A Co-operative Program Between

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PAMI
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Research Update **740**

Is there Value in that Caragana Shelterbelt on *Your* Farm?

There are thousands of miles of mature caragana shelterbelts on Prairie farms. Are they worth anything?

Saskatchewan farms alone have an estimated 25,000 miles of mature caragana shelterbelt . Add Manitoba and Alberta into the equation, and you've got thousands more miles of the hardy shrub-like plant.

During the 1930's, the Prairie Farm Rehabilitation Administration (PFRA) worked extensively with farmers on the Prairies to establish caragana shelterbelts as a method of combating wind erosion. The plant—a native of Asia and Eastern Europe— took hold and thrived in the rigorous Western Canadian climate.

But many of these shelterbelts are ageing and beginning to die. They've become woody, and are beginning to gobble up valuable adjacent farmland as they grow.

Producers can easily rejuvenate caragana shelterbelts by shearing off the stalks at ground level. The plant will regrow quickly from the root system and again provide protection from the wind in a very short time. In the process, producers regain valuable farmland and produce a new, healthy shelterbelt.

But are there value-added uses for the harvested caragana? Can caragana shelterbelts with as much as 95 tons per mile (52t/km) of biomass (woody material) be put to other uses?

PAMI, with support from PFRA, set out to take a look at the market potential for harvested caragana, and in the process answer these questions.

At A Glance

Many potential markets for caragana were considered. In order to have a chance to become competitive in many of the markets examined, a low cost, high volume method of harvesting caragana needs to be developed. We gave each one a Profitability Potential rating. Here are the highlights:

☑ ***Commercial Animal Bedding:*** *There appears to be potential for caragana as bedding litter for pets.*

☑ ***Phytochemicals:*** *Caragana contains some natural elements that could be marketable in the pharmaceutical, neutraceutical and aromatic product markets.*

☒ ***Commercial Firewood:*** *Caragana as firewood would likely have to be retailed at a price lower than most products currently on the market due to its size and visual appearance—profitability in the firewood market would be marginal.*

☒ ***Commercial Residential/Industrial Fuel:*** *The high percentage of bark in caragana wood also limits its potential in markets such as wood pellets for residential and industrial use.*

☒ ***Commercial Landscaping:*** *More processing is required to convert caragana into a more visually appealing product.*

☒ ***Pulpwood/Engineered Wood:*** *Caragana as pulpwood and engineered wood can't compete simply because it doesn't have the necessary physical properties and is too costly to process for this purpose.*

☒ ***Ethanol and Co-products:*** *Supplies of caragana are not extensive enough and competition from other cellulose-based products such as wood wastes and crop residue is stiff.*

☑ ***Good Potential, but more research is required in some cases.***

☒ ***Weak Potential, mainly due to less costly, competing materials or products.***

Commercial Animal Bedding

Profitability Potential: ☑

At the moment, caragana chips cannot compete economically with straw and wood by-products as bedding for livestock, but there is potential for pet bedding in the small package market.

Straw is generally the material of choice for livestock bedding because of its availability and price and the qualities that make it more desirable than wood chips. It offers better absorption, odour control and it can be returned to the land as a value-added product. Wood products such as wood shavings, bark peelings and waste wood chips are often available from industrial sources for the cost of transportation.

Supplying a bedding product for the pet industry appears to offer more promise, particularly to high volume users such as kennel operators. Material for pet bedding can be compressed into packages or bales to lower the cost of transportation.

Competition in the pet bedding market includes wood industry shavings, some pelleted products and some clay products. Cedar and pine shavings are popular for lining individual cages of small animals because they control odour, kill disease and provide an appealing aroma. At the moment, there are no wood products sold into the cat litter market.

High volume users tend to focus on price, rather than factors such as aroma and appearance. The key success factor in this market would be to provide a low-cost product with characteristics comparable or superior to existing wood products.

Consumers requiring small quantities of pet bedding are more interested in aroma, appearance and odour suppression than cost.

Current prices for pet bedding and litter range from $300 to $3,700 per tonne, depending on the product and the packaging. Since pelleted products can be produced for about $120/t, there appears to be a significant potential in this market.

The small-package, pet bedding market holds promise for harvested and processed caragana.

This market should be investigated further. In the high volume market, a low-cost product with comparable or superior qualities to existing products would need to be developed. For the "small package" market, a clean product that looks and smells appealing is required. Identification of a characteristic that sets it aside from other products could provide it with a marketing advantage.

However, more technical information is required to determine whether caragana can be processed into a desirable bedding and litter product. In addition, information on current production costs, product pricing and market demand is essential.

The Costs

The value of the caragana material in its various raw forms such as firewood, wood chips and wood pellets was determined based on two harvesting scenarios - 25 metric tonnes (t) per day and 100 t/day.

Components making up the total cost include logging, transportation to market and any processing required to convert the caragana to an end product. In all cases, it was assumed that the landowner would be willing to pay the processor $12/t to cut and remove the caragana as the farmer will obtain the benefits of increased field size and more effective shelterbelts. This is roughly equal to the cost of a logging operation for a 25 t/day production rate.

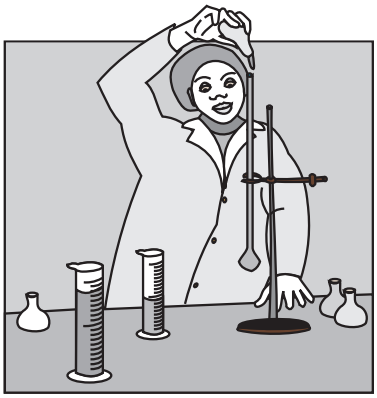
Raw Material Costs

Product	Production Rate in metric tonnes (t/day)	Cost per (t) in dollars
Firewood	25	$30.60
Wood Chips (not debarked)	25	34.60
Wood Chips (not debarked)	100	20.85
Wood Chips (debarked)	100	25.75
Wood Chips - Texas* (not debarked)	100+	33.90
Wood Pellets	25	110.40
Wood Pellets	100	115.85

** A specialized harvester is under development at Texas A & M University that may be suitable for harvesting caragana at a high production rate.*

Phytochemical Applications

Profitability Potential: ☑



Significant potential may exist in the fractionation of caragana into its constituent chemical components for sale into the pharmaceutical, neutraceutical, aromatic or industrial markets.

Existing information suggests that caragana contains a significant level of a group of chemicals called flavonoids. Flavonoids are common in many foods and are an integral part of the human diet.

Flavonoids such as rutin and quercetin have been tested on animals and are claimed to have the ability to block the carcinogenic process. Quercetin has the ability to lower cholesterol and appears to be effective in preventing nutritional muscular dystrophy. Rutin and quercetin both have the ability to suppress tumour development. Rutin can reduce the incidents of hemorrhaging.

Rutin currently retails at prices from $780 to $990 per kilogram. Quercetin retails from $770 to $1630 per kilogram. While this appears to be a lucrative market, more analysis is needed to determine the potential yield and ease of extraction of flavonoids from caragana.

Aromatic oils from sources such as eucalyptus, lavender and rose currently retail at about $500 to $1,400 per litre. The value of the raw product is highly dependent on the yield. Caragana emits an attractive, sweet smell to lure bees to its flowers. It may be possible to extract the oils creating this aroma for sale into the aromatics market. More information is required to determine the potential for caragana in the aromatic oil market.

Caragana to Burn

Commercial Firewood

Profitability Potential: ☒

To determine whether caragana can compete as a firewood, we must first look at the firewood marketplace and the caragana competitors.

There is a significant demand for quality firewood in major urban centres, and the market is divided into two segments—prepackaged bundles and bulk.

Prepackaged bundles containing approximately one cubic foot of wood are available at service stations, convenience stores, building products stores and similar outlets. The price per bundle can range from $4.00 to $5.00, and when extrapolated can reach the equivalent of $500 to $600/cord, or up to $400/t. But in volumetric terms, this is a relatively small market dominated by higher quality woods such as birch and poplar.

By far the largest portion of firewood sold into the urban market is delivered in bulk directly to the consumer in volumes measured in cords or portions of a cord. A cord of firewood is approximately equal to two dry metric tonnes (2t). Market price for bulk firewood ranges from $60 to $200 per cord ($30 to $100/t) depending on the product. Cut and split birch gets the highest price.

While caragana wood burns well, it has a couple of drawbacks that limit its appeal. Because of its small size, it burns quickly so the fire must be tended frequently. The faster burning rate also consumes more wood. Secondly, the visual appeal of caragana is less desirable than traditional firewood, a factor that the average consumer considers important.

Because of these limitations, the retail price for caragana would likely be at the low end of the current price range for firewood. At a break-even cost of $31/t, assuming a minimal transportation distance, caragana firewood can not likely compete successfully in an urban market.

While parks and campgrounds consume large amounts of firewood each year, much of it is obtained from within the parks themselves by removal of deadwood, managed cutting and so on. When parks do purchase firewood, the price paid is generally only in the $25/t range—well below the production cost of caragana firewood.

The popularity and low cost fuel for outdoor wood (or in this case round straw bale) fired boilers creates some tough competition for caragana as firewood.

The major limitation to using caragana for pelleting is the high percentage of bark in the wood chip.

Commercial Residential Fuel

Profitability Potential: ☒

Another potential residential use is the conversion of caragana into wood chips and pellets for solid fuel heating systems. While these systems can use cut and split firewood, chips and pellets are becoming the fuel of choice because of ease of handling. Wood chips and pellets also burn more efficiently and produce less ash.

These systems can be fed manually or automatically. Chips are more likely than pellets to cause problems with plugging of automatic feeding systems. It's also more costly to transport wood chips because of their low density.

To produce wood pellets, chips are dried, ground into sawdust and reconstituted into uniform pellets. For a mass market, wood pellets are preferred because they are easier to handle and store and allow for better heat control. Transportation costs for higher density pellets are about one-third to one-half that of chips.

The major limitation to using caragana for pelleting is the high percentage of bark in the wood chip. High bark content results in a less fuel efficient, looser and lighter wood pellet that is less visually appealing to the consumer.

At a break-even price of $72/t, caragana chips may be able to compete with natural gas provided that the heating system efficiency is comparable, and the transportation distance is limited. At the moment, the maximum achievable heating system efficiency with caragana is unknown. Given its non-uniform chip size and high bark content, it is unlikely to be as high as other wood pellet products.

Since pellets require significant processing, the break-even cost for caragana pelleted products is in excess of $100/t, including the cost of harvesting. Other raw wood products such as waste wood from industrial operations, fire-killed wood and other wood products are available to processors at a considerably lower price than harvested caragana.

A simple, low-cost method of harvesting and an effective, inexpensive method of bark removal is needed to allow caragana to compete in this market. Further research on the efficiency of a caragana-fuelled heating system is also required.

However, niche markets may exist for both caragana chips and pellets. Chips and pellets may be used in small wood-burning stoves and heaters as supplementary heaters, or in heated garages and workshops. In a rural setting, groups of farmers may find it economical to share in the cost of harvesting and chipping caragana wood for use as heating fuel on their farms.

Commercial Industrial Fuel

Profitability Potential: ☒

At the moment, hydroelectric energy is the most cost-effective form of electrical supply, followed by extending the life of existing coal plants and gas cogeneration. The use of biomass fuels for energy production is well down the list of fuel supply options when ranked for efficiency.

Cogeneration is the production of two sources of energy from a single source of fuel. For example, in electricity generation, only about 30 to 40 per cent of the fuel energy is transformed into electricity while as much as 55 per cent is lost as waste heat. Cogeneration involves capturing this lost energy and converting it into a second use, such as for process heat or in other cases, for producing steam for energy generation, with the turbine exhaust steam being put to other uses.

The biomass operations examined were not using cogeneration technology to recover waste heat. Presumably, a cogeneration biomass plant would be more cost-effective and therefore more competitive.

Even if cogeneration technology can be applied in a biomass fuelled operation, caragana faces strong competition from a number of other biomass fuels such as industrial wood waste, logging residues, fire-killed wood residues and crop residues. Currently, the estimated break-even cost for these other biomass fuels is $18/ODt (oven dry tonne). The estimated

production cost for caragana chips is $72/t.

Caragana chips would likely need additional processing to remove most of the bark and to dry it down. Also, the amount of caragana currently available on a sustainable basis is only enough to fuel a relatively small electric generating plant.

Further analysis is required to determine whether biomass cogeneration is feasible, and if such a technology would be able to compete with natural gas cogeneration.

Secondly, a potential supplier of caragana would have to focus on high volume production to reduce production costs, guarantee a sustainable supply and keep transportation costs to a minimum in order to become cost-competitive.

From the Landscape to Landscaping

Profitability Potential: ✗

The landscaping market can be divided into two segments—bulk and packaged material. In both instances, consumers have the option of purchasing wood mulch or rock materials.

The best quality wood mulches contain high amounts of lignin which slows the rate of decay of the material. Rapid decomposition draws nitrogen from the soil and can stunt plant growth. In this respect, caragana is very suitable for mulch because it has a higher lignin content—and a lower carbon to nitrogen ratio than many wood products presently on the market. However, caragana has other hurdles to overcome before it will be widely accepted as a landscaping product.

Cost and appearance are the most important factors to consumers when purchasing wood mulch.

For bulk wood mulch materials, waste wood products such as post peelings and pine tree bark are available at little or no cost to suppliers of landscaping materials. The cost of providing caragana to the industry would in all likelihood exceed the cost of obtaining wood wastes.

Packaged landscape products include cedar chips and various rock aggregates. Several suppliers have expressed the opinion that caragana does not have characteristics that will allow it to stand out. Because of its lower visual appeal, caragana would have to be sold at a lower price than other products. One supplier speculated that a $5/bag ($130/t) might be fair. (Cedar currently sells for about $7/bag).

Caragana Arborescens: ***The main species of caragana grown in Canada, and the focus of this report. Caragana is a member of the Leguminosae (legume) family.***

For caragana to become competitive, it would have to be processed into a more visually appealing product. At $130/t, caragana could undergo significant processing. Its desirable low carbon to nitrogen ratio could be aggressively promoted as a marketing feature. The product's impact on the surrounding environment would also have to be assessed.

Paper, Particle Board and Petroleum

Caragana for Pulpwood

Profitability Potential: ✗

Caragana fibres are considered too short for paper pulp. In addition, the small size of most caragana branches makes effective debarking a difficult task.

World supplies of fibre for pulp production would have to become very short in order for caragana to be considered suitable for pulp production.

Caragana's competitors for fibre materials include the traditional wood based commodities, as well as the more recently popular wheat straw. The abundant supply of wheat straw on the Prairies has led to the construction of the ISOBORD strawboard manufacturing plant at Elie, Manitoba.

Engineered Wood

Profitability Potential: ☒

Examples of engineered wood are particle board, plywood and oriented strand board.

Particle board is made from sawdust or other small, ground-up wood particles pressed together with a binding agent. Particle board is used largely in furniture and cabinet making. Any coloured material in the wood is not acceptable since it may bleed into any surface finishes applied to the board. The dark green bark on caragana would have to be removed from the wood before it could be used for particle board.

Competing materials such as sawdust and other wood wastes from sawmills and industrial operations currently provide a cheap, reliable supply of material for making particle board. Plants for manufacturing engineered wood from straw are being established across the Prairies, where straw is abundant and inexpensive.

Plywood is made by peeling wood layers from whole logs. With an ever-decreasing supply of timber suitable for this purpose, new products such as oriented strand board (OSB) have been developed that can make use of lower quality timber.

Most OSB is manufactured from aspen or poplar. Plantations of poplar are being planted for the purpose of supplying this industry in the future.

Caragana stems are generally too small to produce the proper-sized wood strips and chips used in the manufacture of OSB. Sorting caragana logs of adequate size from the remainder of the branches is not cost effective, nor would it provide a large enough supply to make the effort viable.

It's unlikely that caragana could compete in the engineered wood market.

Ethanol and Co-products

Profitability Potential: ☒

Currently, the projected cost of converting cellulose materials such as caragana to ethanol is estimated to be about $0.44/litre. The cost of producing ethanol from grain ranges from $0.30 to $0.44/litre. The grain by-product of grain ethanol production is channelled into a secondary use such as livestock feed, further increasing its advantage.

Even if changes in the market took place to increase the attractiveness of wood products for ethanol production—such a dramatic increase in grain prices—supplies of caragana are not extensive enough and competition from other cellulose-based products such as wood wastes and crop residue would be stiff.

Identification of a high-value co-product of ethanol production would have to occur before caragana would be a feasible feedstock.

Need More Detail?

A detailed PAMI technical report (RH0994) on this topic is available. The 88 page report, entitled *Preliminary Market Assessment - Market Potential for Caragana*, is available for a reproduction and shipping and handling charge.

Acknowledgements

Funding for this project was provided by the Prairie Farm Rehabilitation Administration (PFRA).

Caragana Facts:

• Native to Siberia from Russia through to Northern China.

• Planted extensively throughout the Canadian Prairies for shelterbelt and ornamental purposes—known for its hardiness.

• Can reach a height of 10 to 15 feet (3 to 5 m) at maturity.

• Branches tend to spread with age, and can reach a width of 10 feet or more.

• It can grow up to 18 inches (45 cm) per year until maturity, and has a life-span of about 50 years.

• The plant produces bright yellow flowers in early summer, followed by pod formation. Pods ripen and crack open, spreading seeds nearby.

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