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The Role of Industrial Hemp in Carbon Farming

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Summary

We submit that industrial hemp be seriously considered as a crop that can contribute significantly to the Australian Government's aim to reduce global atmospheric Carbon Dioxide.

Industrial hemp has been scientifically proven to absorb more CO2 per hectare than any forest or commercial crop and is therefore the ideal carbon sink. In addition, the CO2 is permanently bonded within the fiber that is used for anything from textiles, to paper and as a building material. It is currently being used by BMW in Germany to replace plastics in car construction. It is therefore additional to what would otherwise be grown or sourced from oil. It can be constantly replanted and as such meets permanence criteria as defined by the Kyoto Protocol.

Industrial hemp is not marijuana. Industrial hemp is the name of the soft fiber from the Cannabis Sativa plant. It is distinguished from the psychoactive varieties by having low (less that 0.05) levels of the chemical THC (Tetrahydrocannabinol). It has been developed to grow long fibers and in dense plantations thereby increasing the biomass. See below:-

Hemp can be grown on a widespread scale throughout Australia, on nutrient poor soils and with very small amounts of water and no fertilisers. Hemp can be grown on existing agricultural land (unlike most forestry projects), and can be included as part of a farm's crop rotation with positive effects on overall yields of follow on crops. It can therefore comply with the Australian Government's plans to increase employment and improve the economic position of remote areas. This is especially relevant to the holders of Aboriginal and Torres Strait Islander land.

A brief history of hemp

Hemp has been in cultivation for thousands of years, most notably for ropes for naval vessels and for paper. In the mid 1930's there was the invention of nylon and the spread of plastics, and a general trend away from all things natural. At the same time use of marijuana as a recreational drug increased and hemp was included in the ban on cultivation of any plant of the Cannabis family. This view spread globally with political pressure from the US and since that time there has been a stigma attached to hemp cultivation.

Governments around the world have realised that this valuable crop is not a threat and have encouraged widespread planting of hemp as a means of absorbing CO_2 and have issued carbon credits to farmers growing the crop.

Major producers include Canada, France, and China. In Australia the Department of Primary Industry is encouraging the growth of industrial hemp and is issuing licenses to companies and individuals that meet stringent criteria.

GoodEarth has been through the process and has been awarded a license to grow an industrial hemp crop by the NSW Department of Primary Industries.

The science behind hemp as a carbon sink

One hectare of industrial hemp can absorb 22 tonnes of CO_2 per hectare. It is possible to grow to 2 crops per year so absorption is doubled. Hemp's rapid growth (grows to 4 metres in 100 days) makes it one of the fastest CO_2-to-biomass conversion tools available, more efficient than agro-forestry.

Biomass is produced by the photosynthetic conversion of atmospheric carbon. The carbon uptake of hemp can be accurately validated annually by calculations derived from dry weight yield. This yield is checked at the weighbridge for commercial reasons prior to processing.

Highly accurate figures for total biomass yield and carbon uptake can then be made, giving a level of certainty not available through any other natural carbon absorption process.

The following carbon uptake estimates are calculated by the examining the carbon content of the molecules that make up the fibres of the hemp stem. Industrial hemp stem consists primarily of Cellulose, Hemicellulose and Lignin, whose chemical structure, carbon content, (and therefore absorbed CO_2).

- Cellulose is 70% of stem dry weight. Cellulose is a homogeneous linear polymer constructed of repeating glucose units. The carbon content of cellulose accounts for 45% of its molecular mass.
- Hemicellulose is 22% of stem dry weight. Hemicellulose provides a linkage between cellulose & lignin. It has a branched structure consisting of various pentose sugars.
- Lignin is 6% of stem dry weight. Lignin is a strengthening material usually located between the cellulose microfibrils. The lignin molecule has a complex structure that is probably always is variable .

To summarise the above, one tonne of harvested stem contains:

- 0.7 tonnes of cellulose (45% Carbon)
- 0.22 tonnes of hemicellulose (48% Carbon
- 0.06 tonnes of lignin (40% Carbon)

It follows that every tonne of industrial hemp stems contains 0.445 tonnes Carbon absorbed from the atmosphere (44.46% of stem dry weight).

Converting Carbon to CO_2 (12T of C equals 44T of CO_2(IPCC)), that represents 1.63 tonnes of CO_2 absorption per tonne of UK Hemp stem harvested. On a land use basis, using Hemcore's yield averages (5.5 to 8 T/ha), this represents 8.9 to 13.4 tonnes of CO_2 absorption per hectare of UK Hemp Cultivation.

For the purposes estimation, we use an average figure of 10T/ha of CO_2 absorption, a figure we hold to be a reasonably conservative estimate. This is used to predict carbon yields, but CO_2 offsets will be based on dry weight yields as measured at the weighbridge.

The roots and leaf mulch (not including the hard to measure fibrous root material) left in situ represented approximately 20% of the mass of the harvested material in HGS' initial field trials. The resulting Carbon content absorbed but remaining in the soil, will therefore be approximately 0.084 tonnes per tonne of harvested material. (42% w/w) (5).

Yield estimates are (5.5 - 8 T/ha) this represents 0.46 to 0.67 tonnes of Carbon per hectare (based on UK statistics) absorbed but left in situ after Hemp cultivation.

That represents 1.67 to 2.46 T/ha of CO2 absorbed but left in situ per hectare of UK Hemp Cultivation. Final figures after allowing 16% moisture (Atmospheric 'dry' weight) are as follows:-

CO2 Absorbed per tonne of hemp stem	1.37t
CO2 Absorbed per hectare (stem) (UK)	7.47 to 11.25t
CO2 Absorbed per hectare (root and leaf) UK)	1.40 to 2.06t

Industrial hemp is a self offsetting crop

According to Defra, UK Farming emits a total CO2 equivalent of 57 millions tonnes in GHG's. UK agricultural land use is 18.5 million hectares. This amounts to an average of around 3.1 tonnes of CO2 per hectare total embodied emissions. As a low fertiliser and zero pesticide/herbicide crop, with little management input, the carbon emissions of hemp cultivation is well below the average. Therefore we can assume the matter remaining in soils roughly offsets the cultivation and management emissions.

References

1. Hon, D.N.S. (1996) A new dimensional creativity in lignocellulosic chemistry. Chemical modification of lignocellulosic materials. Marcel Dekker. Inc. New York.(5)

2. Puls,J., J. Schuseil (1993). Chemistry of hemicelluloses: Relationship between hemicellulose structure and enzymes required for hydrolysis. In: Coughlan M.P., Hazlewood G.P. editors. Hemicellulose and Hemicellulases. Portland Press Research Monograph, 1993. (5)

3. Bjerre, A.B., A.S. Schmidt (1997). Development of chemical and biological processes for production of bioethanol: Optimization of the wet oxidation process and characterization of products, Riso-R-967(EN), Riso National Laboratory, Roskilde, Denmark.

4. Anne Belinda Thomsen, Soren Rasmussen, Vibeke Bohn, Kristina Vad Nielsen and Anders Thygese (2005) Hemp raw materials: The effect of cultivar, growth conditions and pretreatment on the chemical composition of the fibres. Riso National Laboratory Roskilde Denmark March 2005. ISBN 87-550-3419-5.

5. Roger M Gifford (2000) Carbon Content of Woody Roots, Technical Report N.7, Australian Greenhouse Office.

These figures do not include the additional carbon dioxide that is saved by substituting unsustainable raw materials, to end products derived from harvested hemp that effectively locks in CO2. Such products include, building materials, plastics, cosmetics, composite boards and insulation materials. According to Limetechnology Ltd, Hemcrete locks up around 110kg of CO2 per m3 of wall, compared to the 200kg of CO2 emitted by standard concrete. It also excludes the carbon savings of replacing tree-derived products and leaving trees to continue to absorb CO2

For a crop, hemp is very environmentally friendly, as it is naturally insect resistant, and uses no herbicides. Hemp grows rapidly in Australia and matures in 90 days compared to traditional forestry taking 20 years. It therefore starts absorbing CO2 from almost from the day it is planted.

Industrial hemp needs limited maintenance and regenerates soil

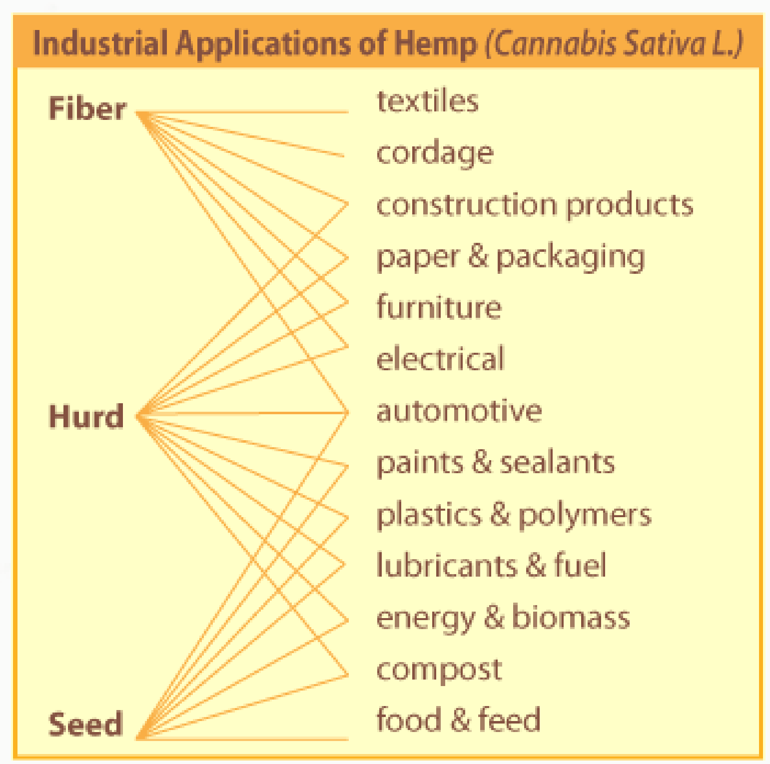
Hemp grows in diverse soil types and conditions without the need for chemical inputs and improves soil structure while also protecting and binding soil. The long roots of the hemp plant help to bind soils and combat erosion. Hemp also is a natural weed suppressant due to the rapid growth of its canopy. Light is blocked out and weeds cannot grow underneath.

Hemp also adds nutrients to soil by tapping into sub-soil nutrients other plants cannot access. It also destroys nematodes and other soil pests, resulting in improved yields of follow on crops. Hemp cleans toxins from the ground by a process called phytoremediation. It was used in Russia to remove radioactive elements following the Chernobyl nuclear disaster. Work undertaken in Germany (noted in Karus and Leson 1994) suggested that hemp could be grown on soils contaminated with heavy metals, while the fiber remained virtually free of the metals. Kozlowski et al. (1995) observed that hemp grew very well on copper-contaminated soil in Poland (although seeds absorbed high levels of copper). Baraniecki (1997) found similar results. Mölleken et al. (1997) studied effects of high concentration of salts of copper, chromium, and zinc on hemp, and demonstrated that some hemp cultivars have potential application to growth in contaminated soils. It is currently being trialled in NSW as a ''mop crop'' to rehabilitate soils that have been contaminated by nearby sewage treatment plants. Where soils have become acidic due to acid rain planting a hemp crop restores the PH balance.

Industrial hemp replaces unsustainable raw materials

The vast quantities of hemp derived products and raw materials created by large scale cultivation could replace many oil-based unsustainable products and materials, particularly in construction, locking in captured CO2 and creating secondary benefits to the global environment. In particular, hemp could be used to replace significant quantities of tree-derived products, allowing reduced use of existing tree populations, thus maintaining their CO2 uptake.

Hemp also produces much higher quantities of stronger and more versatile fibre than cotton, and many other fibre crops, which often have very high chemical residue and water footprints. Extra processing required by hemp is also at least partially offset by its recycling potential. Industrial hemp has thousands of uses with virtually no waste. This proposal focuses on carbon capture, but it is worth emphasising that hemp growers have a crop that is valuable and will be in increasing demand. This is especially true of industrial hemp seed as a food high in protein and Omega 3.



Conclusion

The cultivation of industrial hemp in Australia is vital in our battle to reduce pollution, conserve precious water resources and to improve soil quality.

Industrial hemp is unmatched as a means of sequestering Carbon Dioxide and binding it permanently in the materials it is manufactured into. The accreditation of industrial hemp as a generator of carbon credits will make its cultivation more attractive.

In addition, the fiber is robust and has a large variety of uses as paper, textile and as a biofuel. The seeds are a valuable source of protein for humans and for use in animal feed. This will stimulate a whole new industry and reduce reliance on imported goods.

The widespread cultivation of industrial hemp in Australia will give a much needed economic and sustainable boost to remote country areas and areas suffering high unemployment and hardship.