

THE HENRY M. JACKSON
SCHOOL OF INTERNATIONAL STUDIES
UNIVERSITY *of* WASHINGTON

TASK FORCE REPORT



A Review of Hemp as a Sustainable Agricultural Commodity:
Tools and Recommendations for Winona LaDuke's Hemp Farm
and Sovereign Native American Tribes

2018



University of Washington
The Henry M. Jackson School of International Studies

A Review of Hemp as a Sustainable Agricultural Commodity:
Tools and Recommendations for Winona LaDuke's Hemp Farm
and Sovereign Native American Tribes
Task Force 2018

Authors:

Eunhee Choi
Sydne Dresser
Emma Halliday
Hannah Jolibois
Jiyoon Kim
Patrick Leanza
Claire Mason
Cassie Lynch
Calli Plenert

Coordinator:

Guadalupe Wright

Editor:

Jack Russillo

Advisor:

Patrick Christie

Evaluator:

Winona LaDuke

Part 1 Table of Contents:

Acknowledgements..... 3
Executive Summary..... 4
Introduction..... 5
Hemp Legality..... 7
Tribal Case Study..... 13
 Hemp Industry Demographic Analysis..... 23
 General Legal Recommendations..... 24
Economic Feasibility of Hemp..... 25
Environmental Considerations of Hemp..... 28
General Considerations for Hemp Farming 29
Product Assessment 1: Textiles..... 34
Hemp Fiber Company Example: JungMaven 41
Hemp Fiber Company Example: Bastcore..... 43
 General Recommendations for Textile Startup..... 45
Product Assessment 2: Building Materials..... 46
Hemp Building Materials Company Example: Tiny Hemp Houses..... 49
 General Recommendations for Building Materials Startup..... 51
Product Assessment 3: Food Products..... 51
 General Recommendations for Food Products Startup..... 55
Product Assessment 4: CBDs..... 56
Hemp CBDs Example: Shane Davis’ Experience in CBD Businesses..... 60
 General Recommendations for CBD Startup..... 63
Conclusion..... 64
Key Recommendations..... 65

Part 1 Figure Appendix:

Figure 1: US Tribes that have Pursued Hemp..... 13
Table 1: Fixed Costs of Operating a Hemp Farm in Manitoba and Alberta..... 26
Table 2: Uptake and Removal of Nutrients by Hemp Crops 30
Table 3: Morphological Development of Finola..... 32
Figure 2: General Planting and Development Timeline for Hemp..... 32
Figure 3: Images of Female, Hybrid, and Male Hemp..... 35
Figure 4: Examples of Retted Fiber and Fiber Strength Tests..... 37
Table 4: Average Prices of Hemp Fiber for World Competitors (1995)..... 39
Figure 5: The Bastcore Decorticator..... 44
Table 5: Average Hemp Seed Prices From Large American and Canadian Producers..... 55

This Task Force created a curriculum, per the request of Winona LaDuke. It is located following Part 1 conclusion. Its table of contents and figure appendix can be found in its opening pages. The bibliography for our collective research follows the end of the curriculum.

Acknowledgements

Our Task Force would like to express gratitude to the individuals and organizations that made this report possible.

We first would like to extend our thanks to the many industry experts that took time out of their busy schedules to share their experiences and expertise with us:

Garrett Davey & Brad Bartlett
Shane Davis
Marc Grignon
Scott Holden
Renee Johnson
Robert Jungmann
John Lupien
John Patterson
Janie Simms Hipp
George D. Weiblen

We are indebted to Nicolette Slagle, Research and Deputy Director of Honor the Earth, for her generous support throughout this entire endeavor.

We would especially like to thank executive director of Honor the Earth, Winona LaDuke, for allowing us the opportunity to contribute a small part to her important work.

Finally, we would like to thank Professor Patrick Christie for his support and guidance throughout this process and the Henry M. Jackson School of International Studies for this opportunity.

Executive Summary

This Task Force researched options for integrating economic and ecological sustainability into any society, focusing on the feasibility of creating a private hemp business that is led by Winona LaDuke in Minnesota. Hemp can be made into a viable alternative to a variety of goods.

According to a prophecy from the White Earth Tribe, located in Minnesota, we are in “the time of the seventh fire”. This prophecy says that there will come a time when the Anishinaabe people have to make a choice between two paths. One is well worn, but scorched, and the other is less worn, but green. This narrative is inspiring Anishinaabe leaders and the general public to move toward that greener path. This includes activism, such as resisting oil pipelines that snake through indigenous areas and foster dependence on petroleum-based economies. This vision also includes investing in sustainable agriculture, one that brings healthier economic, social, and cultural opportunities to their people. A key step in walking that path is developing sustainable economies such as hemp production.

Our Task Force combined government research, peer-reviewed studies, and interviews with select legal experts, hemp entrepreneurs, researchers, and farmers. While reading this report, it is important to acknowledge that the US-based hemp industry is at an early stage of rebirth and although hemp was grown and processed in United States for generations, its legal status has fluctuated over the last century. To date, limited amounts of research has been published on the subject in this context and available information was of varying levels of quality and reliability.

The following report has two primary sections. Part 1 focuses on a general background of hemp and the issues related to entering the main commercial industries that utilize the crop (textiles, building materials, food, and CBDs). The report also covers basic cultivation practices for producing specific hemp products. Part 2 of the report consists of a curriculum that reviews the history of hemp, its applications, and the basics for how to farm the crop on a commercially viable scale. It draws heavily from Part 1 of the report and translates technical findings into educational materials, which can be utilized to help people gain industrial hemp knowledge.

Our key recommendations concern areas such as being aware of the unclear state of the US hemp industry; working with a strong legal team when engaging in hemp-related activity; starting a hemp business with focuses in the industries of textiles, building materials, and food before moving on to CBDs; lobbying for hemp issues; and identifying ways that farming and processing technologies can be used to align with visions of social and environmental responsibility.

Introduction

Considering the impacts of environmental degradation and the main drivers of it, indigenous environmental activist Winona LaDuke and her organization Honor the Earth are pushing for more socially and environmentally responsible industries. Their most recent project, Winona's Hemp and Heritage Farm, seeks to create an economically successful hemp farm-to-merchandise business for textiles, food stuffs, building materials, and medicines. Our Task Force offers specific tools and recommendations for this project's production, processing, and marketing of hemp and hemp products.

Hemp has a long history and variety of uses. It can be processed into many products ranging from apparel to insulation. Its fibers can be used to create different woven textiles, which are then turned into value-added goods. Its hurds can be used for environmentally benign building materials like hempcrete. Hemp seeds can be processed for nutritious foods, including hemp milk and oils. Furthermore, cannabidiols (CBDs) extracted from hemp flowers are believed to treat a variety of medical conditions and have been growing in popularity across the United States. Yet, in recent history, US drug laws have conflated recreational cannabis and industrial hemp, preventing hemp farming and processing although it was a thriving domestic agricultural product in the first half of the twentieth century and hundreds of millions of dollars of hemp products are imported annually. Sovereign Native American tribes across the country have attempted to grow hemp, but most have received pushback from local and federal institutions and have had their crops confiscated or destroyed. Presently, with bipartisan support for reform policies, a small number of both tribal and non-tribal people across the country are either planning to or are currently growing and processing hemp under strict regulations. Hemp is still on the list of controlled substances and is still federally indistinguishable from recreational cannabis. In addition to legal pushback, the environmental, social, and economic potentials of hemp are not widely known. The crop is often confused with recreational cannabis although the two are different in their chemical make-up, function, and appearance. Those in opposition of the crop suspect a hidden agenda due to its close physical resemblance to cannabis. This public discourse and lack of knowledge is a hindrance to the support and development of a profitable industry.

It is a risky endeavor to attempt to enter this industry, notably for minority groups like indigenous communities. Native Americans face varying social, economic and political challenges due to their interactions with larger structures in the United States. In our analysis we consider this and find that it is increasingly evident that this is mirrored in the emerging domestic hemp industry. We have found that the industry is predominantly Anglo and male, implying that there are stark racial and gendered disparities in who experiences success in their hemp production endeavors. While Native American tribes have continuously experienced extreme pushback, Anglo men have benefitted from existing social structures in the US, often having access to social capital, infrastructure, wealth, and technology, thus resulting in their ability to confidently approach such a legally risky industry. Yet, we recognize the resolve and resilience of the Anishinaabe and other Native American people (and their non-Native collaborators) and remain optimistic in their fight toward economic sovereignty.

Furthermore, as non-Native students trained at the Jackson School of International Studies, we would like to acknowledge our lack of experience in relevant topical areas, such as agronomy and the socio-cultural Native American experience, but we aspired to provide thorough information that was gathered and analyzed within a nine-week time period.

Our report is divided into two main parts, the first of which is concerned with the overall feasibility of starting a hemp company. This details the legal process of starting the business, with a case study that focus on seven Native American tribes' experiences in producing hemp, before examining the benefits and trends within the main modern hemp industries (textiles, building materials, food, CBD). Within these industries, we identify gaps of information, explain the particular farming processes that are needed to begin cultivating hemp for each specific purpose, and illustrate how each hemp product can be utilized as a reliable and beneficial alternative to current relevant products. The analysis draws from the unique experiences of select informants involved in different realms of hemp production, processing, and product marketing. The second part of the report serves as an instructional tool to learn about the plant's history, its contemporary applications, and how to begin farming hemp for commercial purposes.

We hope this information and analysis are fruitful, supportive, and respectful of Ms. LaDuke and the Anishinaabe people.

Part 1:

Hemp Legality

This section will cover the legality of hemp in the United States and attempt to explain the ambiguity surrounding the crop. Hemp lives in a grey area within US law, being federally illegal, but allowed through individual states' pilot programs. This creates a lot of confusion and conflict between federal and state governments, as states fight for their right to legally grow hemp and the federal government continues to treat it as a controlled substance. "The main obstacles facing this potential market are US government drug policies and Drug Enforcement Agency (DEA) concerns about the ramifications of US commercial hemp production".¹ To further demonstrate how ambiguous the laws surrounding hemp are, even lawyers are conflicted over their legal interpretation of the laws regarding the crop. Some have deemed any attempt at growing hemp absolutely illegal and have stated that the current laws make legally producing hemp impossible.² Other lawyers, however, were confident that producing hemp was legal, but even they admitted that the laws surrounding it were very vague.³

Current Hemp Legislation in the United States

With the passing of the 2014 Farm Bill, the federal government allowed for the growth and cultivation of industrial hemp for research purposes, as long as the state it is being grown in has legalized it under a hemp pilot program or has authorized an institution of higher education to research it.⁴ However, this does not make hemp legal. It is still on the list of controlled substances, and is still federally indistinguishable from cannabis. "Under current US drug policy, all cannabis varieties—including industrial hemp—are considered Schedule I controlled substances under the Controlled Substances Act (CSA, 21 U.S.C. §§801 et seq.), and the Drug Enforcement Agency (DEA) continues to regulate hemp production. Strictly speaking, the CSA does not make growing

¹ Johnson, Renée. "Hemp as an Agricultural Commodity." Congressional Research Service, March 10, 2017. Congressional Research Digital Collection. <https://fas.org/sgp/crs/misc/RL32725.pdf>.

² Janie Simms Hipp. Interview with Janie Simms Hipp. Phone Call, January 26, 2018.

³ Garrett Davey, and Brad Bartlett. Interview with tribal lawyers regarding hemp transportation legalities. Telephone Call, February 19, 2018.

⁴ "Industrial Hemp | National Institute of Food and Agriculture." Accessed February 6, 2018. <https://nifa.usda.gov/industrial-hemp>.

hemp illegal; rather, it places strict controls on its production and enforces standards governing the security conditions under which the crop must be grown, making it illegal to grow without a DEA permit”.⁵ According to the 2014 Farm Bill, the state pilot program acts as an equivalent to the DEA permit, allowing the legal growth of industrial hemp under state laws and regulations. “Industrial hemp legitimately may be grown or cultivated either pursuant to section 7606 or in connection with a DEA permit.”⁶ State pilot programs allow individual states to conduct research on the economic viability of hemp and allow them to create their own specific guidelines to their state’s pilot program. It is up to a state’s department of agriculture to further define the process to obtain a pilot permit, as well as required practices and procedures throughout the entire growth, harvesting, processing, and marketing of the hemp.

Permits

Ensuring that all documentation and permits are valid is vital to legally growing hemp. Because hemp has varying degrees of legality, being illegal federally but legal within state pilot programs, any inaccuracies or unclear representation of a crop can result in legal implications.

Minnesota has established a pilot program intended to study the cultivation, processing, and economics of industrial hemp. This program allows for individual farmers, businesses, and colleges to grow hemp, and produce and sell hemp products. In order to be produced legally, the hemp must be grown harvested under a license, registration, authorization, or production lease with the state pilot program under (or otherwise compliant with) section 7606 of the US Agricultural Act of 2014.⁷ To obtain this permit, Minnesota requires multiple documents to be filled out and turned in to the Minnesota Department of Agriculture (MDA). The pilot program application can be found on the MDA’s website.⁸ Along with a completed application, a processing fee, set of fingerprints (which can be obtained from the local police), permission to run a criminal background check, and detailed map of the growing area are required. This map must be as in-depth and accurate as possible, detailing field location, acres grown, seed planted, number

⁵ Johnson, Renée. “Hemp as an Agricultural Commodity.” Congressional Research Service, March 10, 2017. Congressional Research Digital Collection. <https://fas.org/sgp/crs/misc/RL32725.pdf>.

⁶ “Industrial Hemp | National Institute of Food and Agriculture.” Accessed February 6, 2018. <https://nifa.usda.gov/industrial-hemp>.

⁷ Ibid.

⁸ <http://www.mda.state.mn.us/plants/hemp/appinstructions.aspx>

of fields, and intended final product. Otherwise, the DEA can destroy the field, and may cancel the pilot all together.⁹ An example of the lack of clarity for hemp statutes is that no exact time was given for when the pilot permit would be pulled, but that, if the state deemed necessary, it could pull the permit altogether. The program covers all activities regarding hemp (growing, processing, researching, and selling), as long as all intended uses are stated on the application.¹⁰

Growing

After all permits are in order, there are more legal considerations to acknowledge when growing the hemp. The most important factor to take into account is the tetrahydrocannabinol (THC) content of the crop. The legal limit for THC, the psychoactive chemical in cannabis, found in any product cannot exceed 0.3 percent.¹¹ If the product surpasses this limit, after being tested by an MDA inspector, it is considered cannabis. If it exceeds the legal limit, a second test can be requested, however, if it fails the second time, then the fields must be destroyed.¹² The MDA has complete access to all hemp fields for testing and regulatory purposes, and will test within the first thirty days of harvest to ensure the legal THC limits are not exceeded.¹³

To obtain the seeds, they can either be imported from Canada or the European Union, which the MDA recommends, or bought from select farms around Minnesota.

To import seeds from outside the country, the MDA recommends getting varieties from either the Health Canada List of Approved Cultivars for the 2017 Growing Season¹⁴ or the OECD (The Organization for Economic Co-operation and Development) List of Varieties eligible for

⁹ “FAQs Regarding Minnesota’s Industrial Hemp Pilot Program.” Minnesota Department of Agriculture, February 6, 2018.

<http://www.mda.state.mn.us/plants/hemp/industhempquestions.aspx>.

¹⁰ Ibid.

¹¹ “Statement of Principles on Industrial Hemp.” Federal Register, August 12, 2016.

<https://www.federalregister.gov/documents/2016/08/12/2016-19146/statement-of-principles-on-industrial-hemp>.

¹² “FAQs Regarding Minnesota’s Industrial Hemp Pilot Program.” 2018. Minnesota Department of Agriculture. February 6, 2018.

<http://www.mda.state.mn.us/plants/hemp/industhempquestions.aspx>.

¹³ Ibid.

¹⁴ <https://www.canada.ca/en/health-canada/services/health-concerns/controlled-substances-precursor-chemicals/industrial-hemp/commercial-licence/list-approved-cultivars-2017-growing-season-cannabis-sativa.html> February 6, 2018

seed certification.¹⁵ ¹⁶ The advantage of importing seeds is that, according to the MDA’s website, “In 2016 and 2017, all MDA industrial hemp plots were planted with varieties from the Health Canada Approved Varieties list, and were tested and found to be well below the 0.3 percent delta-9 THC threshold”.¹⁷ Because cannabis is still a federally-controlled substance, the DEA requires a completed Application for Permit to Import Controlled Substances/Domestic and/or Scientific Purposes form to import seeds from outside of the country.¹⁸

The MDA requires several reporting forms throughout the growing season. These required forms are a seed transfer agreement, a planting report, and a final report. The information gathered in the final report should include agronomic data, like seeding rate, cultivation methods, yield, and pesticide or fertilizer use.¹⁹ The MDA also states that farmers cannot save any remaining seed for future growing, nor can they sell it to others.²⁰ All new seeds must be bought for the next planting season. The only exception to this rule is for participants of the Minnesota Crop Improvement Association (MCIA) seed certification program.²¹ The MCIA is an organization that focuses on the improvement of agricultural products and processes to maximize the effectiveness of the farmers and their products. They do this “by providing services to enable them (the farmers) to provide high-quality products to Minnesota, the United States and the world” as well as “provide certification and quality assurance services to a wide array of agricultural and food product producers and handlers”.²²

¹⁵ <http://www.oecd.org/tad/code/codes-schemes-list-of-varieties-crucifers-and-other-oil-or-fibre-species.pdf> February 6, 2018

¹⁶ “FAQs Regarding Minnesota’s Industrial Hemp Pilot Program.” 2018. Minnesota Department of Agriculture. February 6, 2018.

<http://www.mda.state.mn.us/plants/hemp/industhempquestions.aspx>

¹⁷ Ibid.

¹⁸ “Importing Hemp Products into the U.S.” n.d. Accessed February 7, 2018.

https://help.cbp.gov/app/answers/detail/a_id/1751/~/importing-hemp-products-into-the-u.s.

¹⁹ “FAQs Regarding Minnesota’s Industrial Hemp Pilot Program.” 2018. Minnesota Department of Agriculture. February 6, 2018.

<http://www.mda.state.mn.us/plants/hemp/industhempquestions.aspx>.

²⁰ Ibid.

²¹ “Certification Authority for Seed & Noxious Weed Free Forage in MN.” Accessed February 7, 2018. <http://www.mncia.org/>.

²² “About MCIA - Minnesota Crop Improvement Association.” Accessed February 26, 2018.

<http://www.mncia.org/about-mcia>.

Transportation

The laws regarding transportation of hemp is dependent on where the crop is being transported to and from, as well as the types of borders that are crossed. The transportation of hemp or hemp products within the borders of the state of Minnesota is legal, as the pilot program allows for free transportation and trade of all products within state borders. This only applies within state boundaries. It is not a violation of Minnesota's pilot program to sell outside of the state, however it may be in violation of other states laws, depending on which state the hemp is being transported to and their laws regarding hemp.²³ Because not all states have allowed for the growth of hemp under a pilot program, going into a state without one would be transporting a federally illegal substance into the state. Knowledge of the receiving state's laws regarding hemp should be known prior. The transportation of processed products, such as value-added goods like textiles, building materials, and food, is completely legal, and can be shipped anywhere. The ambiguity lies in the transportation of the raw materials, like seeds and whole plants. While there is no information regarding this, there are some rules that are set forth by the federal government regarding the subject. The transportation of live seed and plants (that could be used to farm more hemp) across state lines is illegal²⁴ and any seeds imported into the country through the DEA cannot be sold or transported outside of the state.²⁵ All imported seeds are documented according to DEA requirements, from import, to transfer to certificate holder, to planting in the ground.

In regards to CBDs, which the DEA still considers them a controlled substance, the regulation is stricter than other hemp products. Because marijuana extract rule, issued by the DEA in 2016, any extracted oil from cannabis flowering tops, which is where the majority of oils come from, is still considered a controlled substance.²⁶ However, if collected from the industrial parts of hemp plants (stalk, seed, hurd), then it does fall under the Farm Bill and is not considered a

²³ "FAQs Regarding Minnesota's Industrial Hemp Pilot Program." Minnesota Department of Agriculture, February 6, 2018.

<http://www.mda.state.mn.us/plants/hemp/industhempquestions.aspx>.

²⁴ "Statement of Principles on Industrial Hemp." Federal Register, August 12, 2016.

<https://www.federalregister.gov/documents/2016/08/12/2016-19146/statement-of-principles-on-industrial-hemp>.

²⁵ "FAQs Regarding Minnesota's Industrial Hemp Pilot Program." Minnesota Department of Agriculture, February 6, 2018.

<http://www.mda.state.mn.us/plants/hemp/industhempquestions.aspx>.

²⁶ Garrett Davey, and Brad Bartlett. Interview with tribal lawyers regarding hemp transportation legalities. Telephone Call, February 19, 2018.

controlled substance.²⁷ Another issue faced with CBDs is the marketing claims that are made on the product. The Food and Drug Administration (FDA) has cracked down on CBD producers that claim that CBDs have the ability to prevent, diagnose, treat, or cure cancer without evidence to support these outcomes.²⁸ Whether or not CBD's have any medical benefit to them, because they are not tested by the FDA, any medical claims made are seen as false advertising that could potentially lead sick individuals away from FDA-approved, proven medical treatments.²⁹

Transporting hemp in and out of tribal territory is extremely vague. There are many factors to consider when transporting hemp materials and products. The first thing to account for when transporting across tribal land are the laws surrounding hemp both inside the sovereignty of the tribe and in the surrounding state. Because hemp is being transported into tribal land, the tribe must have legalizing legislation in place for hemp within their borders before crossing any reservation borders. For example, the legality of transporting into the White Earth Reservation would be dependent on the legal status of hemp within the tribe. If the tribe has legalized hemp, then transporting it onto their land would be compliant with their laws. Transporting from tribal lands to the surrounding state would be dependent on the laws of the state. For example, transporting from the White Earth Reservation into Minnesota, and vice versa, would be compliant with Minnesota's laws because each has legalized hemp. The laws for each tribe and state should be known prior to shipment. Another barrier to transportation that could hinder movement into tribal lands would be the type of product that is being moved. Transporting any cannabidiol (CBD) products, which the DEA classifies as a controlled substance, could lead to scrutiny from the DEA, regardless of whether it is derived from hemp or cannabis. Likewise, the flowers of hemp plants are also a controlled substance, according to the DEA, thus transporting them could lead to similar scrutiny. However, transportation of industrial parts of the hemp plant (stalk, hurd, neutralized seed) does not fall under the CSA, so they are relatively safer to transport than CBDs.³⁰

²⁷ Ibid.

²⁸ Commissioner, Office of the. "Press Announcements - FDA Warns Companies Marketing Unproven Products, Derived from Marijuana, That Claim to Treat or Cure Cancer." WebContent.

²⁹ Accessed February 6, 2018.

<https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm583295.htm>.

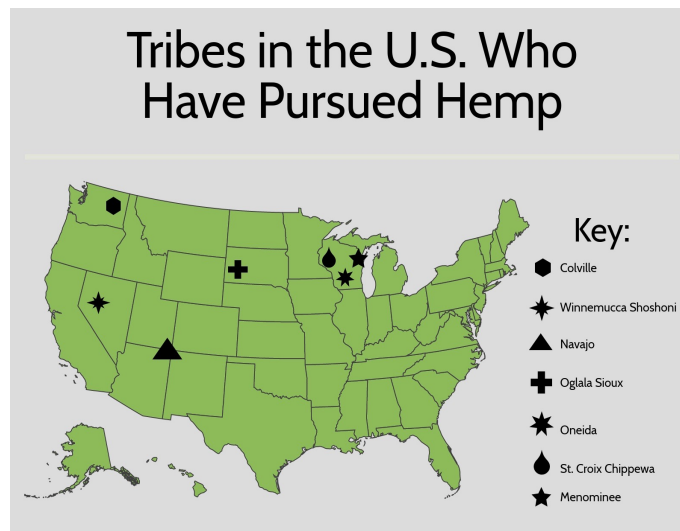
³⁰ Garrett Davey, and Brad Bartlett. Interview with tribal lawyers regarding hemp transportation legalities. Telephone Call, February 19, 2018.

The next section examines various tribes across the United States and their experiences with federal and state governments as they attempted to create hemp industries of their own.

Tribal Case Study

This section will contain a brief overview of several Native American tribes within the United States that have either expressed interest in growing hemp or who have already begun to pursue the opportunity. It is important to note that the tribes included in this exploratory case study—Oglala Sioux, Oneida, St. Croix Chippewa, Menominee, Colville, Winnemucca, and Navajo—are not an exhaustive list. These tribes were chosen based on information widely available and also because of their varying locations within the United States. The Oglala Sioux tribe of Minnesota will be the first example included in this study, as they have had the longest history of attempting to grow hemp in the twenty-first century. Then, the Oneida, St. Croix Chippewa, and Menominee tribes will be investigated because of their proximity to the state of Minnesota. Finally, the other three tribes—Colville, Winnemucca, and Navajo—located in the Western United States, will be examined.

Figure 1



Each of the following sections will contain a brief background of the tribe being discussed as well as their experience with industrial hemp, successes, failures, and where the tribes stand today in regards to their pursuance of industrial hemp.

Oglala Sioux

The Pine Ridge reservation is located in South Dakota and is home to the Oglala Sioux Tribe.³¹ The Oglala, also known as Scatter Their Own, are one of seven groups of the Lakota division within the Great Sioux Nation. Their current population is approximately 40,000 people and the reservation consists of grassy plains in the southern and eastern regions while the west-central region contains spikes from the Black Hills.³²

For historical context, it is necessary to understand the Oglala Sioux's relationship with the United States dating back over a century. The Fort Laramie Treaty of 1868 served as a peace settlement between the Sioux and the United States of America who had been in conflict regarding land rights in years prior. The treaty also defined the Sioux tribe's right to cultivate land for their economic benefit. The eighth article of the treaty states, "When the head of a family or lodge shall have selected lands and received his certificate as above directed, and that agent shall be satisfied that he intends in good faith to commence cultivating the soil for a living, he shall be entitled to receive seeds and agricultural implements..."³³ This treaty is essential to understanding the Sioux's relationship with the United States in regards to sovereignty because it has been used as a tool in the lawsuit of *The United States vs. White Plume, et al*, a lawsuit that will be further explained in the subsequent paragraphs.

The Oglala Sioux Tribal Council amended Ordinance No. 98-27 in July of 1998 with a vote of eight to four. The Ordinance lists numerous other countries currently growing hemp as an example, references historical treaties where the United States and the Oglala Sioux agreed that the tribe has a right to grow food and fiber from the land, as well as notes that hemp was a product grown in the Pine Ridge region when the Sioux and the United States initially signed their treaties. Furthermore, the ordinance explicitly defines the difference between cannabis and hemp and explains the reasoning behind wanting to cultivate the crop including creating a sustainable, land-

³¹ "Friends of Pine Ridge Reservation." Friends of Pine Ridge Reservation. Accessed February 13, 2018. <https://friendsofpineridgereservation.org/about-pine-ridge-reservation-and-fopr/>.

³² "Oglala Lakota Nation." Official Website of the Oglala Sioux Tribe. Accessed February 13, 2018. www.oglalalakotanation.info.

³³ Smith, Steve. "Hemp for Sovereignty: Scale, Territory and the Struggle for Native American Sovereignty." *Space and Polity* 12, no. 2 (August 1, 2008): 231–49. <https://doi.org/10.1080/13562570802173364>.

based economy for the tribe.³⁴ On April 14, 2000, Joe American Horse announced on KILI radio, whose slogan is “The Voice of Lakota Nation”, that the Oglala Sioux tribe would be growing hemp on April 29, 2000, the 132nd anniversary of the signing of the Fort Laramie Treaty of 1868.³⁵ The reason behind the desire to plant hemp was to increase the control over the jurisdiction of tribal lands.³⁶

The tribe’s relationship with growing hemp and its continual controversy is centrally connected to one family, the White Plumes. After Joe American Horse’s announcement, Alex White Plume, a tribe member of the Oglala Sioux, planted hemp seeds on a one-and-a-half-acre lot of land and experienced positive results. The stalks grew to over twelve feet and were below the previous one percent legal THC level to distinguish the plant as hemp rather than cannabis. Regardless, the farm was raided by multiple groups; the DEA, FBI, Bureau of Indian Affairs, and US Marshals. The crops were cut and confiscated and dealt an economic blow to the White Plumes who had relied on the crop’s output for profits. To compensate for their losses and because their crops had been pre-sold to a consortium in Kentucky, the White Plumes sold off several of their prize horses in order to settle payments on their land.³⁷ Although their crops had been seized the year before, the White Plume extended family were determined to grow hemp again in 2001. Alex White Plume did not participate in the 2001 crop cultivation of hemp due to legal agreements he had made in exchange for immunity from prosecution.³⁸ However, he had expressed unease about his family’s reliance on a crop that could once again be taken from them:

Late last fall, when I couldn’t pay my loans, I was ready to lose my lease and we had to sell some of our prime horses, it was about then that I said, ‘Oh I wish we’d never planted this hemp.’ Especially when we sold our fastest horse. But, at the same time, every day we

³⁴ “Oglala Sioux Tribe: Law and Order Code, Hemp Ordinances and Resolution.” Accessed February 13, 2018. https://www.narf.org/nill/codes/ogla_sioux/oglahemp.html.

³⁵ “About.” KILI RADIO. Accessed February 16, 2018. <http://www.kiliradio.org/about.html>.

³⁶ Cook, Tom. “Oglala Sioux Exercising Sovereignty to Grow Industrial Hemp,” April 25, 2005. <https://ratical.org/renewables/OglalaHemp.html>.

³⁷ Dellinger, Laura M. “Hemp Planted Again on Pine Ridge.” *Indian Country Media Network* (blog), May 30, 2001. <https://indiancountrymedianetwork.com/news/hemp-planted-again-on-pine-ridge/>.

³⁸ Smith, Steve. “Hemp for Sovereignty: Scale, Territory and the Struggle for Native American Sovereignty.” *Space and Polity* 12, no. 2 (August 1, 2008): 238. <https://doi.org/10.1080/13562570802173364>.

live, we have to sacrifice something to get something better in the end. So we got over that hump.³⁹

Alex's brother, Percy White Plume, planted his own farm, but it was once again removed by the DEA on July 30, 2001.⁴⁰ 2002 was the first year when the the Oglala Sioux tribe successfully harvested their hemp without it being taken by the DEA or other governmental entity. Although this was considered a success, several days later, the federal government obtained papers that prohibited the White Plume family from growing and harvesting hemp without the explicit permission from the DEA.⁴¹ This was the first growing season where Alex White Plume had been officially charged with a federal infraction and the litigation of the *The United States vs. White Plume et al* began. At the trial's end, on December 30, 2004, the court ordered a permanent injunction against Alex White Plume to prohibit his growing of hemp.⁴²

The PBS film, *Standing Silent Nation*, premiered on July 3, 2007 and focused on the White Plume family's experiences over a four year period immediately following Alex White Plume's receipt of his federal injunction. Through filming, producer Courtney Hermann discovered the greater significance behind the film, "The film originally dealt with the American farm community's right to grow industrial hemp...As Alex's story unfolded, our focus shifted. We now see hemp as a vehicle through which a larger and arguably more important issue is playing out -- the sovereignty of the Lakota Nation".⁴³

Over a decade later, in March of 2016, judge Jeffrey Viken lifted the injunction that had stopped Alex White Plume from growing hemp on the Oglala Sioux land. His reasoning behind the repeal was based on the changing cultural and legal landscape towards cannabis and hemp. The overruling of the previously permanent injunction reasserts the sovereignty of tribes within

³⁹ Dellinger, Laura M. "Hemp Planted Again on Pine Ridge." *Indian Country Media Network* (blog), May 30, 2001. <https://indiancountrymedianetwork.com/news/hemp-planted-again-on-pine-ridge/>.

⁴⁰ Smith, Steve. "Hemp for Sovereignty: Scale, Territory and the Struggle for Native American Sovereignty." *Space and Polity* 12, no. 2 (August 1, 2008): 238. <https://doi.org/10.1080/13562570802173364>.

⁴¹ Ibid.

⁴² "USA v. White Plume, et Al, No. 5:2002cv05071 - Document 143 (D.S.D. 2016)." Justia Law. Accessed February 16, 2018. <https://law.justia.com/cases/federal/district-courts/south-dakota/sddce/5:2002cv05071/24992/143/>.

⁴³ "Film Description | Standing Silent Nation| PBS." *POV | American Documentary Inc.* (blog), January 23, 2007. <http://www.pbs.org/pov/standing/film-description>.

the United States. The ruling also infers that tribal nations have equivalent rights to individual states. The lift of the injunction has been considered a victory for tribal sovereignty.⁴⁴

Oneida

The Oneida tribe originally occupied a region in what is today central New York primarily around Lake Oneida and south to the Susquehanna River. Presently, they are scattered across North America, with the majority of the Oneida Tribe (about 12,000) residing in Wisconsin, 1,700 in Canada, and close to 500 in New York. The Oneida are also referred to as “People of the Standing Stone” and are known for their love of peace and hospitality.⁴⁵

In December of 2017, Wisconsin’s governor, Scott Walker passed a bill to permit farmers to grow and harvest industrial hemp. After the announcement, The Oneida Nation began to weigh options for entering the hemp industry as well as debating which avenues to take. The Oneida Nation planned a meeting with their Community Development Planning Community to discuss different hemp production options. Questions that they expressed interest in discussing included whether or not they would be growing the hemp themselves or simply manufacturing the hemp into finished products. Before going forward, the Oneida Nation wants to ensure that all legal avenues have been considered for both federal and state level to avoid any future problems with the Drug Enforcement Agency or the State of Wisconsin.⁴⁶

St. Croix Chippewa

The Chippewa Indians, also known as Ojibwe, are from the Great Lakes area and lived mainly in Wisconsin, Michigan, Minnesota, North Dakota, and Ontario. Historically, they were hunters and fishermen, although they did grow crops at their summer residences. The Chippewa

⁴⁴ Ecoffey, Brandon. “White Plume’s Hemp Injunction Lifted.” Lakota Country Times, March 31, 2016. http://www.lakotacountrytimes.com/news/2016-03-31/Front_Page/White_Plumes_Hemp_Injunction_Lifted.html.

⁴⁵ Lindsay, Jeff. “The Oneida Indian Tribe of Wisconsin.” The Oneida, September 29, 2012. <https://www.jefflindsay.com/Oneida.shtml>.

⁴⁶ Johnson, Christopher. “Oneida Nation | Oneida Weighs Hemp Options,” December 8, 2017. <https://oneida-nsn.gov/blog/2017/12/08/oneida-weighs-hemp-options/>.

are one of the largest groups of Native Americans in North America.⁴⁷ In 2010, the tribe's population in the United States was around 170,000 people⁴⁸.

Similar to the Oneida tribe, the St. Croix Chippewa were optimistic following Wisconsin Governor Scott Walker's sign off on a bill in December 2017 to allow industrial hemp farming in the state. The tribe has shown a strong interest in processing the hemp to produce CBD oil, which has been used for its medicinal benefits in easing symptoms for people who regularly have seizures. Jeff Cornell, the general counsel for the tribe, has explained that if the state of Wisconsin were to prevent them from processing CBD oil, that the tribe has a right as a sovereign nation to process hemp due to its own tribal laws on the reservation. Cornell explained that as a tribe, the St. Croix Chippewa have already implemented compliance measures to oversee safety measures:

In the CBD ordinance we created, we created departments for safety. We have our own regulatory schemes, our internal control standards where all those safety measures have already been considered and put into place...The processing plant that we'll be putting together is all going to be laboratory grade...Everybody that is working with us in this process are experts in this field.⁴⁹

The tribe expects to invest approximately \$1.2 million over the next years for hemp production. They estimate that fifteen jobs will be created in the short-term, with the potential of up to one hundred jobs in the long-term.⁵⁰

⁴⁷ "Ojibwe Indians." Accessed February 7, 2018. <http://geo.msu.edu/extra/geogmich/ojibwe.html>.

⁴⁸ "CDC - American - Indian - Alaska - Native - Populations - Racial - Ethnic - Minorities - Minority Health," December 2, 2012. <https://web.archive.org/web/20121202213657/http://www.cdc.gov/minorityhealth/populations/REMP/aian.html>.

⁴⁹ Kaeding, Danielle. "Hemp Farming Gets Green Light While St. Croix Chippewa Moves Forward With CBD Oil Production." Wisconsin Public Radio, December 5, 2017. <https://www.wpr.org/hemp-farming-gets-green-light-while-st-croix-chippewa-moves-forward-cbd-oil-production>.

⁵⁰ Ibid.

Menominee

The Menominee tribe is located in Wisconsin to the east of Green Bay. There are currently 8,551 members of the tribe and the reservation is 235,523 acres. On their website, the Menominee state that they live amongst beautiful rivers, lakes, streams, and pristine forests.⁵¹

The Menominee tribe began to grow hemp in the Summer of 2015 to enhance the tribe's self-sufficiency and improve their economic situation. Shortly after planting, the DEA raided their crops on the basis that the plants were not hemp, but high-percentage THC-containing cannabis, although a prior test done by the federal government had come back negative for the presence of THC. The government has yet to release its findings for the test that led to the raid of the crops. News articles stated that the DEA had seized approximately 30,000 plants.⁵²

In November of 2015, the tribe filed a lawsuit against the DOJ and DEA that requested clarification on whether or not the tribe has the right to grow hemp based on the guidelines stated in the 2014 Farm Bill. As stated above, growing hemp is only legal under the bill if it is for the purpose of research and in partnership with an institution of higher learning. The Menominee tribe asserts that they were in collaboration with the College of the Menominee Nation in order to research hemp with the hopes of helping the tribe.⁵³ The case was later dismissed by the judge in May of 2016 on the basis that only states had the right to grow hemp under the 2014 Farm Bill, not tribes. In the Judge's nineteen-page decision, William Griesbach explained:

While Wisconsin law is not enforceable on the Menominee Reservation, that does not change the fact that the growing or cultivating of industrial hemp is not allowed under the laws of the State of Wisconsin. Because the Tribe is located in the State of Wisconsin, the hemp exception to the Controlled Substances Act does not apply to the Tribe.⁵⁴

⁵¹ "Brief History - About Us." The Menominee Indian Tribe of Wisconsin. Accessed February 16, 2018. <http://www.menominee-nsn.gov/CulturePages/BriefHistory.aspx>.

⁵² Krumholz, Ben. "Menominee Tribal Chairman Defends Industrial Hemp Grow." WLTK, October 28, 2015. <http://fox11online.com/news/local/northwoods/menominee-indian-tribe-reacts-to-federal-investigation-of-hemp-crop>.

⁵³ "Hemp Lawsuit after Raid: Menominee Tribe Suing Feds in Fight to Grow Crop." The Cannabist, November 18, 2015. <https://www.thecannabist.co/2015/11/18/menominee-tribe-hemp-lawsuit-dea-doj/44061/>.

⁵⁴ "Menominee Indian Tribe of Wisconsin v. Drug Enforcement Administration and U.S. Dept. of Justice ; Indian Law Bulletins, National Indian Law Library (NILI)." National Indian Law Library, May 23, 2016. https://www.narf.org/nill/bulletins/federal/documents/menominee_v_dea_doj.html.

Although the case has been dismissed, the Menominee tribe continues to reflect on their experience with the DEA and the United States government.

Marcus Grignon, a member of the Menominee Nation who also served as the tribe's agricultural researcher for their hemp project, was interviewed in February 2018 and provided insight on several remaining questions regarding the events that unfolded in 2015.⁵⁵ When asked about his opinion concerning the judge's interpretation of "State" as not inclusive of tribes, Marc explained, "We were trying to set a national precedent for other tribes to basically use tribal sovereignty to create their own hemp programs in states where [they] don't already have a hemp program in place".⁵⁶ Based on the judge's dismissal of the Menominee tribe's lawsuit, it appears that setting a national precedence for other tribes to use their sovereignty to grow hemp may be harder than originally anticipated. Grignon continued on by stating, "We're still dealing with the ramifications of what happened in the 1800s...we have these judges who have these nineteenth century mindsets dictating what tribes can and cannot do with their tribal sovereignty".⁵⁷ The interview then shifted to Grignon raising several questions that had gone unanswered. After the seizure of some 30,000 plants by the DEA, Grignon wanted to know where the crops ended up, "I'd really like to know whatever happened to the seeds. Did they destroy them or did they get shipped to another hemp state where someone bought them?"⁵⁸ Moreover, Grignon pondered why the DEA decided to raid their reservation even after the Menominee tribe had agreed to burn any plants they had grown that were over the allowed level of THC.

Colville

The Colville Reservation is located in both Ferry and Okanogan County in Washington State. The reservation is 1,011,495 acres and had a population of 3,782 people in 1990. Their economy is mainly built on farming, logging, reforestation, and stock raising.⁵⁹

Colville was the first tribe in Washington to grow hemp for seed and fiber and experienced a successful first year. They teamed up with consultant, Doug Fine, author of "Hemp Bound" who

⁵⁵ "HempsteadProjectHeart." Accessed February 17, 2018.

<https://www.hempsteadprojectheart.org/our-story>.

⁵⁶ Grignon, Marcus. Talk with Marcus Grignon. Voice Recording, February 13, 2018.

⁵⁷ Grignon, Marcus. Talk with Marcus Grignon. Voice Recording, February 13, 2018.

⁵⁸ Ibid.

⁵⁹ "Colville (Native Americans of the Plateau)." Accessed February 7, 2018. <http://what-when-how.com/native-americans/colville-native-americans-of-the-plateau/>.

believes that hemp is a potential source of nutrition and energy. Colville planted their hemp on sixty acres and reported success in October 2017 after their harvest.⁶⁰ Their yield was more than a ton of hemp seed production and the tribe was thrilled that their crop brought in revenue within its first year.⁶¹ As of December 2017, Washington state announced that it will not continue issuing licenses to grow hemp in 2018 due to a shortfall in its budget.⁶²

Winnemucca

The Winnemucca Indian Colony is part of the Western Shoshone principal tribe and was established in 1917. It is located in northwestern Nevada in Humboldt County and is closely related to the Paiute Tribe.⁶³ The Winnemucca tribe sued San Joaquin County and the DEA after twenty-six acres of its hemp crop were seized on October 10, 2017. Although the tribe is based in Nevada, it partnered with SG Farms in Stockton, California to grow the hemp for research purposes.⁶⁴ Winnemucca claimed that the seizure of the hemp plants cost an estimated \$77 million and requested a temporary restraining order, return of the plants, and a declaration that banning the grow was unlawful. In December, a federal judge rejected the request to resume growing hemp despite the ban that was put into place for the county. The request was rejected because growing hemp is illegal in California unless it is grown by a research institution, like a college. Currently, growing hemp is banned in San Joaquin County until September 2019.⁶⁵

⁶⁰ “Colville Tribe Will Test Hemp Production on Its Reservation.” Spokesman.com. Accessed February 7, 2018. <http://www.spokesman.com/stories/2017/aug/01/colville-tribe-will-test-hemp-production-on-its-re/>.

⁶¹ “Colville Tribe’s First Hemp Harvest Is a Success, Officials Say.” Tribal Tribune. Accessed February 7, 2018. http://www.tribaltribune.com/news/article_c1b75a36-bd9f-11e7-87c2-ff98971475fa.html.

⁶² “Washington State Halts Issuing of Hemp Licenses, Citing Budget Shortfall.” Marijuana Business Daily, December 5, 2017. <https://mjbizdaily.com/washington-state-halts-issuing-hemp-licenses-citing-budget-shortfall/>.

⁶³ “Winnemucca Indian Colony (Nevada) Genealogy - FamilySearch Wiki.” Accessed February 7, 2018. [https://www.familysearch.org/wiki/en/Winnemucca_Indian_Colony_\(Nevada\)](https://www.familysearch.org/wiki/en/Winnemucca_Indian_Colony_(Nevada)).

⁶⁴ “Tribe Sues DEA, California County for Removal of 26-Acre Hemp Crop.” Marijuana Business Daily, October 31, 2017. <https://mjbizdaily.com/tribe-sues-dea-california-county-removal-26-acre-hemp-crop/>.

⁶⁵ Breitler, Alex. “Hemp Farmers Lose in Federal Court.” recordnet.com. Accessed February 7, 2018. <http://www.recordnet.com/news/20171202/hemp-farmers-lose-in-federal-court>.

Navajo

The Navajo Nation today expands from Arizona to New Mexico, and also includes parts of Utah.⁶⁶ The Nation's Navajoland, also called Diné Bideyah, spans 27,000 miles and has a diverse landscape that consists of arid deserts, plateaus, alpine forests, as well as tall mountains and mesas.⁶⁷ Presently, the population of the Navajo tribe is around 300,000 people, and the unemployment rate is forty to fifty percent.⁶⁸

In October of 2016, numerous articles were posted from different sources stating that the Navajo tribe had signed its first resolution to grow industrial hemp, with help from CannaNative LLC, a native-owned economic development company that aids tribes in developing cannabis based economies on sovereign lands.⁶⁹ The Navajo tribe and CannaNative would be adding to an already existing 70,000 acre farm in New Mexico for the growing of hemp. The CannaNative CEO, Anthony Rivera, believes that the cannabis industry could far surpass the already existing gaming industry, which many tribes rely on for their economic well-being. However, New Mexico does not currently allow the growing of industrial hemp, with the Governor of New Mexico, Susanna Martinez, stating that discrepancies between state and federal law led to her decision to veto the state-wide hemp legislation proposal. With that being said, Rivera still remains optimistic and believes that the Navajo tribe's relationship with the government will clear up present obstacles. The tribe expressed interest in using hemp for a variety of different products, including ropes, tarps, building material, and hemp oil.⁷⁰

In July of 2017, the Navajo Nation Council Health, Education, and Human Services Committee voted four to zero in favor of amending Navajo Nation criminal code so that, "it shall not be unlawful for any business, as defined in 12 N.N.C. § 308 (D), to cultivate and produce

⁶⁶ "History." Accessed February 7, 2018. <http://www.navajo-nsn.gov/history.htm#>.

⁶⁷ "Navajo History." Accessed February 7, 2018. <http://www.discovernavajo.com/navajo-culture-and-history.aspx>.

⁶⁸ "Hemp Gives Economic Hope to Native American Tribes." Money. Accessed February 7, 2018. <http://time.com/money/4543492/hemp-native-americans/>.

⁶⁹ "CannaNative™ | General Hemp." Accessed February 7, 2018. <https://general-hemp.com/portfolio-companies/cannanative/>.

⁷⁰ Borhardt, Debra. "Navajo Tribe Signs Its First Hemp Growing Resolution." Forbes. Accessed February 7, 2018. <https://www.forbes.com/sites/debraborhardt/2016/10/24/navajo-tribe-signs-its-first-hemp-growing-contract/>.

cannabis or hemp, for economic, industrial, or scientific purposes.”⁷¹ The council members voted to approve this amendment in the hopes that it would strengthen the Navajo economy, increase the standard of living, promoting health and wellbeing amongst the Navajo citizens, as well as increasing economic development. The legislation will next be reviewed and approved by the Resources and Development Committee but the Navajo Nation Council serves as the ultimate jurisdiction on this piece of legislation.⁷²

Hemp Industry Demographic Analysis

Through this preliminary research, multiple patterns have surfaced in relation to those who have success while growing hemp and those who encounter problems. The majority of tribes in this study who have attempted to pursue hemp have experienced extreme pushback from the United States government, whether it be raids from the DEA, tribal laws that legalize the growing of hemp going unacknowledged, or cases being dismissed in court. The Colville tribe in Washington is the only exception, as they did not have any conflict with the federal government while cultivating their hemp. Each tribe had expressed interest in cultivating hemp as a strategy to improve their local economies. On the other hand, anglo entrepreneurs and businessmen from states who have approved the Industrial Hemp Research Pilot Program rarely encountered issues in dealing with the DEA and the US government. It is important to recognize this dynamic to due to the racial implications that it may raise. Not only this, but the intersection of gender magnifies the disparity between those who grow hemp and those who do not. The lack of women in the hemp industry is emphasized in the research provided in this report. Considering Winona LaDuke’s goal to grow hemp as a native woman, these disparities should be called into question.

⁷¹ “Navajo Nation Council Committee Approves Production Of Cannabis, Hemp.” *Arizona Daily Independent*, July 1, 2017. <https://arizonadailyindependent.com/2017/07/01/navajo-nation-council-committee-approves-economic-development-through-production-of-cannabis-hemp/>.

⁷² Ibid.

General Legal Recommendations

As long as a hemp company is operating on land within a state or tribal reservation that has passed legalizing legislation, and all permits for growing and commercial purposes are acquired, it is feasible to create a hemp business. In Minnesota, the farming of hemp can take place legally if the owner has been accepted into the state's pilot program and all inspections are passed. Any neighboring states would need to have also legalized the production of hemp for it to be transported out of Minnesota. Concerning individual Native American tribes, their government also must have legalized hemp within their reservation for transportation to occur. For an intertribal co-op to exist, these issues would need to be addressed. As time passes, US or tribal legislation may get passed that clears up the unestablished legal status of hemp. It is also wise to seek out legal guidance whenever making a new decision regarding hemp operations.

Further, the decision between whether or not to operate Winona's hemp farm as a collaboration with the White Earth tribe, or as an entirely separate private business, is a vital one. Based on our research findings, it appears that private businesses experience less conflict with the US government than tribes have. If Winona wishes to pursue hemp for economic means and profit, launching her hemp farm as a private business, separate from the White Earth tribe, is advised. However, if Winona wishes to test tribal sovereignty and Native people's rights, there is no issue in growing her hemp farm as an association with White Earth. Based on the experiences of several other tribes included within this study, it is important to note that the farm may come into conflict with the US government if the farm is related to a Native American tribe. If this is the route taken, crops and investment may be more at risk to raids, but could raise questions regarding the social issues plaguing Native Americans as an excluded group within the industry.

Economic Feasibility of Hemp

The cost of starting a hemp farm depends on numerous factors. First, the resources that are already in place such as land, irrigation systems, and machinery. Other factors depend on the level of expertise the farmer has with the hemp plant and what they would like to achieve while growing, whether it's to make products or produce raw materials for export. To understand what costs will be necessary to begin growing industrial hemp, we can look at Table 1 on the next page.

The first column was retrieved from the Manitoba Agriculture's 2018 Special Crop Production Costs report. The document outlined the costs to produce raw hemp materials. It does not base findings on whether the land was irrigated or not, and is labeled as "general". It is also important to consider that these estimates are general recommendations from Manitoba Agriculture and they encourage producers to calculate their own costs based on aspects that change from farm to farm, like soil and climate. These prices also reflect the assumption that fertilizers are used, which is not true for an organic farm. The averages from the Industrial Hemp Seed Production Costs and Returns in Alberta for 2015 are in the second and third columns of Table 1. The report surveyed ten growers in total who represented nineteen fields and a total of 2,370 acres. From this total, ten fields were on irrigated land and the other nine on dry land, whose results were calculated on a per acre basis. According to the data they collected, irrigating the land is more expensive than growing on dryland. Although this is true from a production standpoint, in the long term, the yield is much greater on irrigated land than on dry land.

There are also a few differences in what information was available due to the different climates of the areas studied, and the different tests conducted. Also, due to the lack of legal ground in the United States for hemp thus far, there are no insurances available for weather or insect damage like the costs reflect in Canada. The costs in total therefore vary based on whether the land is irrigated, the insurances available, and the fixed costs that are already in place from the grower. The operating costs will also vary with each category of product, such as price and product-specific seeds and the labor costs to process various raw materials for value-added products such as clothing or food. Outlined below is simply an example of the base costs necessary for starting a hemp business.

Table 1: Fixed Costs of Operating a Hemp Farm in Manitoba and Alberta

Operating Costs	Manitoba, General (US \$/acre)	Alberta, Irrigated (US \$/acre)	Alberta, Non- Irrigated (US \$/acre)
Seed, Treatment, Fertilizer	\$75.39	\$122.15	\$114.27
Fuel / Utilities	\$13.28	\$5.56	\$15.08
Machinery Operating	\$7.94	\$11.11	\$17.46
Crop Insurance	\$24.54	N/A	N/A
Hail Insurance	\$8.00	N/A	N/A
Other Costs	\$6.15	\$80.17	\$23.02
Land Taxes	\$11.91	N/A	N/A
Labor	\$23.81	\$19.05	\$8.73
Other Variable + Capital Costs	\$51.34 (land investment costs)	\$227.81	\$90.49
Interest on Operating	\$4.51	N/A	N/A
Machinery Investment	\$14.89	N/A	N/A
Machinery Depreciation	\$36.28	\$53.18	\$57.95
Total Production Costs	\$278.04	\$519.03	\$327.00

Because these are different reports, some of the data gathered in one report was not gathered in another, labeled as N/A. Total costs represent all out-of-pocket expenses the farmers encountered during their production periods. Some farmers can avoid these costs if they already have some of the necessary equipment. Manitoba and Alberta, like Minnesota, have widely varying climates. The similarities between these climates and Minnesota make these findings valuable, as they can be used as a reference point for growing hemp in Minnesota. They were also chosen because the majority of hemp grown in Canada comes from these two provinces and therefore they had the most data available.⁷³ To use these data most effectively, the estimated yield a grower can expect is largely based on their experience level. Experience can vary based on prior agricultural experience and is not precisely quantifiable.

Farmers with more growing experience will generally have higher crop yields, meaning they can produce hemp materials more efficiently. The yield for fiber is nearly double that of seed because of the harvesting timeline of the plant, according a Kentucky study. Experience is based on experience level and product yields can vary between 4.6 to 8.1 tons per acre for fiber, and six hundred to more than one thousand pounds per acre for seed.⁷⁴ Farmers with more experience can expect that their yields will be nearer the upper end of the range while farmers with less experience should generally fall in the lower end. When harvested for fiber, it is typically around when the male plants pollinate and both male and female plants are harvested. For seed, only the female plants are harvested as the males will have already died.⁷⁵ As the US industry develops through practice and education, profits are expected to rise. Overall, this information can help in calculating the profits in the first years of owning a hemp farm. The formulas used to calculate profits are:

1. Gross Revenue = (price per unit) x (yield per acre)
2. Net Profit = (gross revenue) – (total cost of production)
3. Breakeven Price = cost / target yield (i.e. kidney bean cost \$510.81 / 1475 lb = \$0.35 per lb)

⁷³ S. (Ed.). (2016). Overview of U.S. Hemp Seed Imports. Retrieved February 15, 2018, from <https://s3-us-west-2.amazonaws.com/seedcx.com/assets/Hemp-Seed-Import-Analysis.pdf>

⁷⁴ D. (2013, July). Economic Considerations for Growing Industrial Hemp: Implications for Kentucky's Farmers and Agricultural Economy. Retrieved February 05, 2018, from <https://www.uky.edu/Ag/AgEcon/pubs/reshempimpfarmer28.pdf>

⁷⁵ Ibid.

Environmental Considerations for Hemp

The environmental impact of hemp is dependent on the ways it is grown and processed. If grown carefully, it can be considered a carbon neutral or even a carbon negative crop. In one example, hemp straw produced on 2.47 acres stored 3.06 tons of carbon.⁷⁶ Not only does hemp store large amounts of carbon, but this carbon is unlikely to be released into the atmosphere again for many years because the materials produced with hemp (textiles and building materials) have long life expectancies. Hempcrete, in particular, has a life expectancy of over thirty years.⁷⁷ Hemp has also been used for bioremediation purposes to remove heavy metals from soil. The long taproot and extensive root system of hemp have also been shown to prevent soil erosion and improve soil quality when planted in a multi-crop system.⁷⁸ Compared to cotton and other natural fiber crops, hemp is less water intensive and requires little to no pesticide and herbicide use. In the United States in particular no pesticides are currently approved by the United States Department of Agriculture (USDA) for use on hemp plants. Similarly the Canadian province of Manitoba has not allowed any in-crop herbicides to be used. The only herbicide that has been reported is glyphosate that was applied prior to planting.⁷⁹ According to a study produced by the MDA in 2017, no hemp growers reported applying pesticides and seven growers reported that they used glyphosate or other pre-emergence herbicide to kill weeds in the field prior to planting, no herbicides were used on fields after planting.⁸⁰ For an ecologically-minded grower, the focus should be on amount and types of fertilizers used in the field, water usages, the distance to processing facilities, and energy required to harvest and process crop. It should also be noted, however, that large-scale hemp processing jobs have been shown to lead to more chronic respiratory symptoms than the processing of other fibers, such as cotton.⁸¹

⁷⁶ Bouloc, Pierre, Serge Allegret, and Laurent Arnaud, eds. *Hemp: Industrial Production and Uses*. 1 vols. Center for Agriculture and Bioscience International (CABI), 2013.

⁷⁷ Ibid.

⁷⁸ Ranalli, Paolo, and Gianpietro Venturi. "Hemp as a Raw Material for Industrial Applications." *Euphytica* 140, no. 1 (2004): 1–6. <https://doi.org/10.1007/s10681-004-4749-8>.

⁷⁹ "Industrial Hemp Production and Management." Manitoba Agriculture, n.d. <http://www.gov.mb.ca/agriculture/crops/production/hemp-production.html#varieties>.

⁸⁰ "Industrial Hemp Pilot Program." Plant Protection Division. Minnesota Department of Agriculture, 2017.

⁸¹ Valić, F., and E. Žuškin. "Effects of Different Vegetable Dust Exposures." *British Journal of Industrial Medicine* 29, no. 3 (1972): 293-97. <http://www.jstor.org/stable/27722728>.

General Considerations for Hemp Farming

Given the diversity of the *Cannabis Sativa L* plant (hemp), each variety has slightly different needs and growing methods. Once grown, the type and length of time for harvesting and processing the hemp is dependent on final desired product. This information will be provided in later chapters of the report divided by product. However, there are some general planting practices that hold true for the majority of varieties. These are outlined in the upcoming sections.

Soil

Ideal soil pH for hemp is somewhere between 7.0 to 7.5, although it can grow in soil with pH as low as 6.0.⁸² The best soils to achieve maximum yields will be well-aerated and loamy, composed mostly of sand, silt, and a smaller amount of clay. Compact soils are known to cause problems for hemp root development and harm the crop. For this reason, it is recommended that land containing a large proportion of clay should be ploughed or harrowed at the end of autumn or the start of winter. If the soil is silty, plowing can wait until spring.⁸³

Nutrient requirements for hemp are similar to that of corn. Agronomists in Kentucky recommend that if maximum industrial hemp yields are the goal, select good corn land and plan on inputs equal to current corn crops. If maximum yields are not the goal, industrial hemp can be expected to perform on lands with lower productivity and with reduced inputs much the same as our current commodity crops would.⁸⁴ In considering fertilizer inputs, it should be noted that nitrogen fertilization should range on the basis of soil fertility. Experimental results show that yield responses of hemp to supplemental nitrogen were negligible in rich soils while there were significant yield increases in nitrogen-limiting conditions. Additionally, hemp is less responsive to

⁸² Thayer, Cheryl, and Megan Burley. "Industrial Hemp from Seed to Market." Cornell University, May 2017.
<https://sips.cals.cornell.edu/sites/sips.cals.cornell.edu/files/shared/documents/industrial-hemp-from-seed-to-market.pdf>.

⁸³ Bouloc, Allegret, and Arnaud, eds., 101.

⁸⁴ Williams, D. W., and Rich Mundell. "An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp," n.d.
https://hemp.ca.uky.edu/sites/hemp.ca.uky.edu/files/uk_ih_information_for_agents3.pdf.

phosphorus or potassium than to nitrogen.⁸⁵ If soil analysis has not been completed, a general recommendation for nutrients to apply are as follows: eighty to 120 pounds per acre nitrogen, forty pounds per acre phosphorus, sixty pounds per acre potassium, and fifteen pounds per acre sulfur.⁸⁶ Hemp leaves are known to play a role in maintaining soil nutrients and are left in the field after harvesting to help retain and replenish nitrogen in soil after harvesting for the stalk.⁸⁷ Below, Table 2 notes the amount of each nutrient hemp removes from the soil in pounds per acre.

Table 2: Uptake and Removal of Nutrients by Hemp Crops⁸⁸

Nutrient	Hemp Total Plant (lb/ac)	Hemp Grain (lb/ac)	Uptake (hemp/day)
Nitrogen	178.4	35.7	5.9
Phosphorous	41.9	16.9	1.4
Potassium	188.3	8.9	5.4
Sulfur	12.5	2.7	Not calculated

A four-year crop rotation is recommended to keep a balance of nutrients in the soil, and avoid the risk of pest build up.^{89 90} There are a number of possibilities for multicrop systems including: planting hemp after a leguminous crop and before wheat or winter cereal. Other methods use hemp with a sugar beet and maize rotation.⁹¹ It is important to note that hemp has proved to be sensitive to herbicides in the soil and it is advisable to avoid the cultivation after maize if atrazine and simazine are used or after tomatoes are treated with herbicides for

⁸⁵ Amaducci, S., D. Scordia, F. H. Liu, Q. Zhang, H. Guo, G. Testa, and S. L. Cosentino. “Key Cultivation Techniques for Hemp in Europe and China.” *Industrial Crops and Products* 68 (June 2015): 2–16. <https://doi.org/https://doi.org/10.1016/j.indcrop.2014.06.041>.

⁸⁶ “Industrial Hemp Production and Management.”

⁸⁷ Ranalli and Venturi. “Hemp as a Raw Material”, 3.

⁸⁸ “Industrial Hemp Production and Management.”

⁸⁹ “Hemp Farming.” Accessed January 31, 2018. <https://hemtecusa.com/page83/page83.html>.

⁹⁰ “Hemp Production.”

⁹¹ Bouloc, Allegret, and Arnaud, eds., 99.

Solanaceae.⁹² If nitrogen is a concern in the soil, nitrogen-fixing crops such as peas, beans, or clovers can be planted in rotation with hemp.⁹³

Seeding

The Alberta Department of Agriculture and Forestry recommends sowing hemp seeds from a half-inch to one inch in depth, though other studies have noted a preferred depth of a quarter-inch to a half-inch. Regardless, hemp seeds should never be planted deeper than one inch.⁹⁴ It is recommended that sowing occurs between mid-May to early June near or above the latitude of fifty degrees north (Minnesota is within this range).⁹⁵ This should be done when soil temperatures are above fifty °F and the danger of a killing frost has passed. A late seeding date between mid-June and July is not recommended and should only be considered when there are no other viable options. Observations have shown that seeds planted during this time period will result in reduced yields and shorter plant heights. Sowing does not require special equipment and hemp seed can be spread randomly or in a line, both methods were shown to smother weeds.⁹⁶ Seeding dates, seeding rates, and fertility of the plant are all management decisions that can be used to reduce competition from weeds without using herbicides. Hemp prefers to grow in a humid-environment. Throughout the growing season, it is ideal to have ten to thirteen inches of rainfall or watering, but this can be supplemented by early soil moisture and adamant weed control. Additionally, young plants that have been growing for up to three weeks or have reached approximately twelve inches tall are especially sensitive to wet soils and flooding. If affected by water damage, plant growth could remain stunted resulting in an uneven or poor crop.⁹⁷

⁹² Amaducci, S., D. Scordia, F. H. Liu, Q. Zhang, H. Guo, G. Testa, and S. L. Cosentino. “Key Cultivation Techniques for Hemp in Europe and China.” *Industrial Crops and Products* 68 (June 2015): 2–16. <https://doi.org/https://doi.org/10.1016/j.indcrop.2014.06.041>.

⁹³ Robinson, Rowan. *The Great Book of Hemp*. 1 vols. Park Street Press, 1996.

⁹⁴ Williams, D. W., and Rich Mundell. “An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp,” n.d. https://hemp.ca.uky.edu/sites/hemp.ca.uky.edu/files/uk_ih_information_for_agents3.pdf.

⁹⁵ “Industrial Hemp Harvest and Storage Management Practices.” Alberta, Canada: Department of Agriculture and Forestry, n.d. [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/crop15539](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/crop15539).

⁹⁶ Bouloc, Allegret, and Arnaud, eds., 102.

⁹⁷ “HempFarming.” Accessed January 31, 2018. <https://hemtecusa.com/page83/page83.html>.

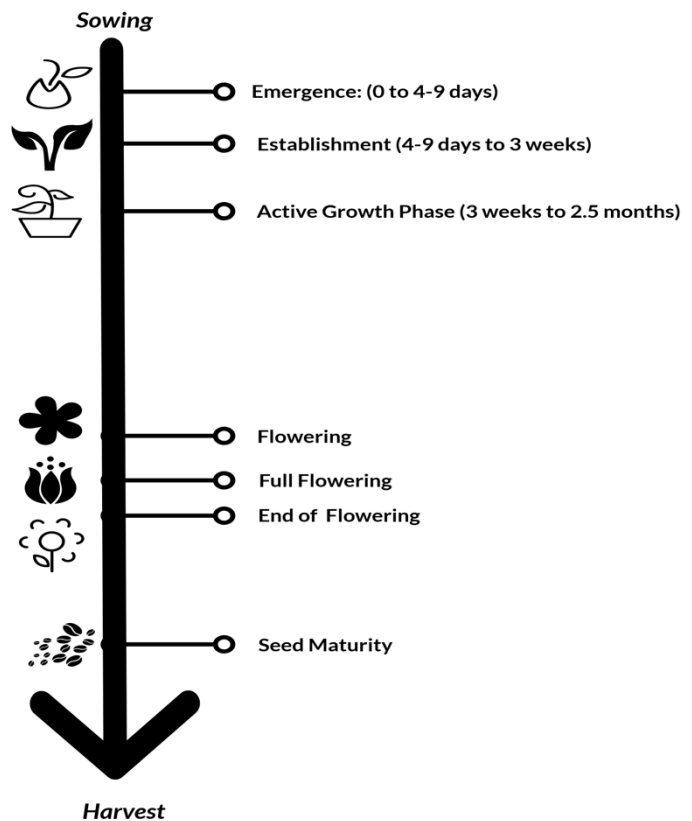
Table 3: Morphological Development of Finola⁹⁸

Morphological stages	Days after sowing
Emergence of seedlings	Day 5-7
First true leaves	Day 7-10
Second true leaves	Day 10-12
Third true leaves	Day 12-15
Fourth true leaves	Day 15-25
Beginning of flowering	Day 25-30
Beginning of pollination	Day 30-35
Peak time of pollination	Day 40-45
Apparent seed formation	Day 55
End of pollination	Day 55-65
Small smell from females	Beginning day 50-60
30-70% mature seed	Day 70-80
60-80% mature seed	Day 90-100
Male flowers	Normally dead by day 100
Harvest time	Day 100-120 after sowing

Sown between mid-May and early June near latitude 50° N

The above table is in reference to the Finola variety of hemp, which is a short growth variety, meaning it can be harvested around one hundred days after sowing. Though timing may vary with seed type, the table gives stages of growth which should be applicable to every hemp variety. The figure to the right outlines the general timeline for hemp general leaf and seed maturation.

Figure 2: General Planting and Development Timeline for Hemp



⁹⁸ “Industrial Hemp Harvest and Storage Management Practices.” Alberta, Canada: Department of Agriculture and Forestry, n.d.

[http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/crop15539](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/crop15539).

Weather

Both hail and wind can cause lower fiber quality and steps must be taken to protect a field from these weather conditions. Hail damage causes hemp stems to branch and lowers the quality of both hurds and fiber produced.⁹⁹ Hail can also make hemp plants in their early growth stages more susceptible to diseases. Wind causes chafing and, in fields with a high density of crop, leads to lower quality yields. Alberta farmers use swathing to protect plants from high winds. Swathing (winrowing) is not a necessary step, but depends on the environmental conditions and variety of hemp being grown. It is typically done as risk management against seed loss due to high winds. However, it risks slower drying times and larger levels of contamination if hail or rain flattens the swathing. Thus, swathing should only be considered if rain is not expected and should be done at fifteen to eighteen percent seed moisture, before the mature seeds shell out.¹⁰⁰

Due to the mechanization of the agricultural industry as a whole in North America, there is little information available for using animal traction systems specifically for hemp. There are some early references for utilizing horses in 1913 through 1943 agricultural reports, but these typically take the form of images without descriptions of the technology or process for using horses. Depending on the role horses are to play in Winona's hemp company, technology and techniques may need to be specially adapted to hemp as problems and needs arise.

⁹⁹ Bouloc, Allegret, and Arnaud, eds., 104.

¹⁰⁰ "Industrial Hemp Harvest and Storage Best Management Practices." Alberta Agriculture and Forestry, 2017.

[http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/crop15539/\\$file/HempHarvestStorage.pdf?OpenElement](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/crop15539/$file/HempHarvestStorage.pdf?OpenElement).

Product Assessment 1: Textiles

Industry Overview

Before cotton, hemp was a leading textile crop. The discovery of other fibers like cotton and synthetics forced hemp off the world view and into a more niche market, however it creates a much more sustainable product than other materials. Hemp is a plant that grows very rapidly, faster than weeds in fact, and does not require pesticides. Its fibers can be used to create a number of different woven textiles, which are then processed to create different value-added products ranging from apparel to insulation. There are social as well as environmental benefits, like many hemp products, but specifically the durability of hemp is relevant in textiles.

Planting

Planting hemp for use as a fiber crop is reliant on a number of factors. Chief amongst them is seed density, timing, and type. For seed varieties, farmers in Canada found that the Joey and Silesia varieties seemed to have the highest fiber yields (over 7137.4 lbs/acre) if fields are irrigated and around 3568.7 lbs/acre on rain-fed fields. Irrigated fields across hemp varieties have a higher output than rainfed fields.¹⁰¹ In fiber production, there is a preference for planting dioecious varieties (hemp with distinct male and female varieties) rather than monoecious (hybrid varieties).¹⁰² See Figure 3 below for further clarification. This is because female plants have higher fiber amounts, but male plants are found to have more primary fibers (bast fibers). The ratio of primary to secondary fibers (woody core fibers) in the male plants have higher tensile strength and lead to higher quality thread.¹⁰³ This finer thread is applied in clothing and textile industries. When fertilizing hemp for fiber production, nitrogen-rich manure should be applied during the vegetative phase, as nitrogen applied later may cause stalks to remain green longer, and fiber and hurd production may suffer during drying stages.¹⁰⁴

¹⁰¹ “Industrial Hemp Production and Management.” Manitoba Agriculture, n.d. <http://www.gov.mb.ca/agriculture/crops/production/hemp-production.html#varieties>.

¹⁰² Bouloc, Allegret, and Arnaud, eds., 105.

¹⁰³ Amaducci, S., D. Scordia, F. H. Liu, Q. Zhang, H. Guo, G. Testa, and S. L. Cosentino. “Key Cultivation Techniques for Hemp in Europe and China.” *Industrial Crops and Products* 68 (June 2015): 2–16. <https://doi.org/https://doi.org/10.1016/j.indcrop.2014.06.041>.

¹⁰⁴ Bouloc, Allegret, and Arnaud, eds., 113.

Figure 3: Images of Female, Hybrid, and Male Hemp¹⁰⁵



From left to right: hemp female Plant; hemp hermaphroditic plant; hemp male plant.

Planting as early as possible is advised, as this allows plants to have a longer growing period and thus have more fiber for processing. Seeds for fiber should be planted in rows, four to eight inches apart, with a seeding density of sixty lbs/acre on the field.¹⁰⁶ This dense planting promotes upward growth of the hemp stem, rather than branching, and discourages weed growth. The lack of branching can make processing the fiber easier while increasing usable fiber yields.

Harvesting

For most fiber varieties, harvest time should occur one hundred to 120 days after sowing, but will depend on climate and weather conditions for that year. Harvest is carried out before maturity and the end of the flowering stage.¹⁰⁷ Harvesting for fiber is usually done by hand and care should be taken that hemp stalks are not broken or cut during harvesting. When first reaping occurs, hemp should be harvested four inches above the ground to avoid the hard, woody portion of the stem. Then, stems are bundled and taken for retting. After retting, the bundles are dried and stored. This is usually done by baling it before sending the hemp straw to processing. Many

¹⁰⁵ “Industrial Hemp Production and Management.” Manitoba Agriculture, n.d.
<http://www.gov.mb.ca/agriculture/crops/production/hemp-production.html#varieties>.

¹⁰⁶ Williams, D. W., and Rich Mundell. “An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp,” n.d.
https://hemp.ca.uky.edu/sites/hemp.ca.uky.edu/files/uk_ih_information_for_agents3.pdf.

¹⁰⁷ Ibid.

farmers have noted trouble with harvesting (especially mechanical harvesting) due to the height of the hemp plants, which is eight to twelve feet. Farmers have dealt with this by harvesting hemp before it is fully mature or planting a seed variety that is naturally shorter. Farmers that are trying to utilize flax machinery have found it easier to harvest shorter hemp stalks. If processing is occurring by hand or other method, this may not be an issue. Due to the illegal status of hemp in much of North America in the twentieth century, there is a lack of mechanization and technology specifically for hemp, which makes harvesting and processing difficult.

Processing

Retting refers to a bacterial process of allowing the crop to partially rot to help separate fibers from the stalk. Retting ensures bast fibers (outer bark) separate from the hurds (pulp), Stalks are then dried and sorted by grades then crushed in a manual hemp-break which is a type of wooden press with boards that break the stalks so hurds can be collected.¹⁰⁸ There are many types of retting and the period that hemp is allowed to ret for drastically impacts the ultimate quality of fiber and hurds that can be collected. This means that all retting produces a slightly different fiber depending on conditions. Currently, there is no uniform process or technology.

Dew retting refers to allowing fibers to break down in the field due to environmental moisture (up to five weeks). Constraints with this method are that the retting time can be inconsistent based on temperature, rainfall and humidity in that harvesting year. In some cases the whole harvest could be lost if the weather is too wet or humid during the retting process as this impacts the speed at which the microbes break down the plant.¹⁰⁹ Additionally, if there is a large crop, storage can be an issue as hemp needs to sit in the field for up to a month and may then need to be covered and stored before it is transported. Using the dew method, final fiber product is also not stellar in terms of quality, typically coarse brown-colored fiber.¹¹⁰

Water retting refers to submerging the crop in a pool of water for 24 hours to allow the plant pectin to break down.¹¹¹ This requires a shorter period of time compared to dew retting and

¹⁰⁸ Robinson, Rowan. *The Great Book of Hemp*. 1 vols. Park Street Press, 1996.

¹⁰⁹ Williams, D. W., and Rich Mundell. "An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp," n.d.
https://hemp.ca.uky.edu/sites/hemp.ca.uky.edu/files/uk_ih_information_for_agents3.pdf.

¹¹⁰ Bouloc, Allegret, and Arnaud, eds., 163.

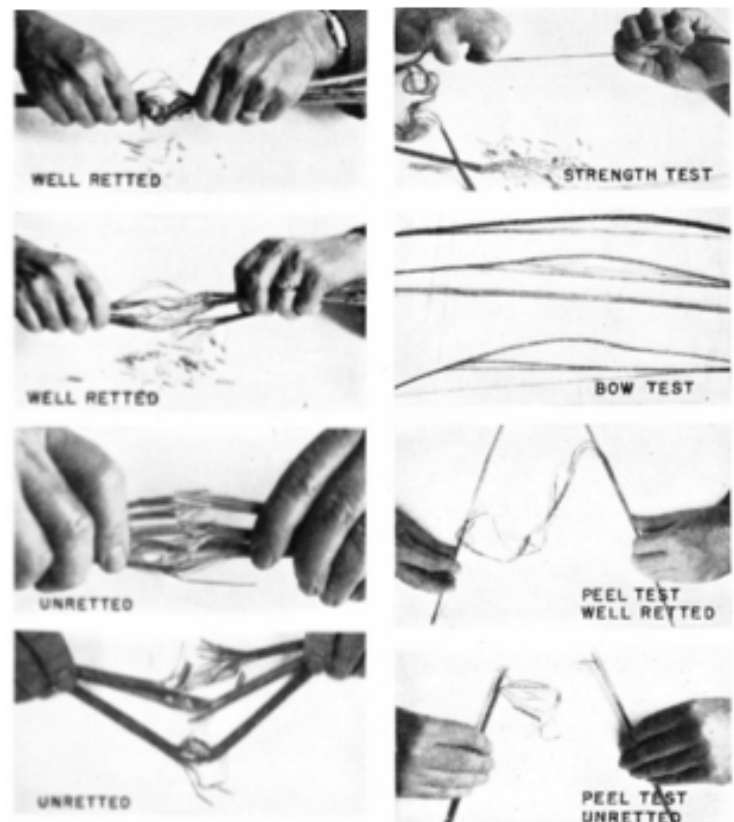
¹¹¹ Thayer and Burley, 4.

the quality of the fiber is considered better. Constraints with this method are concerns with water usage as it would require a large amount of standing water and produce waste water.

Another process, called green retting, is where hemp is left in the field only long enough to dry (four to five days) and then baled and taken to process for fiber. This is considered to end with a very high quality of fiber and hurds, but requires special machinery (usually that has either been patented or is proprietary, like Bastcore's decorticator, which is described later in this section of the report) to complete processing. This is often done through decortication which is the process of stripping the fiber from the rest of the stalk. Quality of fiber is typically judged on the basis of coloration (light fiber being considered the best and black being considered low quality), length (longer fibers have more potential for spinning and clothing usage), and tensile strength. Some of these can be tested/reviewed before crop is sold, but a grower should be in dialogue with the processing facility about what they want for their final product.

Winter retting is a relatively new method that is being pioneered in cold weather climates like Finland. Low temperatures limit bacterial activity, but the freezing and thawing of the hemp can help to separate the bast fibers from the woody core. Due to the lack of bacterial action, the hemp fiber is better colored (lighter) but weaker fiber than with other retting processes.¹¹² See Figure 4 to the right for tests of hemp tensile strength after retting.

Figure 4: Examples of Retted Fiber and Fiber Strength Tests¹¹³



¹¹² Nelson, Robert A. "Hemp Husbandry." Hemp Fiber, 2000. <https://www.hempbasics.com/hhusb/hh3fiber.htm>.

¹¹³ Robinson, R. R. "Hemp." Farmers' Bulletin. U. S. Department of Agriculture, January 1943. <https://archive.org/stream/CAT87204121/farmbul1935#page/n1/mode/2up>.

Following the retting stage, hemp stalks need to dry. The moisture content of the hemp should be less than fifteen percent when it is baled and then should continue drying to around ten percent.¹¹⁴ Then, hemp stalks are transported to where the fiber and hurds of the hemp are separated. For transportation, truck drivers prefer square or rectangular bales compared to round bales, especially across long distances, as they are easier to move and stack. If processing occurs more locally, round bales may be acceptable, but it should be confirmed with processing facility.

At a processing facility, the hemp stems pass through a series of machines. First, the stems are broken by passing through a breaker or fluted rollers, and the fibers are separated from the woody core. Then, combing occurs, which removes any remaining hurds and helps to align the fibers. At the end of processing, fibers should be as long as possible, clean (without hurds), and organized longitudinally.¹¹⁵ Next, the bast fibers will be spun together to make thread.¹¹⁶

Environmental Applications of Hemp Fiber

The Stockholm Environmental Institute (2005) conducted a study comparing the amount of water necessary to grow hemp, cotton, and polyester, and the overall ecological footprint each material had. In the study, hemp's footprint did not vary in terms of water and CO² emissions and represented the lowest ecological footprint of the three textiles. The plant also showed nearly twice the growth rate of cotton, while still being more ecologically neutral, particularly in water usage. Rainfall provides only thirty percent of the water demand for cotton crops and the lesser need for water with hemp can result in water being subsidized in order to sustain the industry.¹¹⁷

¹¹⁴Thayer, Cheryl, and Megan Burley. "Industrial Hemp from Seed to Market." Cornell University, May 2017.

<https://sips.cals.cornell.edu/sites/sips.cals.cornell.edu/files/shared/documents/industrial-hemp-from-seed-to-market.pdf>.

¹¹⁵ Bouloc, Allegret, and Arnaud, eds., 150.

¹¹⁶ Ranalli, Paolo, Mario Di Candilo, Giuseppe Mandolino, Gianpaolo Grassi, and Andrea Carboni. "Hemp for Sustainable Agricultural Systems." *Agro-Food-Industry Hi-Tech*, no. March/April 1999 (1999): 33–38.

¹¹⁷<https://www.sei-international.org/mediamanager/documents/Publications/SEI-Report-EcologicalFootprintAndWaterAnalysisOfCottonHempAndPolyester-2005.pdf>.

Markets & Labor Demands

China is the world's leading producer of hemp fiber at the moment, due to their longstanding tradition of making high quality textiles, using cheap labor, and having land dedicated to growing hemp. With well-established spinning facilities in place, the integration of the hemp fiber industry was very accessible to the country. With 150,000 acres dedicated to growing hemp, according to Cornell University (2016)¹¹⁸, and the next largest competitor being Chile at approximately 115,000 acres, it makes China an industrial force. Europe has also been a historical player in the global hemp market, growing it since the middle ages, however it only dedicates around 50,000 acres to the crop, with France alone making up 15,000 of that total.¹¹⁹

Despite the integration of new technology, Europe still struggles to compete with China's prices.¹²⁰ The prices for major players on the world market are outlined in Table 4, and came from a University of Kentucky study. The average prices of hemp fibers in 1995 are below.

Table 4: Average Prices of Hemp Fiber for World Competitors (1995)

Country	Price (US \$/lb)
Switzerland	\$8.09
Germany	\$6.87
Italy	\$3.40
Belgium/Luxembourg	\$2.58
China	\$1.58
United States	\$0.67

¹¹⁸ Cherney, J. (2016, November 12). Industrial Hemp in North America: Production, Politics and Potential. Retrieved February 15, 2018, from <http://www.mdpi.com/2073-4395/6/4/58/htm>

¹¹⁹ D. (2013, July). Economic Considerations for Growing Industrial Hemp: Implications for Kentucky's Farmers and Agricultural Economy. Retrieved February 05, 2018, from <https://www.uky.edu/Ag/AgEcon/pubs/reshempimpfarmer28.pdf>

¹²⁰ Ibid.

There is very limited information on world pricing, and these prices reflect what was able to be obtained for this report. The major suppliers are consistent with modern day, but the prices are most likely not.¹²¹ They also include only the price of hemp fiber and the transportation costs to move it from production to outside the country, and do not include the costs to reach its destination once it is outside of the source country or the differences in processing that the hemp has undergone. Despite these factors, the demand for hemp fibers that these prices reflect will most likely increase from year to year. For example in 1995 when these statistics were taken, they were four times higher than statistics drawn from 1981. The rise in demand for hemp fibers that took place is therefore likely to continue to rise as legalities change and the crop becomes more widely accepted. The prices that we can expect to see from the United States will also vary as the industry develops, as farmers gain more experience and the product line is mastered.

The global hemp fiber market has been relatively consistent for the past twenty years. It is still small, at half a percent volume of the world textile market in comparison to the cotton market, which makes up eighty-five percent of this market.¹²² In terms of the US hemp market, sales are currently \$688 million annually. This number excludes the profits made by Whole Foods, Costco, and Alfalfa.¹²³ Consumer textiles make up fourteen percent of this market value. Although it is a niche market, hemp textiles do have a dedicated following of environmentalists who will buy hemp clothing and yarns because of the environmental friendliness of the crop.¹²⁴

In terms of labor, the hemp market has historically come with a cost relative to China, making it difficult to engage in successful worldwide competition. To combat the lower prices that China can offer, the benefits of sustainable hemp production based on fair-wage policies must be paired with processing improvements and value-added product market acceptance.¹²⁵ By focusing on the processing end of textiles and marketing fair-trade products, consumers may be more inclined to spend their money on more expensive goods. This could be the future, as a recent

¹²¹ Vantreese, V. L. (1997, June). INDUSTRIAL HEMP: GLOBAL MARKETS AND PRICES. Retrieved February 05, 2018, from <http://www.uky.edu/Classes/GEN/101/Hemp/HEMP97.PDF>

¹²² Ibid.

¹²³ Johnson, Renée. "Hemp as an Agricultural Commodity." Congressional Research Service, March 10, 2017. Congressional Research Digital Collection. <https://fas.org/sgp/crs/misc/RL32725.pdf>.

¹²⁴ Ibid.

¹²⁵ Ranalli, Paolo, Mario Di Candilo, Giuseppe Mandolino, Gianpaolo Grassi, and Andrea Carboni. "Hemp for Sustainable Agricultural Systems." *Agro-Food-Industry Hi-Tech*, no. March/April 1999 (1999): 33–38

advertising study by the agency Nielson concluded that sixty-six percent of more than 30,000 respondents said they would be willing to pay extra for sustainable products.¹²⁶

Various people are consciously spending money on locally-sourced goods. Nonetheless, the opportunity presented here creates room for further engagement with those around the common interest of sustainability. There are also opportunities to hire local people to work on hemp farms to further support the ethos of what a modern sustainable business model looks like.

Hemp Textile Company Example: JungMaven

Case Overview

The following examination of the clothing company, JungMaven, focuses on marketing in the hemp textile industry. From the information that was provided by Robert Jungmann, the founder of JungMaven, this section covers JungMaven's history and business before moving on to its marketing strategies by looking at the company's target market and advertising methods.

History

JungMaven is a company that produces hemp textile products, specializing in hemp shirts and hemp sweatshirts. Jungmann entered the hemp industry in 1993 by founding Manastash, a clothing brand that utilized sustainable materials before creating JungMaven in 2005.¹²⁷ In the beginning, JungMaven's product line was limited to black and white t-shirts with both short and long sleeves. Today, it offers a variety of products, including dresses, socks, bedding, and hats.¹²⁸

Business Strategies

JungMaven has sustained its growth by launching multiple new styles of t-shirts each season. The percentage of the hemp usage differs from product to product. Most of the company's t-shirts are fifty-five percent hemp and forty-five percent organic cotton blend with a price range between fifty and sixty dollars. However, there are also some shirts that are made of one hundred

¹²⁶ N. (2015, September). Global Trust in Advertising: Winning Strategies for an Evolving Media Landscape. Retrieved February 15, 2018, from <https://www.nielsen.com/content/dam/nielsen-global/apac/docs/reports/2015/nielsen-global-trust-in-advertising-report-september-2015.pdf>

¹²⁷ "Manastash." HBX. Accessed February 26, 2018. <https://hbx.com/brands/manastash>.

¹²⁸ "Jungmaven | Hemp Clothing." Accessed February 26, 2018. <https://jungmaven.com/>.

percent hemp fibers. The more hemp fabric used, the higher the price, with one hundred percent hemp t-shirts selling for ninety to one hundred dollars per shirt, without tax. One of the reasons behind why the majority of JungMaven's t-shirts are a mix of hemp and cotton is due to the lower tariff the company must pay in order to import the textile from China.¹²⁹

Currently, three employees operate JungMaven. To fulfill business responsibilities, JungMaven uses contractors from other corporations for public relations and digital marketing matters. Jungmann's goal for the business is to mitigate climate change through hemp's phytoremediative properties, which help restore and clean soil, water, and air.¹³⁰ For costs of production, Jungmaven pays eighteen dollars for their shirts at wholesale. For bulk items, the company can get them for around ten or eleven dollars each. Currently, Jungmaven buys the textiles after they have already been processed and are ready to turn into value-added goods.¹³¹

Target Market

JungMaven started its business with a narrow target market, which has expanded as the business has grown. During JungMaven's startup stages, its primary demographic were men. As commerce increased, the target market expanded to both men and women, particularly in the age range of twenty-five to forty-five. Today, JungMaven seeks out its customers in North American markets, but is also exporting products to Europe and Asia. Eighty percent of the clothing company's demand is domestic, while twenty percent comes from international markets.¹³²

Advertisement Methods

JungMaven advertises for itself mainly through online methods. It uses Adwords (Google's advertising system) and utilizes Google images to show the brand's images to attract people who are browsing on Google. JungMaven also uses social networks like Facebook and Instagram to introduce themselves to potential customers by regularly posting about its products and endeavors as a company. Additionally, JungMaven has mailing lists that send updates to customers and drive people to its site. Other than digital advertisements, JungMaven attends trade

¹²⁹ Robert, Jungmann. Talk with Robert Jungmann. Voice Recording, February 2, 2018.

¹³⁰ Ibid.

¹³¹ Ibid.

¹³² Robert, Jungmann. Talk with Robert Jungmann. Voice Recording, February 2, 2018.

shows (Outdoor Retailer, Capsule, and Agenda) to display its products. In order to attend trade shows, it is important to make appointments with the show's organizing agency.¹³³

Hemp Fiber Company Example: Bastcore

Case Overview

The following case contains the information from Bastcore, a hemp fiber processing company that is located in Omaha, Nebraska.¹³⁴ John Lupien, Bastcore's founder and president, is a recognized expert in the business of hemp processing and product development. Bastcore provides high-quality hemp fiber for those from around the country who are excited about and investing in the possibilities and potential American-grown hemp can bring to fiber systems, including hemp farmers and yarn makers already acquainted with hemp and individuals looking for the possibility of investing in new ventures. This three-year-old business' purposes are developing technology of turn-key system and processing tubular stalks. Their ultimate goal is to create an established line of green commodities utilizing hemp biofibers.¹³⁵

History

Lupien was inspired to study hemp when he discovered that the most widely produced types of fibers, such as polyester and nylon, did not become popular even until 1950s and 1960s. In 1998, Lupien entered the field of hemp as a founder of BastLab, Inc., an agriculture technology company that processes bast fiber crops such as flax, jute, kenaf, and industrial hemp into valuable industrial products.¹³⁶ Since then, there have been a several obstacles, such as a lack of monetary support, stemming from the misunderstanding and limited knowledge from investors on hemp, and murky legal policies. Lupien also faced legal problems while importing seeds and stalks from Canada. Nevertheless, he created Bastcore in 2014.¹³⁷

Bastcore invented its own, more efficient decorticator, a machine that strips the exterior fibers from the stalk of the hemp plant without harming the interior. A traditional European decorticating machine requires more energy and costs than the price of Bastcore's version.

¹³³ Ibid.

¹³⁴ "BASTCORE." Bastcore. Accessed February 3, 2018. <http://www.bastcore.com/>

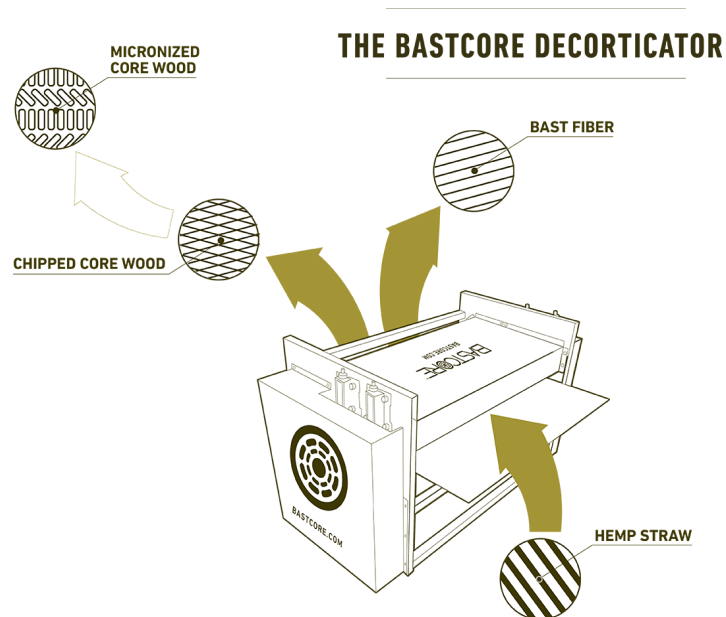
¹³⁵ Lupien, John. Telephone interview by author. February 5, 2018.

¹³⁶ "BastLab LLC." BastLab LLC. 1998. Accessed February 24, 2018. <http://www.bastlab.com/>.

¹³⁷ Lupien, John. Telephone interview by author. February 5, 2018.

Comparatively, the Chinese model is more labor intensive and, even after processing, the hemp still contains moisture, which requires more time to dry.¹³⁸

Figure 5: The Bastcore Decorticator¹³⁹



Bastcore’s decorticator machine separates the bast fiber from the interior of the stalk. After harvesting, hemp undergoes retting prior to going through the decorticator.¹⁴⁰

Business Strategies

Lupien is very optimistic about the hemp market and its potential for future growth. He describes hemp as the plant that has “no effluent problem” and he “is developing something that is closed loop”.¹⁴¹ Lupien especially expects the textile market to grow, thus Bastcore is focusing on creating a textile grade fiber that can create a t-shirt that recreator wants. Johnis also seeing potential from other products such as hempcrete, food, fuel, and even animal bedding.¹⁴²

¹³⁸ Ibid.

¹³⁹ “BASTCORE.” Bastcore. Accessed February 3, 2018. <http://www.bastcore.com/>

¹⁴⁰ Ibid.

¹⁴¹ Lupien, John. Telephone interview by author. February 5, 2018.

¹⁴² Ibid.

The raw hemp that John processes is sourced from farms in Colorado, Kentucky, and Minnesota. Raw hemp from these areas is produced in square bales.¹⁴³ The consistent, high quality of the material allows fineness of fiber after decortication. Additionally, Lupien works closely with farmers and coordinate the final product. He has a standard for processed hemp fiber, which is one to three percent of root contained in a fiber, so that they can have a “clean” product.¹⁴⁴ This strict standard results in a high quality of hemp fiber for consumers.

In the future, Lupien is planning to transport his system nearby sources of raw hemp so that it can be easier to replicate the system in the future. Further, he is hoping to apply feeding and cleaning improvements to Bastcore’s decorticator, which will decrease the time and cost of processing. Lupien also plans to work with farmers in North Carolina and New York, as those states have developed the legal framework for growing hemp.¹⁴⁵ Lupien is hoping to eventually observe high enough demand that exceeds production and demand for other types of fiber.¹⁴⁶

General Recommendations for Textile Startup

- Textiles may be a good industry to start with when stepping into the hemp industry, given that there are a wide range of methods used to process it, including traditional labor-intensive methods that do not require expensive technology and modern mechanical methods. This means it may be possible to start with less technology and build the company in different directions as the experience of the grower expands.
- The grower may start in clothing textiles but may later want to gain technical knowledge and expand into other technical fibers, such as those used in plastic composites.
- Because hemp hurds can be produced alongside textile fibers, the company could expand on textiles as well as industrial building materials such as hempcrete later on.
- It is important to combine many marketing strategies. This is especially important for online marketing, such as social media, as it is more influential than offline marketing.

¹⁴³ Ibid.

¹⁴⁴ Ibid.

¹⁴⁵ Russell, Michelle. “First US hemp fibre contract signed for clothing.” Apparel Industry News | just-style. October 17, 2017. Accessed January 31, 2018. https://www.just-style.com/news/first-us-hemp-fibre-contract-signed-for-clothing_id131957.aspx

¹⁴⁶ Lupien, John. Telephone interview by author. February 5, 2018.

- It is beneficial to begin partnering with a textile processing facility to learn to judge quality for an industrial scale and develop knowledge and technical skills for hemp fiber and then later begin developing local processing plants.
- There are many new technologies that are being developed to process hemp more effectively and on a small scale in the United States and Europe. Much of this technology is proprietary and in the process of being patented. If these endeavors are successful, it can be expected that in a few years there will be less expensive and smaller scale technology on the market that will be useful to small scale farmers.
- Many large organizations, such as the clothing company, Patagonia, offer grants that can pay for industrial hemp products, like textiles.¹⁴⁷ Investigation of these grants is advised.

Product Assessment 2: Building Materials

Industry Overview

Hemp has two co-products that are especially desired for building materials: the exterior bark (used to produce bast fibers) and the woody core of the hemp stalk (used to produce hurds). The natural fibers of the plant can be used to produce hemp wool which is used in insulating materials. This insulation material has thermal properties that are comparable to current synthetic materials and can be used for roof spaces, underneath floorboards, and in-wall construction.¹⁴⁸ Compared to the more valuable bast fiber there is less information on commercial interests in the hurds. But for every unit of fiber, eighty percent of time, labor, and energy is utilized on the hurd, as it makes up a majority of the plant. Therefore, developing markets for hurds should be at the forefront of every grower's mind. One area of growing interest is their ability to produce light concrete and mortars. These products can be used in roof insulation, paving, wall construction, and rendering.¹⁴⁹ Hemp mortars and cements are a mixture of the hurds and binding agents. Different ratios of hurds and binding agents creates different products that have different properties and usages. Hemp building materials do not contain toxic ingredients and they are competitively durable compared to traditional construction practices.

¹⁴⁷ Burgess, Rebecca. "Kentucky Hemp." Fibershed. Fibershed.com. January 6, 2015. Accessed February 26, 2018. <http://www.fibershed.com/2015/01/06/kentucky-hemp/>.

¹⁴⁸ Bouloc, Allegret, and Arnaud, eds., 244.

¹⁴⁹ Ibid., 240.

Planting & Harvesting

The planting requirements for this type of product should be similar to that of fiber, but emphasis should be placed on the hurds. There is no known method of growing hemp with hurds as the focal point of the crop but, regardless of the building material chosen, it is important to prioritize the fiber and hurd quality before, during, and after harvesting. Industrial hemp building products are made from a combination of fibers and hurd from the stalk, so it is important to be able to separate these products in a relatively uniform fashion. Whichever method of retting is chosen, the grower should remember that, while fiber can remain stable for several weeks, hemp hurds cannot. Hurds can deteriorate quickly and some of their market value may be lost.¹⁵⁰ For that reason green retting (page 37), which causes very little deterioration of the hurds, is used.

Processing

There are a number of industrial hemp building products that can be produced, including hempcrete and fiberboard products. The processing varies from product to product.

Hempcrete production is done most often using lime, but other concrete mixes are also possible. It requires hemp hurds to be mixed with a lime mix. This process is relatively simple and can be done on site of building. Before mixing it is important to select the correct binder, as different binders may be appropriate for different applications. A good binder should easily coat all the materials and after setting the materials should display the desired characteristics. This mixture should not contain any small clumps (as this may compromise the quality of the product) and can be put together using a cement mixer, horizontal paddle mixer, or by hand. If using a cement mixer first prepare the binding agent and the water then add hurds gradually.¹⁵¹ Hurds may absorb too much water causing the mixture to fail to reach the right consistency if added in the wrong order. It is important to note that hempcrete is susceptible to frost at the time of setting and should not be produced at lower than twenty-three °F.¹⁵² Hempcrete can either be shaped into blocks, placed in molds or sprayed. Spraying is most often utilized for large buildings, but is

¹⁵⁰ Ibid, 113.

¹⁵¹ Bouloc, Allegret, and Arnaud, eds., 245.

¹⁵² Arrigoni, Alessandro, Renato Pelosato, Melia Paco, Ruggieri Gianluca, Sergio Sabbadini, and Giovanni Dotelli. "Life Cycle Assessment of Natural Building Materials: The Role of carbonation, Mixture Components and Transport in the Environmental of Hempcrete Blocks." *Journal of Cleaner Production*, no. 149 (February 22, 2017): 1051–61.

typically more expensive as it requires specialized equipment. Spraying hempcrete, as opposed to mixing it by hand or paddle, also tends to have lower thermal and sound insulation properties, as it does not have as much air as it would if produced by mixing. The thermal conductivity of hempcrete is related to its density, which will depend on the binder and proportions used to mix the hempcrete however, generally, it is found to be between 0.06 and 0.18 watts per meter °C, with the density of the hempcrete ranging from twelve to fifty pounds per cubic feet.¹⁵³

Hemp fibers that are intended for insulative building materials are first made into hemp wool. This is done by heat fusion of the fibers and then pressing the hemp wool into panels. The panels are then cut as insulation.¹⁵⁴ The air trapped throughout processing gives the insulation good thermal properties, but when inserting this material into buildings it should be handled with care, as pressing or condensing the insulation will reduce these properties.

Environmental Applications of Hemp Building Materials

Environmentally, the current process of making buildings more energy-efficient requires the input of extra chemicals. Hempcrete and hemp insulation products are a great alternative to this, because not only is hemp more energy efficient than traditional methods, but it's healthier for the people in those buildings.¹⁵⁵ The building materials made from hemp are excellent for capturing heat and decreasing the risk of vapor condensation, saving energy and reducing the amount of fossil fuels used throughout the lifetime of a structure. Furthermore, thanks to the action of lime, hemp shives slowly mineralize, becoming inert and reducing the risks of rot and mold formation. (Evrard, 2005). Along with the many benefits previously stated, by using hemp, there becomes less of a need to cut down trees and is actually a carbon negative plant. This means that carbon is taken out of the atmosphere as the plant grows, and is therefore a catalyst for a more sustainable system of building. Additionally, hempcrete is fireproof.¹⁵⁶

¹⁵³ Bouloc, Allegret, and Arnaud, eds., 241.

¹⁵⁴ Ibid., 240.

¹⁵⁵ John Patterson with tiny hemp houses recording.

¹⁵⁶ A. (2012). What is Hempcrete? Retrieved February 15, 2018, from <http://www.americanlimetechnology.com/what-is-hempcrete/>

Markets & Labor Demands

The hempcrete market is still relatively small. It is currently led by Europe, particularly France, Italy, and the United Kingdom, with Germany entering slowly as well. In the United States, industrial applications of hemp are only eighteen percent of US hemp market sales,¹⁵⁷ which tells us that there hasn't been interest on a large scale yet by industrial building companies. Industrial hemp applications offer great potential however in terms of job creation and sustainability. In line with the ethos of sustainable building systems as well, local people could benefit from training on how to make and apply hempcrete to real world projects. The applications for hempcrete can be successful on the local level because it is cheaper to make building products than to buy them, and therefore cheaper to update infrastructure.

Hemp Building Products Company Example: Tiny Hemp Houses

Case Overview

The following case focuses on the company, Tiny Hemp Houses, and illustrates how hemp is being utilized on an industrial scale in construction. This section focuses on the consulting business and education programs that Tiny Hemp Houses operates. The information was obtained during an interview with the Tiny Hemp Houses founder, John Patterson.

Business

The company started earlier this decade as an educational resource, helping those around the United States get educated about hemp as a building material. Patterson began his business with the idea of building houses with natural materials rather than chemical and oil-based ones. Then, he came out with the hemp lime building system (commonly called hempcrete). He got inspiration from Steve Allin of the International Hemp Building Association to build houses with hemp before becoming involved in the beginning movement of industrial hemp. Patterson then decided to become an educator to spread the knowledge about industrial hemp and its benefits.

The hemp that is used by Tiny Hemp Houses is imported from Europe and China. Patterson says that he imports thirty pound bags of hemp from Europe. Considering the size of a tiny hemp house can range from 120 to 400 square feet, eighty to more than 250 bags of hemp

¹⁵⁷ Johnson, R. (2018, January). Background on the U.S. Market for Industrial Hemp and Related Policies. Retrieved January, 2018.

may be needed for construction. Since people are seeking to find lower costs for home construction, the size of the hemp houses tend to be smaller than the average home. However, the space can be used efficiently if the house is well organized and maximizes its square footage. Tiny Hemp Houses believes that using natural materials for building houses is better for the planet and thinks hempcrete is a particularly important material because of its ability to manage temperature and moisture better than concrete.¹⁵⁸

Target Market

Many people who have been interested in investing in hemp houses are people with building or construction backgrounds. They want to build “greener” houses. The targets are mostly people who are in their twenties and thirties. However, this is not restricted, as there is a wide range of people who have shown interest in building with industrial hemp. There is also no specific gender targeted, with an even distribution of gender in its customer base.¹⁵⁹

Construction Consultations

Tiny Hemp Houses also helps clients build houses with more natural, energy-efficient materials, charging \$125 for a single hour, \$500 for five hours, and \$850 for ten hours. The consulting covers basic steps, such as choosing the appropriate property and defining logistics for sewage and electricity installations. Tiny Hemp Houses consultations help plan and give advice to lower construction costs and make the house as efficient as possible.¹⁶⁰

Education Program

There are also various education programs that Tiny Hemp Houses is working on. These range from ninety-minute sessions that educate participants about the overall industrial hemp industry to three-day workshops that explain the process of building hemp houses. The latter programs usually occur on weekends, with an average of thirty people involved. On the first day, participants learn information about hempcrete and set up plans for a hemp house. The second day

¹⁵⁸ John, Patterson. Talk with John Patterson. Voice Recording, February 16, 2018.

¹⁵⁹ Ibid.

¹⁶⁰ “Natural Building Coach.” Tiny hemp houses. Accessed February 26, 2018.

<http://www.tinyhemphouses.com/natural-building-coach.html>.

details the building process and explains how to make the hempcrete, wall, and floor sections. By the last day, the walls will be set up and the house is ready for finishing.¹⁶¹

General Recommendations for Building Products Startup

- Growing hemp for building materials may be done alongside hemp crops for another industrial crop, such as textiles, because the necessary hurds are a by-product.
- Hemp building materials could be used with tribal initiatives, such as solar panel installation and insulation applications, to help offset home energy bills.

Product Assessment 3: Food Products

Industry Overview

Hemp seeds have been used for food for millennia. Overall, hemp seeds have many different possibilities, and are full of essential nutrition necessary to have a healthy lifestyle. Hemp seeds contain linoleic acid and alpha linolenic acid, two essential fatty acids that our bodies cannot produce, as well as gamma linolenic acid and stearidonic acid which help to make up omega-6 and omega-3 fatty acids, which can help reduce the risk of heart disease and depression.¹⁶² Scientists have found that there is an imbalance of omega-6 to omega-3 in western diets (too much omega-6 and not enough omega-3), which is linked to inflammatory diseases, arthritis, and cancer. Therefore, the ratio of three omega-3 fatty acids to one omega-6 fatty acid, which is considered a favorable ratio, can help correct the imbalance outlined by scientists.¹⁶³ Additionally, crushed hemp nuts were found to contain up to fifty percent protein by weight as well as dietary fiber. There are a number of value added hemp seed products that are currently being produced including: protein powder, hemp milk, hemp flour, hemp coffees, and hemp oils. Many of these products, such as hemp milk, have simple recipes that can be produced at home and can positively benefit communities in need of better food options.

¹⁶¹ John, Patterson. Talk with John Patterson. Voice Recording, February 16, 2018.

¹⁶² Bouloc, Allegret, and Arnaud, eds, 233-234.

¹⁶³ Ibid.

Planting

Based on findings from the Alberta Department of Agriculture and Forestry the seed varieties X59 and Joey cultivars tend to have the highest seed yields of 2676.5 lbs/acre for irrigated land and over 892.2 pounds per acre for X59 and over 446.1 pounds per acre for Joey varieties on non-irrigated land.¹⁶⁴ For seed production, the seed planting density in fields should be between twenty and forty pounds per acre this lower seed density compared to fiber will allow the crop to flower and branch.¹⁶⁵ The rows should be spaced eight to sixteen inches apart to further encourage hemp branching. Though it should be noted that if plants are too far apart there may be issues with weeds. Flowering and seed set of the hemp plant is caused by shortening day length.¹⁶⁶ This means regardless of when hemp is planted seed set will occur when days shorten. For that reason it is recommended that hemp for seed production is planted later as less energy will be exerted on stalk growth and more will go towards seed set.

Harvesting

Harvesting should occur when seventy percent of the hemp grain has matured.¹⁶⁷ This is typically forty days or around six weeks after flowering.¹⁶⁸ The highest leaves on the plant should have started to turn yellow and the seeds at the base of the stalk should look about ready to fall off of seventy-five percent of the plants.¹⁶⁹ Harvesting seed by hand begins with reaping when the first seeds reach maturity. The hemp is cut and arranged according to similar heights. There is then a waiting period between one and ten days before seeds were collected. This was done so seeds

¹⁶⁴ “Industrial Hemp Harvest and Storage Management Practices.” Alberta, Canada: Department of Agriculture and Forestry, n.d.

[http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/crop15539](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/crop15539).

¹⁶⁵ Williams, D. W., and Rich Mundell. “An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp,” n.d.

https://hemp.ca.uky.edu/sites/hemp.ca.uky.edu/files/uk_ih_information_for_agents3.pdf.

¹⁶⁶ Thayer, Cheryl, and Megan Burley. “Industrial Hemp from Seed to Market.” Cornell University, May 2017.

<https://sips.cals.cornell.edu/sites/sips.cals.cornell.edu/files/shared/documents/industrial-hemp-from-seed-to-market.pdf>.

¹⁶⁷ Williams, D. W., and Rich Mundell. “An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp,” n.d.

https://hemp.ca.uky.edu/sites/hemp.ca.uky.edu/files/uk_ih_information_for_agents3.pdf.

¹⁶⁸ Bouloc, Allegret, and Arnaud, eds., 160.

¹⁶⁹ Ibid.

could continue to mature while hurds dried.¹⁷⁰ This type of harvest is vulnerable to weather conditions as wind and rain can result in either seed loss or seeds going rancid. Hemp seed throughout the harvesting and storing process must be carefully handled as it is very fragile and cracking the seed can result in a low quality or spoiled product. This is one advantage to harvesting by hand as compared to by combine. If the grower's location is within large scale autumn bird migrations, the grower may want to harvest earlier to avoid loss of crops to birds.

Processing

The next step after harvesting hemp seeds is drying and then storing for later transport. Due to the balance of lipids within hemp seeds the drying and storage process must be handled with care, else the seeds are liable to become rancid. Grain should always be cleaned and dried before storage. Hemp seed should be dried slowly with temperatures of ninety-five °F, and the temperature of the seed should never exceed 104 °F.¹⁷¹ Processors require specific moisture content for stored seed, this is dependent on processor, but is generally around eight or nine percent.¹⁷² One means of storage farmers in Canada have used is mini-bulk bags, provided they are stored in a stable climate and away from pests. Hemp can be kept longer if stored in temperatures between thirty-five to thirty-eight °F.¹⁷³ For many value-added hemp seed products, including hemp milk, the hemp seed must go through a the deshelling process where the outer shell from the hemp nut is removed, usually done by a crushing machine.

Environmental Applications of Hemp Seed

One benefit from growing hemp for seed domestically is the reduction of damaging chemicals required for imported goods. For example, all imported nuts and seeds must be fumigated with methyl bromide, a known ozone depleter, to repel pests. Domestic organically

¹⁷⁰ Ibid.

¹⁷¹ "Industrial Hemp Harvest and Storage Management Practices." Alberta, Canada: Department of Agriculture and Forestry, n.d.
[http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/crop15539](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/crop15539).

¹⁷² Ibid.

¹⁷³ Thayer, Cheryl, and Megan Burley. "Industrial Hemp from Seed to Market." Cornell University, May 2017.
<https://sips.cals.cornell.edu/sites/sips.cals.cornell.edu/files/shared/documents/industrial-hemp-from-seed-to-market.pdf>.

grown hemp seed, on the other hand, is not be subject to such processing.¹⁷⁴ Furthermore, the interest in the farm-to-table movement is growing and hemp could be a niche market within this. The fact that these small scale markets could make hemp an economically-viable crop in the United States warrants exploration, and may be a promising industry for small scale farmers.¹⁷⁵

Markets & Labor Demands

Canada is the North American market leader for hemp food products. Partly due to a lack of history in the textile industry and the competition China presents, Canada decided that hemp food products were a more feasible industry to pursue.¹⁷⁶ A tradition of making oilseed products such as canola, flaxseed, mustard, and soybean oil aided the feasibility of this decision. Canada therefore had the industry in place and was prepared to process oilseed crops when hemp was introduced.¹⁷⁷ Farmers in Canada also receive subsidies from their government to grow hemp seed for the North American health food market, their biggest consumer, making the hemp seed market quite lucrative in Canada.¹⁷⁸ The United States imported approximately \$29 million worth of hemp seed in 2014, and \$45 million in 2015, which made up nineteen percent of its hemp market sales. The world produced a total of 220 million pounds in 2014. When looking at total imports for seed, oil, and oil cake products, the figure reached \$75 million per year.¹⁷⁹ With these numbers in mind, it can be said that there is a growing demand for alternative foods, which are foods regarded as healthier than food produced using conventional or large scale systems. If hemp is eventually distinguished from cannabis and hemp food products are made legal, the alternative food market could be a place to begin marketing them. To get an idea for the price of hemp seed, we can refer to a 2017 study done by Cornell University. Shown below are the average prices hemp seed is being sold for, according to data available at time of collection:¹⁸⁰

¹⁷⁴ Robinson, Rowan. *The Great Book of Hemp*. 1 vols. Park Street Press, 1996.

¹⁷⁵ Cherney, J. (2016, November 12). Industrial Hemp in North America: Production, Politics and Potential. Retrieved February 15, 2018, from <http://www.mdpi.com/2073-4395/6/4/58/htm>

¹⁷⁶ Ibid.

¹⁷⁷ Ibid.

¹⁷⁸ Ibid.

¹⁷⁹ Ibid.

¹⁸⁰ Thayer, C., Burley, M., & Held, D. (2017, May). Industrial Hemp: From Seed to Market. Retrieved February 1, 2018, from <http://ccetompkins.org/resources/industrial-hemp-from-seed-to-market>

Table 5: Average Hemp Seed Prices From Large American and Canadian Producers

Province/State	Price (US \$/lb)
Alberta	\$0.74/lb
Manitoba	\$0.68/lb
North Dakota	\$1.00/lb
Kentucky	\$0.68/lb

As shown, Manitoba is able to keep their prices the lowest in relation to Alberta and North Dakota. If we refer back to Table 1 (page 26), they also had the lowest costs of production. This makes them competitive, and proves that with a streamlined industry and the laws to produce hemp seed in place, competing in the hemp seed market is quite attainable.

Organic food is a \$50 billion per year industry,¹⁸¹ and the idea that our food has ethical, political, and moral implications is a movement that continues to grow. Hemp offers many avenues to expand on this ethos, and hemp seeds specifically can be turned into many different food options that support a holistic view of health. According to the USDA, hemp seeds have 9.47 grams of protein per thirty grams.¹⁸² The nutritional value can then be translated into many different products like protein powder, hemp oil, and hemp milk, all of which are relatively easy to make at home and high in nutritional value. The labor required to turn hemp seeds into these products would be an easy transition once equipped with the proper materials, and could be a training program for local people interested in contributing to the nutrition of the community.

General Recommendations for Hemp Food Startup

- A focus on hemp coffee and hemp milk could be associated with Winona’s Spotted Horse brand, which may give the farm an advantage in terms of already having special knowledge into the industry as well as having a niche product to offer.

¹⁸¹ Pollan, M. (2018, February 14). How We Got From Twinkies to Tofu. Retrieved February 20, 2018, from <https://www.nytimes.com/2018/02/14/books/review/hippie-food-jonathan-kauffman.html>

¹⁸² National Nutrient Databases. (n.d.). Retrieved February 21, 2018, from <https://ndb.nal.usda.gov/ndb/foods/show/3614>

- Safe storage methods should be established, as the seed can rot quickly if not stored well.
- As this is a new US industry, the majority of hemp seeds are currently imported from Canada, so investigation into US seed sources is recommended to develop understanding of domestic markets and opportunities.

Product Assessment 4: CBDs

Industry Overview

CBDs have been shown to have a range of pharmaceutical effects on a variety of medical conditions including: epileptic seizures, anxiety, PTSD, alzheimer's and depression. CBDs impacts have been linked to a variety of neuroreceptors and have been shown to even spur brain cell regeneration in some instances.¹⁸³¹⁸⁴¹⁸⁵ The biological pathways and pharmaceutical implications of CBDs are still under investigation. CBDs are present throughout the hemp plant in various amounts. They are most concentrated in the female flowers and are found in lower concentrations in the roots, stems and leaves, and in even lower concentrations in the seeds, seed oil, and pollen.¹⁸⁶ Though the researchers within this project did their best to obtain information regarding the growth of hemp for the production of Cannabinoids given the limited amount of time, scope of the report, and general state of the industry there was a limited number of reliable sources upon which to draw information in regards to planting, growing, harvesting and processing methods for CBDs. Because CBDs are an emerging market many companies and researchers are keeping their

¹⁸³ Campos, Alline Cristina, Fabricio Araújo Moreira, Felipe Villela Gomes, Elaine Aparecida Del Bel, and Francisco Silveira Guimarães. "Multiple Mechanisms Involved in the Large-Spectrum Therapeutic Potential of Cannabidiol in Psychiatric Disorders." *Philosophical Transactions of the Royal Society B: Biological Sciences* 367, no. 1607 (December 5, 2012): 3364–78.

<https://doi.org/10.1098/rstb.2011.0389>.

¹⁸⁴ Pergolizzi, Joseph V., Jo Ann Lequang, Robert Taylor, Robert B. Raffa, Daniel Colucci, and NEMA Research Group. "The Role of Cannabinoids in Pain Control: The Good, the Bad, and the Ugly." *Minerva Anestesiologica*, January 16, 2018. <https://doi.org/10.23736/S0375-9393.18.12287-5>.

¹⁸⁵ Abrams, Donald I. "The Therapeutic Effects of Cannabis and Cannabinoids: An Update from the National Academies of Sciences, Engineering and Medicine Report." *European Journal of Internal Medicine*, January 9, 2018. <https://doi.org/10.1016/j.ejim.2018.01.003>.

¹⁸⁶ Williams, D. W., and Rich Mundell. "An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp," n.d.

https://hemp.ca.uky.edu/sites/hemp.ca.uky.edu/files/uk_ih_information_for_agents3.pdf.

information private to hold their competitive advantage and protect their interests. For these reasons, there are gaps in the information provided below.

Planting

When planting for CBDs, female plants are preferred and male plants are unnecessary. This is because CBDs in male plants are low compared to female flowers. Additionally, unfertilized female flowers produce more cannabinoids and, therefore, male plants should be removed from the field to prevent cross-pollination. Similar to when growing hemp for seed production, branching should be encouraged by planting seeds further apart. The seed density planted should be in the range of twenty to forty pounds per acre, with rows spaced eight to sixteen inches apart.¹⁸⁷ In an interview with Shane Davis, a grower in Colorado who will be examined later in this section, he noted that he planted around two thousand plants on one acre and typically used five-foot spacing in all directions. His method of planting does not utilize seeds, but instead uses small hemp plants that have already sprouted. He also said it took eight people about a week to complete planting using this method.¹⁸⁸

Harvesting

Harvesting for CBDs will focus on obtaining the floral material, though other parts of the hemp plant may also contain CBDs as mentioned above this is in less concentrated amounts. It is important to note that CBD and THC levels within hemp will fluctuate in response to stress in its environment. Due to these fluctuations, it is extremely important to harvest hemp for CBD production after it is tested and approved by the state department of agriculture. If the grower waits, they may find that their crop no longer falls within the legal limits of 0.3 percent THC and the entire crop may be destroyed. Hemp for Cannabinoids is often harvested by hand. Within the Minnesota Pilot Program in 2017, there were three growers that harvested floral material. They

¹⁸⁷ Williams, D. W., and Rich Mundell. "An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp," n.d. https://hemp.ca.uky.edu/sites/hemp.ca.uky.edu/files/uk_ih_information_for_agents3.pdf.

¹⁸⁸ Interview with Shane Davis, hemp farmer and founder of Boulder Hemp Farm, 7GENx and Slow Hemp, Telephone February 14, 2018.

harvested in small amounts by hand. One grower cut the plants, hung them upside down in a barn for drying and curing, and then mechanically chopped the material prior to final processing.¹⁸⁹

Processing

The information in this section is debated within the industry. Because of the lack of established and regulated practices for creating CBDs, the information we gathered for this report should be consumed as a general guide. Further, more professional consultation should take place before investing into the CBD industry.

There are three main ways CBD is extracted from the hemp flowers: liquid solvents, CO² extraction, and oil extraction. There are also unique extraction stages within each process, depending on the ideal final product, which can be a full-spectrum oil that contains CBD, CBG, terpenes, and other substances, as well as an isolated CBD in a crystal or powder form.

Liquid solvent processing uses hydrocarbons (hexane, butane, ethanol) to run through the plant material and remove the cannabinoids, transferring them to the solution. The hydrocarbons are then evaporated off leaving the CBD oil. Each of the different hydrocarbons has different attributes and will interact with the plant materials in slightly different manner, some gases such as butane are considered to be harsher on the plant material. This means that if the plant material soaks or interacts with the hydrocarbons for too long, the cell walls may breakdown and, rather than extracting just the CBD and other chemicals into the oil, the oil will now contain chlorophyll and other plant cell material that may detract from quality. This can be limited by running the plant material through the solvent and then recovering it rather than soaking it. The dangers with using hydrocarbons is that they are volatile and flammable if not handled using proper safety precautions. This process must also be done using research or instrument grade solvents (ethanol, butane, propane). Benefits to hydrocarbons is that they are cheaper and faster than CO².

CO² extraction is done with a piece of technology called a closed loop extractor. This machine uses pressurized CO² to extract chemicals from the plant material. First, the CO² is pumped into a chamber with the floral material where the pressure causes the extraction of CBD. Then the CO²-CBD solution is pumped into a third chamber where the CO² separates out leaving

¹⁸⁹“Industrial Hemp Pilot Program.” Plant Protection Division. Minnesota Department of Agriculture, 2017.

the CBD solution behind. In addition, there is supercritical CO² extraction, which causes CO² under pressure to take on some characteristics of both its liquid and solid states. Regular CO² extraction will not extract terpene profiles from the plant material, however, supercritical CO² extraction will. Dangers with CO² extraction include highly pressurized gases, and, while CO² is not combustible, there is still a danger of equipment being mishandled. Other downsides may include the cost of equipment and the slow recovery time for the machines. This slow recovery time means that extraction may take longer than using hydrocarbon methods.

Plant to oil infusion is a method that can be done in home in small batches. First, the plant material is decarboxylated, which means the plant material is heated over a period of time to help release the cannabinoids. People use various temperatures, but typically over 212 °F, as at temperatures lower than one hundred °C, the reaction does not reach completion within sixty minutes. Then, the plant material is added to a cooking oil (such as olive oil) and heated to 212°F for up to two hours. This infuses the cannabinoids into a usable form within the oil.

Environmental Applications of CBDs

The environmental impacts of CBD products on the environment are unclear. The current industry lacks regulations in this regard, and many companies are keeping their technology and processing quite secretive. This makes the impacts of these unclear to outsiders, and therefore, we were unable to address these factors deeply within the report. In terms of the health applications, CBD has been used for a variety of medicinal purposes, including treatments for depression, epilepsy, anxiety, pain, and inflammation. This is useful because there are many people that suffer from these disorders, however might not have the resources to seek higher medicine. CBDs are a relatively inexpensive (less than fifty dollars) way to treat illnesses and have even been used to treat addiction.¹⁹⁰ Furthermore, the benefits of these treatments can alleviate other stresses families endure, such as high medical bills.

In the United States, there has not been much large-scale funded research on the societal impacts of CBD because it is not often prescribed by doctors within the United States, compared to other drugs such as opiates. This is a gap in the research provided because it is not established.

¹⁹⁰ Shannon, Scott, and Janet Opila-Lehman. “Cannabidiol Oil for Decreasing Addictive Use of Marijuana: A Case Report.” *Integrative Medicine (Encinitas, Calif.)* 14, no. 6 (December 2015): 31–35.

Markets and Labor Demands

There is little definitive data on the exact amount of CBD sales worldwide, but the Hemp Business Journal claims that the CBD market will reach \$2.1 billion in sales by 2020 in the United States,¹⁹¹ which is a seven hundred percent increase from 2016. The evidence behind this claim comes from Outco, which is the largest cultivator of CBDs in southern California. According to a study, they gathered that thirty-eight percent of traditional, cannabis users would be interested to learn more about CBD oil and its effects.¹⁹² Therefore, there are already communities of people who are interested in benefits of CBDs and would likely be willing to purchase products to try. Other than the market that already uses medicinal cannabis, potential CBD markets could be anybody who is interested in the relaxing and painkilling benefits. Due to the time restrictions of this report, no further conclusions can be further drawn at this time.

CBD Example: Shane Davis' Experience in CBD Businesses

Case Overview

The following case is based on experiences of Shane Davis, who operates several hemp businesses in the state of Colorado: Boulder Hemp Farm, 7GENx, and Slow Hemp. Since Colorado authorized an industrial hemp program in the state, it has become the country's chief producer, with two thousand acres grown in 2015, fifty-one percent of US acreage.¹⁹³ His businesses are focused on hemp economics, which Davis says, "orbits around how hemp can create massive streams of revenue, liberate communities, and create economies".¹⁹⁴

Business Ventures

All of his businesses are currently located in the state of Colorado. With such passion, he is also an anti-fracking activist who opposes fracking of fossil fuel. His interest in hemp business

¹⁹¹ Channel Sales Analysis - The CBD Report." Hemp Business Journal. October 19, 2016. Accessed February 28, 2018. <https://www.hempbizjournal.com/channel-sales-analysis-cbd-report/>.

¹⁹² Coughlin-Bogue, T., Frizzelle, C., Black, L., & Hsieh, S. (2016). Want to Relax? Don't Let Them Talk You Into High-THC Weed. Retrieved February 20, 2018, from <https://www.thestranger.com/feature/2016/04/13/23950787/want-to-relax-dont-let-them-talk-you-into-high-thc-weed>

¹⁹³ Davis, Shane. Telephone interview by author. February 14, 2018.

¹⁹⁴ Ibid.

originated from numerous potential uses and sustainability of the plant, but it also came from his strong ambition to find an alternative for fossil fuel.¹⁹⁵ Davis believes that the extractive industries such as big paper, big pharma, big agriculture and especially petroleum industries strongly influenced on ban of hemp in 1930s:

Originally, Henry Ford's cars were made out of hemp fiber, and ran on hemp ethanol. Ford never intended to run their cars on fossil fuels. They had to make changes so the oil and gas empire could force us to buy what they have to sell. When you go to the gas pump, there are four choices counting diesel. But really, it's an illusion of choice. There is only one, and it's called fossil fuel.¹⁹⁶

Davis is also working with universities across the United States for clinical trials to stand against FDA's recent statement against CBD.¹⁹⁷

Boulder Hemp Farm is his own hemp farm which is located in Boulder County, Colorado at an elevation of 4,995 feet above sea level. Boulder Hemp Farm is organized with scientists dedicated to providing access to CBD and driving scientific hemp research. All products are carefully crafted in small batches, using a scientific approach, and tested by multiple independent labs for purity and potency.¹⁹⁸ Their goal is to "provide access to the best Colorado grown CBD and hemp extracts, while supporting scientific education, discovery, and innovation".¹⁹⁹

7GENx focuses its work on supporting private hemp farmers to meet the current and emerging market demands for use in breeding for agricultural, industrial, and medical purposes. Its team of scientists collect data and analyzes the chemical, genetic, and phenotypic profiles of hemp, allowing the company to create separate varieties of hemp that are targeted for specific usage for current or growing markets.²⁰⁰

Additionally, 7GENx intends to restore regenerative hemp based agriculture, food, fuel, and fiber economies for the health, safety, and welfare of the planet. 7GENx provides hemp cultivation techniques, organic practices, and proprietary CBD rich hemp varieties that satisfy state hemp program standards. Such features are provided for small farms in Colorado and other states with state approved hemp programs. Shane specifically defines "small farms" as farms with

¹⁹⁵ Ibid.

¹⁹⁶ Ibid.

¹⁹⁷ Davis, Shane. Telephone interview by author. February 14, 2018.

¹⁹⁸ "Boulder Hemp." Boulder Hemp. Accessed January 30, 2018. <https://www.boulder-hemp.com/about/>.

¹⁹⁹ Davis, Shane. Telephone interview by author. February 14, 2018.

²⁰⁰ Ibid.

a scale of approximately less than ten acres. Small farms can annually grow hemp in order to create commodities such as fuel, food, and other types of emerging economic commodities. Davis believes that hemp can create much higher profit than other “cash crops” on much smaller acreage of land.²⁰¹

Davis’ other hemp business is Slow Hemp, which is a non-profit organization currently in development that introduces the idea of slow food and slow money. Slow Hemp provides small farms organic standards that guarantee highly qualified hemp from a local environment, with an overall operating ethos of conscious capitalism that yields social and environmental dividends as well.²⁰² This business not only focuses on hemp harvest and chemistry, but also the food system of the community:

When we think of organic, what does that mean? It means your land is certified by the USDA as organic, which means you don’t use pesticides or any of that stuff. But there’s all kinds of other stuff that happens outside the dirt that is certified organic. When it comes to hemp, what matters is where you get your genetics and who you’re getting your plants from, because plants can carry pathogens and viruses.²⁰³

Slow Hemp emphasizes healthiness and effectiveness of clean and organic food from local community, especially hemp. When farmers initiate farming or consumers purchase the products, Slow Hemp provides chemical profile and background of the plant’s cultivation. This process guarantees that plants are created and harvested in local, sanitary, and safe environments with respect to humanity and the ecology in which it was grown. Once Shane gets the farms to grow the hemp, he teaches them how to harvest with hazardous control points. This is a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement, and handling to manufacturing,

²⁰¹ Ibid.

²⁰² Ibid.

²⁰³ MaHarry, Lindsay. “Meet the Man Who’s Using “Hemp-enomics” to Undercut Big Agriculture and Protect Farmers - Culture.” MERRY JANE. January 22, 2018. Accessed February 12, 2018. <https://merryjane.com/culture/hempenomics-shane-davis-interview-hemp-big-agriculture>.

distribution, and consumption of the finished product.²⁰⁴ At the end of the year, Slow Hemp can buy back the small farms' hemp flower to produce CBDs and sell it as a dietary supplement.²⁰⁵

General Recommendations for CBD Oil Startup

- Building a processing plant is expensive and detailed budgets should be made before purchasing all of the equipment, so as to minimize miscalculations.
- If solely interested in not-for-profit local benefits, it may be worth exploring cheaper oil extraction methods and distributing CBD oil locally.
- Know that the CBD industry is much more regulated and technologically complex than other hemp industries, and that one should have as much knowledge and proper equipment specific to CBDs before proceeding.
- Be aware that the processing information that is listed previously in this section of the report is debated within the industry. Because of the lack of established and regulated practices for creating CBDs, the information we gathered should be consumed as a general guide. Further, more professional consultation should take place before investing into the CBD industry.

²⁰⁴ US Food and Drug Administration Home Page. Accessed February 20, 2018.

<https://www.fda.gov/default.htm>.

²⁰⁵ MaHarry, Lindsay. "Meet the Man Who's Using "Hemp-enomics" to Undercut Big Agriculture and Protect Farmers - Culture." MERRY JANE. January 22, 2018. Accessed February 12, 2018.

<https://merryjane.com/culture/hempenomics-shane-davis-interview-hemp-big-agriculture>.

Conclusion

2018 is a significant year for hemp. With the coming of an updated US Farm Bill, new hemp policies are likely while the nascent industry continues to make technological advances. This is an exciting time to be examining this alternative agricultural commodity. This report discusses legal, economic, and agricultural feasibility and educational topics that center around the emerging hemp industry in the United States. Currently, there is a dearth of information around the farming, processing, and marketing practices of hemp. Additionally, pushback from the current administration solidifies that there are no clear, widely-accepted laws that define hemp's legal status in all contexts within the United States. This report compiled the accessible information, given the nine-week timeline, ranging from hemp farming, to processing, to product marketing.

In the first part of the report, our Task Force analyzed the legal status of hemp, including an examination of the laws surrounding hemp on Native American reservations, as well as four main hemp products (textiles, building materials, food, and CBD). We found that when launching a hemp company, it is vital to understand and obey the laws regarding hemp while focusing on other industries before getting involved in CBD production. In the second part of the report, which follows this conclusion, we created a curriculum that functions as an educational overview of hemp in general and how to start a hemp business. The curriculum is meant to inform anybody that is interested in creating a hemp business about its history, its uses, and its cultivation practices. As more technology and research is done on hemp, the commercial viability of using the crop will increase, but this will depend heavily on the unclear legal future that is ahead of hemp.

The organization and content of the overall report is not meant to be a rulebook for how to create a hemp business. As the status of the plant and industry are changing, some of the specifics within our Task Force report may not be accurate a year from now. Practices that may be considered efficient today may be obsolete in a few years. We worked with the information that we could glean from scholarly research and interviews with sources within various parts of the hemp industry. That said, we also attempted to convey information that is relevant to Winona LaDuke's vision of using her hemp farm as a means to develop a sustainable, post-petroleum economy that benefits members of her band at the White Earth Reservation. This included ecological, nutritional, social analyses, tribal-specific examples that bring other Native American pursuits of hemp to light, and an educational component that can help to inform a future hemp industry on its background, applications, and cultivation.

Key Recommendations:

- Prepare to confront obstacles when entering the industry. Work with a strong legal team to inform all new decisions regarding business operations.
- Be in clear communication with state and tribal governments as well as local law enforcement for new business endeavors.
- Commit to lobbying for Minnesota and federal-level policies that decriminalize and support hemp, as well as clarify tribal sovereignty and responsibilities surrounding hemp.
- Invest first in processing products like textiles, building materials, and foods to jumpstart the business and then move into highly-regulated cannabidiols (CBDs).
- Identify how farming and processing technology align with vision of social and environmental responsibility and economic feasibility as well as identifying partners that share the same vision.
- Use general educational material and existing agricultural curriculums to educate general public about hemp and tribal sovereignty.
- Expand on educational review to more technical knowledge surrounding chemistry, genetics, and cross breeding of hemp for local farmers to be able to better judge the genetic stability and longevity of hemp seeds.
- Prepare to confront obstacles when entering the hemp industry, as this is an emerging industry in the United States that brings with it a convoluted history of stigmatization for certain demographics.

HEMP CURRICULUM

INTRODUCTORY NOTES

Hemp as an agricultural product is currently gaining high levels of both attention and scrutiny in the United States. Current interest in hemp farming shown by Winona LaDuke on the White Earth Reservation prompted the creation of this report, and many of its specific areas of focus.

Within this educational overview of hemp, there is a preliminary section outlining a general overview of hemp. This section addresses basic hemp facts, history, and misconceptions, as well as why its garnering attention currently. This is meant to be a resource for general education or to supplement existing agricultural curriculums. There are guiding discussion questions to help facilitate classroom and internal dialogs.

The second section of the overview contains more specific information on hemp production, and is primarily meant to be utilized by people interested in hemp farming in Minnesota. It outlines basic necessary preparation, best growing techniques, as well as processing, harvesting, and marketing practices. The methods covered in this section attempt to be applicable to a range of farming scales and purposes. Its goal is to instill a basic understanding for someone who is curious about harvesting hemp in Minnesota, while also demonstrating the potential opportunities and shortcomings of hemp farming currently.

Curriculum Table of Contents:

History of Hemp	3
Hemp versus Cannabis.....	5
Applications of Hemp	8
Introduction to Growing Hemp in Minnesota.....	17
Preparation	17
Growing Hemp.....	20
Processing, Harvesting, and Marketing	23
What's Next?	35
Curriculum End Notes	36

Curriculum Figure Appendix:

Figure 1: Relatives of the Cannabis Sativa L Plant	6
Table 1: Know What You Eat! Comparing Hemp Seed Butter and Skippy Peanut Butter.....	11
Figure 2: MDA Hemp Pilot Program Application.....	18
Figure 3: Seed Varieties for Desired Yields	22
Table 2: Fiber Harvesting and Processing Cheat Sheet	24
Figure 4: Retting Options.....	26
Figure 5: Hemp Stalk Uses	28
Table 3: Seed Harvesting and Processing Cheat Sheet.....	28
Figure 6: Life Span of Raw Hemp Materials.....	31
Figure 7: Hemp Seed Uses.....	32
Table 4: Introduction to Machinery Used for Harvesting Hemp.....	34

1. EDUCATIONAL OVERVIEW OF HEMP FOR COMMERCIAL USE

1.1 HISTORY OF HEMP

Hemp has a long, global history, and despite the fact that the United States Government has outlawed its growth and production since the 1950s, it has recently begun to make a comeback within the United States. The opposed suspect a hidden agenda due to the close resemblance of hemp to its close relative, cannabis. However, supporters cite key positives like its environmental, social, and economic potentials, and its long and productive history as reasons to remove restrictions on growing hemp.



"Spreading harvested hemp in Kentucky, USA." photograph. 1898. Popular Science Monthly Volume 54. https://commons.wikimedia.org/wiki/File:PSM_V54_D031_Spreading_hemp_in_kentucky.jpg (access February 22, 2018).

From hemp cloth in early Mesopotamia to hemp fiber produced in China 28 BC to CBDs now being used for medicinal purposes, hemp has been utilized all over the world for thousands of years.¹ Hemp was one of the first known cultivated crops, and throughout history and was used mainly for its fiber.² Hemp fiber was made into many necessary products such as paper,

clothing, food, sails, and woven baskets. In more modern times, hemp has continued to be used for fiber, but human scientific alterations have also altered the cultivation of hemp for other uses, such as CBDs, biofuel, makeup, and more.

While the industrial hemp grown today is not native to North America, a relative of this plant, *Apocynum cannabinum*, (also known as Indian hemp or Dogbane) is present in continental United States and most Canadian provinces. Prior to European colonization, Native American, Canadian, and Minnesotan communities used Indian hemp. It was used mostly as fiber to make

items such as bowstrings, nets, and ritual baskets³, but was also cultivated for its seeds, which was turned into meal and chewing gum.⁴ Some North American natives used the roots to make a tea to treat heart palpitations and a variety of other medicinal purposes such as colds, earaches, headaches, and more.⁵ However Indian hemp, while effective, is also highly poisonous and should not be used medicinally without first consulting an expert.

Indian hemp, while traditionally very important, is not the hemp that we are hearing about in today's controversies. We will be discussing *Cannabis sativa L*, which has two main species of plants: cannabis and hemp. When hemp is cultivated on an industrial scale, it is then referred to as industrial hemp.

Hemp originated in China, but spread throughout the greater Eurasian continent, where it was used for its fibers. Puritan Settlers introduced it to North America in 1647. For a century, industrial hemp was key to life in post-colonial America. In the late 1800s, the industry began to decline because of the technical advancements in cotton and the subsequent increase in slavery and cheap labor. Additionally, the introduction of steam and petroleum powered ships further reduced the need for hemp fiber sails and products.^{6 7}

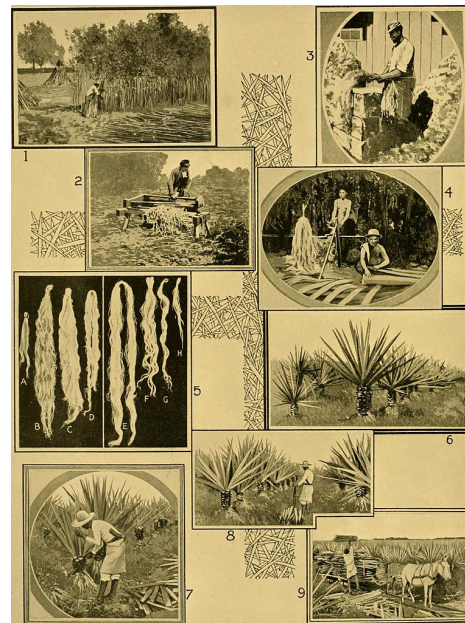
Controversial History of the Term 'Marijuana'

A movement began within the cannabis industry and community to move away from using the word 'marijuana' and towards the use of the word 'cannabis'. Throughout history, the term 'marijuana' has come to be associated with ideas of crime and danger, usually in reference to minority groups. From 2001 to 2010, African Americans were arrested for cannabis possession almost four times the rate of whites.⁷ While this trend can't be change by erasing 'marijuana' from the common language, it is a step in correcting its racially-charged history.

Prior to 1937 both hemp and cannabis were legal to grow throughout the country. However, at that time, journalists in New Orleans began blaming a long stint of crimes on Hispanics and African-Americans, which they claimed were under the influence of cannabis. This began the racialized hysteria over cannabis, which quickly influenced national legislature. The 1937 Marijuana Tax Act, while technically creating a separate definition for hemp, outlawed the cultivation of any cannabis plant. The ban on hemp was temporarily lifted during WWII when the United States was cut off from many of its international hemp suppliers. This began the "Hemp for Victory" campaign. During the wartime effort, a multitude of hemp processing mills were built around the Midwest, but were quietly retired after the war's conclusion and

restrictions were restored after the war. US Congress later repealed the 1937 Marijuana Tax Act and replaced it with the Comprehensive Drug Abuse Prevention and Control Act of 1970. In this, the Drug Enforcement Agency (DEA) took a new stance on raw hemp, officially declaring it too indistinguishable from its psychoactive cousin, and labeled both as a Schedule 1 Narcotic: illegal to produce, own, and distribute.

To this day, however, some states, organizations, and tribes are taking action against this. But, progress has been slow. As of 2017, 38 states and Puerto Rico considered legislation related to industrial hemp. These propositions ranged from changing the definition of hemp to separate it from cannabis, to establishing new licensing requirements and programs.⁸ In 2015, the Minnesota Department of Agriculture (MDA) passed the Industrial Hemp Development Act (IHDA), which created an industrial hemp research pilot program that permits the study, growth, cultivation, and marketing of industrial hemp.⁹ This program provides a commercial hemp license and its participants are required to report back to the MDA with specific information on their crops.



Textile Production of Hemp and Sisal in 1911.

"PLATE XII: Hemp and Sisa." digital scan of book page. 1911. Lamb's textile industry of the United States, embracing biographical sketches of prominent men and a historical résumé of the progress of textile manufacture from the earliest records to the present time;" <https://archive.org/stream/lambtextileindu01brow/lambtextileindu01brow#page/n239/mode/1up> (access February 22, 2018).

DISCUSSION QUESTIONS:

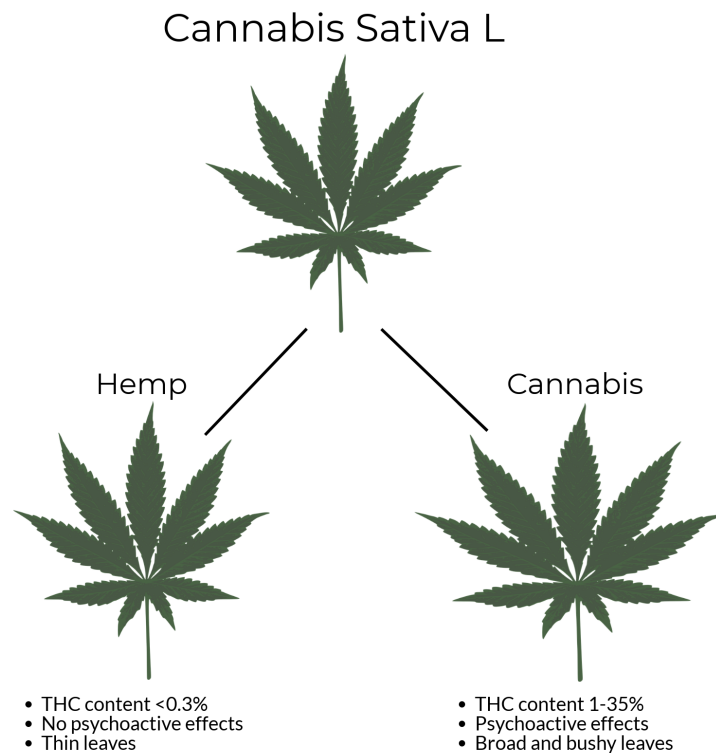
1. What were some of the earliest historical uses of hemp?
2. Why are people pushing to move away from the term marijuana to refer to cannabis? How could this relate to hemp?

1.2 HEMP VERSUS CANNABIS

Hemp and cannabis (commonly referred to as medical marijuana and recreational marijuana) are each members of the *Cannabis Sativa L* family. Although they are commonly confused, hemp and cannabis are completely different in their chemical makeup, function and

appearance. Currently in the United States, they also have different legal status and it is important to know what differentiates the plants from each other.

Figure 1: Relatives of the Cannabis Sativa L Plant



1.2.1 CHEMICAL MAKEUP

Cannabis is known to be used for medicinal and recreational purposes, while hemp has a variety of different functions. This is due to the chemical makeup attributed to each plant, with the main difference being their levels of tetrahydrocannabinol (THC). Cannabis can contain anywhere from one to thirty-five percent THC content.¹⁰ Hemp, on the other hand, has strict regulations in order ensure the THC content does not exceed 0.3 percent.¹¹ Due to this low level of THC, hemp does not have psychoactive effects. In addition, hemp has high cannabidiol (CBD) content which is non-psychoactive, making the minimal amounts of THC less effective.¹²

1.2.2 FUNCTION

CBD and THC are the most prominent cannabinoids found in Cannabis. CBD is not psychoactive, meaning that there is no “high”. CBD will not affect your sensory awareness,

perception, consciousness, reaction time or behavior. In addition, CBD has no physiological effects on your heart rate, blood pressure, or body temperature.¹³ Even at high amounts, CBD is considered safe and non-toxic to humans. The cannabinoid content of industrial hemp is ideal for people looking for the medical benefits of CBD without the “high” of the THC.¹⁴ CBD can be found to reduce anxiety, insomnia, nausea, and inflammation among others.¹⁵

1.2.3 APPEARANCE

There are visual differences when looking at a hemp plant versus a cannabis plant, particularly regarding the leaf shape, height, and branch arrangement. Upon observation, marijuana leaves tend to be broader and bushier than the thinner hemp leaves. Since hemp plants, like the one pictured below, are cultivated for their fibers and seeds for manufacturing, they grow to have tall and narrow physiques with branches clustered at the top. On the contrary, cannabis is cultivated for its flowers so it tends to have a shorter and wider structure.



quinntheislander. "Hemp." photograph. July 22, 2017. Pixabay image database, <https://pixabay.com/en/hemp-plant-farm-marijuana-drug-2540730/> (access February 22, 2018).

DISCUSSION QUESTIONS

1. What is the main chemical that differentiates hemp and cannabis?
2. What are some potential side effects of CBD oil?
3. Do hemp and cannabis have the same physical appearance? Explain.

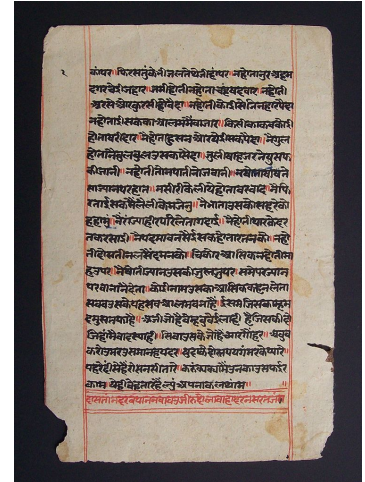
1.3 APPLICATIONS OF HEMP

1.3.1 ENVIRONMENTAL BENEFITS

Hemp is a viable alternative to less eco-friendly manufacturing practices. Using hemp products is a sustainable practice that will have lasting effects on our environment. Hemp can be used as an alternative to trees, does not require the use of chemicals, and is a reusable material. It can also be made into clothing that is more durable than typical fabrics. Although there are more benefits of hemp in the economic and medical realm, these are just a few examples of how growing hemp can be beneficial for the environment.

One benefit of hemp is that it can be used as a fiber source in place of trees, therefore conserving forests. Hemp can be manufactured into paper, rope or wood-like raw materials. In addition, hemp can grow in the span of a few months, whereas trees take years to grow.¹⁶ This fast growing rate allows for one acre of hemp to annually produce as much paper as four acres of trees.¹⁷ The practice of making paper from hemp dates back centuries, with between seventy-five and ninety percent of all paper being made from hemp fiber until the late nineteenth century.¹⁸ Hemp paper does not need to be bleached with harmful chemicals such as chlorine, instead it can be whitened with hydrogen peroxide which is a lot safer for the environment.¹⁹

Hemp can also be manufactured into a variety of different building materials such as hempcrete, fiberboard, cement, insulation, and plastic.²⁰ These materials are durable and can be used as environmentally-friendly alternatives to other building materials, like wood and concrete. Materials



Language Written on Hemp Paper.

Moefuzz. "Ancient Sanskrit Manuscript on Hemp Based Paper." photograph. August 25, 2016. Wikipedia Commons, https://commons.wikimedia.org/wiki/File:ANCIENT_SANSKRIT_ON_HEMP_BASED_PAPER._HEMP_WAS_A_COMMON_AND_DURABLE_FIBRE_IN_THE_PRODUCTION_OF_%22RAG%22_PAPER_FROM_200_BCE_TO_THE_1850_AD.jpg (access February 22, 2018).



Scott Lewis. "Hempcrete." photograph. November 24, 2014. Flickr, <https://www.flickr.com/photos/99781513@N04/15244976244> (access February 22, 2018).

made from hemp are especially sustainable because they are generally rot-free, pest-free, fire-resistant, and have been known to last up to five hundred years.²¹

Due to its vigorous growth, shading capacity and disease resistance, hemp does not require any harmful pesticides or herbicides.²² In addition, fertilizers are not required because the necessary nutrients and minerals are released when the leaves fall onto the soil. When dried in the field, hemp returns up to sixty percent of its nutrients back into the dirt.²³ Because of the natural abilities of the hemp plant, it is possible to grow large organic yields without the need of added chemicals. On a larger scale, hemp can be used as a substitute to both cotton and flax, which together consume fifty percent of all pesticides.²⁴ Hemp replaces cotton as a raw material in the manufacturing of paper and cloth, and can replace flax fiber or seeds in animal feed.



Natrij. "Hemp stalk." photograph. October 6, 2002. Wikipedia Commons, <https://commons.wikimedia.org/wiki/File:Hanfstengel.jpg> (access February 22, 2018).

Products made from hemp can be reused, recycled, and are completely biodegradable. This can be useful in the construction industry by reducing the amount of wasted material.²⁵ Industrial hemp fibers create an insulating material that is stronger and lighter than concrete. By using hemp in place of wood and concrete, homes can be built with smaller carbon footprints.

OTHER FACTS ABOUT HEMP: ^{26 27}

- Hemp can be grown and produced for biomass fuels which replace the need for gas, oil and coal energy.
- Hemp paper can be recycled 7 or 8 times, whereas wood pulp paper can only be recycled 3 times.
- Hemp cloth is stronger, warmer and more absorbent than cotton.
- One acre of hemp will produce as much textile material as 2-3 acres of cotton

DISCUSSION QUESTIONS:

1. What is one way that producing hemp paper can be beneficial for the environment?
2. What are some potential downsides of producing hemp products?

1.3.2 NUTRITIONAL BENEFITS OF HEMP

After the onset of European colonization of North America, and the forced assimilation of native communities into Anglo-American culture, the health and diets of the native peoples have deteriorated significantly. The long lasting effect of the treatment of native cultures by the United States Government and other colonizing institutions can be seen by The Indian Health Service's report noting the strong connection between diabetes and quality of clinical care, education, community outreach and environmental changes in a given society. According to the Centers for Disease Control and Prevention, Native Americans have a greater chance of having diabetes than any other racial/ethnic group in the United States.²⁸ Some national legislation has been passed to fight this health imbalance, but individual and group efforts, including activists on the White Earth Reservation, have continued to grow and fight for a healthier change. Hemp has the ability to positively infiltrate native culture and economies. Smaller scale hemp farms give growers an opportunity to work outside, produce ecologically-conscious materials, and provide healthy food options. It can also provide opportunities for communities to come together, through hemp milk coffee products or perhaps even farm-to-school programs.²⁹ On some reservations, hemp education might present itself in the classroom soon.

An overabundance of fast food, and a lack of access to healthier foods overwhelmingly affects people of color in the United States.³⁰ Since colonization, native diets have shifted from traditional foods towards commercialized, high-fat, low-nutrient, fast food diets. Not only is this cheap food trend unhealthy for the population, but it is detrimental for the economy as well. As of 2015, most of the money spent on food in the White Earth Reservation went off-reservation. This is a common theme in many rural reservations.³¹ Tribal organizations are now fighting for the return of a traditional approach to food in order to combat this epidemic and deepen the people's cultural connection with their histories and traditions. While industrial hemp is not native to North America, cultivating it can still provide greater access to healthy and sustainable nutrition systems.



Gulleo. "Hemp Seeds." photograph. April 23, 2017. Pixabay image database, <https://pixabay.com/en/hemp-cannabis-seeds-grains-healthy-2258608/> (accessed February 22, 2018).

Hemp has proven to have many health benefits, similar to those provided by flaxseed and fish oil. Hemp seed, for instance, possesses excellent nutritional values, with essential fatty acids, almost as much protein as soybean, and is rich in vitamins and minerals. It has the ability to produce the seed hearts and hulls, gluten-free flour, and oil. Products such as granola, granola bars, breads, cakes, porridge, soup, and even a peanut butter substitute (which has higher nutritional values than the typical jar of Skippy's (Table 1)^{32 33} can all be made from hemp. Food products from hemp only have trace amounts of THC, and will not cause psychoactive effects, no matter how much is consumed.³⁴

Hemp seed oil also contains essential amino acids and other key molecular structures that have been associated with cardiovascular health and lowering blood pressure and cholesterol, on top of living a healthy lifestyle.³⁵

TABLE 1: KNOW WHAT YOU EAT!

COMPARING HEMP SEED BUTTER AND SKIPPY PEANUT BUTTER

If someone was to eat one hundred grams (about half a cup, or six tablespoons) of nut butter, this is what they would be putting into their body:

		Hemp Seed Butter	Skippy Peanut Butter
<i>Nutrients</i>	<i>Units</i>	<i>Value/100 grams</i>	<i>Value/100 grams</i>
Energy	kcal	393	656
Protein	g	21.43	21.88
Total Lipids (fat)	g	28.57	53.12
Carbohydrates	g	7.14	18.75
Fiber	g	3.6	6.2
Sugars, total	g	7.14	6.25

1.3.3 HEMP SEED RECIPES

Traditional Uttarakhand Bhang (Hemp) Chutney - Northern India ³⁶

In Uttarakhand, a state in Northern India, hemp is called bhang because they say the taste is so good, if you eat it once, you won't be able to stop!

Ingredients:

- **One quarter cup bhang (hemp) seeds**
- **One quarter cup mint leaves**
- **Two green chili peppers**
- **Two tomatoes**
- **Juice of one lemon**
- **Water, as required**
- **Salt**

Directions:

1. See Roasted Hemp Seeds recipe for how to roast. Set aside for later.
2. Either over open flame or under the broiler, roast the tomatoes, keeping the skin on, until the skin is burned in places.
3. Clean your mint leaves by removing all the stocks.
4. Using a traditional sil batta, blender or food processor, grind the roasted tomatoes, the roasted bhang seeds, green chili and mint leaves to a smooth texture. Use the water as needed, spooning in one tablespoon at a time.
5. Finally, add the lemon juice and season with salt.
6. Serve with rice.

Roasted Hemp Seeds - Asia ³⁷

While hemp seeds can be eaten raw, toasting them can add an extra depth of flavor to the seed and the dishes in which they are used.

Ingredients:

- **Hemp seeds**
- **Cooking oil (optional)**
- **Salt (optional)**

To roast in a skillet:

1. Heat a heavy bottomed skillet, add a tablespoon of your choice of cooking oil (optional).
2. Heat over medium-high heat.
3. Toss in a quarter cup of hemp seeds, spreading them evenly over the skillet. Allow seeds to cook until they have a noticeable aroma, and the outside begins to darken. Stir occasionally to insure the cooking is even. Remove from heat.
4. If desired, add a sprinkling of salt for taste.

To roast in the oven:

1. Preheat the oven to 325° F.
2. On a baking sheet, place the hemp seeds and cover with cooking oil and salt. Be sure to spread out evenly.
3. Bake the seeds until they turn brown, for around fifteen minutes.
4. Eat plain or sprinkle on top of dishes for a crunchy garnish.

Siemieniatka Kanapiø Koðë³⁸ - Eastern Europe

A traditional Christmas Eve hemp-based soup/porridge.

Ingredients:

- **Three-quarter cup raw, shelled hemp seeds**
- **One and one half cups water**
- **One cup hemp milk (see Hemp Milk recipe)**
- **One and one half cups whole milk**
- **Four tablespoons all-purpose flour**
- **Four tablespoons salted butter**
- **Six tablespoons granulated sugar**

Directions:

1. Place the hemp milk in a saucepan and simmer over low heat until it reduces down to about 1 cup of creamy, milky substance.
2. Combine the hemp milk and whole milk in a deep saucepan over medium-high heat. Stir in the flour, butter, and sugar.
3. Bring the mixture to a vigorous boil, then reduce the heat to low, keeping the porridge at a simmer, stirring often. Cook until a thick, creamy consistency, halfway between soup and porridge.
4. Serve hot and enjoy!

Hemp Milk³⁹

A great, slightly nutty and very creamy cow milk substitute.

Ingredients:

- One quarter cup hempseeds
- One cup water
- One teaspoon vanilla extract (optional)

Directions:

Add all ingredients into a blender and blend on high for thirty seconds. If desired, pour the milk through a strainer for an extra smooth finish. Fresh hemp milk can store in the refrigerator for up to four days or can be stored easily stored in the freezer.

Variations:

- Add two tablespoons of cocoa powder for chocolate milk
- Add one quarter cup fresh berries for berry milk
- Add one pitted date or one tablespoon maple syrup for a sweeter finish

DISCUSSION QUESTIONS:

1. What is the relationship between health, culture, and history?
2. What are the main food products that hemp can produce?
3. What are some examples of health benefits that hemp can provide?

1.3.4 HEMP ECONOMICS

Hemp is a relatively new crop being grown commercially in the United States. There is peaking interest in “new” fiber crops to replace cotton in a more environmentally friendly way.⁴⁰ Hemp is seen by many to be a more environmentally and socially beneficial alternative to other crops. The economic opportunities within this new market are often seen as appealing to farmers in the USA.⁴¹ Hemp appears to be more profitable than row crops and is appealing because there is still relatively little farming and production competition within the United States. Many cite the nearly \$600 million of imported hemp into the United States as an opportunity to produce domestically.⁴²

These economic opportunities depend heavily on the existing physical resources available, and the amount of prior experience a farmer has. The purpose of the hemp (regardless of its final product) and what it is being processed for also factor in to the potential profits of a farmer. For these reasons, it is observed with hemp (as with most other commercial farming projects) that the farmers that benefit historically from social structures found within the United



A 2013 study by researchers at the University of Kentucky predicted that despite “showing some positive returns, under current market conditions, it remained unclear whether anticipated hemp returns would be large enough to entice Kentucky grain growers to shift out of grain production” under most circumstances

Hemp as an Agricultural Commodity- Congressional Research Service

Johnson, Renée. “Hemp as an Agricultural Commodity.” Congressional Research Service, March 10, 2017. Congressional Research Digital Collection. <https://fas.org/sgp/crs/misc/RL32725.pdf>.

Image created using Piktochart (<https://piktochart.com/>)

States, often have disproportionate advantages and access to existing infrastructure, land, wealth, and technology, thus resulting in a more profitable hemp crop.⁴³

Hemp is also facing many challenges because it is a new industry. Farmers who want to participate in the American agricultural market face difficulties such as: the need to establish agricultural supply chains, breeding modern hemp varieties, modernizing equipment, recognizing new opportunities,

and updating methods of harvesting, processing, and manufacturing.⁴⁴ These considerations are seen as “challenges” when the primary goal of hemp farming is making a profit, as they often impede the ability to make money on hemp quickly and easily. These intensive profit-seeking

agricultural practices are sometimes seen in farms influenced by the European pastoral perspective.⁴⁵ On the other hand, farmers with goals outside of making profits could perhaps see the new hemp industry, and the aforementioned considerations, as opportunities for innovation rather than limits to production.

The current lack of modern processing technology is seen as a large inhibitor to mass production of hemp. Hemp is notorious for requiring high labor costs to farm and process, deterring many farmers from beginning the growing process in the United States. However, there are promising new advancements in this area that could promise higher economic gains, such as the machinery used at BastCore in Nebraska.⁴⁶ The application of this expensive and exclusive technology would likely benefit large scale production companies and can make hemp production less environmentally sustainable, both by increasing the size of production and non-renewable energy consumption.⁴⁷ While technological advances have been shown to raise profits in most agricultural contexts, this additional profit has sometimes been shown to go to those who benefit from existing power structures in agriculture and farming.⁴⁸

China currently produces and exports more hemp than any other country. China's market dominance also makes it difficult for American producers to be competitive on a global scale. Several factors have allowed the Chinese market to grow to the biggest in the world. Chinese newspapers have called hemp "green gold", saying "hemp brings in more than 24,710 yuan (\$3,706 per acre), compared to just a few thousand yuan for more common crops like corn. It also has few natural enemies so there is little need for expensive pesticides".⁴⁹ Conversely, in the United States, corn is a heavily subsidized crop and there are many legal restrictions on growing

hemp. Currently, the retail sale of hemp products in the United States is around \$600 million annually, with most of that hemp being imported from Canada and China.⁵⁰

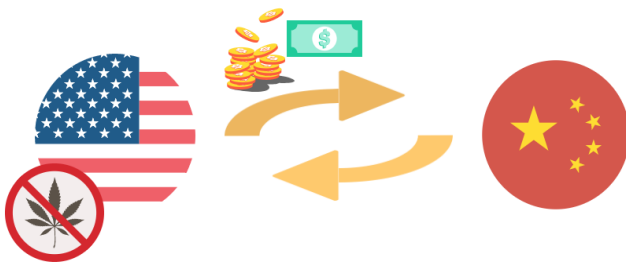


image created using
piktochart
(<https://piktochart.com/>)

With the many uses for hemp also come a variety of employment opportunities for local economies. From tilling the fields, to making t-shirts and plant-based milks, there are many different jobs utilizing a variety of skill sets. The growth of hemp in the economy even increases the number of highly skilled jobs such as CBD research, and even energy-storage devices (“supercapacitors”) for electric cars. When hemp is “cooked” into carbon, it can be turned into conductive nanosheets that are used for energy storage.⁵¹



Image created using piktochart (<https://piktochart.com/>)

On a small scale, hemp is appealing economically because it can provide a source of income to farm owners and workers, while potentially being more profitable than other, more environmentally degrading, crops. Hemp provides these jobs, while also supplying a local community with a variety of products ranging from medicine, to foods, to fibers. Hemp also provides nutrients to soil that could be beneficial to the growth of other crops. Having jobs that promote direct contact and understanding of land and natural patterns can be rewarding in ways that are not measured monetarily.⁵²

DISCUSSION QUESTIONS:

1. What are some positives and negatives economically to growing hemp?
2. How important are monetary gains to you personally when deciding which plants to grow?
3. What is an example of a job that hemp growing can create?



"Logo." Photograph. Nicolette Slagle. (Accessed February 22, 2018)

2. INTRODUCTION TO GROWING HEMP IN MINNESOTA

The following curriculum intends to create a framework for how modern hemp farms are actualized, covering stages of production from the acquisition of proper permits to the harvesting of a fully-grown crop. It touches upon less mechanical and resource-intensive ways of harvesting hemp and instead focuses on more contemporary farming procedures and technologies. Its purpose is to exhibit potential opportunities and shortcomings, as well as create a basic understanding for someone who is curious about harvesting hemp on an industrial scale.

2.1 PREPARATION


2.1.1 PERMITS

Hemp is classified in the United States as a “Schedule 1 Controlled Substance”, under the Controlled Substances Act (CSA) because it is part of the cannabis plant family. Because of this, the DEA strictly controls the farming of hemp. The classification under the CSA does not make

growing hemp illegal. Rather, it places strict controls on its production and makes it illegal to grow without a DEA permit.⁵³ However, in some select states, such as Minnesota, there are hemp growing pilot programs, which were intended to study the cultivation, processing, and economics of industrial hemp. According to the Agricultural Act of 2014 (The Farm Bill), the state pilot program acts as an equivalent to the DEA permit, allowing the legal growth of industrial hemp under state laws and regulations.⁵⁴ Through participating in these programs, farmers are allowed to grow cannabis plants that contain less than 0.3 percent THC concentration (thus, these types of cannabis plants fall under the definition of “hemp”).^{55 56}

To start growing hemp in Minnesota, there are certain permits that need to be obtained from the Minnesota Department of Agriculture (MDA). All first-time applicants must submit an Informed Consent Form (in order for the MDA to perform a federal and state background check on the applicant), a set of fingerprints (which can be given by the Bureau of Criminal Apprehension or local police department), a payment, a map outline the land and fields in which hemp will be grown, and the completed application forms.⁵⁷ All licenses will be valid until the 31st of December of the year the license is issued. Each year, applicants must re-apply to be admitted into the pilot program.⁵⁸ This application can be found on the MDA website and allows participants to grow, process, research, and sell hemp as long as it complies with state laws.

Figure 2: MDA Hemp Pilot Program Application

 DEPARTMENT OF AGRICULTURE		625 Robert Street North, Saint Paul, MN 55155-2538 www.mda.state.mn.us	
PLANT PROTECTION DIVISION Phone: 651-201-6123		Minnesota Statute 500.221	
HEMP PILOT PROGRAM APPLICATION			
PART 1 – APPLICANT INFORMATION			
Applicant Name <input type="text"/>			
Business Name <input type="text"/>			
Physical Street Address (no PO Box) <input type="text"/>		City <input type="text"/>	State <input type="text"/>
Mailing Address (if different) <input type="text"/>		City <input type="text"/>	State <input type="text"/>
Primary Phone <input type="text"/>		Primary Email <input type="text"/>	
Were you a pilot participant in 2017? Yes <input type="checkbox"/> No <input type="checkbox"/> <i>(If No, please complete the background check request form)</i>			

Minnesota Department of Agriculture. "Hemp Pilot Program Application." pdf. January 8, 2018.
<http://www.mda.state.mn.us/plants/hemp/~media/Files/plants/hemp/ag03341hempx.pdf> (access February 22,

The current legal classification of hemp as a Schedule 1 controlled substance makes growing hemp substantially more legally complicated than a federally legal crop. Some

commonly cited challenges faced by farmers include: taking additional measures to prevent plant and seed theft, allowing several inspections by federal and state agents, apply for special permits, receiving criminal background checks, not being able to obtain federal crop insurance and the limited selling ability of hemp products across state and country borders⁵⁹.

2.1.2 GETTING SEEDS & APPROVAL

After all the permits are in order, the next step to take into consideration is the growing and farming of the hemp. There are different varieties of hemp that can be grown to suit the needs of the farmer. Some varieties are grown for their high grain yields, fibers only, or seed production.⁶⁰ Scientists are working to breed hemp varieties that focus on optimizing the resources naturally abundant in the plants. Seeds can either be imported from Canada or bought from select local farms, such as Minnesota Hemp Farms Inc. The MDA recommends getting varieties from either the Health Canada List of Approved Cultivars for the 2017 Growing Season or The Organization for Economic Co-operation Development (OECD) List of Varieties eligible for seed certification.⁶¹

Purchasing seeds from Canada can be beneficial due to the high quality and probability that the hemp varieties will remain under the legal threshold of .3 percent THC.⁶² However, obtaining hemp seeds from Canada to import into the United States can be difficult.

The MDA requires several reporting forms throughout the growing season, such as a seed transfer agreement, a planting report, and a final report. The information gathered in the final report should include “agronomic data, like seeding rate, cultivation methods, yield, pesticide/fertilizer use. Participants should gather this data throughout the growing season in preparation for the MDA report.”⁶³ The MDA also states all of the hemp seeds gathered from must be processed without withholding any to replant the next year.⁶⁴ For this reason, a new batch of seeds must be purchased each season of hemp production. The only exception to this rule is if you are a part of the Minnesota Crop Improvement Association seed certification program.⁶⁵ The MCIA is an organization that focuses on the improvement of agricultural products and processes to maximize the effectiveness of the farmers and their products. They do this “by providing services to enable them (the farmers) to provide high-quality products to

Minnesota, the United States and the World”, as well as “provide certification and quality assurance services to a wide array of agricultural and food product producers and handlers”.⁶⁶

2.2 GROWING HEMP

Hemp can be planted and harvested in order to produce maximum yields of various products including fibers, seeds and oils. Although there are general rules for growing hemp that are not dependent on the desired product, there are a variety of different growing techniques that can be used to produce a specific yield. For example, when growing hemp some important factors include the climate, soil type, water input and crop rotations. In order grow hemp for fiber, seed, or oil production, the seed varieties and planting must be taken into consideration.

2.2.1 CLIMATE

Hemp yields depend heavily on the climate they are grown in. When planting hemp seeds, it is vital to ensure that the soil conditions are not below forty-five °F since hemp prefers a warmer or humid climate. Research in Western Canada has observed that early seed planting dates, like early May, have resulted in higher mortality rates due to the cold soils that cause seedling pathogens.⁶⁷ Earlier seeding dates also produce taller plants with a thicker stalk due to the longer vegetative growing period. Although results are not conclusive, it is important to note that there are many factors such as soil temperature and moisture that impact a yield.

During the growing season, it is ideal to have ten to thirteen inches of rainfall or watering, but this can be supplemented by early soil moisture and adamant weed control.⁶⁸ In order to produce maximum yields, roughly half the moisture is required during the stages where the hemp is beginning to flower. If the plants do not have enough water during this stage, they will produce low crop yields.⁶⁹ Accomplishing this planting as early as possible is recommended because it allows plants to have a longer growing period and thus have more fiber for processing.

2.2.2 SOILS

There are a number of soil and weather conditions that can also impact hemp fiber growth. Rocky or compact soils should be avoided. The best soils to achieve maximum yields on

are loamy soils with high nutrients and good drainage. In addition, well-aerated and loamy soils are composed mostly of sand, silt, and with smaller amount of clay being ideal. Compact soils are known to cause problems for hemp root development and harm the crop. For this reason, it is recommended that land containing a large proportion of clay should be ploughed or harrowed at the end of autumn or the start of winter. If the soil is silty, plowing can wait till spring.⁷⁰

Nutrient requirements for hemp are similar to that of corn. Agronomists in Kentucky recommend that if maximum industrial hemp yields are the goal, select good corn land and plan on inputs equal to current corn crops. If maximum yields are not the goal, industrial hemp can be expected to perform on lands with lower productivity and with reduced inputs much the same as our current commodity crops would.⁷¹ Young plants that have been growing for up to three weeks or have reached approximately twelve inches tall are especially sensitive to wet soils and flooding.⁷² If affected by water damage, plant growth could remain stunted resulting in an uneven or poor crop.⁷³ Ideal soil pH is somewhere between 7.0 to 7.5, although it can grow in soil with pH as low as 6.0. Nutrient requirements for hemp are similar to that of corn, so a lack of nitrogen in soil can impede growth.⁷⁴ Hemp plants have fully developed at around 110 days.⁷⁵

2.2.3 CROP ROTATION

A four-year crop rotation is recommended to keep a balance of nutrients in the soil, and avoid the risk of pest build up.^{76 77} Hemp can be rotated with crops such as corn or wheat, but not with fields of canola, edible beans, soybeans or sunflowers. This is due to hemp's demand of nutrients that certain crops can provide and others cannot.⁷⁸ That being said, hemp leaves can be left in the field after harvesting to help retain and replenish nitrogen in soil after harvesting for the stalk.⁷⁹ For good seed production, hemp fields may require additional supplements such as nitrogen, phosphorus, potassium, and sulfur.⁸⁰ One acre of hemp requires general inputs of nutrients including about eighty to 120 pounds of nitrogen, forty pounds of phosphorus, sixty pounds of potassium, and fifteen pounds of sulfur.⁸¹

2.2.4 VARIETIES

There are different varieties of hemp that can be grown to suit the needs of the farmer and market. Some varieties are grown for their high yields or fiber, seed, oil production, or for research and development.⁸² Scientists are working to breed hemp varieties that focus on

optimizing the resources naturally abundant in the plants. These varieties of hemp seeds are only grown for research and are not commercially available yet.⁸³ Parkland Industrial Hemp Growers (PIHG) are seed producers based out of Manitoba's Parkland region that specialize in growing a variety of seeds that can be used for different purpose. PIHG's hemp seed breeding program was designed to bring superior seed varieties into the industry. The seeds they breed to have low THC content, large seeds, high yields, seed production, or high fiber industry.⁸⁴ Some of their most popular seed varieties are dual-purpose varieties that are suitable for both seed and fiber production. Figure 3 shows which seed variety PIHG can grow to produce certain desired yields.

Figure 3: Seed Varieties for Desired Yields

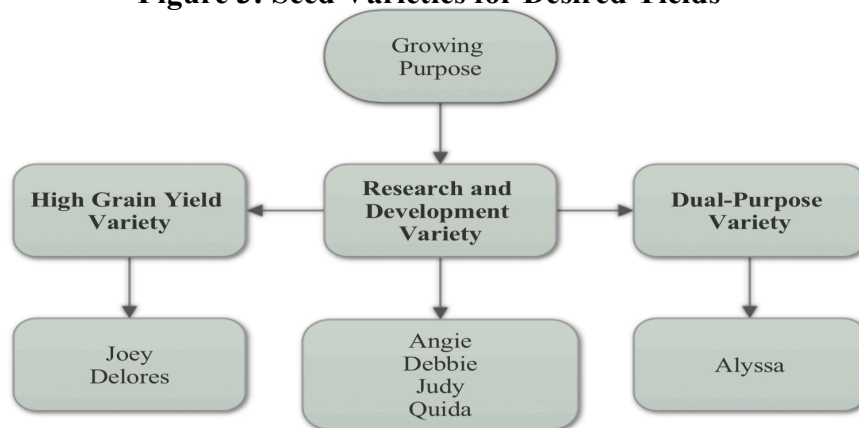


Image created using Smartdraw (<https://www.smartdraw.com/flowchart/flowchart-maker.htm>)

2.2.5 PLANTING

How hemp seeds are planted is a crucial aspect in determining the results of the yield. There are multiple varieties of hemp that can be grown to tailor certain needs such as small or large seed, and low or high oil content. When planting hemp for seed production, it is recommended to have the plants placed further apart to encourage flowering and branching of the plants. Seeds for fiber should be planted in rows four to eight inches apart, with a seeding density of sixty pounds per acre in the field. If planting hemp for fiber production, the plants should be placed closer together to promote height growth rather than branching out, while discouraging weed growth.⁸⁵

2.3 PROCESSING, HARVESTING, AND MARKETING

Hemp harvesting is one of the most underdeveloped and problematic parts of hemp cultivation. This stage requires careful planning and execution. Even before the seeds have been planted, it is important to understand and make choices regarding harvesting, processing, and marketing hemp.⁸⁶ Because hemp is relatively new to large scale North American farms, industry standards have not been set. This means that there is a large variety of information, which leaves space for personal creativity, but will also require further research both by the farmer and the industry. Varieties grown for fiber only will be established, managed, and harvested differently than those grown for seed, dual-purpose or cannabinoids.⁸⁷

Hemp is a dioecious plant, meaning the male plants produce more fibers than the females, and the females produce more seeds than the males. Scientists have also been working to develop a hybrid plant as well. Knowing the intended final product is important when choosing the seed. There is also the option of dual harvesting, which is when all parts of the hemp plant are harvested and used. This creates a trade off decision for the farmer⁸⁸, as harvesting for fiber and seeds typically occur at different periods in the growing cycle. Other factors that impact harvesting include machinery accessibility, weather, climate, and personal philosophy. It is important to have all these factors determined before harvesting begins.

2.3.1 FIBER HARVESTING AND PROCESSING

Hemp is typically harvested for its fiber and its seeds. In the past, hemp fiber and seed have been grown separately due to the difference in harvest methods for each product. Farmers are now finding ways to produce both these products from one harvest, but farming each product separately is, for now, the most efficient method.

TABLE 2: FIBER HARVESTING AND PROCESSING CHEAT SHEET







Step	General Description
Defoliation ⁸⁹ 	<ul style="list-style-type: none"> -Removal of unnecessary leaf mass (chemical and organic options) -Takes place when male plants have reached ten to fifteen percent of pollination stage (about five to eight days prior to harvesting fiber)
Cutting ⁹⁰ 	<ul style="list-style-type: none"> -Machine or by hand -Whole stalks for Fiber -Length of cut depends on type of plant, height of plant, and quality of fiber desired -Recommended to cut stock at least 4 inches above the ground
Retting ⁹¹ 	<ul style="list-style-type: none"> -Microbial breakdown of layers of hemp stalk -Allows easier separation of fiber and non-fiber portions - Four types: Dew, Water, Green, Winter Retting -After retting, stalks should be less than fifteen moisture content
Decortication ⁹² 	<ul style="list-style-type: none"> -Separates bast fiber from the hurds without harming the fiber -Can be done by hand or by machine
Baling (Storage) 	<ul style="list-style-type: none"> -Round or Square -Stalk moisture should be less than fifteen percent at time of baling -Can be done with any kind of baler -Similar to hay baling
Transportation ⁹³ 	<ul style="list-style-type: none"> -Legal within Minnesota -If transporting outside of Minnesota, check laws of other state(s)

Image created using piktochart (<https://piktochart.com/>)

2.3.2 HARVESTING & PROCESSING FOR FIBER

Historically, hemp has been mainly used for its fiber. The fiber from the plant stems can be utilized in many ways from low-tech yarn and fabric to construction material and even new high-tech products.⁹⁴ Fiber hemp is typically harvested when the plants have finished shedding pollen, prior to seed setting on female plants, one hundred to 120 days after planting. Harvesting fiber at this time will produce smooth, high quality fabrics, whereas delaying harvesting results in developing coarser fibers.⁹⁵

For those looking to produce hemp fiber for a product other than textiles, such as hempcrete or insulation, producers do not always require hemp to be cut at the beginning of pollination. It is important to check with the processor and product marketer to see what product they are looking for.

Harvesting for fiber is a tedious process, and will require close attention and an open mind, because industry standards have still not been set for hemp. However, certain machines and techniques used for hay and other crops can be adjusted for harvesting hemp. While mowing the crop, keeping the stalks long and in tact is important for producing quality fibers. Hemp should be harvested four inches above the ground to avoid the hard, woody portion of the stem, but not suffer from loss of fiber yield.

After harvesting, hemp stalks must be retted before baling or chopping. Retting is the process where microbial activity breaks down the pectin layer between the bast and hurd fibers. This allows the two layers to be easily separated later in the processing procedure. There are many different avenues for retting, depending on the weather and equipment available.⁹⁶



Aleks. "Hemp harvesting in France." photograph. September 1, 2007. Wikipedia Commons, https://commons.wikimedia.org/wiki/File:R%C3%A9colte_chanvre1.jpg (access February 22, 2018). (access February 22, 2018).

Figure 4: Retting Options

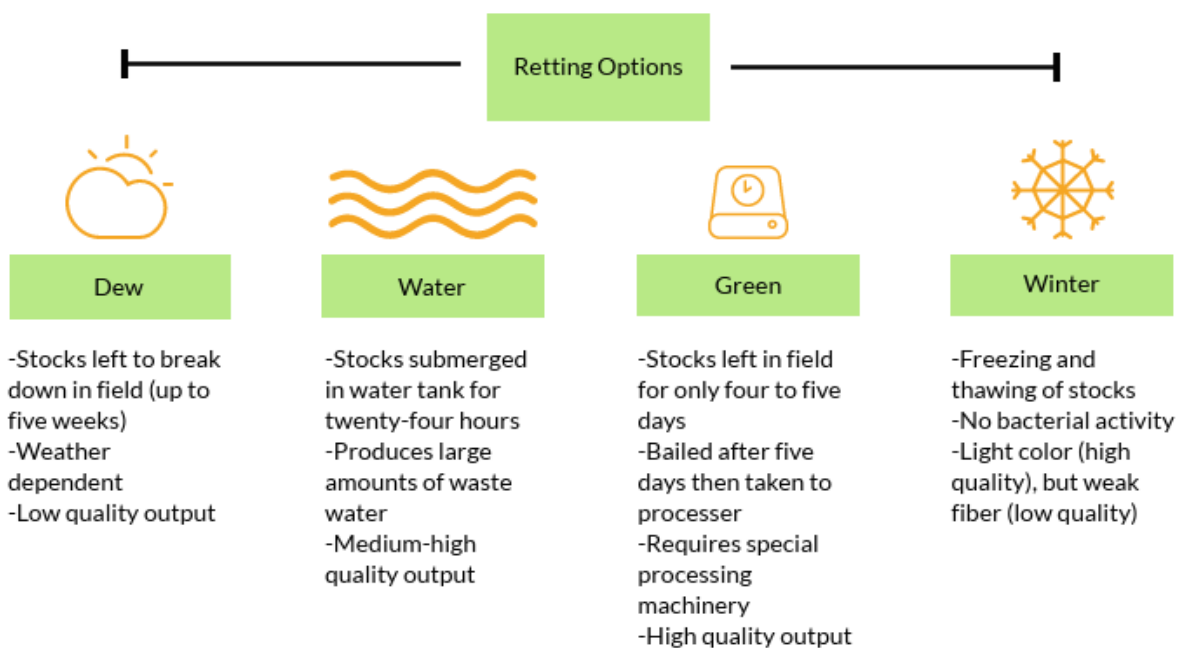


Image created using piktochart (<https://piktochart.com/>)

The normal length of retting takes twenty-one to twenty-eight days to complete, but final results depend highly on the weather. Turning over once or twice during this process, when they start changing in color from green to pale yellow, is recommended to assure an even and complete retting. While there is not any specialized equipment available for this particular process, rotary rakes have been recommended to avoid loss of fiber yield and quality. Over-retting will dramatically reduce the quality of the fiber produced. Unless specified by the end fiber user, retting may not be absolutely necessary.⁹⁷ In China and Hungary, where labor costs and environmental concerns are relatively low, most hemp fiber is water retted, due to the significant volumes of wastewater. Research in Europe has been focusing on developing a less labor and resource intensive retting process.⁹⁸

Baling is an important step, as it not only provides both long and short-term storage, but also is how the hemp will be delivered to the buyer. Bales are stored indoors in dry conditions to stop the retting process before rotting. It is recommended to check in with the buyer to see how they would like the hemp baled. Square bales are preferred for transportation, but present a challenge in preventing spoilage if the bales are stored for longer periods of time. Normal hay balers can be used with hemp, but softcore balers allow bales to dry faster in storage.⁹⁹

Decortication is the process of separating the fiber from the hurds. This can be done by hand or machine. Working with the stocks by hand produces the best results, but is very inefficient. Not many machines have been created solely for the harvesting of hemp. Some machines can be adjusted to harvest hemp, but many still have issues when trying to deal with hems tough fibers. Typically, stems will pass through a breaker or rollers, then combed through to remove any remaining hurds. However this process is also time consuming and uses technology that was originally meant for other fibers. Machines like Bastcore's patented decorticator are being worked on to create hemp-specific equipment. Because this process is still relatively new, machines like this are not commonly offered in current markets.

The quality of fiber produced is determined in the harvesting steps leading up to final transportation out. By making certain decisions, such as when to harvest, retting and baling method, and keeping the stems long will all create higher quality fiber. These methods can require more effort and finances.

After the hemp has been harvested and baled, it is often sent to an outside processor that will transform the hemp fibers into the desired product. It is important to be in close contact with this processor for their specific needs. While transportation is highly dependent on to where the hemp is being delivered, within the state of Minnesota, transportation is legal. It is not a violation of Minnesota's hemp pilot program to sell outside of the state, but it is important to check the laws in the state to which the hemp is being transported.¹⁰⁰

2.3.3 HEMP STALK USES

The stalk of a hemp plant has an outer bark that contains long and tough bast fibers which can then be processed into rope, textiles, or clothing. The core of the stock contains shorter fibers (hurds), which are used in the manufacturing to make denser materials such as insulation or particleboard. In addition, the entire stalk can be fermented into biofuels or processed into paper products.

Figure 5: Hemp Stalk Uses

Hemp Stalk Uses

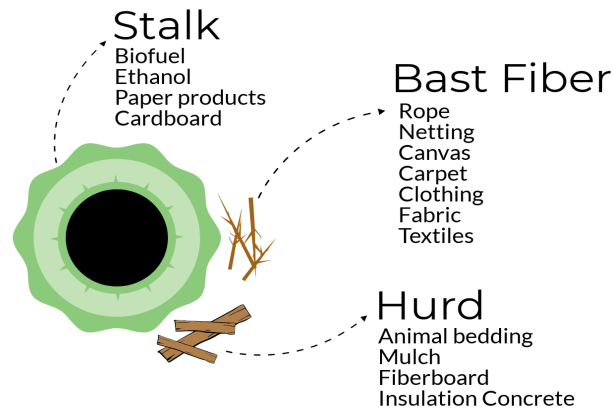








Image created using piktochart (<https://piktochart.com/>)

2.3.4 HARVESTING & PROCESSING HEMP SEEDS

Harvesting for just seeds is a more delicate processes than harvesting for fiber. When harvesting, precautions must be taken before each step to prevent shattering the seeds. Seeds meant for consumption must be tended carefully and uncontaminated of any foreign substance. The hemp market is not as large as the fiber market, but it is steadily growing due to hems rising popularity in the health market.

TABLE 3: SEED HARVESTING AND PROCESSING CHEAT SHEET

Step		General Information
Seed Sampling ¹⁰¹		<ul style="list-style-type: none"> -Required in Canada to determine that the harvest has less than 0.3 percent THC -Will depend on the type of permit the grower has received -Sent off prior to harvest
Swathing (Winrowing) ¹⁰²		<ul style="list-style-type: none"> -Used to reduce shattering loss -Weather and variety dependent -Can increase contamination -Can be hard on combine machinery
Combine Harvesting ¹⁰³		<ul style="list-style-type: none"> -Using combine machinery -Will require modified machinery settings -Seed must be immediately put aeration or through a dryer after harvesting -Occurs at ten to twelve percent moisture content

<p>Storage, Aeration, Drying¹⁰⁴</p>		<ul style="list-style-type: none"> -Must be properly dried, stored, and monitored to insure quality (especially if seed is for food products) -Moisture content of seeds in storage determined by processor (around eight or nine percent) -Properly dried and monitored hemp seed will store for one to two years without loss of food quality -Options: hopper bins with aeration, flat metal bins with aeration, mini-bulk bags
<p>Seed Cleaning¹⁰⁵</p>		<ul style="list-style-type: none"> -Typically done by third party cleaner -Must be cleaned prior to delivery -Avoiding cross contamination is key (99.9 percent purity)
<p>Transportation¹⁰⁶</p>		<ul style="list-style-type: none"> -Legal within Minnesota -If transporting outside of Minnesota, check laws of other state(s) -Truckers must be licensed to haul hemp seed from farm to cleaner to processor

Images created using piktochart (<https://piktochart.com/>)

Harvesting seeds is a different process from harvesting fiber. Harvest timing for seeds is aimed at maximizing seed yield and quality. This takes place after the female plants have flowered and the seeds begin to shatter, about seven to ten days after the male varieties start shedding pollen.¹⁰⁷ Not only do seeds tend to mature at different rates on different plants, they can also mature at different times on the same plant (bottom to top). If harvested too late, the bottom seeds will shatter, resulting in yield loss. If harvested too early, the seeds will be too green and have too much moisture, also resulting in yield loss. Birds will also feed on the shattered seeds. Determining when to harvest the seeds will require individual decisions on when harvesting will amount to minimal seed losses. Considerations should also be given to both the combine and drying capabilities. The earlier in the harvest, the more the seeds need to dry before they will reach the required moisture level. The later the harvest, the sooner the seeds must be worked with to insure maximum quality and reduce rotting.¹⁰⁸

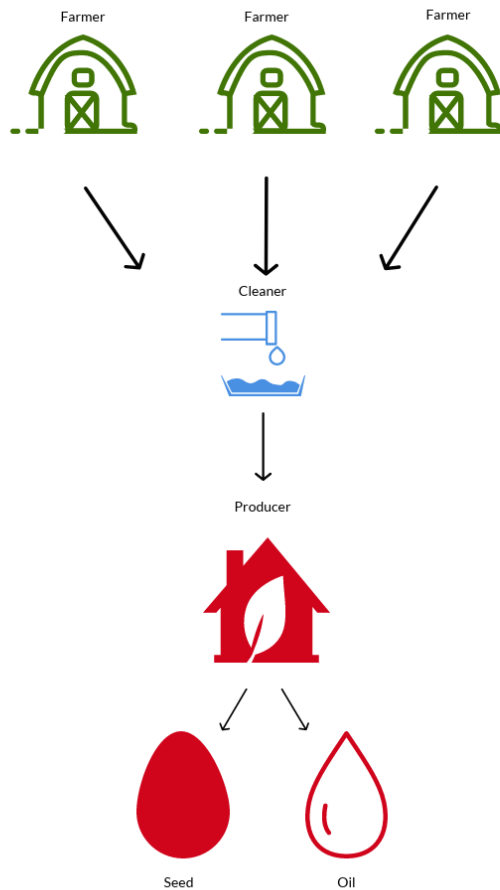
Swathing (winrowing) is not a necessary step, but depends on the environmental conditions and variety of hemp being grown. Using a swather, farmers drive through the field and transfer the harvested material into long piles in the field. It is typically done as risk management against seed loss due to high winds. However it risks seed quality and quantity loss, slower drying times, and increased levels of contamination if hail or rain flattens the swathing.

Therefore swathing should only be considered if rain is not in the forecast. Swathing can be carried out at fifteen to eighteen percent seed moisture, prior to the bottom seeds shelling out.

Prior to combining, it is important to insure that all equipment is sharpened, dry and clean of all contaminants. Straight combining has been preferred to regular combining for harvesting hemp seed. The machine is adjusted to cut off just the seed heads, around the top third of the plant, depending on the variety. The remaining stocks will be left over and must be destroyed. These leftovers can be burned, but this is detrimental to the environment. Another option is plowing the stems back into the ground, but various pieces of equipment for this task is limited. After harvesting, hemp seed can be easily damaged, and should be treated very carefully when moving from combine to dryer. Combining should occur at ten to twelve percent moisture.¹⁰⁹

Hemp seed is sold as a raw food and therefore must be properly dried, stored and monitored to preserve seed quality. If this is not completed in coordination to industry standards, seeds can quickly be rejected from processors. The seeds, once removed from the stocks, should be moved into controlled storage as soon as possible, ideally the same day that it was harvested. Controlling the temperature and constant rotation while aerating and drying is also highly important, because the spreading of moisture can ruin an entire batch of seeds. It is important to be in contact with the specific processor to produce the moisture content they require. However, it is typically around eight or nine percent.¹¹⁰

Figure 6: Life Span of Raw Hemp Materials



Images created using piktochart (<https://piktochart.com/>)

There are a few different storage systems for hemp seeds. Hopper bins with aeration, batch, and continuous flow dryers are most common in Canada, but flat metal bins with aeration and mini-bulk bags have also been used. Note that the hemp seeds should also be rotated when seasons change, due to the change in air temperature and moisture. Aeration is used to reduce the moisture content to typical conditions, and if weather conditions are unfavorable, additional heat can be added to dry the seed more quickly. Closely monitoring the seed from combining until drying is key for ensuring highest quality.¹¹¹

Once the processor calls for the seeds, they must be cleaned before they can be transported out. Cleaning is required to remove contaminants such as weed seeds, plant parts, insects and cracked seeds. This is typically done by a third party cleaner, but certain steps

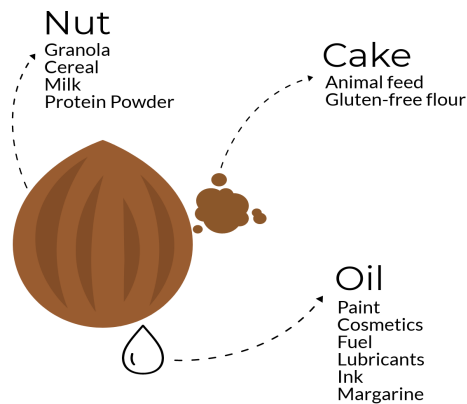
can be done to ensure that the seed is kept pure prior to this stage. Because hemp seed is often sold as a gluten free product, researching and maintaining industry guidelines is crucial. Prior to harvesting, make sure that all equipment is cleaned of all contaminants, especially wheat. Transportation then happens from the cleaning plant to the processing plant. It is advised to inspect transportation trucks for cleanliness before loading clean seed, just to insure that the seed remains pure before processing.¹¹² At the processing plant, the hemp seed is treated depending on what the final product will be. Specific processes depend on the specific processing plants.

For instance, at Hemp Oil Canada, hemp seed oil is cold pressed, producing a hemp cake and oil. Hemp seeds are hulled through a no-head mechanical process, which maintains all nutritional benefits. From here, they can be made into many different products.¹¹³

2.3.5 HEMP SEED USES

Hemp plants produce a large number of seed which have a variety of uses. The entire seed can be processed to make granola, protein powder, and a variety of dairy products including milk. Hemp oil can be extracted from the seeds and is commonly used in cosmetics and other body products. The oil can also be used in paint, fuel, ink, and lubricants. Additionally, the cake of the seed, which is residue remaining after the oil has been extracted from the seed, can be processed into animal feed and or made into gluten-free food.

Figure 7: Hemp Seed Uses
Hemp Seed Uses



Images created using piktochart (<https://piktochart.com/>)

2.3.6 DUAL HARVESTING

Dual harvesting is when growers try to avoid the wastefulness of focusing on growing just one type of hemp, and instead grows to harvest both fiber and seed. This is becoming more popular as demands in the hemp market increase. First, the tops of the plants are cut off. Next, the remaining stalks are harvested identically to harvesting for fiber-only production: the stems are cut, retted, dried, and pressed into bales. Both these steps can be performed separately, or at the same time by mounting a sickle-bar mower under the header of the modified combine to operate close to the ground.¹¹⁴

The issue with dual harvesting is that the fiber often matures sooner than the seeds do. The grower must make a judgment call on when to harvest the hemp without sacrificing too much of either the fiber quality or the seed yield. Also, the weather must be appropriate (dry and not overly hot or cold) for both retting and drying.¹¹⁵

2.3.7 HARVESTING & PROCESSING FOR CBDS

Harvesting and producing hemp for cannabinoids is another underdeveloped process, and optimum methods are not well defined in field-scale systems. Cannabinoids are present throughout both cannabis and hemp. For cannabis, THC is the primary psychoactive compound. CBD is the main compound in hemp. While CBD does have some medicinal advantages, such as pain, seizure and anxiety relief, it does not have any psychoactive effects. In hemp, CBDs are found concentrated in the flowers of the female plants.

Unfertilized female flowers tend to produce more cannabinoids than fertilized, seed producing female flowers. It is still not known if the entire plant would be harvested and processed, or just the female flowers, when attempting to produce CBD products on a larger, field scale.¹¹⁶ Processing hemp to make CBD is still being investigated. The three known ways to extract CBDs from the flower are liquid solvent, CO² extraction, and oil infusion. While liquid solvent and CO² extraction require labs and technology that are expensive and highly-regulated, oil infusion can be done at home, but there is no established method to extract CBDs this way.¹¹⁷ Further research and advice from professionals is encouraged before proceeding with CBDs.

2.3.8 HARVESTING EQUIPMENT

Harvest equipment should be an early consideration when deciding to grow a hemp crop, as it is a large determinant for how much time and labor goes into harvesting crops, as well as the overall quality of the harvested hemp, which impacts its final product. As of 2016, the equipment for optimal cutting does not yet exist in the United States.¹¹⁸ Forage harvesting and handling implements have performed well enough when dealing with harvesting hemp for fiber. However, harvesting will require adjustments to these older machines, and will also provide a special challenge to both the combine and the operator. Many Canadian farmers have noted that hemp is incredibly hard on mechanical equipment to harvest¹¹⁹, and it is important to frequently sharpen the knives in the machine in order to handle the tough, fibrous stems.¹²⁰ Proper settings, adjusted depending on the crop and environment, will improve the yield and quality of the seed and reduce wear on the machinery. Producers at the Canadian Hemp Trading Alliance (CHTA) found that setting the combine in canola, peas or bean settings for the cylinder and concave is a good starting point for harvesting hemp.¹²¹ Higher yields may be possible as the technology continues to improve.¹²² There is no data on animal traction methods.

TABLE 4: INTRODUCTION TO MACHINERY USED FOR HARVESTING HEMP

Machine	Use	Product	Info
Tractor Drawn Harvester ¹²³	Harvest	Fiber	<ul style="list-style-type: none"> -Typically used in Europe -Spreaders cut stems and lay them in windrows for field retting -Work with a second machine to gather and tie the dried stems into (parallel alignment) bundles for pickup by the processor -Limited capacity per day, additional adjustments and modifications necessary
Swather ¹²⁴	Harvest	Seed	<ul style="list-style-type: none"> -Not very common, but used in a few areas in Western Canada -Sometimes tangles stems/cuts them shorter than desired -Requires longer drying times -Better for smaller acreages
Combine Tractor ¹²⁵ ₁₂₆	Harvest	Seed	<ul style="list-style-type: none"> -The norm in most countries -Recommended by CHTA, but proper modifications needed -Better results with shorter fibers, tall fibers tend to wind around moving parts -Combines three separate harvesting operations into a single process

2.3.9 NON-INDUSTRIAL HARVESTING

While industrial machinery is most common on medium to large-scale farms, some of those venturing into the hemp industry are looking at non-industrial ways of harvesting hemp. One option, for small to medium farms, is to cut the fiber by hand. While this is labor and time intensive, it does allow the farmer to have the most control over the harvest. Stocks that have been kept long and handled with care produce higher quality hemp. It also significantly decreases the environmental impact. Depending on the intended scale and use of the hemp, harvesting by hand can be a viable option. After World War II, farmers traded in their horses for

tractors. However, people are now looking back to horsepower. Not only can a palpable connection be formed between farmer and work animal, but it also allows for a farmer to get back in touch with nature and native roots while maintaining a low carbon footprint.¹²⁷ While it does significantly change the efficiency and output of the farm, for those more focused on the overall experience, and not simply the profitable product, working with a less industrial, more environmentally-conscious, a horse or animal traction method is certainly viable, even without much modern research.¹²⁸

2.3.10 MARKETING

Hemp is a small acreage, contract crop, not a cash flow crop. This means a production contract should be figured out before the crop is planted. Processors typically take the crop over a period of time, not all at once. Processors have many specifications that a producer must meet, but they allow a farmer to grow its business without buying all the processing equipment.

Markets for hemp fiber and seed in the United States could be reaching a critical point, as research is continuing to assess the long-term feasibility of developing a domestic industry.¹²⁹ This emerging market is continuing to expand as the possibilities of hemp continue to grow. Additional research and change to existing regulations and legalities is needed for the industry to move forward¹³⁰ and will likely influence its future trends and developments.

2.4 WHAT'S NEXT?

There are many reasons hemp is gaining attention in the United States currently. With the potential that accompanies an underutilized crop, also come challenges and disadvantages. Due to hemp's ongoing ban in the United States, there are few technologies that help make harvesting hemp more efficient, profitable, and ecologically conscious. However, with a bipartisan renewed interest in the legalization of hemp, these problems may be overcome.

Curriculum End Notes:

-
- ¹ Anonymous. "Chronology of Hemp Use and Politics throughout History." *Missoula Independent* (Missoula, Mont.), August 28, 2008.
- ² Dunford, N.T., "Hemp and Flaxseed Oil: Properties and Applications for Use in Food," in *Specialty Oils and Fats in Food and Nutrition - Properties, Processing and Applications*, ed. Talbot, Geoff, 2015. 39.
- ³ DiTommaso et al. "The Biology of Canadian Weeds. 143. Apocynum Cannabinum L." (Cornell: 2009). <http://www.nrcresearchpress.com/doi/pdf/10.4141/CJPS08103>.
- ⁴ Small, Ernest. *Evolution and Classification of Cannabis Sativa (Marijuana, Hemp) in Relation to Human Utilization*, Botanical Review: (Springer Link, 2015), <https://link.springer.com/article/10.1007/s12229-015-9157-3?no-access=true>.
- ⁵ DiTommaso et al. "The Biology of Canadian Weeds. 143. Apocynum Cannabinum L." (Cornell: 2009). <http://www.nrcresearchpress.com/doi/pdf/10.4141/CJPS08103>.
- ⁶ Dunford, N.T., "Hemp and Flaxseed Oil: Properties and Applications for Use in Food," in *Specialty Oils and Fats in Food and Nutrition - Properties, Processing and Applications*, ed. Talbot, Geoff, 2015. 39.
- ⁷ Halperin, Alex. "Marijuana: Is It Time to Stop Using a Word with Racist Roots?" *the Guardian*, January 29, 2018. <http://www.theguardian.com/society/2018/jan/29/marijuana-name-cannabis-racism>.
- ⁸ "State Industrial Hemp Statutes." National Conference of State Legislatures (2017). <http://www.ncsl.org/research/agriculture-and-rural-development/state-industrial-hemp-statutes.aspx>.
- ⁹ Wiatrowski, Margaret. "Industrial Hemp Program." Minnesota Department of Agriculture, 2017. <http://www.mda.state.mn.us/industrialhemp>.
- ¹⁰ "Hemp vs Marijuana | The Difference Between Hemp and Marijuana." *Ministry of Hemp* (blog). Accessed January 31, 2018. <https://ministryofhemp.com/hemp/not-marijuana/>.
- ¹¹ "Statement of Principles on Industrial Hemp." Federal Register, August 12, 2016. <https://www.federalregister.gov/documents/2016/08/12/2016-19146/statement-of-principles-on-industrial-hemp>.
- ¹² Bhattacharyya, S, P Fusar-Poli, S Borgwardt, C Martin-Santos, M Seal, J Crippa, Z Atakan, and P McGuire. "P02-01 Opposite Neural Effects of the Main Psychoactive Ingredients of Cannabis- Neural Basis for Potential Therapeutic Effects of Cannabidiol- ClinicalKey," January 1, 2009. <https://www-clinicalkey-com.offcampus.lib.washington.edu/#!/content/playContent/1-s2.0-S0924933809709241?returnurl=null&referrer=null>.

¹³ “What Is CBD Hemp Oil?” *Medical Marijuana, Inc.* (blog). Accessed February 4, 2018. <https://www.medicalmarijuanainc.com/what-is-cbd-hemp-oil/>.

¹⁴ Shannon, Scott, and Janet Opila-Lehman. “Effectiveness of Cannabidiol Oil for Pediatric Anxiety and Insomnia as Part of Posttraumatic Stress Disorder: A Case Report.” *The Permanente Journal* 20, no. 4 (2016): 108–11. <https://doi.org/10.7812/TPP/16-005>.

¹⁵ Ibid.

¹⁶ Ketler, Alanna. “5 Ways Hemp Will Change Our World.” *Collective Evolution*, April 1, 2012. <http://www.collective-evolution.com/2012/04/01/5-ways-hemp-will-change-our-world/>.

¹⁷ “Hemp Uses, Information Facts - Natural Hemp Products - Hemp Basics.” *Hemp Basics | Natural Hemp Products*. Accessed February 22, 2018. <https://hempbasics.com/shop/hemp-information>.

¹⁸ “Environmental Benefits of Hemp.” Accessed February 14, 2018. http://eap.mcgill.ca/CPH_3.htm.

¹⁹ Ketler, Alanna. “5 Ways Hemp Will Change Our World.” *Collective Evolution*, April 1, 2012. <http://www.collective-evolution.com/2012/04/01/5-ways-hemp-will-change-our-world/>.

²⁰ Ibid.

²¹ Ibid.

²² Piotrowski, Stephan, and Michael Carus. “Ecological Benefits of Hemp and Flax Cultivation and Products.” *Nova Institute*, 2011. <http://eiha.org/media/2014/10/Ecological-benefits-of-hemp-and-flax-cultivation-and-products-2011.pdf>.

²³ “Environmental Benefits of Hemp.” Accessed February 14, 2018. http://eap.mcgill.ca/CPH_3.htm.

²⁴ “Environmental Benefits of Hemp.” *Hemp Benefits*, July 15, 2012. <https://hempbenefits.org/environmental-benefits-of-hemp/>.

²⁵ “Environmental Benefits of Hemp.” Accessed February 14, 2018. http://eap.mcgill.ca/CPH_3.htm.

²⁶ Ketler, Alanna. “5 Ways Hemp Will Change Our World.” *Collective Evolution*, April 1, 2012. <http://www.collective-evolution.com/2012/04/01/5-ways-hemp-will-change-our-world/>.

²⁷ “Environmental Benefits of Hemp.” *Hemp Benefits*, July 15, 2012. <https://hempbenefits.org/environmental-benefits-of-hemp/>.

²⁸ Smith, Mary L., and Ann Bullock MD. “Native Americans with Diabetes.” *Centers for Disease Control and Prevention*, January 10, 2017. <https://www.cdc.gov/media/dpk/diseases-and-conditions/native-americans-diabetes/native-americans-diabetes.html>.

-
- ²⁹ “White Earth Land Recovery Project 2011 Annual Report.” WELRP. <https://www.scribd.com/document/110644871/2011-Annual-Report-1-1>.
- ³⁰ Freeman, Andrea. “Fast Food: Oppression through Poor Nutrition.” *California Law Review* 95, no. 6 (2007): 2221–59. <https://doi.org/10.2307/20439143>.
- ³¹ Walker, Jason. “SFA Interview: Zachary Paige, White Earth Land Recovery Project.” Sustainable Farming Association of Minnesota, April 21, 2015. <http://www.sfa-mn.org/sfa-interview-zachary-paige-white-earth-land-recovery-project/>.
- ³² “Agricultural Research Service: USDA Branded Food Product Database. Food Composition Databases Show Foods -- HEMP SEED BUTTER, UPC: 608819794747.” United States Department of Agriculture. <https://ndb.nal.usda.gov/ndb/search/list>.
- ³³ “Agricultural Research Service: USDA Branded Food Product Database. Food Composition Databases Show Foods -- SKIPPY, PEANUT BUTTER SPREAD, CREAMY, UPC: 048001212107.” United States Department of Agriculture. <https://ndb.nal.usda.gov/ndb/search/list>
- ³⁴ Dunford, N.T., “Hemp and Flaxseed Oil: Properties and Applications for Use in Food,” in *Specialty Oils and Fats in Food and Nutrition - Properties, Processing and Applications*, ed. Talbot, Geoff, 2015. 40.
- ³⁵ Rodriguez-Leyva, Delfin, Pierce, Grant N. “The Cardiac and Haemostatic Effects of Dietary Hempseed” *Nutrition & Metabolism*. 2010. <https://nutritionandmetabolism.biomedcentral.com/track/pdf/10.1186/1743-7075-7-32?site=nutritionandmetabolism.biomedcentral.com>.
- ³⁶ Plattershare, and Plattershare. “Traditional Uttaranchal Bhang (Hemp) Chutney Recipe. How to Make Traditional Uttaranchal Bhang (Hemp) Chutney by Plattershare - Plattershare.” Plattershare. Accessed February 24, 2018. <https://www.plattershare.com/recipe/traditional-bhaag-hemp-ki-chutney>.
- ³⁷ “Toasting Your Hemp Seeds.” *HempMeds* (blog), December 5, 2014. <https://hempmedspx.com/toasting-hemp-seeds/>.
- ³⁸ “Siemieniatka Kanapioø Koðë.” *Ethnic Foods R Us* (blog). Accessed February 24, 2018. <https://ethnicfoodsrus.com/around-the-world-recipes/german-cuisine/siemieniatka-kanapio-kode/>.
- ³⁹ “How to Make Homemade Hemp Milk.” Accessed February 24, 2018. <https://kitchen.nutiva.com/how-to-make-homemade-hemp-milk/>.
- ⁴⁰ Ranalli, Paolo, Mario Di Candilo, Giuseppe Mandolino, Gianpaolo Grassi, and Andrea Carboni. “Hemp for Sustainable Agricultural Systems.” *Agro-Food-Industry Hi-Tech*, no. March/April 1999 (1999): 33–38.
- ⁴¹ Fortenbery, T. Randall, and Michael Bennett. “Opportunities for Commercial Hemp Production.” *Review of Agricultural Economics* 26, no. 1 (2004): 97–117. <http://www.jstor.org/stable/1349790>.

⁴² Johnson, Renée. “Hemp as an Agricultural Commodity.” Congressional Research Service, March 10, 2017. Congressional Research Digital Collection. <https://fas.org/sgp/crs/misc/RL32725.pdf>.

⁴³ “USDA ERS - Socially Disadvantaged Farmers: Race, Hispanic Origin, and Gender.” Accessed February 16, 2018. <https://www.ers.usda.gov/topics/farm-economy/beginning-disadvantaged-farmers/socially-disadvantaged-farmers-race-hispanic-origin-and-gender/>.

⁴⁴ Johnson, Renée. “Hemp as an Agricultural Commodity.” Congressional Research Service, March 10, 2017. Congressional Research Digital Collection. <https://fas.org/sgp/crs/misc/RL32725.pdf>.

⁴⁵ “An Anishinaabeg Agriculture and Agro-Forestry Curriculum.” White Earth Tribal and Community College, n.d.

⁴⁶ Bartsch, Maddy. “A New Breed of Fiber Mill: BastCore Hemp Processing – Fibershed.” Fibershed (blog). Accessed February 16, 2018. <http://www.fibershed.com/2017/11/01/a-new-breed-of-fiber-mill-bastcore-hemp-processing/>.

⁴⁷ Werf, Hayo M.G. van der, Hayo M.g, and Lea Turunen. “The Environmental Impacts of the Production of Hemp and Flax Textile Yarn.” *Industrial Crops and Products* 27, no. 1 (January 5, 2007): 1–10. http://www.academia.edu/6480447/The_environmental_impacts_of_the_production_of_hemp_and_flax_textile_yarn.

⁴⁸ Hart, Tim, and Michael Aliber. “The Need for an Engendered Approach to Agricultural Technology.” *Agenda: Empowering Women for Gender Equity*, no. 84 (2010): 75-90. <http://www.jstor.org/stable/27917354>.

⁴⁹ Chen, Stephen. “How China Quietly Grew Into a Cannabis Superpower.” *South China Morning Post*, August 27, 2017. <http://www.scmp.com/news/china/society/article/2108347/green-gold-how-china-quietly-grew-cannabis-superpower>.

⁵⁰ Johnson, Renée. “Hemp as an Agricultural Commodity.” Congressional Research Service, March 10, 2017. Congressional Research Digital Collection. <https://fas.org/sgp/crs/misc/RL32725.pdf>.

⁵¹ Huanlei Wang, Zhanwei Xu, Alireza Kohandehghan, Zhi Li, Kai Cui, Xuehai Tan, Tyler James Stephenson, Cecil K. King’ondou, Chris M. B. Holt, Brian C. Olsen, Jin Kwon Tak, Don Harfield, Anthony O. Anyia, and David Mitlin. Interconnected Carbon Nanosheets Derived from Hemp for Ultrafast Supercapacitors with High Energy, *ACS Nano* **2013** 7 (6), 5131-514. DOI: 10.1021/nn400731g

⁵² “An Anishinaabeg Agriculture and Agro-Forestry Curriculum.” White Earth Tribal and Community College, n.d.

-
- ⁵³ Johnson, Renée. “Hemp as an Agricultural Commodity.” Congressional Research Service, March 10, 2017. Congressional Research Digital Collection. <https://fas.org/sgp/crs/misc/RL32725.pdf>.
- ⁵⁴ Agricultural Act of 2014, H. R. 2642—357 § (2014). <https://www.gpo.gov/fdsys/pkg/BILLS-113hr2642enr/pdf/BILLS-113hr2642enr.pdf>.
- ⁵⁵ “Industrial Hemp Pilot Program.” Plant Protection Division. Minnesota Department of Agriculture, 2017.
- ⁵⁶ “Minnesota Statutes 18K, Section 2, Defenitions.” Government. The Office of the Revisor of Statutes. Accessed February 23, 2018. <https://www.revisor.mn.gov/statutes/?id=18K.02>.
- ⁵⁷ “FAQs Regarding Minnesota’s Industrial Hemp Pilot Program.” Government. Minnesota Department of Agriculture. Accessed February 24, 2018. <http://www.mda.state.mn.us/plants/hemp/industhempquestions.aspx>.
- ⁵⁸ Ibid.
- ⁵⁹ Rainey, Libby. “Going into Its Fourth Harvest, Industrial Hemp Industry Still Facing Growing Pains.” Newspaper. *The Denver Post* (blog), September 10, 2017. <https://www.denverpost.com/2017/09/10/colorado-culvitors-hemp-farm-harvest/>.
- ⁶⁰ “Seed Production | Parkland Industrial Hemp Growers.” Accessed February 5, 2018. <http://www.pihg.net/production/>.
- ⁶¹ “FAQs Regarding Minnesota’s Industrial Hemp Pilot Program.” Minnesota Department of Agriculture, February 6, 2018. <http://www.mda.state.mn.us/plants/hemp/industhempquestions.aspx>.
- ⁶² Ibid.
- ⁶³ Ibid.
- ⁶⁴ Ibid.
- ⁶⁵ “Certification Authority for Seed & Noxious Weed Free Forage in MN.” Accessed February 7, 2018. <http://www.mncia.org/>.
- ⁶⁶ “About MCIA - Minnesota Crop Improvement Association.” Accessed February 26, 2018. <http://www.mncia.org/about-mcia>.
- ⁶⁷ “Hemp Production EGuide » Production » Seeding.” Accessed February 14, 2018. <http://www.hemptrade.ca/eguide/production/seeding>.
- ⁶⁸ Ibid.
- ⁶⁹ “HempFarming.” Accessed January 31, 2018. <https://hemtecusa.com/page83/page83.html>.
- ⁷⁰ Bouloc, Pierre, Serge Allegret, and Laurent Arnaud, eds. *Hemp: Industrial Production and Uses*. 1 vols. CAB International, 2013.

⁷¹ Williams, D. W., and Rich Mundell. “An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp,” n.d.

https://hemp.ca.uky.edu/sites/hemp.ca.uky.edu/files/uk_ih_information_for_agents3.pdf.

⁷² “HempFarming.” Accessed January 31, 2018. <https://hemtecusa.com/page83/page83.html>.

⁷³ Ibid.

⁷⁴ Thayer, Cheryl, and Megan Burley. “Industrial Hemp from Seed to Market.” Cornell University, n.d.

<https://sips.cals.cornell.edu/sites/sips.cals.cornell.edu/files/shared/documents/industrial-hemp-from-seed-to-market.pdf>.

⁷⁵ “We Grow the Legacy of Industrial Hemp.” Legacy Hemp. Accessed February 5, 2018. <https://legacyhemp.com/farming-hemp-101>.

⁷⁶ “HempFarming.” Accessed January 31, 2018. <https://hemtecusa.com/page83/page83.html>.

⁷⁷ “Hemp Production.” *Purdue Industrial Hemp Project* (blog). Accessed February 5, 2018. <https://dev.purduehemp.org/hemp-production/>.

⁷⁸ Government of Alberta, Alberta Agriculture and Forestry. “Industrial Hemp Enterprise.” Fact sheet. Accessed February 14, 2018.

[http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex126](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex126).

⁷⁹ Ranalli, Paolo, and Gianpietro Venturi. “Hemp as a Raw Material for Industrial Applications.” *Euphytica* 140, no. 1 (2004): 1–6. <https://doi.org/10.1007/s10681-004-4749-8>.

⁸⁰ “Industrial Hemp Production and Management.” Manitoba Agriculture, n.d. <http://www.gov.mb.ca/agriculture/crops/production/hemp-production.html#varieties>.

⁸¹ Ibid.

⁸² “Seed Production | Parkland Industrial Hemp Growers.” Accessed February 5, 2018. <http://www.pihg.net/production/>.

⁸³ Ibid.

⁸⁴ Ibid.

⁸⁵ “Industrial-Hemp-from-Seed-to-Market.Pdf.” Accessed February 14, 2018.

<https://sips.cals.cornell.edu/sites/sips.cals.cornell.edu/files/shared/documents/industrial-hemp-from-seed-to-market.pdf>.

⁸⁶ “Farming Hemp 101.” Legacy Hemp. <https://legacyhemp.com/farming-hemp-101>.

⁸⁷ Williams, D.W., and Rich Mundell. “An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp Research.” University of Kentucky College of Agriculture, Food and Environment, 2015. https://bracken.ca.uky.edu/files/2015_hemp_article.pdf.

⁸⁸ Ashton, William, Dr., Gillian Richards Dr., and Eleni Galatsanou. “Case Study: Hemp Oil Canada - Strategies for Growth of Bulk Food Processing in Manitoba.” Brandon University Rural Development Institute, 2015. <https://www.brandonu.ca/rdi/files/2011/02/Hemp-Oil-Canada-Case-Study.pdf>.

⁸⁹ Fortenbery, T. Randall, and Michael Bennett. “Opportunities for Commercial Hemp Production.” *Review of Agricultural Economics* 26, no. 1 (2004): 97–117. <http://www.jstor.org/stable/1349790>.

⁹⁰ Williams, D.W., and Rich Mundell. “An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp Research.” University of Kentucky College of Agriculture, Food and Environment, 2015. https://bracken.ca.uky.edu/files/2015_hemp_article.pdf.

⁹¹ Ehensing, Daryl T. “Feasibility of Industrial Hemp Production in the United States Pacific Northwest.” Department of Crop and Soil Science: Oregon State University, 2014. http://ir.library.oregonstate.edu/concern/administrative_report_or_publications/j.

⁹² Fortenbery, T. Randall, and Michael Bennett. “Opportunities for Commercial Hemp Production.” *Review of Agricultural Economics* 26, no. 1 (2004): 97–117. <http://www.jstor.org/stable/1349790>.

⁹³ “Statement of Principles on Industrial Hemp.” *Federal Register*, August 12, 2016. <https://www.federalregister.gov/documents/2016/08/12/2016-19146/statement-of-principles-on-industrial-hemp>.

⁹⁴ Williams, D.W., and Rich Mundell. “An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp Research.” University of Kentucky College of Agriculture, Food and Environment, 2015. https://bracken.ca.uky.edu/files/2015_hemp_article.pdf.

⁹⁵ “Hemp Production EGuide” in *Fiber Production*. Canadian Hemp Trade Alliance. <http://www.hemptrade.ca/eguide/fibre-production/time-of-fibre-harvest>.

⁹⁶ Williams, D.W., and Rich Mundell. “An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp Research.” University of Kentucky College of Agriculture, Food and Environment, 2015. https://bracken.ca.uky.edu/files/2015_hemp_article.pdf.

⁹⁷ “Hemp Production EGuide” in *Fiber Production*. Canadian Hemp Trade Alliance. <http://www.hemptrade.ca/eguide/fibre-production/time-of-fibre-harvest>.

⁹⁸ Fortenbery, T. Randall, and Michael Bennett. “Opportunities for Commercial Hemp Production.” *Review of Agricultural Economics* 26, no. 1 (2004): 97–117. <http://www.jstor.org/stable/1349790>.

⁹⁹ Baxter, W.J., and Gordon Scheifele. “Growing Industrial Hemp in Ontario.” Ontario Ministry of Agriculture, Food and Rural Affairs, 2009. <http://www.omafra.gov.on.ca/english/crops/facts/00-067.htm#harvesting>.

¹⁰⁰ “Statement of Principles on Industrial Hemp.” *Federal Register*, August 12, 2016. <https://www.federalregister.gov/documents/2016/08/12/2016-19146/statement-of-principles-on-industrial-hemp>.

¹⁰¹ “Industrial Hemp Harvest and Storage Best Management Practices.” Alberta Agriculture and Forestry, 2017.

[http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/crop15539/\\$file/HempHarvestStorage.pdf?OpenElement](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/crop15539/$file/HempHarvestStorage.pdf?OpenElement).

¹⁰² Ibid.

¹⁰³ Ibid.

¹⁰⁴ “Hemp Production EGuide” in *Fiber Production*. Canadian Hemp Trade Alliance.

<http://www.hemptrade.ca/eguide/fibre-production/time-of-fibre-harvest>.

¹⁰⁵ Ibid.

¹⁰⁶ Transportation: “FAQs Regarding Minnesota’s Industrial Hemp Pilot Program.” Minnesota Department of Agriculture, February 6, 2018.

<http://www.mda.state.mn.us/plants/hemp/industhempquestions.aspx>.

¹⁰⁷ “Hemp Production EGuide” in *Fiber Production*. Canadian Hemp Trade Alliance.

<http://www.hemptrade.ca/eguide/fibre-production/time-of-fibre-harvest>.

¹⁰⁸ “Industrial Hemp Harvest and Storage Best Management Practices.” Alberta Agriculture and Forestry, 2017.

[http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/crop15539/\\$file/HempHarvestStorage.pdf?OpenElement](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/crop15539/$file/HempHarvestStorage.pdf?OpenElement).

¹⁰⁹ Ibid.

¹¹⁰ “Hemp Production EGuide” in *Harvest Management*. Canadian Hemp Trade Alliance.

<http://www.hemptrade.ca/eguide/fibre-production/time-of-fibre-harvest>.

¹¹¹ “Industrial Hemp Harvest and Storage Best Management Practices.” Alberta Agriculture and Forestry, 2017.

[http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/crop15539/\\$file/HempHarvestStorage.pdf?OpenElement](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/crop15539/$file/HempHarvestStorage.pdf?OpenElement).

¹¹² “Hemp Production EGuide” in *Storage Conditioning*. Canadian Hemp Trade Alliance.

<http://www.hemptrade.ca/eguide/fibre-production/time-of-fibre-harvest>

¹¹³ Ashton, William, Dr., Gillian Richards Dr., and Eleni Galatsanou. “Case Study: Hemp Oil Canada - Strategies for Growth of Bulk Food Processing in Manitoba.” Brandon University Rural Development Institute, 2015. <https://www.brandonu.ca/rdi/files/2011/02/Hemp-Oil-Canada-Case-Study.pdf>.

¹¹⁴ “Hemp Production EGuide” in *Harvest Management*. Canadian Hemp Trade Alliance.

<http://www.hemptrade.ca/eguide/fibre-production/time-of-fibre-harvest>

¹¹⁵ Baxter, W.J., and Gordon Scheifele. “Growing Industrial Hemp in Ontario.” Ontario Ministry of Agriculture, Food and Rural Affairs, 2009.

<http://www.omafra.gov.on.ca/english/crops/facts/00-067.htm#harvesting>

-
- ¹¹⁶ Williams, D.W., and Rich Mundell. “An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp Research.” University of Kentucky College of Agriculture, Food and Environment, 2015. https://bracken.ca.uky.edu/files/2015_hemp_article.pdf.
- ¹¹⁷ Calvo, Amberley. “Hemp Oil Extraction Techniques - The Best Way to Extract CBD..” March 19, 2015. <https://elixinol.com/blog/hemp-oil-extraction-techniques/>.
- ¹¹⁸ Williams, D.W., and Rich Mundell. “An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp Research.” University of Kentucky College of Agriculture, Food and Environment, 2015. https://bracken.ca.uky.edu/files/2015_hemp_article.pdf.
- ¹¹⁹ Tourangeau, Wesley. “Re-Defining Environmental Harms: Green Criminology and the State of Canada’s Hemp Industry.” *Canadian Journal of Criminology and Criminal Justice* 57, no. 4 (October 2015): 528–54.
- ¹²⁰ “Hemp Production EGuide” in *Harvest Management*. Canadian Hemp Trade Alliance. <http://www.hemptrade.ca/eguide/fibre-production/time-of-fibre-harvest>
- ¹²¹ Ibid.
- ¹²² Baxter, W.J., and Gordon Scheifele. “Growing Industrial Hemp in Ontario.” Ontario Ministry of Agriculture, Food and Rural Affairs, 2009. <http://www.omafra.gov.on.ca/english/crops/facts/00-067.htm#harvesting>
- ¹²³ Fortenbery, T. Randall, and Michael Bennett. “Opportunities for Commercial Hemp Production.” *Review of Agricultural Economics* 26, no. 1 (2004): 97–117. <http://www.jstor.org/stable/1349790>.
- ¹²⁴ Baxter, W.J., and Gordon Scheifele. “Growing Industrial Hemp in Ontario.” Ontario Ministry of Agriculture, Food and Rural Affairs, 2009. <http://www.omafra.gov.on.ca/english/crops/facts/00-067.htm#harvesting>
- ¹²⁵ “Hemp Production EGuide” in *Harvest Management*. Canadian Hemp Trade Alliance. <http://www.hemptrade.ca/eguide/fibre-production/time-of-fibre-harvest>
- ¹²⁶ Baxter, W.J., and Gordon Scheifele. “Growing Industrial Hemp in Ontario.” Ontario Ministry of Agriculture, Food and Rural Affairs, 2009. <http://www.omafra.gov.on.ca/english/crops/facts/00-067.htm#harvesting>
- ¹²⁷ LaDuke, Winona. “Winona’s Hemp & Heritage Farm.” Winona’s Hemp & Heritage Farm. <https://www.winsonashemp.com/>.
- ¹²⁸ Raver, Anne. “Horses as Farm Equipment.” *The New York Times*, May 15, 2013, sec. Home & Garden. <https://www.nytimes.com/2013/05/16/garden/farm-equipment-that-runs-on-oats.html>.
- ¹²⁹ Fortenbery, T. Randall, and Michael Bennett. “Opportunities for Commercial Hemp Production.” *Review of Agricultural Economics* 26, no. 1 (2004): 97–117. <http://www.jstor.org/stable/1349790>.

¹³⁰ Ashton, William, Dr., Gillian Richards Dr., and Eleni Galatsanou. “Case Study: Hemp Oil Canada - Strategies for Growth of Bulk Food Processing in Manitoba.” Brandon University Rural Development Institute, 2015. <https://www.brandonu.ca/rdi/files/2011/02/Hemp-Oil-Canada-Case-Study.pdf>.

Task Force Bibliography

- “About.” KILI RADIO. Accessed February 16, 2018. <http://www.kiliradio.org/about.html>.
- “About MCIA - Minnesota Crop Improvement Association.” Accessed February 26, 2018. <http://www.mncia.org/about-mcia>.
- Abrams, Donald I. “The Therapeutic Effects of Cannabis and Cannabinoids: An Update from the National Academies of Sciences, Engineering and Medicine Report.” *European Journal of Internal Medicine*, January 9, 2018. <https://doi.org/10.1016/j.ejim.2018.01.003>.
- Agricultural Act of 2014, H. R. 2642—357 § (2014). <https://www.gpo.gov/fdsys/pkg/BILLS-113hr2642enr/pdf/BILLS-113hr2642enr.pdf>.
- “Agricultural Research Service: USDA Branded Food Product Database. Food Composition Databases Show Foods -- HEMP SEED BUTTER, UPC: 608819794747.” United States Department of Agriculture. Accessed February 22, 2018. <https://ndb.nal.usda.gov/ndb/foods/show/191126?fgcd=&manu=&lfacet=&format=&count=&max=50&offset=&sort=default&order=asc&qlookup=hemp+butter&ds=&qt=&qp=&qa=&qn=&q=&ing=>.
- “Agricultural Research Service: USDA Branded Food Product Database. Food Composition Databases Show Foods -- SKIPPY, PEANUT BUTTER SPREAD, CREAMY, UPC: 048001212107.” United States Department of Agriculture. Accessed February 22, 2018. <https://ndb.nal.usda.gov/ndb/foods/show/15962?fgcd=&manu=&lfacet=&format=&count=&max=50&offset=&sort=default&order=asc&qlookup=peanut+butter+skippy&ds=&qt=&qp=&qa=&qn=&q=&ing=>.
- Amaducci, S., D. Scordia, F. H. Liu, Q. Zhang, H. Guo, G. Testa, and S. L. Cosentino. “Key Cultivation Techniques for Hemp in Europe and China.” *Industrial Crops and Products* 68 (June 2015): 2–16. <https://doi.org/https://doi.org/10.1016/j.indcrop.2014.06.041>.
- American Lime Technology. “What is Hempcrete?” American Lime Technology Website RSS. Accessed February 20, 2018. <http://www.americanlimetechnology.com/what-is-hempcrete/>.
- “An Anishinaabeg Agriculture and Agro-Forestry Curriculum.” White Earth Tribal and Community College, n.d.
- Anonymous. “Chronology of Hemp Use and Politics throughout History.” Missoula Independent, August 28, 2008. University of Washington.
- Arrigoni, Alessandro, Renato Pelosato, Melia Paco, Ruggieri Gianluca, Sergio Sabbadini, and Giovanni Dotelli. “Life Cycle Assessment of Natural Building Materials: The Role of carbonation, Mixture Components and Transport in the Environmental of Hempcrete Blocks.” *Journal of Cleaner Production*, no. 149 (February 22, 2017): 1051–61.
- Ashton, William, Dr., Gillian Richards Dr., and Eleni Galatsanou. “Case Study: Hemp Oil Canada - Strategies for Growth of Bulk Food Processing in Manitoba.” Brandon University Rural Development Institute, 2015. <https://www.brandonu.ca/rdi/files/2011/02/Hemp-Oil-Canada-Case-Study.pdf>.
- Bartsch, Maddy. “A New Breed of Fiber Mill: BastCore Hemp Processing – Fibershed.” *Fibershed* (blog). Accessed February 16, 2018. <http://www.fibershed.com/2017/11/01/a-new-breed-of-fiber-mill-bastcore-hemp-processing/>.
- “Bastcore Hemp Processing Innovations.” Bastcore. Accessed February 28, 2018. <http://www.bastcore.com/>.

- Bhattacharyya, S, P Fusar-Poli, S Borgwardt, C Martin-Santos, M Seal, J Crippa, Z Atakan, and P McGuire. "P02-01 Opposite Neural Effects of the Main Psychoactive Ingredients of Cannabis- Neural Basis for Potential Therapeutic Effects of Cannabidiol- ClinicalKey," January 1, 2009. <https://www-clinicalkey-com.offcampus.lib.washington.edu/#!/content/playContent/1-s2.0-S0924933809709241?returnurl=null&referrer=null>.
- Borchardt, Debra. "Hemp Cannabis Product Sales Projected to Hit \$1 Billion In 3 Years." *Forbes*. Accessed February 5, 2018. <https://www.forbes.com/sites/debraborchardt/2017/08/23/hemp-cannabis-product-sales-projected-to-hit-a-billion-dollars-in-3-years/>.
- "Navajo Tribe Signs Its First Hemp Growing Resolution." *Forbes*. Accessed February 7, 2018. <https://www.forbes.com/sites/debraborchardt/2016/10/24/navajo-tribe-signs-its-first-hemp-growing-contract/>.
- "Boulder Hemp." Boulder Hemp. Accessed February 28, 2018. <https://www.boulder-hemp.com/>.
- Boulloc, Pierre, Serge Allegret, and Laurent Arnaud, eds. *Hemp: Industrial Production and Uses*. 1 vols. Center for Agriculture and Bioscience International, 2013.
- Breitler, Alex. "Hemp Farmers Lose in Federal Court." *recordnet.com*. Accessed February 7, 2018. <http://www.recordnet.com/news/20171202/hemp-farmers-lose-in-federal-court>.
- Bricken, Hilary. "Menominee Hemp Lawsuit Another Federal Knock Against Tribal Cannabis." *Above the Law* (blog). Accessed February 13, 2018. <https://abovethelaw.com/2016/06/menominee-hemp-lawsuit-another-federal-knock-against-tribal-cannabis/>.
- "Brief History - About Us." The Menominee Indian Tribe of Wisconsin. Accessed February 16, 2018. <http://www.menominee-nsn.gov/CulturePages/BriefHistory.aspx>.
- Calvo, Amberley. "Hemp Oil Extraction Techniques - The Best Way to Extract CBD..." March 19, 2015. <https://elixinol.com/blog/hemp-oil-extraction-techniques/>.
- Campos, Alline Cristina, Fabricio Araújo Moreira, Felipe Villela Gomes, Elaine Aparecida Del Bel, and Francisco Silveira Guimarães. "Multiple Mechanisms Involved in the Large-Spectrum Therapeutic Potential of Cannabidiol in Psychiatric Disorders." *Philosophical Transactions of the Royal Society B: Biological Sciences* 367, no. 1607 (December 5, 2012): 3364–78. <https://doi.org/10.1098/rstb.2011.0389>.
- "Canadian Hemp Trade Alliance » Hemp Production EGuide." Accessed February 5, 2018. <http://www.hemptrade.ca/eguide>.
- "CannaNative™ | General Hemp." Accessed February 7, 2018. <https://general-hemp.com/portfolio-companies/cannanative/>.
- "CDC - American - Indian - Alaska - Native - Populations - Racial - Ethnic - Minorities - Minority Health," December 2, 2012. <https://web.archive.org/web/20121202213657/http://www.cdc.gov/minorityhealth/populations/REMP/aian.html>.
- "Certification Authority for Seed & Noxious Weed Free Forage in MN." Accessed February 7, 2018. <http://www.mncia.org/>.
- "Channel Sales Analysis - The CBD Report." *Hemp Business Journal*. October 19, 2016. Accessed February 28, 2018. <https://www.hempbizjournal.com/channel-sales-analysis-cbd-report/>

- Chen, Stephen. "How China Quietly Grew Into a Cannabis Superpower." South China Morning Post, August 27, 2017. <http://www.scmp.com/news/china/society/article/2108347/green-gold-how-china-quietly-grew-cannabis-superpower>.
- Cherney, J. (2016, November 12). Industrial Hemp in North America: Production, Politics and Potential. Retrieved February 15, 2018, from <http://www.mdpi.com/2073-4395/6/4/58/htm>
- "CHTA » Hemp Production EGuide » The Hemp Plant." Accessed February 5, 2018. <http://www.hemptrade.ca/eguide/background/the-hemp-plant>.
- "Colville (Native Americans of the Plateau)." Accessed February 7, 2018. <http://what-when-how.com/native-americans/colville-native-americans-of-the-plateau/>.
- "Colville Tribe Will Test Hemp Production on Its Reservation." Spokesman.com. Accessed February 7, 2018. <http://www.spokesman.com/stories/2017/aug/01/colville-tribe-will-test-hemp-production-on-its-re/>.
- "Colville Tribe's First Hemp Harvest Is a Success, Officials Say." Tribal Tribune. Accessed February 7, 2018. http://www.tribaltribune.com/news/article_c1b75a36-bd9f-11e7-87c2-ff98971475fa.html.
- Commissioner, Office of the. "Press Announcements - FDA Warns Companies Marketing Unproven Products, Derived from Marijuana, That Claim to Treat or Cure Cancer." WebContent. Accessed February 6, 2018. <https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm583295.htm>.
- Cook, Tom. "Oglala Sioux Exercising Sovereignty to Grow Industrial Hemp," April 25, 2005. <https://ratical.org/renewables/OglalaHemp.html>.
- Coughlin-Bogue, Tobias, Christopher Frizzelle, Lester Black, and Steven Hsieh. "Want to Relax? Don't Let Them Talk You Into High-THC Weed." The Stranger. 2016. Accessed February 21, 2018. <https://www.thestranger.com/feature/2016/04/13/23950787/want-to-relax-dont-let-them-talk-you-into-high-thc-weed>.
- D. (2013, July). Economic Considerations for Growing Industrial Hemp: Implications for Kentucky's Farmers and Agricultural Economy. Retrieved February 05, 2018, from <https://www.uky.edu/Ag/AgEcon/pubs/reshempimpfarmer28.pdf>
- Davis, Shane. Interview with Shane Davis, n.d.
- Dellinger, Laura M. "Hemp Planted Again on Pine Ridge." *Indian Country Media Network* (blog), May 30, 2001. <https://indiancountrymedianetwork.com/news/hemp-planted-again-on-pine-ridge/>.
- DiTommaso, Antonio, David R. Clements, Stephen J. Darbyshire, and Joseph T. Dauer. "The Biology of Canadian Weeds 143. *Apocynum Cannabinum* L. in Canadian Journal of Plant Sciences." NRC Research Press, 2009.
- Dunford, N.T. *Specialty Oils and Fats in Food and Nutrition - Properties, Processing and Applications "Hemp and Flaxseed Oil: Properties and Applications for Use in Food."* Edited by Geoff Talbot. Oklahoma State University, 2015. https://app-knovel-com.offcampus.lib.washington.edu/web/view/khtml/show.v/rcid:kpSOFFNPP4/cid:kt00UM0AB3/viewerType:khtml/root_slug:2-hemp-and-flaxseed-oil-properties-and-applications-for-use-in-food/url_slug:hemp-flaxseed-oil-properties?b-toc-cid=kpSOFFNPP4&b-toc-root-slug=&b-toc-url-slug=hemp-flaxseed-oil-properties&b-toc-title=Specialty%20Oils%20and%20Fats%20in%20Food%20and%20Nutrition%20-%20Properties%2C%20Processing%20and%20Applications&page=2&view=collapsed&zoom=1.

- Ecoffey, Brandon. "White Plume's Hemp Injunction Lifted." *Lakota Country Times*, March 31, 2016. http://www.lakotacountrytimes.com/news/2016-03-31/Front_Page/White_Plumes_Hemp_Injunction_Lifted.html.
- "Environmental Benefits of Hemp." *Hemp Benefits*, July 15, 2012. <https://hempbenefits.org/environmental-benefits-of-hemp/>.
- "Environmental Benefits of Hemp." Accessed February 14, 2018. http://eap.mcgill.ca/CPH_3.htm.
- "FAQs Regarding Minnesota's Industrial Hemp Pilot Program." Government. Minnesota Department of Agriculture. Accessed February 24, 2018. <http://www.mda.state.mn.us/plants/hemp/industhempquestions.aspx>.
- "Farming Hemp 101." *Legacy Hemp*. Accessed February 21, 2018. <https://legacyhemp.com/farming-hemp-101>.
- "Film Description | Standing Silent Nation| PBS." *POV | American Documentary Inc.* (blog), January 23, 2007. <http://www.pbs.org/pov/standing/film-description>.
- "Food Composition Databases Show Foods List." Accessed February 7, 2018. <https://ndb.nal.usda.gov/ndb/search/list>.
- Fortenbery, T. Randall, and Michael Bennett. "Opportunities for Commercial Hemp Production." *Review of Agricultural Economics* 26, no. 1 (2004): 97–117. <http://www.jstor.org/stable/1349790>.
- Freeman, Andrea. "Fast Food: Oppression through Poor Nutrition." *California Law Review* 95, no. 6 (2007): 2221–59. <https://doi.org/10.2307/20439143>.
- "Friends of Pine Ridge Reservation." Friends of Pine Ridge Reservation. Accessed February 13, 2018. <https://friendsofpineridgereservation.org/about-pine-ridge-reservation-and-foprr/>.
- Garrett Davey, and Brad Bartlett. Interview with tribal lawyers regarding hemp transportation legalities. Telephone Call, February 19, 2018.
- Global Trust in Advertising: Winning Strategies for an Evolving Media Landscape. Retrieved February 15, 2018, from <https://www.nielsen.com/content/dam/niensenglobal/apac/docs/reports/2015/nielsen-global-trust-in-advertising-report-september-2015.pdf>
- Government of Alberta, Alberta Agriculture and Forestry. "Industrial Hemp Enterprise." Fact sheet. Accessed February 14, 2018. [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex126](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex126).
- Grignon, Marcus. Talk with Marcus Grignon (Menominee). Voice Recording, February 13, 2018.
- "Guidelines for Estimating Special Crop Production Costs in Manitoba 2018." Special Crop Production Costs. 2018. Accessed February 8, 2018. <https://www.gov.mb.ca/agriculture/business-and-economics/financial-management/pubs/cop-specialcrop-production.pdf>
- Hashim, Nadra. *Hemp and the Global Economy: The Rise of Labor, Innovation, and Trade*. Lexington Books, 2017. <https://books.google.com/books?hl=en&lr=&id=VD1DDwAAQBAJ&oi=fnd&pg=PA1&dq=hemp+economy+jobs&ots=0t2DzAsOge&sig=C8bDnBrSScQhnQwBdWJy1WtIqqQ#v=onepage&q=155&f=false>.
- "Hemp Gives Economic Hope to Native American Tribes." *Money*. Accessed February 7, 2018. <http://time.com/money/4543492/hemp-native-americans/>.

- “Hemp History.” The Minnesota Hemp Industries Association. Accessed February 7, 2018. <http://www.minnesotahia.org/hemp-history.html>.
- “Hemp Lawsuit after Raid: Menominee Tribe Suing Feds in Fight to Grow Crop.” The Cannabist, November 18, 2015. <https://www.thecannabist.co/2015/11/18/menominee-tribe-hemp-lawsuit-dea-doj/44061/>.
- “Hemp Production.” *Purdue Industrial Hemp Project* (blog). Accessed February 5, 2018. <https://dev.purduehemp.org/hemp-production/>.
- “Hemp Production EGuide.” Canadian Hemp Trade Alliance. Accessed February 21, 2018. <http://www.hemptrade.ca/eguide/fibre-production/time-of-fibre-harvest>.
- “Hemp Uses, Information Facts - Natural Hemp Products - Hemp Basics.” Hemp Basics | Natural Hemp Products. Accessed February 22, 2018. <https://hempbasics.com/shop/hemp-information>.
- “Hemp vs Marijuana | The Difference Between Hemp and Marijuana.” *Ministry of Hemp* (blog). Accessed January 31, 2018. <https://ministryofhemp.com/hemp/not-marijuana/>.
- “HempFarming.” Accessed January 31, 2018. <https://hemtecusa.com/page83/page83.html>.
- “HempsteadProjectHeart.” Accessed February 17, 2018. <https://www.hempsteadprojectheart.org/our-story>.
- “History.” Accessed February 7, 2018. <http://www.navajo-nsn.gov/history.htm#>.
- Huanlei Wang, Zhanwei Xu, Alireza Kohandehghan, Zhi Li, Kai Cui, Xuehai Tan, Tyler James Stephenson, et al. “Interconnected Carbon Nanosheets Derived from Hemp for Ultrafast Supercapacitors with High Energy - ACS Nano (ACS Publications).” Accessed February 26, 2018. <https://pubs.acs.org/doi/abs/10.1021/nn400731g>.
- “Importing Hemp Products into the U.S.” Accessed February 7, 2018. https://help.cbp.gov/app/answers/detail/a_id/1751/~/-importing-hemp-products-into-the-u.s.
- “Industrial Hemp Production and Management.” Manitoba Agriculture, n.d. <http://www.gov.mb.ca/agriculture/crops/production/hemp-production.html#varieties>.
- “Industrial Hemp | National Institute of Food and Agriculture.” Accessed February 6, 2018. <https://nifa.usda.gov/industrial-hemp>.
- “Industrial Hemp Harvest and Storage Best Management Practices.” Alberta Agriculture and Forestry, 2017. [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/crop15539/\\$file/HempHarvestStorage.pdf?OpenElement](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/crop15539/$file/HempHarvestStorage.pdf?OpenElement).
- “Industrial Hemp in the United States.” Company Website. BastLab LLC. Accessed February 27, 2018. <http://www.bastlab.com/blog-five/>.
- “Industrial Hemp Pilot Program.” Minnesota Department of Agriculture, February 6, 2018. <http://www.mda.state.mn.us/industrialhemp>.
- “Industrial Hemp Pilot Program.” Plant Protection Division. Minnesota Department of Agriculture, 2017.
- Jannie Simms Hipp. Interview with Janie Simms Hipp. Phone Call, January 26, 2018.
- Johnson, Christopher. “Oneida Nation | Oneida Weighs Hemp Options,” December 8, 2017. <https://oneida-nsn.gov/blog/2017/12/08/oneida-weighs-hemp-options/>.
- Johnson, R. (2017, March 10). Hemp as an Agricultural Commodity. Retrieved February 15, 2018, from <https://fas.org/sgp/crs/misc/RL32725.pdf>.

- Johnson, R. (2018, January). Background on the U.S. Market for Industrial Hemp and Related Policies. Retrieved January, 2018. <http://www.americanlimetechnology.com/what-is-hempcrete/>.
- Johnson, Renée. "Hemp as an Agricultural Commodity." Congressional Research Service, March 10, 2017. Congressional Research Digital Collection. <https://fas.org/sgp/crs/misc/RL32725.pdf>.
- Jungmann, Robert. JungMaven interview. Voice Recording, February 2, 2018.
- "Jungmaven | Hemp Clothing." Accessed February 26, 2018. <https://jungmaven.com/>.
- Kaeding, Danielle. "Hemp Farming Gets Green Light While St. Croix Chippewa Moves Forward With CBD Oil Production." Wisconsin Public Radio, December 5, 2017. <https://www.wpr.org/hemp-farming-gets-green-light-while-st-croix-chippewa-moves-forward-cbd-oil-production>.
- Ketler, Alanna. "5 Ways Hemp Will Change Our World." Collective Evolution, April 1, 2012. <http://www.collective-evolution.com/2012/04/01/5-ways-hemp-will-change-our-world/>.
- Krumholz, Ben. "Menominee Tribal Chairman Defends Industrial Hemp Grow." WLUK, October 28, 2015. <http://fox11online.com/news/local/northwoods/menominee-indian-tribe-reacts-to-federal-investigation-of-hemp-crop>.
- Laate, Emmanuel Anum. "Hemp as an Agricultural Commodity." Alberta Agriculture and Forestry. 2015. Accessed February 27, 2018. From [https://www1.agric.gov.ab.ca/\\$Department/deptdocs.nsf/all/econ16267/\\$FILE/2015IndustrialHempCOP.pdf](https://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/econ16267/$FILE/2015IndustrialHempCOP.pdf)
- Lash, Robin. "Industrial Hemp: The Crop for the Seventh Generation." American Indian Law Review, Vol 27, No. 1. University of Oklahoma College of Law, 2003 2002. www.jstor.org/stable/pdf/20070692.pdf.
- Lindsay, Jeff. "The Oneida Indian Tribe of Wisconsin." The Oneida, September 29, 2012. <https://www.jefflindsay.com/Oneida.shtml>.
- Lupien, John. Interview with John Lupien, n.d.
- MaHarry, Lindsay. "Meet the Man Who's Using 'Hemp-Enomics' to Undercut Big Agriculture and Protect Farmers - Culture | MERRY JANE." MERRY JANE, January 22, 2018. <https://merryjane.com/culture/hempenomics-shane-davis-interview-hemp-big-agriculture>.
- "Manastash." HBX. Accessed February 26, 2018. <https://hbx.com/brands/manastash>.
- Manoucheri, David. "Tribal Group Sues San Joaquin County over Hemp Grow." KCRA, October 31, 2017. <http://www.kcra.com/article/tribal-group-sues-san-joaquin-county-over-hemp-grow/13120413>.
- "Menominee Indian Tribe of Wisconsin v. Drug Enforcement Administration and U.S. Dept. of Justice ; Indian Law Bulletins, National Indian Law Library (NILL)." National Indian Law Library, May 23, 2016. https://www.narf.org/nill/bulletins/federal/documents/menominee_v_dea_doj.html.
- "Minnesota Statutes 18K, Section 2, Definitions." Government. The Office of the Revisor of Statutes. Accessed February 23, 2018. <https://www.revisor.mn.gov/statutes/?id=18K.02>.
- "Natural Building Coach." Tiny hemp houses. Accessed February 26, 2018. <http://www.tinyhemphouses.com/natural-building-coach.html>.
- "Navajo History." Accessed February 7, 2018. <http://www.discovernavajo.com/navajo-culture-and-history.aspx>.
- "Navajo Nation Council Committee Approves Production Of Cannabis, Hemp." *Arizona Daily Independent* (blog), July 1, 2017.

- <https://arizonadailyindependent.com/2017/07/01/navajo-nation-council-committee-approves-economic-development-through-production-of-cannabis-hemp/>.
- Nelson, Robert A. "Hemp Husbandry." *Hemp Fiber*, 2000. <https://www.hempbasics.com/hhusb/hh3fiber.htm>.
- "News from DEA, News Releases, 10/09/01." Accessed February 23, 2018. <https://www.dea.gov/pubs/pressrel/pr100901.html>.
- "Oglala Lakota Nation." Official Website of the Oglala Sioux Tribe. Accessed February 13, 2018. www.oglalalakotanation.info.
- "Oglala Sioux Tribe: Law and Order Code, Hemp Ordinances and Resolution." Accessed February 13, 2018. https://www.narf.org/nill/codes/oglala_sioux/oglahemp.html.
- "Ojibwe Indians." Accessed February 7, 2018. <http://geo.msu.edu/extra/geogmich/ojibwe.html>.
- Patterson, John. Tiny Hemp Houses interview. Voice Recording, February 16, 2018.
- Pergolizzi, Joseph V., Jo Ann Lequang, Robert Taylor, Robert B. Raffa, Daniel Colucci, and NEMA Research Group. "The Role of Cannabinoids in Pain Control: The Good, the Bad, and the Ugly." *Minerva Anestesiologica*, January 16, 2018. <https://doi.org/10.23736/S0375-9393.18.12287-5>.
- Piotrowski, Stephan, and Michael Carus. "Ecological Benefits of Hemp and Flax Cultivation and Products." Nova Institute, 2011. <http://eiha.org/media/2014/10/Ecological-benefits-of-hemp-and-flax-cultivation-and-products-2011.pdf>.
- Pollan, M. (2018, February 14). How We Got From Twinkies to Tofu. Retrieved February 20, 2018, from <https://www.nytimes.com/2018/02/14/books/review/hippie-food-jonathan-kauffman.html>
- Ranalli, Paolo, and Gianpietro Venturi. "Hemp as a Raw Material for Industrial Applications." *Euphytica* 140, no. 1 (2004): 1–6. <https://doi.org/10.1007/s10681-004-4749-8>.
- Ranalli, Paolo, Mario Di Candilo, Giuseppe Mandolino, Gianpaolo Grassi, and Andrea Carboni. "Hemp for Sustainable Agricultural Systems." *Agro-Food-Industry Hi-Tech*, no. March/April 1999 (1999): 33–38.
- Rainey, Libby. "Going into Its Fourth Harvest, Industrial Hemp Industry Still Facing Growing Pains." Newspaper. *The Denver Post* (blog), September 10, 2017. <https://www.denverpost.com/2017/09/10/colorado-cultivars-hemp-farm-harvest/>.
- Robbins, Lynn, Will Snell, Greg Halich, Leigh Maynard, Carl Dillon, and David Spalding. "Economic Considerations for Growing Industrial Hemp: Implications for Kentucky's Farmers and Agricultural Economy." University of Kentucky, July 2013. <https://www.uky.edu/Ag/AgEcon/pubs/reshempimpfarmer28.pdf>.
- Robinson, R. R. "Hemp." *Farmers' Bulletin*. U. S. Department of Agriculture, January 1943. <https://archive.org/stream/CAT87204121/farmbul1935#page/n1/mode/2up>.
- Robinson, Rowan. *The Great Book of Hemp*. 1 vols. Park Street Press, 1996.
- Rodriguez-Leyva, Delfin, and Grant N Pierce. "The Cardiac and Haemostatic Effects of Dietary Hempseed." *Nutrition & Metabolism* 7 (April 21, 2010): 32. <https://doi.org/10.1186/1743-7075-7-32>.
- Russell, Michelle. "First US Hemp Fibre Contract Signed for Clothing." Apparel News Website. just-style, October 17, 2017. https://www.just-style.com/news/first-us-hemp-fibre-contract-signed-for-clothing_id131957.aspx.

- S. (Ed.). (2016). Overview of U.S. Hemp Seed Imports. Retrieved February 15, 2018, from <https://s3-us-west-2.amazonaws.com/seedcx.com//assets/Hemp-Seed-Import-Analysis.pdf>
- “Seed Cake Sows Confusion.” Accessed February 22, 2018. <http://www.nepia.com/insights/signals-online/cargo/seed-cake/seed-cake-sows-confusion/>.
- “Seed Production | Parkland Industrial Hemp Growers.” Accessed February 5, 2018. <http://www.pihg.net/production/>.
- Shannon, Scott, and Janet Opila-Lehman. “Effectiveness of Cannabidiol Oil for Pediatric Anxiety and Insomnia as Part of Posttraumatic Stress Disorder: A Case Report.” *The Permanente Journal* 20, no. 4 (2016): 108–11. <https://doi.org/10.7812/TPP/16-005>.
- Small, Ernest. “Evolution and Classification of Cannabis Sativa (Marijuana, Hemp) in Relation to Human Utilization.” Springer Link, August 19, 2015. <https://link.springer.com/article/10.1007/s12229-015-9157-3?no-access=true>.
- Smith, Mary L., and Ann Bullock MD. “Native Americans with Diabetes.” Centers for Disease Control and Prevention, January 10, 2017. <https://www.cdc.gov/media/dpk/diseases-and-conditions/native-americans-diabetes/native-americans-diabetes.html>.
- Smith, Steve. “Hemp for Sovereignty: Scale, Territory and the Struggle for Native American Sovereignty.” *Space and Polity* 12, no. 2 (August 1, 2008): 231–49. <https://doi.org/10.1080/13562570802173364>.
- “State Industrial Hemp Statutes.” National Conference of State Legislatures, December 13, 2017. <http://www.ncsl.org/research/agriculture-and-rural-development/state-industrial-hemp-statutes.aspx>.
- “Statement of Principles on Industrial Hemp.” Federal Register, August 12, 2016. <https://www.federalregister.gov/documents/2016/08/12/2016-19146/statement-of-principles-on-industrial-hemp>.
- Thayer, C., Burley, M., & Held, D. (2017, May). Industrial Hemp: From Seed to Market. Retrieved February 1, 2018, from <http://ccetompkins.org/resources/industrial-hemp-from-seed-to-market>
- Thayer, Cheryl, and Megan Burley. “Industrial Hemp from Seed to Market.” Cornell University, May 2017. <https://sips.cals.cornell.edu/sites/sips.cals.cornell.edu/files/shared/documents/industrial-hemp-from-seed-to-market.pdf>.
- “Tribe Sues DEA, California County for Removal of 26-Acre Hemp Crop.” Marijuana Business Daily, October 31, 2017. <https://mjbizdaily.com/tribe-sues-dea-california-county-removal-26-acre-hemp-crop/>.
- “US Food and Drug Administration Home Page.” US Food & Drug Administration. Accessed February 28, 2018. <https://www.fda.gov/default.htm>.
- “USA v. White Plume, et Al, No. 5:2002cv05071 - Document 143 (D.S.D. 2016).” Justia Law. Accessed February 16, 2018. <https://law.justia.com/cases/federal/district-courts/south-dakota/sddce/5:2002cv05071/24992/143/>.
- “USDA ERS - Socially Disadvantaged Farmers: Race, Hispanic Origin, and Gender.” Accessed February 16, 2018. <https://www.ers.usda.gov/topics/farm-economy/beginning-disadvantaged-farmers/socially-disadvantaged-farmers-race-hispanic-origin-and-gender/>.

- Vantreese, V. L. (1997, June). INDUSTRIAL HEMP: GLOBAL MARKETS AND PRICES. Retrieved February 05, 2018, from <http://www.uky.edu/Classes/GEN/101/Hemp/HEMP97.PDF>
- Walker, Jason. "SFA Interview: Zachary Paige, White Earth Land Recovery Project." Sustainable Farming Association of Minnesota, April 21, 2015. <http://www.sfa-mn.org/sfa-interview-zachary-paige-white-earth-land-recovery-project/>.
- Wang, Mei, Yan-Hong Wang, Bharathi Avula, Mohamed M. Radwan, Amira S. Wanas, John van Antwerp, Jon F. Parcher, Mahmoud A. ElSohly, and Ikhlas A. Khan. "Decarboxylation Study of Acidic Cannabinoids: A Novel Approach Using Ultra-High-Performance Supercritical Fluid Chromatography/Photodiode Array-Mass Spectrometry." *Cannabis and Cannabinoid Research* 1, no. 1 (December 1, 2016): 262–71. <https://doi.org/10.1089/can.2016.0020>.
- "Washington State Halts Issuing of Hemp Licenses, Citing Budget Shortfall." *Marijuana Business Daily*, December 5, 2017. <https://mjbizdaily.com/washington-state-halts-issuing-hemp-licenses-citing-budget-shortfall/>.
- "We Grow the Legacy of Industrial Hemp." *Legacy Hemp*. Accessed February 5, 2018. <https://legacyhemp.com/farming-hemp-101>.
- Werf, Hayo M.G. van der, Hayo M.g, and Lea Turunen. "The Environmental Impacts of the Production of Hemp and Flax Textile Yarn." *Industrial Crops and Products* 27, no. 1 (January 5, 2007): 1–10. http://www.academia.edu/6480447/The_environmental_impacts_of_the_production_of_hemp_and_flax_textile_yarn.
- "What Is CBD Hemp Oil?" *Medical Marijuana, Inc.* (blog). Accessed February 4, 2018. <https://www.medicalmarijuanainc.com/what-is-cbd-hemp-oil/>.
- "White Earth Land Recovery Project 2011 Annual Report." WELRP, 2011. <https://www.scribd.com/document/110644871/2011-Annual-Report-1-1>.
- Williams, D.W., and Rich Mundell. "An Introduction to Industrial Hemp, Hemp Agronomy, and UK Agronomic Hemp Research." University of Kentucky College of Agriculture, Food and Environment, 2015. https://bracken.ca.uky.edu/files/2015_hemp_article.pdf.
- "Winnemucca Indian Colony (Nevada) Genealogy - FamilySearch Wiki." Accessed February 7, 2018. [https://www.familysearch.org/wiki/en/Winnemucca_Indian_Colony_\(Nevada\)](https://www.familysearch.org/wiki/en/Winnemucca_Indian_Colony_(Nevada)).

**THE HENRY M. JACKSON
SCHOOL OF INTERNATIONAL STUDIES**

UNIVERSITY *of* WASHINGTON

The Henry M. Jackson School of International Studies
jsis.washington.edu
Phone: (206) 543-6001 Email: jsis@uw.edu

