



TRADE & INDUSTRIAL POLICY STRATEGIES

INDUSTRIAL DEVELOPMENT PROJECTS

INDUSTRIAL HEMP

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**A contribution to South Africa's Post COVID-19 Recovery Plan:
Tapping into new and unmet sources of demand to support
the establishment of new companies, factories,
value chains and employment opportunities**

Trade & Industrial Policy Strategies (TIPS) is a research organisation that facilitates policy development and dialogue across three focus areas: trade and industrial policy, inequality and economic inclusion, and sustainable growth

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INTRODUCTION

As South Africa responds to COVID-19 and aims to stimulate the economy and job creation post lockdown, an opportunity should not be missed to consider investing in new product markets which could increase the size and dynamism of the manufacturing sector. Such a package could contribute to arresting the current trend of deindustrialisation and shift the trajectory of the industrial base into new, sustainable growth areas and value chains. This would result in new factories, new downstream demand for primary and intermediate inputs, new export products, increased foreign exchange earnings, and importantly new direct and indirect long-term jobs.

Using the idea of “business *unusual*” TIPS economists have put together a Post COVID-19 recovery programme in South Africa that could provide the impetus to arrest the current trend of deindustrialisation and herald in the beginning of a new generation of industrial activity.

Seven initial projects have been identified. They represent a wide array of economic activity in the special purpose machinery, agro-industries, bioplastics, shipping, alternative fuel, biochemicals and automotive component manufacturing sectors.

This project looks at commercial scale cultivation and production of de-hulled (possibly organic) hemp seeds for human consumption for the export market.

This document is a research paper. The author is not able to assist with project implementation, advice and support.

INDUSTRIAL HEMP

PROJECT SUMMARY SHEET

TITLE	Commercial scale cultivation and production of de-hulled (possibly organic) hemp seeds for human consumption for the export market.
LEAD DEPARTMENT	Department of Trade, Industry and Competition. Other Departments: Department of Health (DoH), Department of Science and Innovation (DSI) and Department of Agriculture, Land Reform and Rural Development (also Agriculture Research Council, ARC).
PROJECT SUMMARY	The project is to cultivate industrial hemp in the Eastern Cape at a commercial scale as an agricultural (possibly organic) crop and to beneficiate the crop in the agro-processing sector to produce de- hulled hemp seeds for human consumption for export to the United States (US) and Canada in the short run; and Europe and (possibly) Australia in the medium term. To deliver the project, organic farming skills will need to be developed and supported, Good Harvesting Practices will need to be used to gather the crop and Good Storage and manufacturing standards (international) applied in the production of seed for export. Capacity, capabilities, auxiliary and support activities developed to service this initiative will provide strategic and competitive positioning as future industrial hemp value chain market opportunities become more commercially
APPROXIMATE BUDGET	R20 million to R40 million (cost of land hard to estimate)
STAKEHOLDERS	<ul style="list-style-type: none"> • A black commercial farmer to develop and operate the farm; • ARC to assist and support in terms of appropriate seed cultivar, crop density and other agronomic and cultivation parameters; • Possibly the Land Bank in relation to identification and procurement of suitable land and relevant extension services; • The Department of Health (DoH), which need to fast-track permit and regulatory approvals; • International firm (probably Canadian) which will sign an offtake agreement and provide upgrading and capacity building for the black commercial farmer; • A local agro-processing company with Good Manufacturing Practice accreditation to undertake de-hulling and or oil extraction;
CAPITAL INVESTMENT	<ul style="list-style-type: none"> • Physical infrastructure fencing and securing site as per South African Health Products Regulatory Authority/DoH guidelines and regulations; • Capital equipment: irrigation (if necessary); tractors and trailers (for harvesting). No combine harvester required as seed better picked by hand (also more labour intensive).
OUTCOMES	<ul style="list-style-type: none"> • Job creation: Main job creation occurs at the farm in terms of crop planting, crop maintenance and harvesting (twice a year). Additional job creation in auxiliary services and support service, agro-processing and transport. International studies suggest 12% of jobs are in agriculture, 16% in manufacturing, 15% in management and administration. As there is no industry in South Africa it is hard to estimate actual numbers but harvesting is labour intensive. • Entirely new export product and export revenue stream. Global market is growing, hence seen as a good export basket diversification strategy. Potential to create South African brand globally. • A strategic intervention to start creating capacity and capabilities in an agricultural crop which will inevitably face increasing demand over time as the uses of industrial hemp in mainstream products is extended.

Commercial scale cultivation and production of de-hulled (possibly organic) hemp seeds for human consumption for the export market

Introduction

There is a growing international trend towards decriminalising the cultivation and beneficiation of industrial hemp and/or marijuana. This has led to a nascent market for hemp and marijuana crops and a wide range of new and novel beneficiated products. These market opportunities have attracted substantial hype across social and popular media. The so called “Green Rush” is equated to the American “Gold Rush” of the 1850 and perpetuates the idea of limitless opportunities for individual wealth generation, economic growth and job creation. Actual returns and growth have, however, fallen significantly below expectations and in many circumstances substantial losses have been incurred¹. Careful economic consideration of market fundamentals and existing operating environments support the idea that some future growth potential undoubtedly exists and as such it is worthwhile developing South Africa’s capacity and capability to leverage such opportunities when they materialise or gain momentum. In the short run, however, commercially viable and legal options for a South African industry are narrowly defined. The most attractive and seemingly feasible opportunity currently is the commercial scale cultivation of industrial hemp for the production of seed for human consumption. (Lowitt 2018; 2019).

The proposed project is based on research conducted as part of a SA-TIED initiative (Lowitt 2019) to create an inter-regional industrial hemp value chain between South Africa and Malawi². The project is to cultivate industrial hemp in the Eastern Cape as an agricultural (possibly organic) crop and to beneficiate the crop in the agro-processing sector to produce de-hulled hemp seeds for human consumption for export to (among others) the US and Canada in the short run; and Europe and (possibly) Australia in the medium term³. To deliver the project, organic farming skills will need to be developed and supported, Good Harvesting Practices will need to be used to gather the crop and Good Storage and Processing standards (international) applied in the production of seed for export. Capacity, capabilities, auxiliary and support activities developed to service this initiative will provide strategic and competitive positioning as future industrial hemp value chain market opportunities become more commercially viable. The project thus offers an immediate labour-intensive new commercial opportunity in a value chain which has strong long-term growth potential. The project also creates the opportunity to support the development of black commercial farmers, and create an anchor industry which can crowd in small businesses and small growers over time.

The project proposal is a major departure from all local industrial hemp initiatives to date. Previous work by the Agricultural Research Council, Council for Scientific and Industrial Research, House of Hemp, Department of Agriculture, Fisheries and Forestry and the IDC have all considered growing the industry based on small, rural emerging farmers growing hemp at a small scale. The project suggested in this proposal is for a large-scale commercial operation to be supported, which would enjoy economies of scale and be commercially viable. The key outcome of the project would be: the creation of a large numbers of jobs in rural Eastern Cape, substantial new exports, increased activity

¹ For example. in 2018 Canada legalised the recreational use of marijuana. In 2020 demand for recreational marijuana was substantially below projections while supply was substantially greater than projected. A resultant excess mountain of marijuana has been created and the price of marijuana has plummeted below the cost of production (Financial Times, 2020),

² The project was predicated on the ratification of new legislation in Malawi to legalise industrial hemp cultivation. Unfortunately disputed election results have resulted in political instability in Malawi and the legislation has not been ratified making the project not feasible as a joint country initiative. The research is thus applied to South Africa.

³ Currently hemp seed is not allowed for human consumption in Europe or Australia but in both regulations are being changed to allow its consumption. Australia is planning to establish a domestic hemp seed industry but whether this will be sufficient to meet local demand is unknown at this time.

and jobs in the agro-processing sector and agronomy support sector; opportunities for black large-scale farmers and an anchor on which to support small growers and businesses in the future.

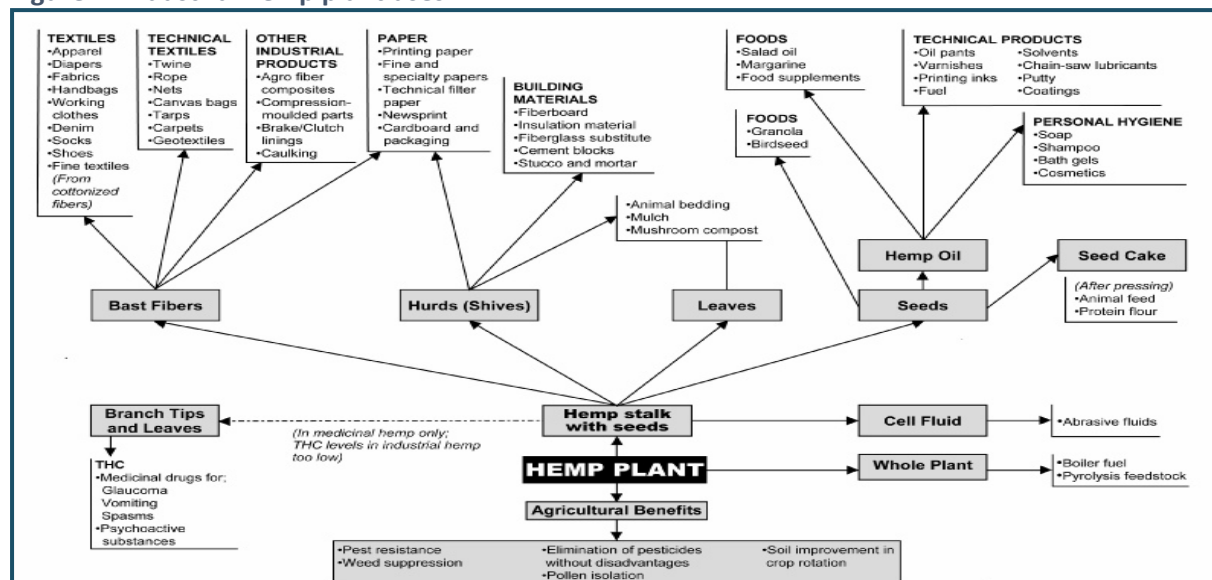
Industrial hemp

Industrial hemp and marijuana are genetically and chemically distinct forms of the Cannabis Sativa plant. Plants are covered in tiny hairs called trichomes which secrete a resin containing chemical compounds known as cannabinoids.

There are two kinds of cannabinoids. THC (tetrahydrocannabinol) is a psychoactive chemical and is responsible for the narcotic “high” experienced when consuming marijuana. CBD (cannabidiol) is a non-psychoactive cannabinoid and has no narcotic properties and cannot produce any form of “drug high”. The key differentiator between industrial hemp and marijuana (legally and chemically) is that industrial hemp has very low levels of THC. It is generally accepted that plants with less than 0.3% THC do not have narcotic properties and can therefore be grown commercially in countries that allow hemp cultivation. More specifically, in terms of legislation Canada, the US, South Africa and most non-European Union (EU) countries define industrial hemp as any cultivar of Cannabis Sativa with a THC level below 0.3%. In the EU, industrial hemp must have a THC level of not greater than 0.2%⁴.

The industrial hemp plant is a fast growing, annual herbaceous plant with a deep tap root. It can grow up to 5m depending on cultivar and growing conditions. The plant has a slender main stem and when grown at commercial densities the stems are almost unbranched. The stem comprises two parts: the bark or bast which contains the long fibres used in textiles (about 1/3 of the stem) and the woody inner portion of the stem known as the hurd. The hurd has much shorter fibres than the bast and accounts for approximately 2/3rds of the stem. At the end of the growing cycle the plant forms seed heads which contain seeds, seed oils and the cannabinoid CBD. Different cultivars have different characteristics in terms of hurd, bast and seed properties; and different planting densities are adopted to encourage desired characteristics. As such the end use of a hemp crop needs to be determined before sowing.

Figure 1: Industrial hemp plant uses



Source: Cornell Cooperative Extension of Tompkins County. From seed to market. <http://ccetompkins.org/>.

Industrial hemp has multiple uses based on which portion of the plant is utilised. Different uses require different seed varieties, growing conditions, planting conditions, plant densities and

⁴ As the project foresees the EU as an important future export market, locally cultivated industrial hemp should contain no more than 0.2% THC.

harvesting. As such, industrial hemp is usually grown as a mono crop with a primary market in mind. Secondary income streams related to residual plant material can be enjoyed. For example if a crop is grown primarily for seed for human consumption, the stalks and leaves available after the seeds have been harvested can be processed and sold as animal bedding or mulch⁵.

There are four key categories of uses of industrial hemp: i) a green substitute for various industrial products; ii) a food for human consumption; iii) an input (oil extracted from seeds) to personal care and cosmetic products; and iv) therapeutic products.

Climate change proponents and environmentalists emphasise the potential of industrial hemp bast fibres and hurds to provide green, sustainable and renewable alternatives to traditional building materials, paper products, textiles and industrial products such as plastics. For example, motor vehicle dashboards can be made from hemp based bio-composite products instead of fossil fuel based injection moulded plastic; hemp based fabrics can be substituted for synthetic fibres and use 70% less water than cotton; and hemp can be used to produce insulation material which does not involve fibreglass or asbestos. Industrial hemp is strongly positioned to be a green substitute for multiple industrial products; however, current market demand and price differentials are insufficient to make such products commercially viable at scale.

Industrial hemp seeds have fundamentally different applications and uses than bast fibres and hurds. Seeds can be used as a food for human consumption or the oil from the seeds can be extracted and used in the production of personal care products or for therapeutic preparations. These three uses collectively account for 64% of current industrial hemp product sales in the US retail market⁶ (Johnson 2018).

As food industrial hemp seeds offers the second highest source of protein in the plant kingdom (soybeans are 7% richer). They contain eight essential amino acids, high levels of omega-3 and polyunsaturated fats. This chemical composition provides the seed's nutritional and health credentials and its acceptance as the wellness and health market's latest super food. Raw (and sometimes roasted) seeds are predominantly sold de-hulled as a standalone product in health food stores. Seeds are also increasingly demanded as part of cereals, mueslis and other processed snacks manufactured for the wellness and health market. Industrial hemp seed is legal for human consumption in the US and Canada (the largest current markets) but not in Australia and Europe where it is currently used only as bird seed. In both the EU and Australia, legislative changes to allow human consumption are in progress (EIHA 2018) in line with new health findings and trends. Hemp seed for human consumption should be legalised in the EU and Australia by 2021. Trade volumes in industrial hemp seed for human consumption have been increasing consistently over the past 10 years with prices also rising substantially as demand outstrips supply (Johnson 2018).

The fatty acids which contribute to hemp seeds being a super food also play a role in the suitability of the seed oil as a natural and sustainable input into a range of personal care and cosmetic products. Hemp seeds fatty acids are high in linoleic and alpha linoleic acid, both of which are crucial to skin care. This combined with a shift towards sustainable, natural and environmentally conscious personal care products in developed countries has resulted in hemp oil based shampoos, soaps, bath gels, lip balms, body lotions, massage oil and colour cosmetics gaining market share in developed countries. Personal care products account for 24% of total industrial hemp retail product sales in the US (Johnson 2018).

⁵ The residual would not, however, be suitable for use in the textile or biocomposite industry as the plant was not bred and grown to produce long bast fibers.

⁶ The US is currently the largest consumption market for industrial hemp products other than hemp for textile use.

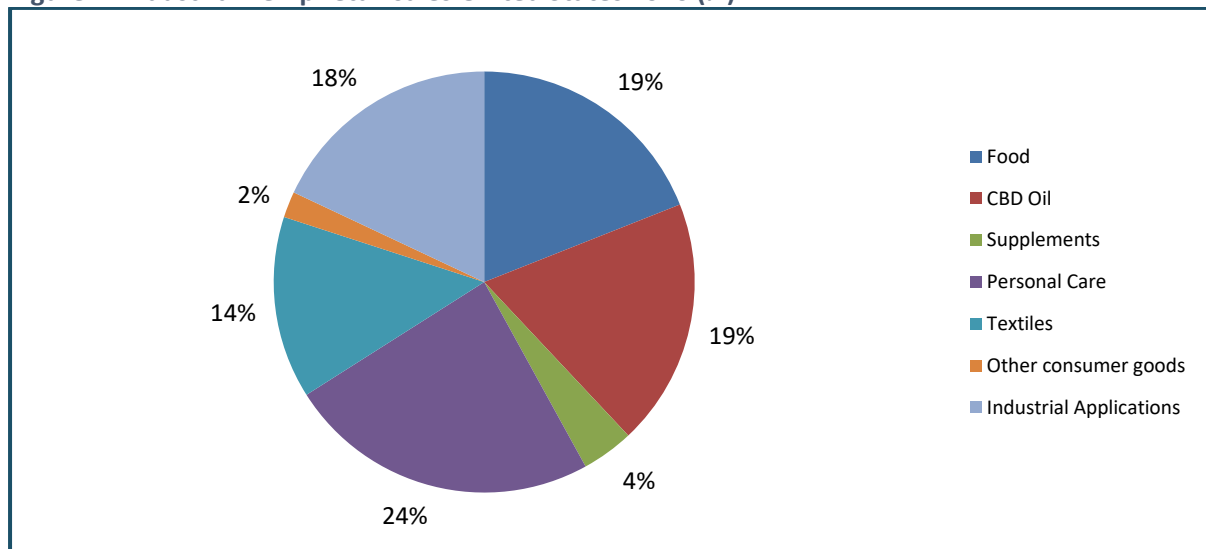
Once the oil has been extracted from the seed for use in the personal care market the residual matter is known as oilseed cake. Because of its high residual protein content and amino and polyunsaturated fatty acids, oilseed cake makes an especially good animal feed and existing research shows that cows, sheep, fish and egg laying chickens all thrive on the product.

The final use of the hemp plant is as an input for therapeutic products. A key perceived demand for industrial hemp is argued to derive from the massive global demand for CBD oil (which is extracted from the trichomes covering the flowers, leaves and stalks of the industrial hemp plant). This use is characterised as the medicinal or therapeutic use of the plant. CBD oil is claimed to be a “wonder” natural medicine/therapy with strong anti-inflammatory, anti-seizure and anti-nausea properties. In addition it is claimed that the oil is able to lower blood pressure and cholesterol, strengthen the immune system and work as a sleep aid. Unfortunately, the industrial hemp plant contains about 3% CBD while a marijuana plant contains 18% to 20% CBD. This means it is commercially more viable to produce CBD oil from a marijuana plant than an industrial hemp plant. Other limitations to the potential of this opportunity include the existence of cheap synthetic CBD oils which compete positively with plant based CBD oil on consistency and price; and a massive global oversupply of CBD oil which has seen international prices plummet⁷.

Markets and prices

The US market is the most developed industrial hemp market currently. The personal care market is particularly strong in the United States due to consumer demand for natural products and chemical free cosmetics. The use of industrial hemp as a super food and medicinal product is also strong. Industrial application demand lags behind consumer consumption uses at present but with R&D and increased climate change pressure for substitute products, applications and demand are expected to increase in the long term.

Figure 2: Industrial hemp retail sales United States 2016 (%)



Source: Hemp Industries Association, <https://www.thehia.org>

The US, besides being the largest retail market in the world, also accounts for 60% of global trade in industrial hemp products. Imports of seed for human consumption comprises the largest category of imports by some margin.

⁷ Market conditions are different for medical grade CBD oil, but such product is based on genetically and chemically fingerprinted plants cultivated in strictly controlled indoor greenhouses. Medical grade CBD oil is also sourced from marijuana plants not hemp plants.

Table 1: US Imports of industrial hemp (US\$ '000)

	2013	2014	2015	2016	2017
Seeds	26 942	29 326	54 191	51 018	42 897
Oils	2 264	3 446	4 836	6 142	7 603
Oil Cake	6279	8 159	16 281	8 620	11 494
Fibres	78	114	292	690	780
Yarn	482	909	1 497	1 867	2 739
Woven fabrics	1 057	900	1 020	744	1 819
Total	37 102	42 854	78 117	69 081	67 322

Source: Hemp Industries Association, <https://www.thehia.org>

The market in the EU is somewhat different and less sophisticated. Market volumes and values are not available but usage of tonnes of industrial hemp cultivated are available as are their downstream uses. In Europe, in 2016, 85 000 tonnes of industrial hemp was harvested comprising 25 000 tonnes of fibres, 43000 tonnes of hurd (woody inner portion of the stem), 11 5000 tonnes of seeds and 240 tonnes of leaves and flowers.

With regard to industrial hemp seeds harvested: 44% was used in animal feed, 43% for human consumption in various foods, only 0.3% was used to extract oils for cosmetic and personal care products and 13% was used to extract oil for human consumption (food application not CBD). Only 240 tonnes of the 85 000 tonne crop in Europe was used for medicinal and therapeutic applications. This accounts for only 0.003% of usage compared to 23% in the US.

That the uses of industrial hemp are so different in the US and Europe creates the widest possible array of potential market opportunities for any country thinking of pursuing commercial scale cultivation of industrial hemp as an input or intermediate product in the global market.

Despite industrial hemp cultivation being legal in up to 30 countries, at present there are less than half a dozen dominant producers globally. Data are a problem but it appears that China is the dominant global supplier of industrial hemp producing roughly 70% of global output. China's production at present is focused on fibre production only. Canada is said to be the second largest producer at roughly 15% of the global market; however, it produces only for seed for human consumption. EU countries account for the majority of the remaining share of global production with France being the single largest EU producer at around 9% of global production. France produces industrial hemp almost exclusively for the paper industry and more specifically paper to be used in cigarette production.

Crucial to any industrial hemp project is a view on commercial viability along the value chain. As expected with any agricultural crop or feed stock, market prices increase as value is added down the value chain. Different price levels are shown for South Africa, the US and Australia.

Table 2: Relative prices for downstream hemp products in South Africa Rand/kg (2015)

PRODUCT	PRICE
Stalk fibre	9.00
Stalk hurd	6.00
Oil	100.00
Seedcake	50.00
Dehulled seeds	115.00

Source: Coogan (2016)

Table 3: Relative Prices for downstream hemp products in the US US\$/kg (2003-2013)

PRODUCT	2003	2009	2013
Hemp Seeds		5.47	9.08
Hemp Oil	6.36	8.14	5.03
Seed cake		9.01	10.45
Fibres and waste	0.87	1.36	1.08
Yarns	7.02	7.47	6.89
Woven fabric	1.65	3.4	4.72

Source: Fortenbery (2014)

Table 4: Relative prices for upstream and downstream hemp products in Australia US\$/ton (1995)

PRODUCT	PRICE
Raw Stalks	55.00
Dry Stems	125.00
Raw fibres	647.00
Dry Fibres	800.00
Bast fibres	630.00
Hurds	55.00
Dry hurds	40.00
Seeds	1200.00
Organic Seeds	1680.00

Source: Crawford et al. (2012)

The tables show a high level of variation in absolute values for different products but are consistent in relative values for different downstream uses. In terms of primary processing, hurd (the woody core of the plant used predominantly for animal bedding) is the least valuable processed output. This is followed by fibres and oil. Seed command the highest price. In South Africa there is little value attributed to the less beneficiated products of the industrial hemp value chain. Prices for fibre, hurd and even seedcake as an alternative source of protein for animal feed suggest low market knowledge, acceptance and interest compared to higher value added uses. Hemp oil (used for human food consumption and as an input to cosmetics and personal care products) and shelled seeds are relatively equal in value and demonstrate that there is market knowledge and interest in the health and wellness aspects attributed to industrial hemp⁸.

Planting, growing and harvesting

Industrial hemp is grown by seed with virtually every regulatory body responsible for licensing insisting on the use of certified seeds bought annually. This is to ensure low THC and plant characteristics are maintained over time. Seeds are developed through breeding programmes to meet specific characteristics needed for the dominant use of the plant. In South Africa, this service is provided by the ARC unit for Industrial Crops. Seeds are usually planted between September and November on beds prepared in a manner similar to other row crops. Soil with a pH of 6 to 7.5 is recommended and the soil should offer good water retention properties with sandy loam and clay loam being the two preferred soil types. If sowing for commercial purposes, it is suggested that potassium, nitrogen and phosphorus be added before seeds are planted, although this is contested by some agronomists who argue additional nutrients are not in fact required. Germination occurs within three to five days of planting, and it is recommended that at this stage if there is no rainfall, the crop be watered at a rate of 3ml to 6ml per hectare. Optimum growth temperatures are 15 to 27 degrees Celsius. The crop will grow rapidly for three to four months, creating branches and leaves in its vegetative phase of growth before forming seed heads as the length of the day begins to decrease.

⁸ Although a dynamic market in South Africa is a bonus, the project is focused on meeting international demand for the primary crop. Secondary market revenue from plant residuals after seed has been harvested will improve the return on investment for the project.

Planting density differs fundamentally depending on the end use of the plant and the variety. Different densities impact the diameter of the stem, the fibre length, fibre content, fibre yield, number and density of branches and hence seed heads and quantity of seeds and oil content. Essentially, closely planted crops will produce long, tall plants with a few side branches, which are preferred for fibre production. Plants cultivated for seeds will be planted less densely so that more side branches develop as this is where flowers and hence seeds are produced. As such, plants cultivated for seed and oil will be shorter squatter plants with a fuller vegetative pattern. Amaducci et al. (2015) recommend that when growing for fibre for textile use, a density of 150 to 200 plants per square meter be sown; for non-textile fibre at 250 to 350 a square meter; for paper and pulp at 90 a square meter; for essential oil at 15 a square meter and 12 square meter for seed. These fundamentally different densities suggest that different scales of farming and different yields and commercial feasibility will differ depending on the end use of the crop.

Different end uses also respond differently to variable input conditions. For example, higher temperatures and lower rainfall conditions will accelerate flower development and seed production but will delay vegetative plant growth and fibre maturation⁹. Additional fertilisers are found to improve yields when grown for seed but not when grown for fibre.

The method and timing of harvesting are also impacted by the envisaged end use of the plant. When harvesting for fibre the whole plant needs to be harvested. This is traditionally done by hand in developing countries and using modified combine harvesters in developed countries. If the plant is being grown for seed or oil, harvesting is a bit of an art. Seeds are formed in flower heads. Seed maturation starts at the bottom of the flower and moves upwards so that a flower will have mature seeds at the bottom while still having green seeds at the top. Once the seed is mature the nut soon comes loose from its shell, called shattering. During shattering the useful part of the seed falls to the ground and is lost in terms of yield. As such, timing when to harvest is crucial for seed. The optimal window for seed harvest is when only 70% of the seed is ripe and seed moisture is at 20% to 30%. Delaying harvesting may increase yield but quality will decrease as the seeds dry out further. Harvesting for seed and oil only requires the harvesting of flowers and not the whole plant. Handpicking is the best option to ensure quality and reduce seed damage but is labour intensive.

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⁹ This strengthens the case to be made for South African growers to concentrate on seed production.