HELPING THE NORTH CAROLINA FARM BUREAU COMMERCIALIZE CARBON SEQUESTRATION THROUGH HEMP

Debdeep Basu
db343@duke.edu

Master of Engineering Management
Fall 2019
Duke University
December 11, 2019

Introduction

The US and especially the North Carolina Farm Bureau is at a crossroads with respect to an issue that can not only reverse climate change but revolutionize the way farming is conducted and commercialized in the state and across the country. Hemp has long been banned by governments due to fears of misuse, but the economic potential it holds is too tempting, and the rest of the world is cashing in on it fast. This report aims to arrive at a robust strategy and execution plan to help the NC farmers create a marketplace of differentiated offerings from hemp to deliver maximum value for target customers and capture a significant portion of that value for themselves in the process.

Climate Change

Global warming is accelerating due to the uncontrolled emission of greenhouse gases, especially carbon dioxide, which is mostly being generated by industries such as power, manufacturing, automotive, and airlines. As climate change is worsening, governments and regulatory authorities across the world have put regulations in place that incentivize businesses to reduce the amount of greenhouse gases (GHGs) they emit (and to an extent force them to control emissions) by placing financial repercussions on GHG emissions above a specified allowable limit. However, these have not had the intended consequences. Let us take a deeper look.

The Carbon Market – Paying to Compensate for Excess Carbon Emissions

Despite regulations being put in place such as the Obama administration's clean power plan[1] in 2014 and the Kyoto Protocol[2] in 1997, greenhouse gas emissions by businesses have not reduced as much as intended. However, certain systems have arisen that incentivize companies to reduce their carbon emissions and enable them to 'compensate' for emitting in excess of permissible limits sets by authorities:

Regulated carbon trading – In this method, a regulatory authority such as California's Greenhouse Gas Scheme or the Regional Greenhouse Gas Initiative (in northeastern states) sets a cap on the maximum permissible limit of greenhouse gases each company can emit by allocating or auctioning carbon credits, with each credit being equivalent to a ton of carbon dioxide emitted[3]. Companies that emit more than their allocated credits must purchase credits from the companies who have reduced their emissions and thus have credits to spare. This acts as a closed market for trading carbon credits.

Voluntary carbon offsetting – Buying carbon offsets refers to funding projects that reduce carbon dioxide emissions, such as restoring forests, increasing the energy efficiency of power plants / manufacturing units / buildings / transportation systems, harvesting carbon sinks, etc. Companies purchase carbon offsets from third party providers or schemes to compensate for the excess of carbon dioxide emitted at a particular occasion, place, or event / fulfill their corporate social responsibility / achieve carbon neutrality, etc.[4]

Carbon offsetting has its own set of loopholes that are exploited by both buyers and sellers. Due to the emerging and completely unregulated nature of the carbon offset market, there are very few ways to verify the quality of offsets by providers and projects. Trees may die, some projects may fail, and there are chances of offset providers sometimes deceiving their customers. However, standards are now emerging for rating the quality of offset providers and projects, such as the Voluntary Carbon Standard (VCS), the Gold Standard and the Climate, Community and Biodiversity Standard[5]. All in all, carbon offset trading has opened new avenues for

commercializing the reduction of carbon dioxide from the atmosphere, such as forest planting, conversion to renewable energy sources, and most excitingly – carbon GHG collection and sequestration through a variety of biological methods. Let us explore in the next section.

Natural Ways to Reverse Global Warming

Removal of carbon dioxide from the earth's atmosphere cannot be left to the mercy of corporations trading carbon credits in regulated markets. According to a special report by the Intergovernmental Panel on Climate Change (IPCC)[6], global warming is likely to reach 1.5°C between 2030 and 2052 and this change cannot be avoided without the rapid enhancement in the natural capacity of carbon sinks to suck carbon out of the atmosphere[7].

There are many natural ways to "sequester" or trap carbon from the atmosphere through biological, chemical, and physical processes[8]. It can be achieved through agricultural practices such as changing the nature of land use, or artificial processes such as trapping industrially produced CO_2 using a variety of carbon sinks.

However, one of the most effective natural ways to reverse climate change is carbon biosequestration – the process of using plants to sequester excess CO_2 in the atmosphere. Once the plants are harvested these plants, they are slow smoldered to create a substance called biochar, a form of charcoal which is then mixed with nutrients and subsequently added back to the soil[9].

Hemp – The Next Big Thing That Can Rescue the Planet

Hemp, using less water and resources than any of its biomass counterparts, is one of the most effective agents of carbon biosequestration on the planet, yielding as much as up to 13 tons of biochar per hectare annually. Besides being a 100% biodegradable, hemp sequesters carbon as it grows, and for every 1 kg of hemp harvested, ~1.624 kg of CO_2 is sequestered from the atmosphere. Hemp based construction materials such as hempcrete[10] can sequester carbon for a long time after construction and their manufacturing processes do not contribute to global warming.

Hempcrete insulation locks up around 110 kg of CO_2 per cubic meter of wall and the excellent insulation and airtightness of hempcrete / hemp lime results in little heating or cooling losses from the building, effectively reducing the power needed to run HVAC systems by up to 60%. Besides, their anti-mold properties result in improved indoor air quality and the strength of the fibers result in several hundred year lifespans of buildings, making hemp the ideal material for construction.

Yet, this is only a fraction of the use hemp can be put to. The outer bast fiber of hemp stalk can make textiles, canvas and rope while its woody core can be used to make paper, construction and animal bedding. Hemp seeds contain high protein, fiber, and omega-3 fats. Their oil can be used for paints, adhesives, cooking and plastics. All in all, hemp is a more sustainable, organic and regenerative crop which makes it a better substitute to anything that can be made with cotton, soy, or corn[11].

With such high economic potential and a vast array of uses, hemp is already being cultivated across many countries such as Canada and Australia and is being utilized for various purposes. The big question is – why has hemp not been commercialized to its full potential in the US yet?

The United States and Hemp – A Complicated Relationship

For a very long time, hemp production was banned in the United States because of its genetic similarity to marijuana. However, seeing its immense potential, the process to legalize the production of industrial hemp was started again in 2014. The passage of the Agriculture Improvement Act of 2018 (the 2018 Farm Bill) removed the power of the US Drug Enforcement Administration to restrict the import of hemp and hemp seeds which are accompanied by a quality certificate from the importing country's national testing authority[13]. With this, the legalization of industrial hemp production is now back on track.

Hemp production was legalized in North Carolina in 2015, but only as part of the state's pilot program as allowed under federal law and only in conjunction with the NC State and NC A&T Universities. On October 31, 2019, the US Department of Agriculture (USDA) released a rule setting out its plan for hemp production and gave states 2 options – either to accept its plan or to submit the state's hemp production plan for approval to the USDA, which must contain detailed procedures for the production of industrial hemp and subsequent testing to check whether THC concentration is limited to 0.3% on a dry weight basis[14].

The North Carolina Farm Bureau must now make a few crucial decisions to help its farmers cash in on the hemp revolution. The first decision is whether to draft its own plans for hemp production and testing or accept the USDA's plan. The second and more important set of decisions, however, is going to revolve around the ways it is going to enable and empower its farmers to produce and package all possible hemp offerings to the right target market and through the right channels.

Conclusion

Having looked at the current scenario and options available to the North Carolina Farm Bureau, the next logical step is to use a set of strategy frameworks to analyze how the Bureau can effectively commercialize hemp and create a set of unique value offerings to help its farmers capture their fair share of profits from the carbon trading market.

Analysis

Jobs to be Done – In this case, suppliers of hemp (i.e. NC farmers) need to understand the jobs to be done, pains to be relieved, and gains to be created for a target customer base comprising of businesses whose operations involve significant emissions of carbon dioxide.

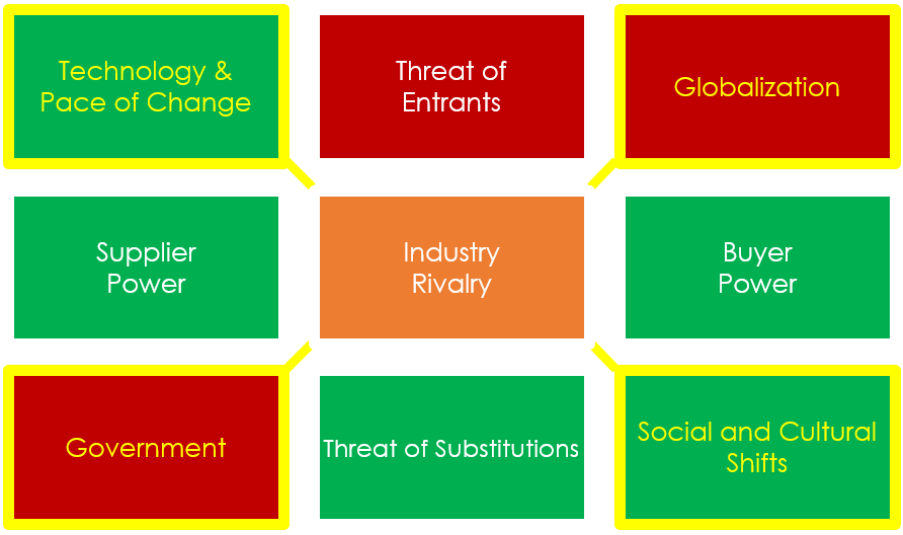
For such customers, the jobs to be done are:
- Reduce carbon dioxide emissions
- Achieve carbon neutrality with maximum cost effectiveness

Pains faced by them:
- High costs incurred in reducing carbon emissions
- Significant infrastructure and operational overhaul required in reducing emissions
- Choosing a verified and quality tested carbon offset project
- Transparency regarding the tonnage of CO_2 being reduced by an offset project

Incremental gains to be created for them:
- Achieve corporate social responsibility targets
- Improve their 'green image' as a company that uses clean technology to reduce emissions

Porter's Forces – The hemp industry in the US is still waiting to take off, hence there are no incumbents in the game and the North Carolina Farm Bureau can be considered an insurgent looking to gain an early mover advantage in an untapped, uncontested marketplace. Considering that all but 4 states have legalized industrial hemp production in the US, farmers from other states might follow suit quickly and therefore the threat of entrants is high. Threat from globalization is red because there are companies in other countries that are already offering hemp-based solutions (such as Atlas365 in Canada) which the target customers might choose to import from. Finally, the entire possibility of this market opening up depends on the policies and decisions chosen by the Government, which puts that box in the red.

On the other hand, industry rivalry is moderate because a number of carbon offset projects exist in the market. Since NC farmers grow hemp themselves, the issue of supplier power doesn't exist. There is a vast multitude of companies worldwide looking to achieve carbon neutrality, which makes buyer power green. Other ways to sequester carbon exist, but hemp cultivation is one of the most effective ones, hence the threat of substitutions is low. Finally, social and cultural shifts and technology pace of change will act as tailwinds for hemp to capture the carbon offset market, and are hence green. Therefore, it makes sense for the NC Farm Bureau to enter this market.



Applying the R–W–W Screen to Carbon Sequestration Using Hemp

Is it Real? – As discussed in the sections earlier, the market for reduction of carbon dioxide emissions is real and quite significant in volume. Looking past the obvious set of target customers, i.e. companies in the power generation, manufacturing, and transportation industries, any and every business entity today wants to maintain an image of being carbon neutral. And they are willing to shell the bucks for doing so, as well. A good example of this is Coldplay's decision to fund the planting of 10,000 mango trees in India in 2002 to offset one of their albums[15].

Speaking of the product, hemp's ability to sequester carbon dioxide more than any other category of biomass crop has been proven beyond doubt. All that remains is to create a digital marketplace that facilitates the trade of carbon offsets from hemp cultivation, thereby ensuring that farmers capture the right amount of value. The creation of a successful offering that will satisfy the market depends on a robust business model and a platform that seamlessly connects buyer and seller, facilitates payments, and enables end-to-end transparency.

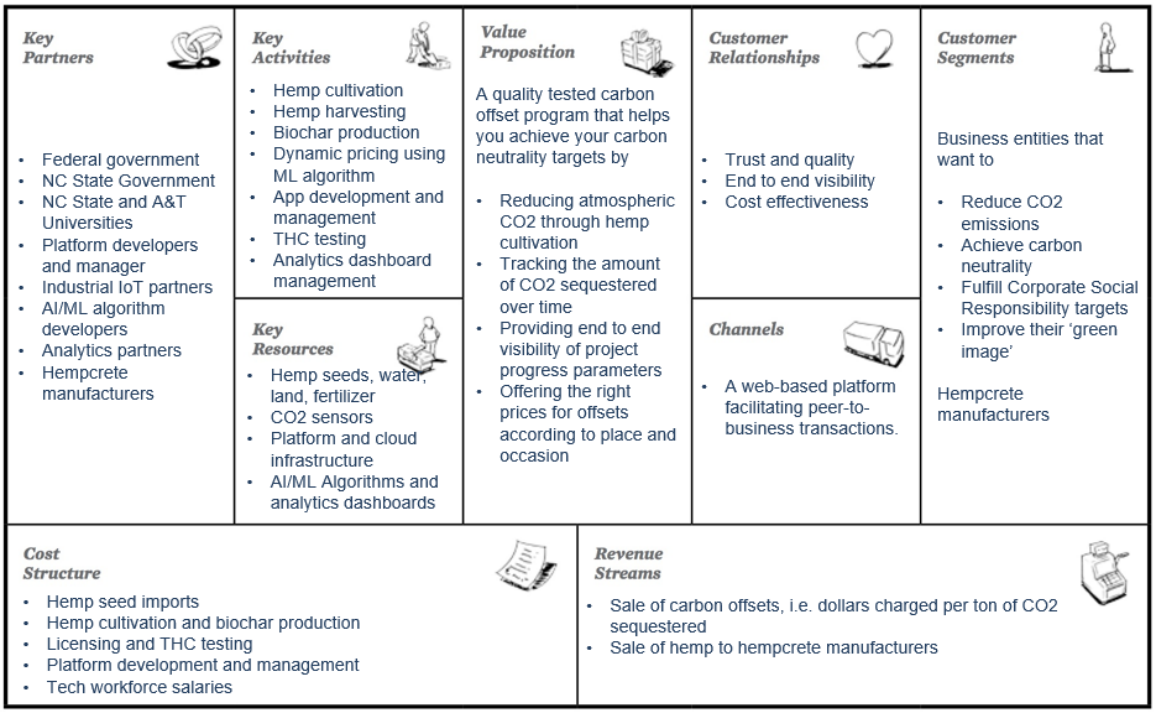
Can we win? – The hemp industry is waiting for legal frameworks and regulations to be sorted out between the states and the center. Once done, the launch of said marketplace will give the NC Farm Bureau the competitive advantage of a first mover, i.e. unfettered access to an entire market. As farmers from other states follow suit, this advantage can be sustained not just by offering competitive carbon rates, but by increasing the trust and transparency provided through the platform, enabling all stakeholders to track the quality and progress of all crucial aspects of the project. Industrial IoT and descriptive analytics will play a major role in this.

Speaking of resources, North Carolina farmers have excelled at tobacco cultivation for decades and there is no dearth of agricultural best practices, real estate, fertilizers and other supplements, or administrative support from the Farm Bureau, which must set the farmers up for success by facilitating the creation and consumption of this project from start to finish. One of the key activities in this regard will be to monitor the market and set the right carbon rates in response to demand.

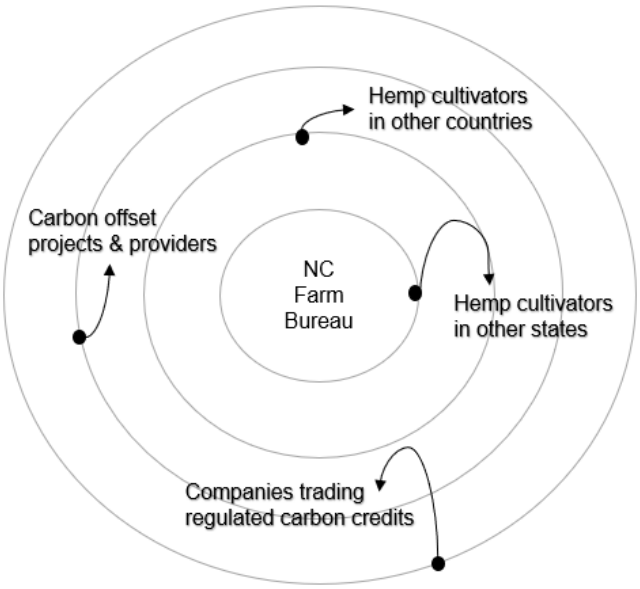
Is it worth doing? – The initial setup costs to get the project off the ground is expected to be significant, but once the hemp starts growing and sequestering carbon and the harvest gets converted to biochar, the process will turn into a cycle, giving rise to an ecosystem that is easily sustained and keeps churning extremely high returns. There are risks associated with the project, but those can be checked off by meticulous agricultural management.

The similarity of hemp cultivation to that of tobacco indicates that the new project fits the NC Farm Bureau's overall growth strategy. Considering the immense commercialization potential of hemp, it is certain that the top management of the NC Farm Bureau will support it wholeheartedly.

Business Model Canvas – A composite business design is required to sell carbon offsets through hemp cultivation as well as hemp as a construction material. The value created for both offerings, to a certain extent, is the same. However, the BMC is primarily focused on value creation and value capture via offset trading, with the sale of hemp for hempcrete production as an additional revenue stream from the hemp that is left over after the production of biochar.

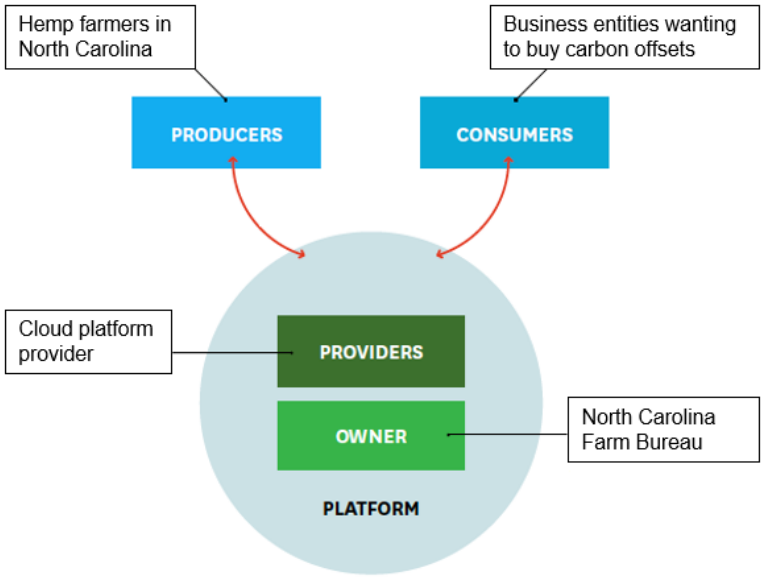


NC Farm Bureau's Competitive radar – As the project kicks off, North Carolina farmers will not only be competing against hemp farmers in other US states but against hemp farmers internationally as well. Due to the similar nature of the offering, another set of competitors will be the different carbon offset providers and projects that are targeting the same customer segments. Finally, with sustained success, we can even break into and capture the regulated carbon trading market in the future, which constitutes the periphery of the competitive radar.



Recommendations

The Next Gen Carbon Marketplace – Creating a digital platform for trading carbon offsets is the first step in implementing the project. The pilot version of the platform will be web-based, developed and hosted in the cloud, with the plan to develop a mobile app after achieving a set of economic and operational targets.



The ultimate ownership of the platform will lie in the hands of the NC Farm Bureau, which has to hire a tech and administrative workforce in order to develop, launch, and maintain the platform, source cloud storage and infrastructure, and do so within approved budgets.

The cloud services provider whose infrastructure the platform is based on will be the third-party the owner deals with. For e.g. Azure / AWS.

The platform will connect providers of carbon offsets, i.e. NC farmers, with the buyers of carbon offsets, i.e. any commercial entity that

wishes to purchase them. As conventionally defined, one carbon offset will be equivalent to one ton of CO_2 sequestered through hemp cultivation by the provider. The platform will also have a section that connects NC farmers with hempcrete builders looking to buy raw material for construction.

Let's talk about the carbon offset project first. For each buyer that signs up in the platform and chooses a farmer to buy carbon offsets from, the platform will act as a one-stop-shop for the process, from choice and negotiation to transaction and end-to-end project visibility. To enable transparency and hold the provider accountable to the sequestration targets they have been paid for, the first and most important aspect is to track the amount of CO_2 that is being absorbed per unit of land under hemp cultivation.

Tracking Carbon Sequestration Using IoT and Descriptive Analytics – Carbon dioxide sensors need to be installed at the hemp farms according to the unit area and concentration measurements that the NC Farm Bureau decides to implement for testing the amounts of CO_2 sequestered. Calculations can also be made after harvesting by multiplying the tonnage of hemp harvested by 1.62 and cross checking it with the amount of CO_2 reduced by comparing sensor readings before cultivation and after harvesting. Sensors will collect CO_2 data in real time and be connected to a central command center in the cloud which stores all that data. CO_2 data belonging to a particular offset project will be owned jointly by the concerned buyer and the NC Farm Bureau.

On top of the data engineering layer will reside a data science layer that organizes the data collected from sensors, runs a set of calculations, and generates a set of findings that are of relevance to the farmer, the buyer, the Bureau, and other stakeholders who might wish to view the health / progress / crucial parameters of the project. These findings will then be creatively visualized in an interactive Tableau dashboard that will reside on top of the data science layer, acting as the end user interface accessible via one section of the platform. The buyer / provider can log in using their credentials to view this dashboard. Buyers will be able to rate providers based on the quality of service provided and sellers can rate buyers based on their experience working with them.

Secure Peer-to-Business Payments – The platform will also act as a secure payment gateway facilitating direct payments from the buyer to the farmer, with a percentage of the payment going to the Bureau towards tech, administrative, and other expenses. Direct payments, instead of issuing financial tokens or any other form of non-cash payments will provide the right incentive for farmers to get onboard the platform and hence the program. The gateway will be secured by the Elliptic Curve Digital Signature Algorithm[16] and a mobile phone based two-factor authentication system for making the payment (pin + verification code via text or email).

Dynamic Pricing Using Machine Learning – One of the distinguishing features of this platform will be an Machine Learning algorithm in the backend that drives dynamic pricing for every transaction based on a comprehensive set of business rules that are coded into the system. The aim of dynamic pricing, as will be advertised to farmers and buyers alike, will be to set the best possible price for each transaction depending on a number of parameters, such as quality rating of the provider, and buyer rating, track record of emissions, past and current emission reduction efforts, and offset purchase history of the buyer. Several additional factors will also be considered such as the seasonality, location, and occasion (in case of an event) for which the buyer wants to offset emissions.

Business Development and Marketing Strategy – To get buyers on board the platform, the following segments need to be scoped for prospective clients and targeted using a variety of sales and marketing efforts outlined later in this section. The segments to target are:

1. Power generation, transportation, manufacturing, and companies with heavy emissions
2. Companies with moderate to low emissions wanting to achieve carbon neutrality
3. Companies wanting to contribute to carbon reduction for CSR purposes
4. Individuals or commercial entities wanting to offset particular events

Prospects in the above segments can be targeted using the following marketing tactics:

- A discount on their first purchase of an offset project.
- A loyalty program which adds 'carbon points' for each offset project purchase, depending on purchase volume. The points can be redeemed for discounts or for more tonnage of CO2 sequestered per deal.

Besides, the following can be done to promote the platform and drive buyer adoption:

- Collaborations with entertainment industry entities such as bands, events, and movie production houses, wherein they are offered a hefty discount on their first offset project purchase in exchange for comprehensive publicity for the platform before, during, and after release.
- Similar collaborations with popular tech companies in exchange for free ads on their platforms targeting our target buyer segments.
- Signing long term deals and partnerships to lock buyers in, by offering them a higher percentage of carbon points per purchase.

Besides this, another strategy to kickstart the implementation of this program is to crowdsource the initial funding required for tech development via websites such as Kickstarter and GoFundMe.

Collaborations with hempcrete manufacturers – By collaborating with and selling to hempcrete manufacturers such as Hempitecture and American Hemp LLC, the NC Farm Bureau can not only ensure the commercialization of hemp leftover after the production of biochar, but contribute to further carbon sequestration while maintaining a parallel revenue stream. Being associated with these companies will also boost the Bureau's brand and establish credibility as a leading supplier of hemp as well as a leading carbon offset provider.

Appendix – Bibliography

[1] https://www.bbc.co.uk/news/world-us-canada-33753067

[2] https://www.investopedia.com/terms/c/carbontrade.asp

[3] https://nativeenergy.com/2018/02/how-does-carbon-trading-work/

[4] https://science.howstuffworks.com/environmental/green-science/carbon-offset.htm

[5] https://science.howstuffworks.com/environmental/green-science/carbon-offset3.htm

[6] https://www.ipcc.ch/sr15/

[7] https://www.downtoearth.org.in/blog/climate-change/best-way-to-remove-carbon-sequestering-it-in-its-natural-sinks-66492

[8] https://en.wikipedia.org/wiki/Carbon_sequestration

[9] http://www.hemptrade.ca/eguide/background/the-sengbusch-classification-system

[10] https://samjohnstonlaw.wordpress.com/2016/02/21/the-environmental-benefits-of-industrial-hemp/

[11] https://www.forbes.com/sites/natalieparletta/2019/06/28/could-hemp-be-the-next-big-thing-in-sustainable-cotton-fuel-wood-and-plastic/#4ae1409321c2

[12] http://www.hemptrade.ca/eguide/background/hemps-environmental-impact

[13] https://content.govdelivery.com/accounts/USDAAMS/bulletins/23f8ef9

[14] https://www.dtnpf.com/agriculture/web/ag/news/world-policy/article/2019/10/28/issued-usda-rules-will-allow-wide

[15] https://www.theguardian.com/travel/2006/dec/10/ethicalholidays.escape

[16] https://developers.google.com/pay/api/android/guides/resources/payment-data-cryptography