Realizing Composting Opportunities in the Western Canadian Hog Industry

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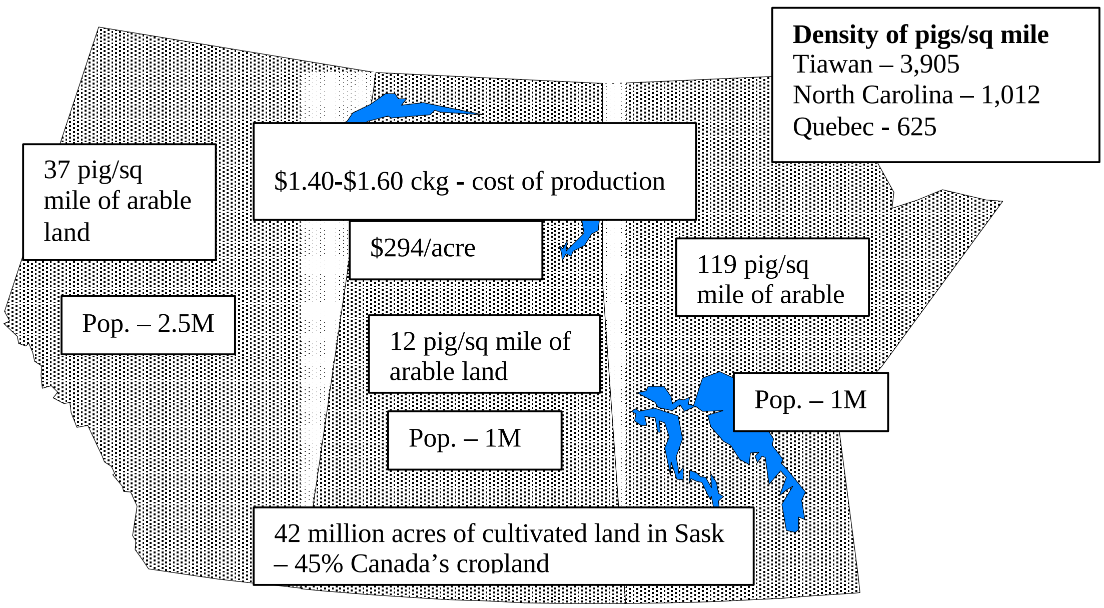
A Snapshot of the Western Canadian Pork Industry

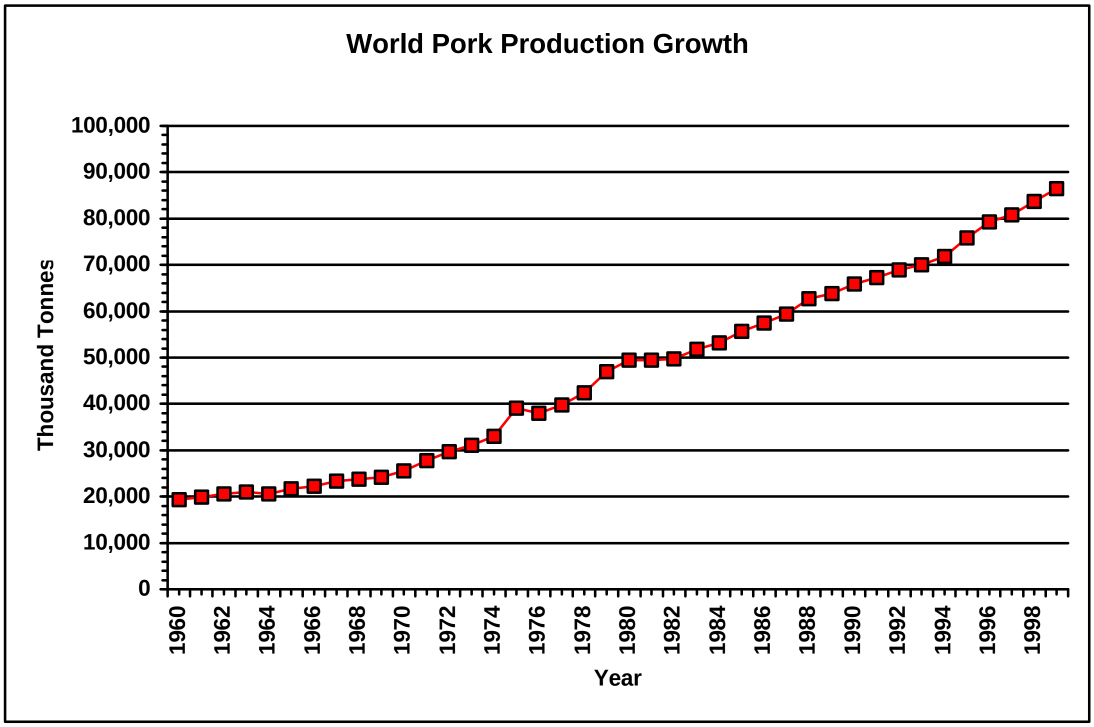
The prairie provinces of Western Canada are blessed with large amounts of space and relatively low populations. Although the agricultural culture varies province to province generalizations are commonly accepted – Alberta beef, Saskatchewan wheat and Manitoba pork. The removal of the Crow Rate in 1995 has forced farmers within the prairies to look at their production options and how best to use their grains at home. Livestock production utilizes feed grains produced locally, diversifies the agricultural base, and provides employment opportunities. Like all agricultural commodities, livestock prices fluctuate cyclically. Short-term price downturns are not uncommon and those producers that now make up the industry continue to see the advantages of producing pork in the prairies.



Globally, the outlook remains strong with the expectation that meat consumption, particularly pork, will continue to increase.

Pork Consumption/Capita/Year		
	1992	1996
Japan	15.4 kgs	18.8 kgs
China	22.9	27.0
Asia	10.3	11.8
World	13.0	13.7

Source: Pork Central: Saskatchewan Agriculture and Food, 1999

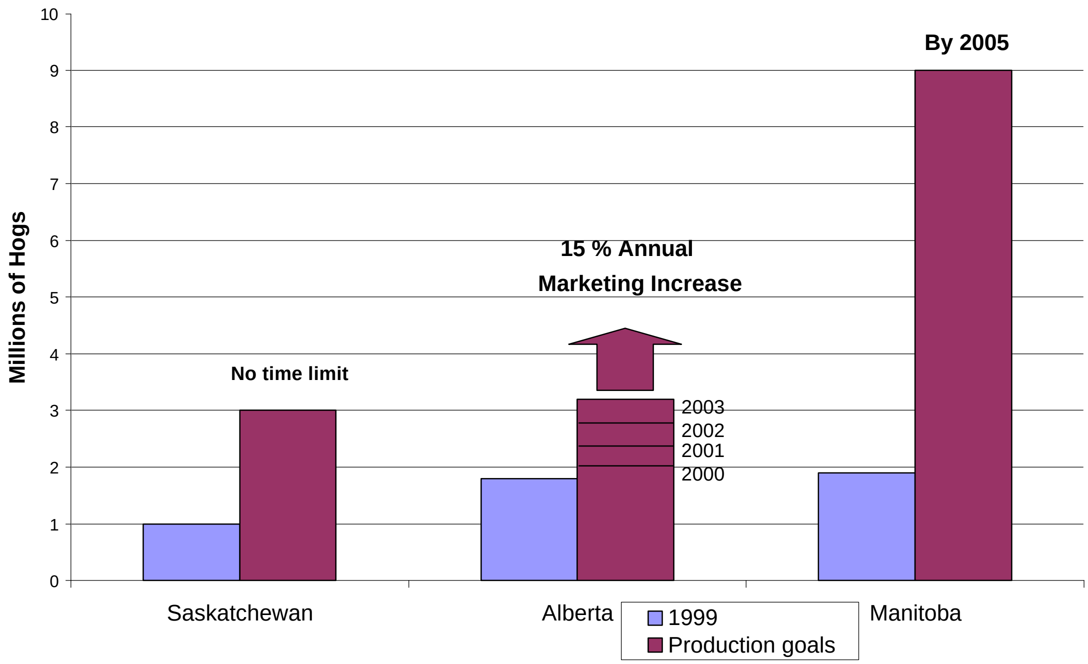


Source: Pork Central: Saskatchewan Agriculture and Food, 1999

The Western Canadian pork industry in is well positioned to increase pork production as some of the larger pork producing countries face critical challenges. Changing legislation in Europe that limits the application of excess nutrients will stabilize, or in some cases, reduce production in many European countries. Production experienced some major setbacks in Asia following outbreaks of hoof and mouth in Taiwian and is not expected to rebound in the near future. As pork production increases in Western Canada, producers may follow the example of the United States where production chains are more vertically aligned; integrating producers, feed companies, and processors. These strategic alliances may result in a stronger industry by removing some of the risk for the primary producer.

In addition to global forces, pork production in the prairies is considered a viable long term option due to expansive areas of relatively inexpensive cultivated land, much of which is semi-arid, affordable feed grains and low populations; all of which contributes to a lower cost of production. Significant changes have taken place over the past twenty years in the pork industry. Hog production; although still sometimes a part of a mixed farming operation has taken on a new face. Large, capital intensive hog barns are becoming more common and this trend is likely to continue. These bio-secure hog production units produce thousands of pigs a cycle through the implementation of carefully developed breeding and nutrition programs.

Current and Projected Hog Production, Prairie Provinces



Source: Saskatchewan Agriculture and Food, Manitoba Agriculture, Alberta Agriculture, Food and Rural Development

Manure: Inevitable and Valuable

Livestock production (of all types) in the prairie region results in large amounts of organic nitrogen and phosphorus. Using 1998 fertilizer prices, prairie researchers estimated that the nutrient value of nitrogen from animal manure is approximately $164 million. Phosphorus value was estimated at $159 million (Larney, 1998).

The present industry is characterized by a variety of production units. Small units might have less than 30 sows to 500 feeder pigs. These units often use straw bedding, especially for the feeder pigs, which is removed with the manure and stockpiled. The stockpiled solid manure is usually spread in the fall and may or may not be incorporated.

Small sow farrow to finish units, generally with 30-150 sows, store manure in pits below slatted floors. The liquid manure is pumped to a tanker truck every 3-4 weeks and applied with a dribble bar all year round, it may or may not be incorporated.

Larger sow farrow to finish units with 150-400 sows, often have an earthen manure storages. Some operations of this size have above ground glass lined steel tanks, although these are still not as common as earthen structures. The capacity of these storages is generally 3-6 months; manure is injected in spring and fall.

Intensive operations are defined by the number of animals confined, the length of time the animals are confined, and the space allotted to those animals. Although intensive livestock operations in the prairies can broadly be classified as production units with more than 300-400 animal units, it must be noted that each province has their own definition which in turn triggers a set of regulations or guidelines. Three hundred animal units, as an example, translates into a 480 sow farrow to finish operation or 1500 finisher pigs. Intensive hog operations in the prairies are generally 600-2400 sow farrow to finish units, with 3 or 4 site production facilities. Some 5,000 sow farrow to finish units are being proposed that will also use a 4 site model. Liquid manure systems are generally the norm for large intensive operations that are characterized by engineered earthen manure storages (EMS) with 9 months to 400 days of storage (depending on provincial regulations). Manure is collected in shallow pits under partially slatted floors and flushed to the EMS on a regular basis. Accounting for wash water a 1200 sow farrow to finish facility or an 8800 finisher barn would require approximately 8M gallons of storage over 400 days (Johnson, pers. comm., 1999). Manure from the EMS is usually injected in spring or fall using a tanker truck with an injector unit or a flexible drag hose system behind a tractor.

A new development in the industry is the concept of contract finishing (1,000-12,000 animals) where the larger farrow to feeder unit supplies grower/finisher pigs (45-60lbs) to an individual to feed out to market weight. The low labour requirement (1 person per 1,000 head) at this stage of the production cycle allows one option for small operators to remain in the industry. The larger pigs are often housed in new or converted barns that have a liquid or solid manure handling system. Biotech shelters are also popular and they use straw or sawdust bedding. Manure is removed from these shelters when the manure pack gets too deep, then stockpiled and land applied in the spring or fall.

Variability in Manure

Unfortunately not all manure is created equal. Nutrient compositions vary greatly in both solid and liquid manure and are a function of livestock type, age, type of feed, composition of feed, rations, climate, the presence of bedding, manure storage and manure handling. Despite variability, manure contains both the macronutrients nitrogen, phosphorus, potassium required for crop production, as well as a host of secondary nutrients like sulfur, calcium, magnesium, copper, iron, zinc, manganese and boron. However, the concentrations of nutrient elements are very low per unit of volume or weight as compared to commercial fertilizers. The following table indicates the range of nutrient concentrations from liquid hog manure and provides a partial comparison to commercial fertilizer concentrations.

	Liquid Hog Manure	Commercial Fertilizer
Total N	14-40lbs/1,000gal	2,000lb/1,000 gal
Total P	1-20lbs/1,000gal	700lb/1,000 gal
Total K	10-30lbs/1,000gal	700lb/1,000 gal
Total S	0.1-3lbs/1,000 gal	600lb/1,000 gal
Total Cu	0.05-0.5lb/1,000 gal	
Total Mn	0.05-0.5lbs/1,000gal	
Total Zn	0.05-1 lb/1,000 gal	
Total Fe	0.2-1 lb/1,000gal	

(Adapted from Schoenau, 1997)

In addition to the variability, the relative amounts of nutrients do not necessarily exist in the desired proportions called for in fertilizer recommendations. The Nitrogen to phosphorus ratio, for instance, in liquid hog manure, is often 3:1. In order to meet a N:P requirement of 10:1 for crop production, applying for the nitrogen requirement will result in the application of more phosphorus than required in the fertilizer recommendation. Likewise, N:S ratios in manure may limit crop growth. Canola is an example. Liquid hog manure used in Saskatchewan field trials is generally 15:1 (Charles, 1998). In the case of canola, symptoms of sulfur deficiency are apparent when N:S ratios exceed 10:1. To have optimum N:S ratios of 7:1, manure applications may have to be supplemented with additions of sulfur.

Manure's value as a fertilizer increases when it is managed as a nutrient resource and soil amendment. In the case of liquid hog manure, annual testing is recommended to establish nutrient values and calculate application rates. The value of liquid swine manure is primarily related to its ability to provide large amounts of ammonium NH_4 (N) for crop production, up to 60-75% of total N in the first year of application (Schoenau, 1998). The remaining nitrogen is tied up in the solid portion of the manure. Approximately 20% of the total N will become available through mineralization of the solids during the growing season. Hog manure at only 2-5% solids has limited value as a soil amendment as it lack the bulk and carbon content of solid manures like cattle.

Hog manure for compost

In order to capture the solids from liquid hog manure, operators would have to retrofit the manure handling system to include some sort of separation unit. New or expanding operations could consider separators or a solid manure system.

Across the prairies there is only a handful of sow farrow to finish facilities that are separating solids from liquids. These operations utilize a variety of processes to remove the solids. One operation in Saskatchewan (1200 sow farrow to finish) has a four-cell storage system. The first cell acts as a primary settling basin for removal of the majority of the solids. The liquid fraction then flows from cell to cell and liquids from the fourth cell are removed diluted with well water and run through irrigation pivots. The solids are removed from the first cell throughout the summer months and run through a screw press to remove additional liquids. The producer using this system estimates that 250 tons of total solids are removed each summer (pers. comm., Wayne Vermette, 1999). Liquids from the separation process return to the fourth cell for irrigation. The solids are approximately 60% moisture and are composted with a carbon source over a period of months. Lab analysis in 1999 of the solids, following composting, are showing total N as 2.4lbs per tonne (pers. Comm. Wayne Vermette, 1999). This nutrient value is surprisingly low when compared to a nutrient analysis that was received in 1994, that indicated a total N of 42.34lbs/tonne, before composting (EnviroTest, 1994).

In some cases, liquids and solids are separated as they leave the barn and travel to the storage. Solid manure is separated using a series of screens and a settling tank, followed by a solids separator, usually in the form of a screw press or auger. Solids can be composted upon removal with other materials as an alternative to land application. This process has been largely transferred from experience in the dairy industry. The separated solids are generally 60% moisture with nutrient values reported at 40-45lbs of N per ton (Norwest Labs, 1998); these solids can be land-applied or composted with a carbon source.

Other proposed systems include a series of concrete cells that act as settling tanks. Solids are flocculated out and eventually removed for composting. Liquids are treated and recycled through the barn for washwater. Centrifuging solids is also an option that has been employed in municipal waste treatment plants and the oil and gas industry.

Conventional finishing barns sometimes opt for a solid manure system. Manure is scraped from gutters daily and moved with a conveyor belt to a compost facility (Coors de Lint, 1998). Some finishing units across the prairies have gone to bio-tech shelters which are low cost housing units (coverall hoop structures) where groups of feeder pigs are finished. This type of unit has become popular with small and expanding producers and they use a solid manure system. Straw or sawdust is added to the barn as needed and the structure is cleaned out with a front end loader between cycles; this material can be windrowed and composted without adding any additional carbon.

Compost Standards

Before composting, operators will need to decide what quality compost they want to produce. The quality of compost will be determined by its end use – agricultural land application, horticulture and so on. All compost that is sold in Canada must comply with the requirements of the *Fertilizers Act and Regulations.* Each province regulates the disposal and use of animal waste, and compost that is produced and used in a particular province falls under the jurisdiction of the agency that regulates animal waste. Agriculture and Agri-Food Canada, the provincial and territorial government and the Standards Council of Canada through the Bureau de normalisation du Quebec are responsible for the development of standards and regulations for compost and composting (The Composting Council of Canada, 1999). Collectively, these groups define compost as *"A solid mature product resulting from composting, which is a managed process of bio-oxidation of a solid heterogeneous organic substrate including a thermophilic phase."* Compost classifications all include the same criteria for product safety, but there are differences between classification systems based on product maturity, foreign matter, trace elements and pathogens. This information can be obtained from The Composting Council of Canada.

Considerations for Composting Hog Manure

In the case of a hog operation that uses a traditional liquid manure system, the decision to move to composting will necessitate the purchase of a separation unit. The separated solids will then require the addition of a carbon source in order to reach the C:N ratio of 20-30:1 required for good composting. Facilities that have a solid manure system with straw or sawdust may not need to add a bulking agent depending on the C:N ratios. Sufficient moisture, oxygen and a pH of 6-8 are necessary, regardless of whether the solids are coming from a separator or out of a straw or sawdust based system. A good composting recipe and process is essential. Poorly balanced compost mixes do not allow for the optimal breakdown of solids. A low C:N ratio can result in high losses of ammonia. To high a C:N ratio may result in poor composting activity as there is not enough available nitrogen for the compost microorganisms to work efficiently. In the same way temperatures over 70^0C may result in higher losses of ammonia. Excess moisture or moisture deficiencies also need to be corrected to ensure proper composting activity.

Equipment can include anything from a front-end loader to a windrow machine with costs anywhere from $5,0000 to $60,000+ (Composting Workshop, 1998). Labour required to prepare and turn windrow piles will vary with the compost process used (static pile Vs windrow Vs in vessel). Site preparation is also a consideration. Sites should be engineered with an impermeable base, a slope to prevent pooling (4% or as regulated by provincial authority) and a runoff collection system. In vessel compost facilities may or may not be covered and require the construction of concrete (or other) vessels.

Although not a priority for producers in the prairies, the composting process results in the release of carbon dioxide, water vapour and a variety of nitrogen compounds including ammonia and N_20. Greenhouse gas emissions are gaining considerable attention as federal and provincial agencies are being pressured to look at the contributions from livestock and livestock activity. Gathering more information on the generation of gases and the relative amounts of gases may be important before we expand livestock composting facilities.

The documented benefits of composting include: a reduction in volume of up to 60%; improved handling; reduced odour, fewer pests and flies; and high public acceptability. In addition, weed seeds and pathogens are destroyed during the composting process if the proper temperatures are maintained for the appropriate length of time (Paul, 1996).
In the final analysis, compost is a stable organic complex of nutrients that improve soil fertility, tilth and water holding capacity.

Compost Vs Liquid Manure Fertilizer

Prairie hog producers need to be made aware of both the costs and benefits when they consider composting as a manure management option. What is often heard is that composting has to compete with the one cent per gallon land application costs for liquid manure or $2.50 per ton solid manure application costs (Alberta Agriculture, Food and Rural Development, 1997). However, given costs as high as $100,000 annually for manure application on a 2400 sow farrow to finish barn, the cost of retrofitting and composting might make sense over a 20 year period; the generally accepted time until major upgrades are required for equipment and infrastructure.

Using compost for traditional crop production may be limited, as transportation costs still remain high, despite the reduction in volume. The following example uses some rough figures generated from custom applicators and compost producers For 320 acres (1/2 a section) of Canola your fertilizer recommendation is 100lbsN/acre. Using a compost product with 15lbs of N/ton would need approximately 7tons of product per acre. Assuming a cost of $7.50/ton for the compost, $6/acre to spread, plus $4/ton to transport (within 5 miles) the cost per acre is $62.50, a total of $20,000 for the 320 acres (the cost for the compost would rise as the distance from the source increases). If the farmer were to inject liquid hog manure at a rate of 4,000gal/acre (approximately equivalent to 100lb N), the cost would be around $40/acre ($0.01/gal) for a total cost of $12,800. Although the cost for the compost is considerably higher, the compost will increase the soil organic matter and water holding capacity which in turn increases the ability of the soil to capture and utilize nutrients – these benefits should be considered in a cost analysis.

Marketing organic fertilizers

In order to make compost a viable option, markets have to be developed where compost captures a premium price. These markets might include golf courses, tree nurseries, sod farms, greenhouses and landscape applications. As a soil conditioner and amendment, there are opportunities for compost to be used in sandy, saline and eroded soils, on drill sites, power line reclamation sites, for road construction and the remediation of chemical spill sites.

Interestingly, there is quite a bit of development and activity in the area of organic fertilizers in Western Canada.

EcoAg Initiatives, a private company based in Alberta, has developed a partnership with some cattle feedlot operators and an established member of the fertilizer industry. Manure removed from various feedlots is windrowed on site. The management and maintenance of the compost piles is provided through EcoAg Initiatives. Mobile units regularly visit the sites to monitor and turn the compost. A variety of finished products, under the label of "The Real Thing™ Farm Compost, are marketed through Agri-Core (previously Alberta and Manitoba Wheat Pools). EcoAg Initiatives indicated that they are considering hog manure as a potential input (pers. comm., Jim Shaner, 1999).

Discussions with Agrium indicate that there is interest in the organic fertilizer business and the opportunities that it provides (pers. comm., Connie Kohut, 1999). Saskferco, who market through Cargill, note that Cargill has had some positive experience in the US with organically based fertilizers and potentially see this area as an opportunity for Canada (pers. comm., Grant McQuarry, 1999). In Manitoba, Modern Organics Inc. out of Winnipeg indicate that they market a variety of compost based organic products; some can be applied with other fertilizers, others stimulate biological activity. Most of their uptake is from the organic growers.

As the livestock industry grows in Western Canada, it is essential that we educate livestock producers about managing manure as a fertilizer. Holistic management plans should account for all the inputs and strive to limit the export of nutrients away from the farm. Simultaneously, we need to educate crop producers about the value of manure fertilizers through demonstration. With respect to the hog industry, the cost of retrofitting may limit conversion; however, in the future, solid manure systems may prove more practical than liquid systems. Realizing this opportunity will hinge in large part on the development of a market that capitalizes on the added value of compost as a stable source of nutrients and an effective soil conditioner.

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