904010 Hemp oil not elsewhere specified or indicated, Whether/Not Refined Not Chemically Modified. *2019 is a partial year, January-September.

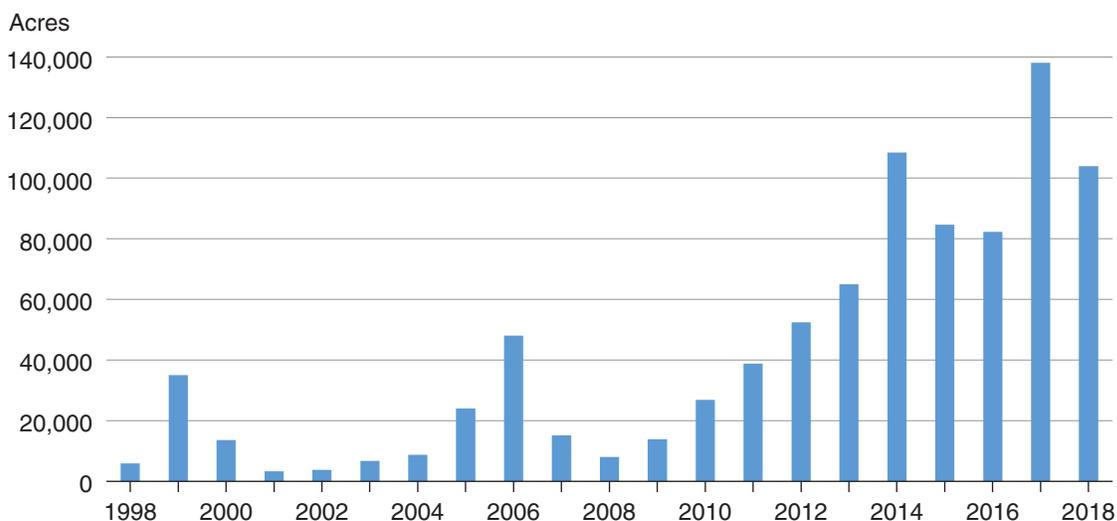
Source: USDA, Economic Research Service calculations using data from U.S. Department of Commerce, Bureau of Census.

Opportunities for hemp seed exports to the United States increased once U.S. production was allowed under the pilot programs. According to the USDA, Agricultural Marketing Service interim rule, hemp seeds can be imported into the United States from Canada if accompanied by either: (1) a phytosanitary certification from Canada’s national plant protection organization to verify the origin of the seed and confirm that no plant pests are detected; or (2) a Federal Seed Analysis Certificate (SAC, PPQ Form 925) for hemp seeds grown in Canada (Federal Register, 2019b).

Despite overall market growth, Canadian hemp production remains volatile, ranging from 80,000 acres to nearly 140,000 acres between 2014 and 2018 (Figure 8).³⁷ Planting volatility may be influenced by competition from conventional field crops; for example, Canada’s acreage of minor oilseeds is also fairly volatile year to year in response to world prices. Hemp production was expected to expand in 2019 as Health Canada reported double the number of hemp licenses (Glass, 2019). Canada recently legalized marijuana cannabis as well as marijuana edibles, oils, and extracts. The hemp regulations were modified to allow hemp producers to sell hemp to cannabis processors to make CBD oil.

³⁷Some private sector estimates are lower at 70,000 acres in 2018 including 20,000 devoted to CBD (Arnason, 2019).

Figure 8
Canadian hemp acreage 1998-2018



Source: Health Canada.

Europe

Hemp production has a long history in Europe and was an important source of canvas and rope for European navies as far back as the 1700s. The European hemp industry has remained relatively small, in part because of the high cost of specialized equipment to handle hemp fiber and limited demand for textile and food uses of hemp. France, the United Kingdom, Romania, and Hungary are among the largest producing European nations. The European Union subsidized fiber crops, including hemp, as part of the Common Agricultural Policy in the 1970s, but later phased out most of the support programs. Like trends in Canada, European hemp production is rebounding in response to expanded demand for organic seed for food consumption and the emerging demand for CBD oil products (European Industrial Hemp Association, 2015).

The European Union supplies hemp seeds globally but the allowable THC content for hemp is only 0.2 percent in most of Europe, rather than the 0.3 percent allowed in Canada and the United States. Hemp cultivars from Europe typically meet U.S. and Canadian standards for THC content, but some U.S. and Canadian cultivars have too much THC to be legally exported to Europe. A list of Canada's approved hemp cultivars includes seeds from Italy, Hungary, France, Finland, Germany, Romania, and Ukraine.

China

While the current regulatory and legal environment in China is evolving, and data sources for China's hemp production differ, it is likely China is the world's largest industrial hemp producer as of 2019 (Moon, 2019). Hemp has been grown in China for thousands of years for textile and fiber use, and many sources state it was first cultivated in China.³⁸ Much of the available industrial equipment for processing hemp is from China. As a low-cost producer with agronomic expertise, China

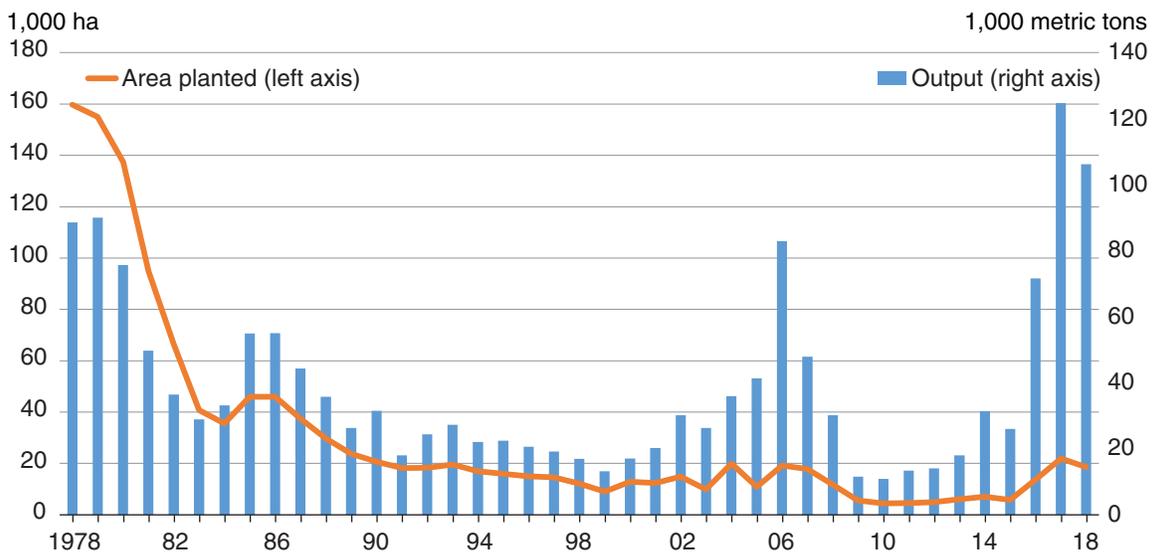
³⁸See, for example, Encyclopedia Britannica "Hemp, Description and Uses" 2019.

may be able to increase production very quickly to become a major competitor in the world hemp market.

Chinese producers face similar, if not greater, regulatory and market uncertainties than U.S. growers. Hemp production requires a license, which is only available in some provinces, and the government has sought to discourage speculation in cannabis-related stocks. Much of the existing information regarding China hemp production is either highly speculative market analysis or stern reminders about narcotics regulations. Given China’s strong anti-narcotics laws, the legal status of hemp cultivation in China is uncertain, and there is likely more production than is reported to the government.

Even with potential under-reporting, official statistics indicate that production more than doubled from 26,000 metric tons in 2015 to 125,000 metric tons in 2017. In 2018, the most recent year for which data are available from the China National Bureau of Statistics, reported production was down to 106,000 metric tons (Figure 9). Despite China’s ranking in global production, hemp is still a minor crop for China.³⁹

Figure 9
China hemp production, 1978-2018



Note: ha = hectare.

Source: China National Bureau of Statistics.

³⁹To put hemp production in context, China produced 1.8 million metric tons of barley in 2017 and 2.2 million metric tons of millet.

Economic Viability

Moving forward, economic prospects for the U.S. industrial hemp industry remain uncertain but the pilot programs revealed some influencing factors. Competition with alternative crops for acreage, global competitiveness, market transparency, and the ability to manage regulatory and market risks will determine patterns of development in the emerging U.S. hemp industry. In addition, concentration among growers, processors, and retailers will likely evolve that may affect competitive price discovery. The pilot programs highlighted the value of data and information available for growers and processors making decisions. As hemp markets grow and mature, this will be even more critical.

Competition for Acreage

Hemp is competing for acreage against commodity and specialty crops with established markets and decades of agronomic research and industry experience. Still, the farm sector as a whole is in a period of reduced income and increased pricing uncertainty which may encourage growers to plant a new crop even if risks are high (Key et al., 2019). So far, the largest hemp acreage is found in States that are not leading producers of conventional field crops such as corn, soybeans, wheat, or cotton. Some competing crops are eligible for farm program payments, including the Agriculture Risk Coverage/Price Loss Coverage programs and low-interest marketing assistance loans from the USDA, Farm Service Agency. Conventional field crops and many minor and specialty crops were eligible for the Market Facilitation Program payments in 2018 and 2019, while hemp was not. These programs provide a source of price risk protection for other crops that was not available for hemp.

States have a variety of fee structures for licensing, sampling, and/or testing THC content that could have different impacts on competitiveness among regions and/or different end uses of hemp. For example, given the current profitability levels of CBD production, higher application and licensing fees may not be a significant burden on CBD producers. However, these fees could potentially render hemp unprofitable for grain and fiber where margins are tighter or uncompetitive with other commodity crop returns. For major crops such as corn and soybeans, a profit difference of as little as a few dollars an acre can cause significant yearly shifts between crops, so even a relatively small fee could discourage hemp production if competing crops have no fee.

Hemp may compete for investment with legal marijuana in many States and Canada. While the legalization of marijuana potentially expands the pool of expertise and processing facilities, the marijuana industry also competes with hemp for growers, processors, and investors. The legalization of medical marijuana in most States and recreational marijuana in a few States and Canada has allowed marijuana processors to scale up processing. Outside investors may be attracted to the potentially larger market and profit potential for marijuana. This could ultimately help lower barriers to expansion of the domestic hemp industry, by promoting the growth of the processing industry and building expertise in production. Since hemp and marijuana are the same plant species, it complicates the legal and production issues for hemp producers for now. For example, several States are now trying to ban “smokable hemp” to address law enforcement concerns. Canada added THC testing requirements for hemp after marijuana was legalized. Marijuana can crossbreed with planted hemp or wild hemp, causing problems with seed quality and THC content for both crops.

Governments and private companies have spent billions of dollars in the last 50 years developing wheat, corn, and soybean varieties with improved yields and disease resistance. Specialty crops (i.e., fruits and vegetables) have also benefited from considerable research to improve varieties for

yield, shipping stability, taste, and disease resistance. The legal status of hemp limited such varietal improvements from occurring in any country. While strain improvement efforts are ramping up for hemp as production has expanded, they are still in the early stages and lag many other crops.

Global Competitiveness

As the hemp markets evolve, supplies could grow more quickly than demand—particularly given the rapid growth in licensed producers and planted acres—and prices may fall rapidly as some growers realized in 2019.⁴⁰ New entrants are more likely to be producers in marginal production areas, with lower yields and lower profits. Their economic viability could be less than the producers who were early movers from pilot program regions, particularly if the additional output does cause prices to fall. If some States can achieve economies of scale with regards to growing, processing, and testing, that will make it more difficult for producers in other areas to profitably enter the market.

There is growing demand for hemp extracts, including CBD oil, and may possibly be for other products in the future. If hemp for CBD or other purposes proves to be a profitable crop, competition from abroad will likely increase. Canada and Europe both have established infrastructure, management expertise, and markets. China has access to lower wage employees, unknown capacity, and the potential for more lenient regulatory standards in the future.

The current lack of input standardization and market information exacerbates risk in U.S. hemp markets. For example, there are challenges in obtaining seed that is optimized for targeted end-uses, particularly CBD oil production or other extracts. Hemp seeds react differently depending on weather and soil conditions, making hemp crop test results uncertain. Seeds developed outside a commercial plant breeding program are likely to have highly variable results. There are State-level efforts to overcome these challenges. Colorado's Department of Agriculture has a certified hemp seed program, which certifies that certain strains are appropriate for Colorado's climate and are low risk for testing over the legal limit for THC. Montana has a similar program. On a national level, there are currently no U.S. private or federally developed standards for hemp seed as there are for other commodities like corn or soybeans, so standards still need to be created and adopted to ensure well-functioning markets.⁴¹ Given the different end uses of hemp, separate standards may be needed for the different strains. Canada has a list of approved hemp cultivars (seed varieties), but all varieties are subject to THC testing.⁴² The European Union has a similar list of registered cultivars, but little information on the suitability for end uses.

Market Transparency

Transparency in both the input and hemp products markets will be important to establishing economic viability and helping producers and processors manage risk. A critical economic issue will be the level of consumer demand for hemp and hemp products and how elastic (responsive to changes in price) that demand will be in the long term. That will determine the extent to which hemp can compete for acreage, and where hemp will be economically viable. Hemp appears to be a profitable crop in some States for some uses at the current amount supplied. However, minor and

⁴⁰Prices at a November 2019 hemp auction market held in Tennessee were reportedly about 25 percent of what producers had expected as buyers were said to be disappointed in quality of the product (AgriFax, 2019).

⁴¹There are not enough data or research to establish a seed program for the U.S. market now.

⁴²There were 52 cultivars on the Canadian approved list for the 2019 growing season (Health Canada, 2019).

specialty crops, like hemp, tend to have relatively inelastic demand and relatively elastic supply as markets mature.⁴³ Development of the processing sector (i.e., availability of buyers and market access) is likely to be uneven as hemp markets evolve. Growers will need reliable current information on processor location, capacity, and pricing to make decisions about investment.

It is certainly possible that the production and/or imports of hemp for CBD will grow more rapidly than the demand, putting downward pressure on CBD prices, like what happened with the early hemp industry in Canada. It is also possible that the demand for hemp-derived products will continue to outpace increases in hemp production in the United States and globally for some time and continue to draw investment and new producers into hemp farming. Hemp for CBD offers an opportunity for higher economic returns for hemp producers, but also possesses more volatile financial and regulatory risk than markets for hemp fiber and grain. However, if supply outpaces demand and prices fall rapidly, many producers and processors could be faced with significant startup and input costs that may force them to exit the industry.

In a mature agricultural crop market, increased demand temporarily raises the price for the available supply because the supply is inelastic in the short term (the amount of production cannot increase right away). The higher price attracts new entrants to the market the following crop year, which then causes prices to fall, and eventually the market reaches an equilibrium where there is enough supply to meet demand at the stable market price.

Like other commodities, the industry structure will evolve as hemp markets develop. Growers and processors may choose to vertically integrate to manage risks and/or distinguish their products in the marketplace and develop brand labelling. Growers may choose to horizontally integrate through cooperatives to address economies of scale or other issues. Global alliances can develop over time with shared investment or other resources such as data and information.⁴⁴

In many States, the producers and processors who participated in pilot programs had more practical and current knowledge of hemp economics and production than most universities and governmental agencies. The absence of pricing transparency remains a serious impediment. While all hemp growers will be required to report acreage planted information to the USDA, Farm Service Agency under the USDA, Agricultural Marketing Service interim rule, there are no requirements to report pricing or sales data. Without access to consistently reported reliable price and production information, U.S. growers do not have the information to move beyond speculative decision-making which will create added risks and market volatility.

Risk Management

Risks are typically high as an industry develops and U.S. hemp growers and processors face market and regulatory uncertainty. Hemp is now eligible for federally subsidized crop insurance under the Whole Farm Revenue Protection policy, administered by the USDA, Risk Management Agency. It is

⁴³For example, mustard is a profitable contracted crop in certain areas of the United States and Canada, but there is only so much mustard that the world demands at any price. When there is a large carryover from the previous crop year because of a large crop or reduced trade demand, mustard prices fall and acreage drops as farmers switch to more profitable crops the following year. If mustard acreage did not shrink, prices would fall even more sharply because of relatively inelastic demand. Mustard is grown on about 750,000 acres in the U.S. and Canada, which is more than double the most optimistic estimates of current hemp acreage in North America.

⁴⁴See, for example, Yang and Burge, 2019.

also eligible for Farm Service Agency Noninsured Crop Disaster Assistance in 2020 for producers with a 2018 Farm Bill license issued by a State, Tribe, or USDA agency. Under the Whole Farm Revenue Protection policy, hemp will not qualify for replant payments. Growers will be eligible to purchase whole farm revenue protection if they have a license under a State or Tribal production plan to grow commercial industrial hemp approved by the USDA or USDA production plan and a valid marketing contract (USDA RMA, 2019). Even when insurance is available, producing hemp with THC above the compliance level will not constitute an insurable cause of loss.

Producers will still face the risk of processor financial stability and the evolving regulatory and policy environment. Many new market entrants to hemp are small and new to farming. They will compete against large, established farms that have a higher tolerance for risk and greater capital resources, as well as some crop diversification to reduce risk.

A significant risk in hemp markets is managing levels of THC. If a product tests higher than 0.3 percent THC, it cannot legally be sold or possessed for sale. Income goes to zero and additional costs for disposal and legal risks are incurred. Product standards and testing are critical sources of information and key to risk management. The American Society for Testing and Materials has several dozen voluntary standards under development for cannabis and hemp producers and processors, with participants from 25 countries involved, but interaction with Federal and State standards is not clear. Once developed, the Society's standards will reflect the needs of cannabis producers as well as hemp producers, and foreign as well as U.S. regulatory requirements. Guidelines for product testing are included in the USDA, Agricultural Marketing Service interim rule (Federal Register, 2019b). State and Tribal plans must incorporate procedures for sampling and testing hemp including timing of testing, how samples are collected, ensuring testing is completed by a Drug Enforcement Agency-registered laboratory using a reliable methodology, and how results are reported and interpreted.⁴⁵

Regulatory Environment

In addition to the core economic challenges, the regulatory environment is still evolving, both for hemp in general and separately for CBD oil and other extracts. While the 2018 Farm Bill removed some previous legal restrictions on growing industrial hemp, the FDA's authority to regulate the sale of hemp and cannabis products for food and drug use has not changed (Dabrowska and Johnson, 2019). The potentially most profitable hemp product (i.e., CBD or other oil extracts) can only legally be sold in the United States for a subset of the end uses that potential customers demand. Before food and drug use is allowed, the FDA must consider issues, such as cumulative exposure risks and long-term effects, that may require more research before issuing regulations.⁴⁶ Absent new FDA regulations, legislation could also change the status of CBD oil and reduce uncertainty about access to potentially lucrative markets. If food and nutritional supplement uses were legalized in the United States, there is a possibility that foreign competitors would immediately enter the market with ample supplies. Prices could fall sharply as a result, depending on the strength of demand, which is unknown at this time.

⁴⁵The October 2019 U.S. Department of Agriculture's Agricultural Marketing Service interim rule establishes a process to calculate a confidence level for reporting THC test results, defines the "acceptable hemp THC level," and explains how to interpret test results with the measurement of uncertainty. AMS provides USDA guidelines for sampling and testing and information on registering a testing laboratory.

⁴⁶The Food and Drug Administration has authority to issue a regulation allowing the use of such ingredients in food and dietary supplements and has stated that they are actively considering this issue (Federal Register, 2019b).

The absence of completed regulations has caused serious problems for the hemp industry. The FDA is issuing cease and desist orders to CBD oil manufacturers for making illegal health claims, and for marketing CBD as a food or drug. Idaho State police confiscated a load of industrial hemp being shipped from Oregon to Colorado in January 2019, on the grounds that since the USDA had not yet approved Oregon's production plan, it was not protected under the interstate commerce provisions of the 2018 Farm Bill. The USDA issued a legal opinion that States and Indian Tribes cannot prohibit the interstate transportation or shipment of hemp lawfully produced under the 2014 Farm Bill pilots (Vaden, 2019). The Ninth Circuit Court of Appeals (*Big Sky Scientific LLC v. Idaho State Police*) returned the case to Idaho State court. A similar case occurred in August 2019 in South Dakota, involving confiscation of a shipment of hemp from Colorado to Minnesota.

Conclusions

Overall, the pilot programs for industrial hemp authorized in the 2014 Farm Bill were successful in restarting production of a crop that had not been commercially grown in the United States for decades. Some common challenges and lessons learned in moving production beyond the pilot programs have become apparent. The 2018 Farm Bill addressed many of these challenges or authorized subsequent regulations to address them, but lack of reliable, transparent data and peer-reviewed research and market information continues to be a challenge.

While the numbers of planted acres and participants in the U.S. industrial hemp industry increased rapidly under the pilot programs, and hemp can now be grown legally in nearly every State, the long-term trends for U.S. industrial hemp are uncertain. The long-term economic viability of industrial hemp in the United States will be affected by:

- competition from conventional field crops and marijuana (in States where it is legal) for acreage,
- well-established foreign competitors for hemp product markets,
- the ability to decrease production and pricing uncertainty through transparency and risk management, and,
- continued market development.

The history of specialty crops in the United States generally shows that they remain specialty crops. It is difficult to imagine, for example, the demand for acres for industrial hemp matching the demand for acres to grow corn or soybeans for animal or human food. On the other hand, the recent rapid growth of the alternative plant protein food sector does show some possibility for a “specialty” crop to suddenly become a growing market sector. The next few years should see a resolution of the legal and regulatory issues constraining hemp production in the United States, leaving domestic production, imports, consumer demand, and exports to dictate growth and long-term market size.

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Appendix A: A Brief History of U.S. Hemp Before the 2014 Farm Bill

Hemp was grown in the United States during the Colonial era as an essential source of fiber for sailing ship rigging, ropes, and canvas. Hemp fiber, extremely strong and rot-resistant, was a strategic resource for U.S. and European navies. The invention of steam ships reduced the military and commercial shipping demand for hemp, although some uses for other textiles, paper, and rope remained. Demand for U.S.-produced hemp fell steadily through the late 1800s as cheaper imported jute and abaca became more widely available, and innovations in cotton processing provided an alternative domestic supply of textiles and rope (Hemp Industries Association). Hemp supplies decreased in response, with U.S. production falling to a mere 105,000 pounds (52.5 tons) on 140 acres by 1933 (USDA Agricultural Statistics Yearbook, 1946).

At the same time, public health concerns with cannabis consumption were increasing. The Marihuana Tax Act of 1937 (Public Law 75-238) established taxes on cannabis products and enacted additional Federal restrictions which effectively discouraged industrial hemp production in the United States.⁴⁷ What is now defined as industrial hemp met the definition of “marihuana” in that law. Although taxes to register, grow, and dispense cannabis for medical and industrial purposes were only \$1-3, the reporting requirements were considerable, and there was a tax of \$100 per ounce--the equivalent purchasing power of nearly \$2,000 today--for sales to unregistered parties. Violations were subject to a fine up to \$2,000 and prison time. Hemp production in the United States remained small, partly due to the legal restrictions on “marihuana” but also due to the falling demand and ready availability of alternatives for most uses.

In 1941 and 1942, Japan invaded much of Southeast Asia, effectively cutting off the U.S. supply of imported alternatives to hemp fiber. The Department of the Army and the U.S. Department of Agriculture issued the legally required tax stamps to U.S. farmers to grow hemp in support of the war effort. Production reached a 20th century peak of 70,340 tons of fiber and 7,000 tons of seed on 146,200 acres in 1943.⁴⁸ Following the end of WWII, planted acres declined again in response to competition from synthetic fibers which had become widely available, increasing public anti-drug sentiment, and Federal regulations that included hemp in the definition of marijuana. The U.S. Department of Agriculture reported 1,140 acres of hemp in 1951; later years had no recorded production. Synthetic fibers replaced natural fibers for rope and many textile uses. Flax continued to provide a cost-effective natural substitute for other textile and food uses of hemp, as well as providing valuable linseed oil as a byproduct of fiber production. However, there was still some demand for hemp for specialty food and textile uses and hemp imports were reported from Chile, Peru, Italy, Yugoslavia, and Italy (USDA Agricultural Statistics Yearbook, 1958).

In 1970, the Controlled Substances Act (CSA, Public Law 91-513) replaced the Marihuana Tax Act of 1937 as the Nation’s comprehensive drug policy. The Act labeled any variety of cannabis, including what is now defined as industrial hemp, as a Schedule 1 drug and made it illegal to grow without a Drug Enforcement Agency permit. This effectively ended hemp production in the United States, except for a few small experimental projects. It was very difficult to obtain permits, and the

⁴⁷See Appendix E: Selected Legislation Relevant to Hemp for excerpts.

⁴⁸To put this in context, U.S. corn production in 1943 was about 75 million tons.

required paperwork and physical security made hemp production prohibitively expensive. Cannabis was, and is, subject to international narcotics treaties to which the United States is a signatory.

However, the Controlled Substances Act did not end U.S. demand for specialty textile and food uses. The United States imported hemp oils for cosmetic products, hemp fabrics and clothing, raw hemp as an industrial input, and non-viable hemp seeds as a food ingredient. Major suppliers were the Philippines, Canada, and Europe. The logical inconsistency of permitting the import of a crop that could not be legally grown in the United States did not go unnoticed by producers, importers, and their representatives in Congress. The United States continued to import small amounts of hemp in the 1960s from Eastern Europe (USDA Agricultural Statistics Yearbook, 1967).

State and Tribal attempts to legalize hemp production in the United States in the 1990s and 2000s were challenged successfully by the Drug Enforcement Agency. The courts consistently upheld the Agency's authority to regulate cannabis, which included hemp.⁴⁹ Meanwhile, peer-reviewed drug trials in the United States were demonstrating efficacy of CBD oil for the treatment of epilepsy. Although some States began legalizing medical marijuana as early as 1996, Federal laws still classified all cannabis as a Schedule 1 drug. From the Marihuana Tax Act of 1937 until the passage of the 2014 Farm Bill, hemp was subject to the same legal restrictions as marijuana.

⁴⁹See *Monson vs DEA*, 589 F. 3d 952, 8th Circuit Court, 2007, for example.

Appendix B: Individual State Pilot Programs

The following States did not participate and/or did not report information for industrial hemp pilot programs; Alabama, Alaska, Arizona, Arkansas, California, Connecticut, Delaware, Florida, Georgia, Idaho, Iowa, Kansas, Louisiana, Maryland, Michigan, Mississippi, Missouri, Nebraska, New Hampshire, New Jersey, New Mexico, Ohio, Rhode Island, South Dakota, Texas, Wyoming, and Utah.

Appendix table B1

Colorado State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain	N/A	N/A	N/A	N/A	N/A
	Fiber	N/A	N/A	N/A	N/A	N/A
	CBD	N/A	N/A	N/A	N/A	N/A
	Total	1,811	3,567	8,988	12,024	30,950
	GH (sq ft)	253,000	570,980	1,360,000	2,300,000	4,788,523
	USDA FSA	N/A	N/A	2,153	2,511	5,562
	Vote Hemp	N/A	N/A	5,921	9,700	21,578
Processors (number)	Grain	Administered through Colorado Department of Public Health and Environment	Administered through Colorado Department of Public Health and Environment	Administered through Colorado Department of Public Health and Environment	N/A	N/A
	Fiber				N/A	N/A
	CBD				N/A	N/A
	Total				20	95
Fees		N/A	N/A	N/A	N/A	\$500 Application plus \$5/acre and/or \$3.00/1,000 sq ft
Applications (number)	Registrants	131	166	312	386	835
	University	N/A	N/A	N/A	N/A	N/A
Staff** (number)	Full time	N/A	N/A	N/A	N/A	3.5
	Part time	N/A	N/A	N/A	N/A	N/A

Notes: N/A = not available. Colorado used the terminology “registrants” to refer to the individuals or entities who applied to grow hemp. Acreage information taken from 2018 year-end review. Only registered acres reported with data as of 11/26/18.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

Hawaii State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain			N/A	N/A	2
	Fiber			N/A	N/A	N/A
	CBD			N/A	N/A	N/A
	Total			1	1	2
	GH (sq ft)			N/A	N/A	1,000
	USDA FSA			N/A	N/A	N/A
	Vote Hemp			1	1	1
Processors (number)	Grain			Information not avail- able	Information not avail- able	Information not available
	Fiber					
	CBD					
	Total					
Fees				No Fees	No Fees	\$500 Application plus \$500 Grower applica- tion fee \$500+\$250 grower licensee fee+\$40/hour for inspection+laboratory testing costs plus \$2/ acre + \$0.33/sq. ft. acre and/or \$3.00/1,000 sq ft
Applications (number)	Approved			0	0	10
	University			0	0	N/A
Staff** (number)	Full time			0	1	1
	Part time			0	0	0

Notes: N/A = not available. Actual production did not begin until 2018.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

Illinois State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain					N/A
	Fiber					N/A
	CBD					N/A
	Total					1
	GH (sq ft)					N/A
	USDA FSA					N/A
	Vote Hemp					1
Processors (number)	Grain					N/A
	Fiber					N/A
	CBD					N/A
	Total					N/A
Fees						No Fees
Applications (number)	Approved					3
	University					3
Staff** (number)	Full time					N/A
	Part time					N/A

Notes: N/A = not available.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

Indiana State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain	N/A	N/A	N/A	N/A	11
	Fiber	5	5	5	5	N/A
	CBD	N/A	N/A	N/A	N/A	N/A
	Total	5	5	5	5	16
	GH (sq ft)	N/A	N/A	N/A	N/A	N/A
	USDA FSA	N/A	N/A	N/A	N/A	12
	Vote Hemp	N/A	N/A	2	5	5
Processors (number)	Grain	0	0	0	0	0
	Fiber	0	0	0	0	0
	CBD	0	0	0	0	0
	Total	0	0	0	0	0
Fees		No Fees				
Applications (number)	Approved	3	5	5	8	12
	University	3	5	5	8	12
Staff** (number)	Full time	3	2	2	2	2
	Part time	0	0	0	0	0

Notes: N/A = not available.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

Appendix table B5

Kentucky State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain	15	435	812	955	2,337
	Fiber	11	55	102	160	335
	CBD	7	430	1,413	2,145	4,028
	Total	33	922	2,300	3,200	6,700
	GH (sq ft)	N/A	N/A	116,313	294,197	750,812
	USDA FSA	N/A	N/A	1,693	2,209	4,711
	Vote Hemp	N/A	N/A	2,525	3,271	6,700
Processors (number)	Grain	4	6	5	18	18
	Fiber	2	4	12	22	25
	CBD	3	12	30	31	49
	Total	9	22	47	71	92
Fees		No Fees	No Fees	No Fees	\$50 grower fee + \$350 grower participation fee + \$150 for second THC; processor fee \$400-1,000; \$400 for broker and seed dealers; Site modification fee \$500	\$100 Grower application + \$400 per address + \$250 for secondary THC test (if required); Processor fees \$500-\$3,000; Broker/Handler/Seed Dealer \$500; Site modification fee \$750
Applications (number)	Approved	20	99	137	204	210
	University	N/A	8	17	17	14
Staff** (number)	Full time	0	0	3	3	3
	Part time	1	2	1	2	2

Notes: N/A = not available.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents

Source: USDA, Economic Research Service compilation.

Maine State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain			N/A	N/A	N/A
	Fiber			N/A	N/A	N/A
	CBD			N/A	N/A	N/A
	Total			1	32	550
	GH (sq ft)			N/A	N/A	N/A
	USDA FSA			N/A	N/A	27
	Vote Hemp			1	30	550
Processors (number)	Grain			N/A	N/A	N/A
	Fiber			N/A	N/A	N/A
	CBD			N/A	N/A	N/A
	Total			N/A	N/A	N/A
Fees				\$100 application per non-continuous location + \$500 license+\$0.10/sq ft if applicable	\$100 ap- plication per non- continu- ous location + \$500 license + \$50/acre	\$100 applica- tion per non- continuous location + \$500 license + \$50/ acre
Applications (number)	Approved			2	34	82
	University			N/A	N/A	N/A
Staff** (number)	Full time			0	0	0
	Part time			0.15	0.65	0.65

Notes: N/A = not available.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents

Source: USDA, Economic Research Service compilation.

Massachusetts State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain					N/A
	Fiber					N/A
	CBD					N/A
	Total					21
	GH (sq ft)					N/A
	USDA FSA					N/A
	Vote Hemp					21
Processors (number)	Grain					0
	Fiber					0
	CBD					9
	Total					9
Fees						\$500 Application plus \$100 application fee + \$300 grower fee + \$150 for second THC test if applicable/acre and/or \$3.00/1,000 sq ft
Applications (number)	Approved					14
	University					N/A
Staff** (number)	Full time					4
	Part time					1

Notes: N/A = not available.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents

Source: USDA, Economic Research Service compilation.

Minnesota State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain			38	1,014	623
	Fiber			N/A	N/A	14
	CBD			N/A	N/A	72
	Total			38	1209	709
	GH (sq ft)			N/A	N/A	55,000
	USDA FSA			18	1,429	583
	Vote Hemp			51	1,205	710
Processors (number)	Grain			0	0	2
	Fiber			0	0	0
	CBD			0	0	6
	Total			0	0	8
Fees				\$550 grower participation fee + \$250 for THC testing beyond 1st test if required + \$100/location fee	\$550 grower participation fee + \$250 for THC testing beyond 1st test if required + \$100/location fee; \$350 each for processor, broker/handler, or seed dealer license	\$37 application fee + \$550 grower participation fee + \$250 for THC testing beyond 1st test if required + \$100/location fee; \$350 each for processor, broker/handler, or seed dealer license
Applications (number)	Approved			6	47	65
	University			1	1	1
Staff** (number)	Full time			1	2	2
	Part time			0	0	0

Notes: N/A = not available.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

Montana State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain				0	0
	Fiber				0	0
	CBD				0	0
	Total				550	22,000
	GH (sq ft)				N/A	N/A
	USDA FSA				577	13,161
	Vote Hemp				542	22,000
Processors (number)	Grain				0	0
	Fiber				0	1
	CBD				0	2
	Total				0	3
Fees				\$450 applica- tion+\$250 per THC test; Seed dealer \$55 (standard for all seed dealers in MT)	\$450 application + \$250 per THC test; Seed dealer \$55 (standard for all seed dealers in MT)	
Applications (number)	Approved				14	58
	University				N/A	2
Staff** (number)	Full time				1	1
	Part time				0	0

Notes: N/A = not available.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

Nevada State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain			N/A	0	N/A
	Fiber			N/A	0	N/A
	CBD			N/A	0	N/A
	Total			N/A	0	1,523
	GH (sq ft)			N/A	0	176,912
	USDA FSA			155	96	110
	Vote Hemp			216	417	1,881
Processors (number)	Grain			N/A	N/A	N/A
	Fiber			N/A	N/A	N/A
	CBD			N/A	N/A	N/A
	Total			N/A	N/A	N/A
Fees				N/A	N/A	N/A
Applications (number)	Approved			N/A	N/A	N/A
	University			N/A	N/A	N/A
Staff** (number)	Full time			N/A	N/A	3
	Part time			N/A	N/A	0

Notes: N/A = not available. 2016 - first planted crop; Nevada Department of Agriculture did not start recording information until the 2018 crop.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

New York State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain			N/A	N/A	N/A
	Fiber			N/A	N/A	N/A
	CBD			N/A	N/A	N/A
	Total			30	2,000	720
	GH (sq ft)			N/A	N/A	66,615
	USDA FSA			N/A	266	332
	Vote Hemp			30	2,000	2,240
Processors (number)	Grain			0	0	0
	Fiber			0	10	14
	CBD			0	8	22
	Total			N/A	18	36
Fees				No Fees	\$500 grower fee; \$500 processor fee	\$500 grower fee; \$500 processor fee
Applications (number)	Approved			2	78	104
	University			2	2	2
Staff** (number)	Full time			0	2	2
	Part time			2	3	3

Notes: N/A = not available. 2016 and 2017- total acres approved only; 2018 - total acres harvested only, approved acres were 3,500; GH sq ft are harvested totals.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

North Carolina State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain			N/A	N/A	N/A
	Fiber			N/A	N/A	N/A
	CBD			N/A	N/A	N/A
	Total			N/A	3,000	3,184
	GH (sq ft)			N/A	N/A	N/A
	USDA FSA			N/A	452	3,301
	Vote Hemp			0	965	3,184
Processors (number)	Grain			N/A	N/A	N/A
	Fiber			N/A	N/A	N/A
	CBD			N/A	N/A	N/A
	Total			N/A	100	300
Fees				N/A	\$250 applica- tion + \$250 grower par- ticipation fee + \$150 each for 1st and 2nd in- spection + \$2/ acre for 49-500 acres and/or \$2/1,000 sq. ft.	\$250 application + \$250 grower participation fee + \$59 for 1st in- spection & \$150 for 2nd inspec- tion + \$2/acre for 49-500 acres and/or \$2/1,000 sq. ft.
Applications (number)	Approved			N/A	120	450
	University			N/A	10	20
Staff** (number)	Full time			N/A	10	10
	Part time			N/A	0	0

Notes: N/A = not available. 2017- only provided combined approved and university acres; 2018 - only provided approved acres.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

North Dakota State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain			N/A	N/A	N/A
	Fiber			N/A	N/A	N/A
	CBD			N/A	N/A	N/A
	Total			70	3,020	2,800
	GH (sq ft)			N/A	N/A	N/A
	USDA FSA			71	2,653	2,669
	Vote Hemp			70	3,020	2,778
Processors (number)	Grain			N/A	0	0
	Fiber			3	5	5
	CBD			N/A	0	0
	Total			3	5	5
Fees				\$150 for either grower or processor + \$25/ac	\$150 for either grower or processor + \$25/ac	\$150 for either grower or pro- cessor + \$25/ac
Applications (number)	Approved			5	34	27
	University			2	2	2
Staff** (number)	Full time			1	1	1
	Part time			0	0	0

Notes: N/A = not available.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

Appendix table B14

Oklahoma State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain					N/A
	Fiber					N/A
	CBD					N/A
	Total					447
	GH (sq ft)					63,000
	USDA FSA					N/A
	Vote Hemp					445
Processors (number)	Grain					N/A
	Fiber					N/A
	CBD					N/A
	Total					N/A
	GH					N/A
Fees						\$500 application fee + \$5/acre +\$500/location fee + \$. 33/sq. ft (if applicable) + \$35/ hr inspection fee + actual cost of THC testing; \$100 seed dealer license fee
Applications (number)	Approved					28
	University					28
Staff** (number)	Full time					N/A
	Part time					N/A

Notes: N/A = not available. 2018 - all acres and GH are cert seed.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

Oregon State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain		N/A	N/A	N/A	N/A
	Fiber		N/A	N/A	N/A	N/A
	CBD		N/A	N/A	N/A	N/A
	Total		105	1,200	3,000	11,754
	GH (sq ft)		N/A	N/A	N/A	N/A
	USDA FSA		N/A	5	180	496
	Vote Hemp		N/A	500	3,469	7,808
Processors (number)	Grain		N/A	N/A	N/A	N/A
	Fiber		N/A	N/A	N/A	N/A
	CBD		N/A	N/A	N/A	N/A
	Total		13	66	189	212
Fees			\$500 (3 yr licensee) + actual THC testing costs	\$500 (1 year license fee) + actual THC testing costs + \$500 for seed dealer	\$1,300 grower par- ticipation fee +actual cost of THC test- ing; \$1,300 processor fees; \$120 seed dealer fee	\$1,300 grower par- ticipation fee +actual cost of THC test- ing; \$1,300 processor fees; \$120 seed dealer fee
Applications (number)	Approved		13	83	246	584
	University		N/A	N/A	N/A	N/A
Staff** (number)	Full time		0	0	1	2
	Part time		2	3	7	5

Notes: N/A = not available. 2015-2018 only approved acres provided.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

Pennsylvania State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain				N/A	N/A
	Fiber				N/A	N/A
	CBD				N/A	N/A
	Total				36	585
	GH (sq ft)				N/A	18,000
	USDA FSA				7	34
	Vote Hemp				36	580
Processors (number)	Grain				1	1
	Fiber				N/A	0
	CBD				N/A	2
	Total				1	3
Fees				\$250 applica- tion + \$3000 participation fee + \$200 each for 1st and 2nd THC test if appli- cable	\$250 applica- tion + \$2,000 participation fee + \$150 each for 1st and 2nd THC test if appli- cable + \$100 site modification fee	
Applications (number)	Approved				16	35
	University				2	3
Staff** (number)	Full time				2	2
	Part time				1	1

Notes: N/A = not available.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

South Carolina State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain					N/A
	Fiber					N/A
	CBD					N/A
	Total					1,600
	GH (sq ft)					N/A
	USDA FSA					86
	Vote Hemp					256
Processors (number)	Grain					0
	Fiber					1
	CBD					1
	Total					2
Fees						\$50 app + \$400 permit for grow- ers; \$100 app + \$3,000 license for processors
Applications (number)	Approved					20
	University					N/A
Staff** (number)	Full time					N/A
	Part time					N/A

Notes: N/A = not available.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

Tennessee State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area (acres except for GH)	Grain		N/A	N/A	N/A	N/A
	Fiber		N/A	N/A	N/A	N/A
	CBD		N/A	N/A	N/A	N/A
	Total		660	225	130	1,034
	GH (sq ft)		N/A	N/A	N/A	N/A
	USDA FSA		N/A	58	50	729
	Vote Hemp		N/A	225	200	3,338
Processors (number)	Grain		N/A	N/A	N/A	N/A
	Fiber		N/A	N/A	N/A	N/A
	CBD		N/A	N/A	N/A	N/A
	Total		N/A	N/A	N/A	N/A
Fees			Grower application fee \$250 + \$35/hr for field inspections + \$175 THC testing + \$2/acre	Grower application fee \$250 + \$35/hr for field inspections + \$175 THC testing + \$2/acre; processor fee \$250	Grower application fee \$250 + \$35/hr for field inspections + \$175 THC testing + \$2/acre; processor fee \$250	Grower application fee \$250 + \$35/hr for field inspections + \$175 THC testing + \$2/acre; processor fee \$250
Applications (number)	Approved		49	64	79	226
	University		2	2	2	3
Staff** (number)	Full time		0	0	0	0
	Part time		1	2	2	2

Notes: N/A = not available.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

Vermont State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain	N/A	N/A	N/A	N/A	N/A
	Fiber	N/A	N/A	N/A	N/A	N/A
	CBD	N/A	N/A	N/A	N/A	N/A
	Total	17	71.45	181	580	3,298
	GH (sq ft)	N/A	N/A	N/A	N/A	N/A
	USDA FSA	N/A	N/A	2	2	20
	Vote Hemp	N/A	N/A	180	575	1,820
Processors (number)	Grain	1	1	1	1	1
	Fiber	N/A	N/A	N/A	2	2
	CBD	3	3	3	3	20
	Total	4	4	4	6	23
Fees		\$25 applica- tion fee + \$120 for 1st THC testing + Seed dealer fees based on tonnage	\$25 applica- tion fee + \$120 for 1st THC testing + Seed dealer fees based on tonnage	\$25 applica- tion fee + \$120 for 1st THC testing + Seed dealer fees based on tonnage	\$25 applica- tion fee + \$120 for 1st THC testing + Seed dealer fees based on tonnage	\$25 applica- tion fee + \$120 for 1st THC testing + Seed dealer fees based on tonnage
Applications (number)	Approved	8	9	34	109	461
	University	1	1	1	1	1
Staff** (number)	Full time	0	0	0	0	0
	Part time	0.25	0.25	0.25	0.25	1.5

Notes: N/A = not available. 2013-2018 only approved acreages recorded by Vermont Agency of Agriculture.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

Virginia State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain		N/A	N/A	N/A	N/A
	Fiber		N/A	N/A	N/A	N/A
	CBD		N/A	N/A	N/A	N/A
	Total		0	37	87	135
	GH (sq ft)		N/A	N/A	N/A	N/A
	USDA FSA		N/A	11	11	16
	Vote Hemp		N/A	37	87	135
Processors (number)	Grain		0	0	0	0
	Fiber		0	0	0	20
	CBD		0	0	0	0
	Total		0	0	0	20
Fees			No Fees	\$57.00	\$57.00	\$45.00
Applications (number)	Approved		29	34	85	85
	University		29	34	85	85
Staff** (number)	Full time		0	0	0	0
	Part time		0	0	0	0

Notes: N/A = not available.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

Washington State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain			N/A	N/A	N/A
	Fiber			N/A	N/A	N/A
	CBD			N/A	N/A	N/A
	Total			N/A	177.5	142
	GH (sq ft)			N/A	N/A	N/A
	USDA FSA			N/A	65	N/A
	Vote Hemp			0	175	142
Processors (number)	Grain			N/A	0	0
	Fiber			N/A	0	9
	CBD			N/A	0	0
	Total			N/A	0	9
Fees				N/A	\$450 each for grower or processor/marketer application; \$800 for combination (grower/processor/marketer license) application +\$300 licensee fee (for all) +\$200 inspection+ mileage fee + time fee. THC testing \$200-\$2,000	\$450 each for grower or processor/marketer application; \$800 for combination (grower/processor/marketer license) application +\$300 licensee fee (for all) +\$200 inspection+ mileage fee + time fee. THC testing \$200-\$2,000
Applications (number)	Approved			N/A	6	11
	University			N/A	1	N/A
Staff** (number)	Full time			N/A	1	0
	Part time			N/A	0	0

Notes: N/A = not available.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

West Virginia State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres except for GH)	Grain			N/A	N/A	N/A
	Fiber			N/A	N/A	N/A
	CBD			N/A	N/A	N/A
	Total			10	14	155
	GH (sq ft)			N/A	N/A	N/A
	USDA FSA			N/A	N/A	253
	Vote Hemp			10	14	155
Processors (number)	Grain			N/A	N/A	N/A
	Fiber			N/A	N/A	N/A
	CBD			N/A	N/A	N/A
	Total			N/A	N/A	N/A
Fees				\$100+\$5/ac + inspection \$35/ hr plus driving time; \$150 per THC test per sample	\$100+\$5/ac + inspection \$35/hr plus driving time; \$150 per THC test per sample	\$100+\$5/ac + inspection \$35/ hr plus driving time; \$150 per THC test per sample
Applications (number)	Approved			15	22	46
	University			1	1	1
Staff** (number)	Full time			1	2	2
	Part time			0	1	1

Notes: N/A = not available.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

Wisconsin State Pilot Program for Industrial Hemp

		2014	2015	2016	2017	2018
Reported Area* (acres)	Grain					N/A
	Fiber					N/A
	CBD					N/A
	Total					1,700
	GH					22 acres
	USDA FSA					665
	Vote Hemp					1,850
Processors (number)	Grain					Small number
	Fiber					Small number
	CBD					100
	Total					Over 200
Fees						Application fee: 0-30 acres=\$150; 31-199acres=\$5/ acre; 200ac+=\$1,000 + \$350 grower participation fee + \$250 each for 1st and second THC test; \$100 processor fee; \$50 site modi- fication fee (plus any acreages fee changes); change of farm manager fee = \$15 (to cover cost on new background check)
Applications (number)	Approved					247
	University					N/A
Staff** (number)	Full time					0
	Part time					5

Notes: N/A = not available. 2018 - only gave total number of acres harvested; authors' research indicates approximately 22 acres of GH space.

*Area may include licensed, planted, or harvested acres and/or greenhouse (sq ft) depending upon data the State collects and reports. Acreage reported by the USDA, Farm Service Agency and Vote Hemp included for comparison.

**Staff data are reported in full-time employment equivalents.

Source: USDA, Economic Research Service compilation.

Appendix C: Uses of Hemp

Three main categories of hemp use are food from hemp seed, fiber from hemp stalks, and oil from the flowers and seeds.⁵⁰ There is also a market for hemp “hurds,” which are the inner layer of the stalk that can be used for animal bedding or insulation. Hemp fiber is used for making fabric, paper, and rope, while the seeds can be eaten or used as a feed ingredient for animals. Seeds can also be crushed for hemp oil, an ingredient in soap, cosmetic products, and industrial oils, such as biofuels, paints, and solvents.

Hemp can be used for hundreds of consumer products and industrial inputs, including paper, construction materials, automotive parts, packing materials, bio-plastics, fabrics, and bio-energy, but the magnitude of demand for these uses is unknown. Estimates released by the Hemp Business Journal are that in 2017, 23 percent of market sales value for hemp were derived from CBD, followed by personal care with 22 percent, industrial applications at 18 percent, 17 percent from foodstuffs, 13 percent from consumer textiles, 5 percent from supplements, and 2 percent from other consumer products (Hemp Business Journal, no date). These shares will shift over time as new hemp products or competing hemp-alternatives are developed. The Journal also projects hemp-derived CBD products will account for 34 percent of market sales value for hemp by 2022.

Cost-effective alternatives already exist for most uses, particularly flax and synthetic fibers. The potentially highest value use of hemp is CBD oil - a hemp or marijuana extract that can be added to foods, beverages, and cosmetics - but its legal status is still evolving. Hemp seed and hemp seed oil are generally recognized as safe by the Food and Drug Administration for human food use. There are unsubstantiated claims as to its efficacy for a wide range of medical and health issues, from pain management to acne reduction. Hemp extract products are not approved by the Food and Drug Administration for food or drug use, except for one licensed epilepsy drug.

⁵⁰See “Hemp as an Agricultural Commodity” (Johnson, 2018) for additional information about potential uses of hemp.

Appendix D: Literature Review

The pilot programs revealed some significant research and knowledge gaps; a review of existing literature confirms those gaps. Most of the available peer-reviewed literature is dated, primarily focused on processing methods for fiber and seed, and was conducted outside of the United States under different production scenarios and regulatory contexts. The available literature can roughly be categorized around product use, agronomic production, and economics. Economic literature makes up the smallest of the three categories of extant hemp literature and is the focus of this section.

Hemp product use studies typically draw from the hard sciences (i.e., medicine, chemistry, engineering, pharmacology, etc.) and have largely focused on paper products or other fiber uses. Agronomic literature from both the peer-reviewed journals as well as from university staff papers and bulletins comprise the second category of hemp literature and focuses on production issues (Alden et al., 1998). University research has been constrained by the Controlled Substances Act, Title II of the Comprehensive Drug Abuse Prevention and Control Act of 1970, and the lack of data needed to publish peer-reviewed literature. Farm-level production (farm-gate production/first-use stage) studies are still largely relegated to university fact sheets and white papers (for example, Ehrensing, 1998; Thomson et al., 1998; Robbins et al., 2013; Fortenbery and Mick, 2014; Shepherd and Mark, 2019; Anderson et al., 2019; Hanchar 2019; Harper et al., 2019).

There is little peer-reviewed economic analysis of industrial hemp, and the widespread availability of speculative market analysis in non-journal outlets is potentially confusing to both investors and producers. Most of the economic literature that does exist discusses hemp fiber and grain products and was written before CBD oil became a major product category. While some recent work has been released in this area (e.g. Sterns, 2019), most of the university studies are dated and not applicable to the current farm-level economic environment and production systems (Mark and Snell, 2019).

For example, the report, “*Industrial Hemp in the United States: Status and Market Potential*,” provided a detailed look at the potential of hemp production in the U.S. and Canada around 2000 (USDA ERS, 2000). Small and Marcus (2002) offer a comprehensive overview of potential hemp uses and encourage caution regarding new crops “touted as goldmines.” Fortenbery and Bennett (2004) concluded that “Hemp appears slightly more profitable than traditional row crops, but less profitable than other specialty crops.” Cherney and Small (2016) give a concise summary of the economic literature in their article “Industrial Hemp in North America: Production, Politics, and Potential.” More recently, Johnson (2018) sums up the state of hemp economics as “It is not possible to predict with any degree of confidence the potential market and employment effects of relaxing the current restriction on U.S. hemp production.” In a separate paper, Johnson (2019) offers a historical perspective on the economic literature available and legislative changes relevant to the industry.

Currently the most profitable, and fastest developing, hemp market is for CBD oil, about which there is very little peer-reviewed economic or agronomic literature. Few articles exist in the economics literature to address hemp for grain purposes and even fewer for CBD or other extracts. Both potential producers and State licensing authorities found it difficult to obtain information on the economic viability of planting hemp for CBD oil or other extract production during the pilot programs.

The economics of hemp studies that are published largely address a specific topic that was in the national spotlight in their year of writing. Further, most of the economics articles only address hemp production from a micro-economic level without a focus on competition with conventional crops for acreage (e.g. Alden et al., 1998; Bowyer 2001; Fortenbery and Bennett, 2004).

With the passage of the 2018 Farm Bill, some of the constraints for research funding have been removed. Universities and private companies are beginning to release updated working papers, fact-sheets, and budgets based on information from the pilots, but literature on commercial production is still largely absent. At the forefront of the research are those States that have been in hemp production the longest, including Colorado, Kentucky, Oregon, Tennessee, and Vermont.

Enterprise budgets to help producers analyze basic production costs are included with some of the most recently released economic information available (e.g. Hanchar, 2019; Cui and Smith, 2019). The University of Kentucky has published six hemp budgets covering fiber, grain, and CBD. The four CBD budgets cover the two most common production practices started in the United States and two potential mechanical harvest methods that are being explored in trials (Shepherd and Mark, 2019). Colorado and Pennsylvania also have crop production budgets available for growers in their States.

There is existing literature addressing the economics of hemp production in countries other than the United States. Canada has good representation in the literature and is often used as the baseline for U.S. hemp economics (e. g. Thayer and Burley, 2017; Halliday and Lynch, 2018). One Canadian publication showed that on average, gross margins for hemp seed production were \$825.63/acre and \$479.43/acre (C\$) for irrigated and non-irrigated hemp enterprises in Alberta (Vera et al., 2010). China and European countries make up the bulk of available literature that is not Canadian focused (Wang and Shi, 1999; Beherec, 2000; Ranalli and Venturi, 2004; Garnier et al., 2007; Carus et al., 2013; Amaducci et al., 2015; Foti et al. 2019).

Industry research is beginning to bridge some of the literature gaps, but lacks third-party validation needed to overcome potential perceived biases and often is only available to customers or others with structured relationships. Nesin (2019) is an example of private company research that has been released to help customers gain a deeper understanding of the CBD industry. Within these articles, they explore the volatility in the hemp market and the potential for a rapid transition of hops producers to hemp for CBD and oversupplying the market.

The extent of gaps in the current economic and market literature cannot be overstated. There is a significant need for more farm-level enterprise research and research-on-demand for particular products to determine the profitability of hemp for various uses (grain, fiber, and CBD or other extracts) and by regions. Many producers and processors are using anecdotal information and/or obsolete data to guide production decisions. Enterprise budgets developed for one region or one type of end use may not reflect costs and revenues for another region or use. Reliable data to analyze the cost of production are scarce. Research and education publications into the nature of contracts between processors and producers would also be beneficial. Significant market research gaps also include international competitiveness and trade, processing alternatives, and market organization and structure.

Appendix E: Selected Legislation Relevant to Hemp

Hemp references are bolded where hemp is not the major subject of the sections included below.

Marihuana Tax Act of 1937

....

(b) The term “marihuana” means all parts of the plant *Cannabis sativa L* , whether growing or not; the seeds thereof; the resin extracted from any part of such plant; and every compound, manufacture, salt, derivative, mixture, or preparation of such plant, its seeds, or resin- but shall not include the mature stalks of such plant, fiber produced from such stalks, oil or cake made from the seeds of such plant, any other compound, manufacture, salt, derivative, mixture, or preparation of such mature stalks (except the resin extracted therefrom), fiber, oil, or cake, or the sterilized seed of such plant which is incapable of germination.

SEC. 2. (a) Every person who imports, manufactures, produces, compounds, sells, deals in, dispenses, prescribes, administers, or gives away marihuana shall (1) within fifteen days after the effective date of this Act, or (2) before engaging after the expiration of such fifteen-day period in any of the above mentioned activities, and (3) thereafter, on or before July 1 of each year, pay the following special taxes respectively:

(1) Importers, manufacturers, and compounders of marihuana, \$24 per year.

(2) Producers of marihuana (except those included within subdivision (4) of this subsection), \$1 per year, or fraction thereof, during which they engage in such activity.

(3) Physicians, dentists, veterinary surgeons, and other practitioners who distribute, dispense, give away, administer, or prescribe marihuana to patients upon whom they in the course of their professional practice are in attendance, \$1 per year or fraction thereof during which they engage in any of such activities.

(4) Any person not registered as an importer, manufacturer, producer, or compounder who obtains and uses marihuana in a laboratory for the purpose of research, instruction, or analysis, or who produces marihuana for any such purpose, \$1 per year, or fraction thereof, during which he engages in such activities.

(5) Any person who is not a physician, dentist, veterinary surgeon, or other practitioner and who deals in, dispenses, or gives away marihuana, \$3 per year: Provided, That any person who has registered and paid the special tax as an importer, manufacturer, compounder, or producer, as required by subdivisions (1) and (2) of this subsection, may deal in, dispense, or give away marihuana imported, manufactured, compounded, or produced by him without further payment of the tax imposed by this section.

...

SEC. 5. It shall be unlawful for any person who shall not have paid the special tax and registered, as required by section 2, to send, ship, carry, transport, or deliver any marihuana within any Territory, the District of Columbia, or any insular possession, or from any State, Territory, the

District of Columbia, any insular possession of the United States, or the Canal Zone, into any other State, Territory, the District of Columbia, or insular possession of the United States: Provided, That nothing contained in this section shall apply to any common carrier engaged in transporting marihuana; or to any employee of any person who shall have registered and paid the special tax as required by section 2 while acting within the scope of his employment; or to any person who shall deliver marihuana which has been prescribed or dispensed by a physician, dentist, veterinary surgeon, or other practitioner registered under section 2, who has been employed to prescribe for the particular patient receiving such marihuana; or to any United States, State, county, municipal, District, Territorial, or insular officer or official acting within the scope of his official duties.

SEC. 6. (a) It shall be unlawful for any person, whether or not required to pay a special tax and register under section 2, to transfer marihuana, except in pursuance of a written order of the person to whom such marihuana is transferred, on a form to be issued in blank for that purpose by the Secretary.

...

SEC. 7. (a) There shall be levied, collected, and paid upon all transfers of marihuana which are required by section 6 to be carried out in pursuance of written order forms taxes at the following rates:

(1) Upon each transfer to any person who has paid the special tax and registered under section 2 of this Act, \$1 per ounce of marihuana or fraction thereof

(2) Upon each transfer to any person who has not paid the special tax and registered under section 2 of this Act, \$100 per ounce of marihuana or fraction thereof.

(b) Such tax shall be paid by the transferee at the time of securing each order form and shall be in addition to the price of such form. Such transferee shall be liable for the tax imposed by this section but in the event that the transfer is made in violation of section 6 without an order form and without payment of the transfer tax imposed by this section, the transferor shall also be liable for such tax.

(c) Payment of the tax herein provided shall be represented by appropriate stamps to be provided by the Secretary and said stamps shall be affixed by the collector or his representative to the original order form.

(d) All provisions of law relating to the engraving, issuance, sale, accountability, cancelation, and destruction of tax-paid stamps provided for in the internal-revenue laws shall, insofar as applicable and not inconsistent with this Act, be extended and made to apply to stamps provided for in this section.

...

SEC. 12. Any person who is convicted of a violation of any provision of this Act shall be fined not more than \$2,000 or imprisoned not more than five years, or both, in the discretion of the court.

2014 Farm Bill

SEC. 7606. LEGITIMACY OF INDUSTRIAL HEMP RESEARCH.

(a) In General. --Notwithstanding the Controlled Substances Act (21 U. S. C. 801 et seq.), the Safe and Drug-Free Schools and Communities Act (20 U. S. C. 7101 et seq.), chapter 81 of title 41, United States Code, or any other Federal law, an institution of higher education (as defined in section 101 of the Higher Education Act of 1965 (20 U. S. C. 1001)) or a State department of agriculture may grow or cultivate industrial hemp if--

- (1) the industrial hemp is grown or cultivated for purposes of research conducted under an agricultural pilot program or other agricultural or academic research; and
- (2) the growing or cultivating of industrial hemp is allowed under the laws of the State in which such institution of higher education or State department of agriculture is located and such research occurs.

(b) Definitions. --In this section:

(1) Agricultural pilot program. --The term ``agricultural pilot program'' means a pilot program to study the growth, cultivation, or marketing of industrial hemp--

(A) in States that permit the growth or cultivation of industrial hemp under the laws of the State; and

(B) in a manner that--

(i) ensures that only institutions of higher education and State departments of agriculture are used to grow or cultivate industrial hemp;

(ii) requires that sites used for growing or cultivating industrial hemp in a State be certified by, and registered with, the State department of agriculture; and

(iii) authorizes State departments of agriculture to promulgate regulations to carry out the pilot program in the States in accordance with the purposes of this section.

(2) Industrial hemp. --The term ``industrial hemp'' means the plant *Cannabis sativa* L. and any part of such plant, whether growing or not, with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis.

(3) State department of agriculture. --The term ``State department of agriculture'' means the agency, commission, or department of a State government responsible for agriculture within the State.

2018 Farm Bill

SEC. 7129. SUPPLEMENTAL AND ALTERNATIVE CROPS; HEMP.

Section 1473D of the National Agricultural Research, Extension, and Teaching Policy Act of 1977 (7 U. S. C. 3319d) is amended--

(1) in subsection (a)--

(A) by striking "2018" and inserting "2023"; and

(B) by striking "crops," and inserting "crops (including canola),";

(2) in subsection (b)--

(A) by inserting "for agronomic rotational purposes and as a habitat for honey bees and other pollinators" after "alternative crops"; and

(B) by striking ``commodities whose" and all that follows through the period at the end and inserting "commodities.";

(3) in subsection (c)(3)(E), by inserting “(including hemp (as defined in section 297A of the Agricultural Marketing Act of 1946))” after “material”; and

(4) in subsection (e)--

(A) in paragraph (1), by striking “and” at the end;

(B) in paragraph (2), by striking the period at the end and inserting “; and”; and

(C) by adding at the end the following new paragraph:

“(3) \$2,000,000 for each of fiscal years 2019 through 2023.”.

SEC. 7501. CRITICAL AGRICULTURAL MATERIALS ACT.

(a) Hemp Research. --Section 5(b)(9) of the Critical Agricultural Materials Act (7 U. S. C. 178c(b)(9)) is amended by inserting “, and **including hemp** (as defined in section 297A of the Agricultural Marketing Act of 1946)” after “hydrocarbon-containing plants”.

(b) Authorization of Appropriations. --Section 16(a)(2) of the Critical Agricultural Materials Act (7 U. S. C. 178n(a)(2)) is amended by striking “2018” and inserting “2023”.

SEC. 7605. LEGITIMACY OF INDUSTRIAL HEMP RESEARCH.

(a) In General. --Section 7606 of the Agricultural Act of 2014 (7 U. S. C. 5940) is amended--

(1) by redesignating subsections (a) and (b) as subsections (b) and (a), respectively, and moving the subsections so as to appear in alphabetical order;

(2) in subsection (a) (as so redesignated)--

(A) by redesignating paragraph (3) as paragraph (4); and

(B) by inserting after paragraph (2) the following:

“3) State. --The term ‘State’ has the meaning given such term in section 297A of the Agricultural Marketing Act of 1946.”;

(3) in subsection (b) (as so redesignated), in the subsection heading, by striking “In General” and inserting “Industrial Hemp Research”; and

(4) by adding at the end the following:

“(c) Study and Report. --

“(1) In general. --The Secretary shall conduct a study of agricultural pilot programs--

“(A) to determine the economic viability of the domestic production and sale of industrial hemp; and

“(B) that shall include a review of--

“(i) each agricultural pilot program; and

“(ii) any other agricultural or academic research relating to industrial hemp.

“(2) Report. --Not later than 12 months after the date of enactment of this subsection, the Secretary shall submit to Congress a report describing the results of the study conducted under paragraph (1).”.

(b) <<NOTE: 7 USC 5940 note.>> Repeal. --Effective on the date that is 1 year after the date on which the Secretary establishes a plan under section 297C of the Agricultural Marketing Act of 1946, section 7606 of the Agricultural Act of 2014 (7 U.S.C. 5940) is repealed.

SEC. 10113. HEMP PRODUCTION.

The Agricultural Marketing Act of 1946 (7 U.S.C. 1621 et seq.) is amended by adding at the end the following:

“Subtitle G--Hemp Production

“SEC. 297A. <<NOTE: 7 USC 1639o.>> DEFINITIONS.

“In this subtitle:

“(1) Hemp. --The term ‘hemp’ means the plant *Cannabis sativa* L. and any part of that plant, including the seeds thereof and all derivatives, extracts, cannabinoids, isomers, acids, salts,

and salts of isomers, whether growing or not, with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis.

"(2) Indian tribe. --The term 'Indian tribe' has the meaning given the term in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 5304).

"(3) Secretary. --The term 'Secretary' means the Secretary of Agriculture.

"(4) State. --The term 'State' means--

"(A) a State;

"(B) the District of Columbia;

"(C) the Commonwealth of Puerto Rico; and

"(D) any other territory or possession of the United States.

"(5) State department of agriculture. --The term 'State department of agriculture' means the agency, commission, or department of a State government responsible for agriculture in the State.

"(6) Tribal government. --The term 'Tribal government' means the governing body of an Indian tribe.

"SEC. 297B. <<NOTE: 7 USC 1639p.>> STATE AND TRIBAL PLANS.

"(a) Submission. --

"(1) In general. --A State or Indian tribe desiring to have primary regulatory authority over the production of hemp in the State or territory of the Indian tribe shall submit to the Secretary, through the State department of agriculture (in consultation with the Governor and chief law enforcement officer of the State) or the Tribal government, as applicable, a plan under which the State or Indian tribe monitors and regulates that production as described in paragraph (2).

"(2) Contents. --A State or Tribal plan referred to in paragraph (1)--

"(A) shall only be required to include--

"(i) a practice to maintain relevant information regarding land on which hemp is produced in the State or territory of the Indian tribe, including a legal description of the land, for a period of not less than 3 calendar years;

"(ii) a procedure for testing, using post-decarboxylation or other similarly reliable methods, delta-9 tetrahydrocannabinol concentration levels of hemp produced in the State or territory of the Indian tribe;

"(iii) a procedure for the effective disposal of--

"(I) plants, whether growing or not, that are produced in violation of this subtitle; and

"(II) products derived from those plants;

"(iv) a procedure to comply with the enforcement procedures under subsection (e);

"(v) a procedure for conducting annual inspections of, at a minimum, a random sample of hemp producers to verify that hemp is not produced in violation of this subtitle;

“(vi) a procedure for submitting the information described in section 297C(d)(2), as applicable, to the Secretary not more than 30 days after the date on which the information is received; and

“(vii) a certification that the State or Indian tribe has the resources and personnel to carry out the practices and procedures described in clauses (i) through (vi); and

“(B) may include any other practice or procedure established by a State or Indian tribe, as applicable, to the extent that the practice or procedure is consistent with this subtitle.

“(3) Relation to state and tribal law. --

“(A) No preemption. --Nothing in this subsection preempts or limits any law of a State or Indian tribe that--

“(i) regulates the production of hemp; and

“(ii) is more stringent than this subtitle.

“(B) References in plans. --A State or Tribal plan referred to in paragraph (1) may include a reference to a law of the State or Indian tribe regulating the production of hemp, to the extent that law is consistent with this subtitle.

“(b) Approval. --

“(1) In general. --Not later than 60 days after receipt of a State or Tribal plan under subsection (a), the Secretary shall--

“(A) approve the State or Tribal plan if the State or Tribal plan complies with subsection (a); or

“(B) disapprove the State or Tribal plan only if the State or Tribal plan does not comply with subsection (a).

“(2) Amended plans. --If the Secretary disapproves a State or Tribal plan under paragraph (1)(B), the State, through the State department of agriculture (in consultation with the Governor and chief law enforcement officer of the State) or the Tribal government, as applicable, may submit to the Secretary an amended State or Tribal plan that complies with subsection (a).

“(3) Consultation. --The Secretary shall consult with the Attorney General in carrying out this subsection.

“(c) Audit of State Compliance. --

“(1) In general. --The Secretary may conduct an audit of the compliance of a State or Indian tribe with a State or Tribal plan approved under subsection (b).

“(2) Noncompliance. --If the Secretary determines under an audit conducted under paragraph (1) that a State or Indian tribe is not materially in compliance with a State or Tribal plan--

“(A) the Secretary shall collaborate with the State or Indian tribe to develop a corrective action plan in the case of a first instance of noncompliance; and

“(B) the Secretary may revoke approval of the State or Tribal plan in the case of a second or subsequent instance of noncompliance.

“(d) Technical Assistance. --The Secretary may provide technical assistance to a State or Indian tribe in the development of a State or

Tribal plan under subsection (a).

“(e) Violations. --

“(1) In general. --A violation of a State or Tribal plan approved under subsection (b) shall be subject to enforcement solely in accordance with this subsection.

“(2) Negligent violation. --

“(A) In general. --A hemp producer in a State or the territory of an Indian tribe for which a State or Tribal plan is approved under subsection (b) shall be subject to subparagraph (B) of this paragraph if the State department of agriculture or Tribal government, as applicable, determines that the hemp producer has negligently violated the State or Tribal plan, including by negligently--

“(i) failing to provide a legal description of land on which the producer produces hemp;

“(ii) failing to obtain a license or other required authorization from the State department of agriculture or Tribal government, as applicable; or

“(iii) producing *Cannabis sativa* L. with a delta-9 tetrahydrocannabinol concentration of more than 0.3 percent on a dry weight basis.

“(B) Corrective action plan. --A hemp producer described in subparagraph (A) shall comply with a plan established by the State department of agriculture or Tribal government, as applicable, to correct the negligent violation, including--

“(i) a reasonable date by which the hemp producer shall correct the negligent violation; and

“(ii) a requirement that the hemp producer shall periodically report to the State department of agriculture or Tribal government, as applicable, on the compliance of the hemp producer with the State or Tribal plan for a period of not less than the next 2 calendar years.

“(C) Result of negligent violation. --A hemp producer that negligently violates a State or Tribal plan under subparagraph (A) shall not as a result of that violation be subject to any criminal enforcement action by the Federal Government or any State government, Tribal government, or local government.

“(D) Repeat violations. --A hemp producer that negligently violates a State or Tribal plan under subparagraph (A) 3 times in a 5-year period shall be ineligible to produce hemp for a period of 5 years beginning on the date of the third violation.

“(3) Other violations. --

“(A) In general. --If the State department of agriculture or Tribal government in a State or the territory of an Indian tribe for which a State or Tribal plan is approved under subsection (b), as applicable, determines that a hemp producer in the State or territory has violated the State or Tribal plan with a

culpable mental state greater than negligence--

"(i) the State department of agriculture or Tribal government, as applicable, shall immediately report the hemp producer to--

"(I) the Attorney General; and

"(II) the chief law enforcement officer of the State or Indian tribe, as applicable; and

"(ii) paragraph (1) of this subsection shall not apply to the violation.

"(B) Felony. --

"(i) In general. --Except as provided in clause (ii), any person convicted of a felony relating to a controlled substance under State or Federal law before, on, or after the date of enactment of this subtitle shall be ineligible, during the 10-year period following the date of the conviction--

"(I) to participate in the program established under this section or section 297C; and

"(II) to produce hemp under any regulations or guidelines issued under section 297D(a).

"(ii) Exception. --Clause (i) shall not apply to any person growing hemp lawfully with a license, registration, or authorization under a pilot program authorized by section 7606 of the Agricultural Act of 2014 (7 U. S. C. 5940) before the date of enactment of this subtitle.

"(C) False statement. --Any person who materially falsifies any information contained in an application to participate in the program established under this section shall be ineligible to participate in that program.

"(f) Effect. --Nothing in this section prohibits the production of hemp in a State or the territory of an Indian tribe--

"(1) for which a State or Tribal plan is not approved under this section, if the production of hemp is in accordance with section 297C or other Federal laws (including regulations); and

"(2) if the production of hemp is not otherwise prohibited by the State or Indian tribe.

"SEC. 297C. <<NOTE: 7 USC 1639q.>> DEPARTMENT OF AGRICULTURE.

"(a) Department of Agriculture Plan. --

"(1) In general. --In the case of a State or Indian tribe for which a State or Tribal plan is not approved under section 297B, the production of hemp in that State or the territory of that Indian tribe shall be subject to a plan established by the Secretary to monitor and regulate that production in accordance with paragraph (2).

"(2) Content. --A plan established by the Secretary under paragraph (1) shall include--

"(A) a practice to maintain relevant information regarding land on which hemp is produced in the State or

territory of the Indian tribe, including a legal description of the land, for a period of not less than 3 calendar years;

"(B) a procedure for testing, using post-decarboxylation or other similarly reliable methods, delta-9 tetrahydrocannabinol concentration levels of hemp produced in the State or territory of the Indian tribe;

"(C) a procedure for the effective disposal of--

"(i) plants, whether growing or not, that are produced in violation of this subtitle; and

"(ii) products derived from those plants;

"(D) a procedure to comply with the enforcement procedures under subsection (c) (2);

"(E) a procedure for conducting annual inspections of, at a minimum, a random sample of hemp producers to verify that hemp is not produced in violation of this subtitle; and

"(F) such other practices or procedures as the Secretary considers to be appropriate, to the extent that the practice or procedure is consistent with this subtitle.

"(b) Licensing. --The Secretary shall establish a procedure to issue licenses to hemp producers in accordance with a plan established under subsection (a).

"(c) Violations. --

"(1) In general. --In the case of a State or Indian tribe for which a State or Tribal plan is not approved under section 297B, it shall be unlawful to produce hemp in that State or the territory of that Indian tribe without a license issued by the Secretary under subsection (b).

"(2) Negligent and other violations. --A violation of a plan established under subsection (a) shall be subject to enforcement in accordance with paragraphs (2) and (3) of section 297B(e), except that the Secretary shall carry out that enforcement instead of a State department of agriculture or Tribal government.

"(3) Reporting to attorney general. --In the case of a State or Indian tribe covered by paragraph (1), the Secretary shall report the production of hemp without a license issued by the Secretary under subsection (b) to the Attorney General.

"(d) Information Sharing for Law Enforcement. --

"(1) In general. --The Secretary shall--

"(A) collect the information described in paragraph (2); and

"(B) make the information collected under subparagraph (A) accessible in real time to Federal, State, territorial, and local law enforcement.

"(2) Content. --The information collected by the Secretary under paragraph (1) shall include--

"(A) contact information for each hemp producer in a State or the territory of an Indian tribe for which--

"(i) a State or Tribal plan is approved under section 297B(b); or

"(ii) a plan is established by the Secretary

under this section;

"(B) a legal description of the land on which hemp is grown by each hemp producer described in subparagraph (A); and

"(C) for each hemp producer described in subparagraph (A)--

"(i) the status of--

"(I) a license or other required authorization from the State department of agriculture or Tribal government, as applicable; or

"(II) a license from the Secretary; and

"(ii) any changes to the status.

"SEC. 297D. <<NOTE: 7 USC 1639r.>> REGULATIONS AND GUIDELINES; EFFECT ON OTHER LAW.

"(a) Promulgation of Regulations and Guidelines; Report. --

"(1) Regulations and guidelines. --

"(A) In general. --The Secretary shall promulgate regulations and guidelines to implement this subtitle as expeditiously as practicable.

"(B) Consultation with attorney general. --The Secretary shall consult with the Attorney General on the promulgation of regulations and guidelines under subparagraph (A).

"(2) Report. --The Secretary shall annually submit to the Committee on Agriculture of the House of Representatives and the Committee on Agriculture, Nutrition, and Forestry of the Senate a report containing updates on the implementation of this subtitle.

"(b) Authority. --Subject to subsection (c) (3) (B), the Secretary shall have sole authority to promulgate Federal regulations and guidelines that relate to the production of hemp, including Federal regulations and guidelines that relate to the implementation of sections 297B and 297C.

"(c) Effect on Other Law. --Nothing in this subtitle shall affect or modify--

"(1) the Federal Food, Drug, and Cosmetic Act (21 U. S. C. 301 et seq.);

"(2) section 351 of the Public Health Service Act (42 U. S. C. 262); or

"(3) the authority of the Commissioner of Food and Drugs and the Secretary of Health and Human Services--

"(A) under--

"(i) the Federal Food, Drug, and Cosmetic Act (21 U. S. C. 301 et seq.); or

"(ii) section 351 of the Public Health Service Act (42 U. S. C. 262); or

"(B) to promulgate Federal regulations and guidelines that relate to the production of hemp under the Act described in subparagraph (A) (i) or the section described in subparagraph (A) (ii).

"SEC. 297E. <<NOTE: 7 USC 1639s.>> AUTHORIZATION OF APPROPRIATIONS.

"There are authorized to be appropriated such sums as are necessary

to carry out this subtitle.”.

SEC. 10114. <<NOTE: 7 USC 1639o note.>> INTERSTATE COMMERCE.

(a) Rule of Construction. --Nothing in this title or an amendment made by this title prohibits the interstate commerce of hemp (as defined in section 297A of the Agricultural Marketing Act of 1946 (as added by section 10113)) or hemp products.

(b) Transportation of Hemp and Hemp Products. --No State or Indian Tribe shall prohibit the transportation or shipment of hemp or hemp products produced in accordance with subtitle G of the Agricultural Marketing Act of 1946 (as added by section 10113) through the State or the territory of the Indian Tribe, as applicable.

TITLE XI--CROP INSURANCE

SEC. 11101. DEFINITIONS.

Section 502(b) of the Federal Crop Insurance Act (7 U.S.C. 1502(b)) is amended--

(1) by redesignating paragraphs (6), (7), (8), (9), (10), and (11) as paragraphs (7), (8), (10), (11), (12), and (13) respectively;

(2) by inserting after paragraph (5) the following:

“(6) Cover crop termination. --The term ‘cover crop termination’ means a practice that historically and under reasonable circumstances results in the termination of the growth of a cover crop.”; and

(3) by inserting after paragraph (8) (as so redesignated) the following:

“(9) **Hemp.** --**The term ‘hemp’ has the meaning given the term in section 297A of the Agricultural Marketing Act of 1946.**”.

SEC. 11106. INSURANCE PERIOD.

Section 508(a)(2) of the Federal Crop Insurance Act (7 U. S. C. 1508(a)(2)) is amended by striking “and sweet potatoes” and inserting “sweet potatoes, **and hemp**”.

SEC. 11113. SUBMISSION OF POLICIES AND MATERIALS TO BOARD.

Section 508(h) of the Federal Crop Insurance Act (7 U.S.C. 1508(h)) is amended--

(1) in paragraph (1)(B)--

(A) by redesignating clauses (i) through (iii) as subclauses (I) through (III), respectively, and indenting appropriately;

(B) in the matter preceding subclause (I) (as so redesignated), by striking “The Corporation shall” and inserting the following:

“(i) In general. --The Corporation shall”;

(C) in clause (i)(I) (as so redesignated), by inserting “subject to clause (ii),” before “will likely”; and

(D) by adding at the end the following:

“(ii) **Waiver for hemp.** --The Corporation may waive the viability and marketability requirement under clause (i)(I) in the case of a policy or pilot program relating to the production of hemp.”; and

(2) in paragraph (3)(C)--

(A) in clause (ii), by striking “and” at the end;

(B) in clause (iii), by striking the period at the end and inserting “; and”; and

(C) by adding at the end the following:

"(iv) in the case of reviewing policies and other materials relating to the production of hemp, may waive the viability and marketability requirement under subparagraph (A)(ii)(I)."

SEC. 11119. AGRICULTURAL COMMODITY.

Section 518 of the Federal Crop Insurance Act (7 U. S. C. 1518) is amended by inserting "hemp," before "aquacultural species".

SEC. 11121. REIMBURSEMENT OF RESEARCH, DEVELOPMENT, AND MAINTENANCE COSTS.

Section 522(b) of the Federal Crop Insurance Act (7 U. S. C. 1522(b)) is amended--

(1) in paragraph (2), by adding at the end the following:

"(K) **Waiver for hemp.** --The Board may waive the viability and marketability requirements under this paragraph in the case of research and development relating to a policy to insure the production of hemp."; and

(2) in paragraph (3)--

(A) by striking "The Corporation" and inserting the following:

"(A) In general. --Subject to subparagraph (B), the Corporation"; and

(B) by adding at the end the following:

"(B) **Waiver for hemp.** --The Corporation may waive the marketability requirement under subparagraph (A) in the case of research and development relating to a policy to insure the production of hemp."

SEC. 12619. CONFORMING CHANGES TO CONTROLLED SUBSTANCES ACT.

(a) In General. --Section 102(16) of the Controlled Substances Act (21 U.S.C. 802(16)) is amended--

(1) by striking "(16) The "and inserting "(16) (A) Subject to subparagraph (B), the"; and

(2) by striking "Such term does not include the" and inserting the following:

"(B) The term 'marihuana' does not include--

"(i) hemp, as defined in section 297A of the Agricultural Marketing Act of 1946; or

"(ii) the".

(b) Tetrahydrocannabinol. --Schedule I, as set forth in section 202(c) of the Controlled Substances Act (21 U.S.C. 812(c)), is amended in subsection (c)(17) by inserting after "Tetrahydrocannabinols" the following: ", except for tetrahydrocannabinols in hemp (as defined under section 297A of the Agricultural Marketing Act of 1946)".