Manure Management Update

2015 Conference

CONFERENCE PROCEEDINGS

January 19, 2015
Lethbridge, Alberta

Manure Management Update 2015 Conference Proceedings

January 19, 2015

Lethbridge Lodge
Lethbridge, Alberta, Canada

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The Organizing Committee would like to thank Brenda McLellan and Susan Haustein and the Ag Info Call Centre for their help with the conference.

And a special thank you to all the speakers for sharing their time and providing insights.

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Social License Reality: Livestock Production and Manure Management

Tom Goddard

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Key points

- Agriculture has opportunities to develop social licence for securing existing and developing new markets.
- Social licence is the privilege to operate with minimal restrictions by maintaining public trust for doing what is right.
- Livestock organizations need to move strategically to maintain social licence and develop the sector.

Agriculture is at an interesting time in history. More and more of the population are becoming more distant from agriculture production and are either seeking to understand agriculture production or looking at it from their non-agriculture contexts.

The urban population in Alberta became larger than the rural population in the early 1950s. The Alberta urban population is now about six times larger than the rural population and growing at a much faster rate. Alberta is not unique in this, it is a global trend. As the years pass since this cross-over and increase in urbanization, citizens are becoming more distant or removed from farms and farming. Their frame of reference for agriculture is no longer coming from grandparents or an aunt or uncle, but from school books, the media, and grocery stores. These non-agriculture contexts inform the consumer and voting public. They are environmentally aware, food conscious, media savvy, and can provide social licence to agriculture or some other industry.

Social license can be defined as "The privilege to operate with minimal formalized restrictions or requirements through maintaining public trust by doing what is right." The public customers expect a certain standard of behaviour that is carried in regulations or is what they expect from providers of their food. Regulations could be something supposedly familiar like SPCA (Society for the Prevention of Cruelty to Animals) or foreign to them like AOPA (Agriculture Operations Practices Act). General expectations could be proper storage of commodities and clean, refrigerated display cases. Social licence is dynamic and needs to be continually earned or maintained. It can be lost easily, through some sort of disaster, often precipitated by a specific event such as a food product recall or disease outbreak.

When one thinks of disease outbreaks in agriculture, BSE (Bovine spongiform encephalopathy) always pops to mind but there are others such as recent events with avian influenza. Packing plant recalls of contaminated meats always brings a chorus of activist criticisms. Meats are not the only commodity impacted; vegetables can be affected as well. A large *salmonella* outbreak in green vegetables in the United States was tracked back to organic farms. Conventional, organic, free-range, and other systems of production are not immune from public criticisms when disasters occur. Social licence takes a hit in all cases.

In early 2013, the Retail Council of Canada served notice that they expected changes in animal husbandry practices for poultry and hogs that were over and above regulatory requirements. Later in the same year, a food service company refused eggs from particular Alberta suppliers in response to an undercover video revealing animal cruelty. Undercover videos across the livestock sector in Canada (and the United States) have been effective in impacting social licence and public perception of agriculture. Those videos receive more attention than the positive efforts of the National Farm Animal Care Coalition (NFACC) – bad news travels faster, farther. These events do however, underline the need for all players in the food supply chain to work together to develop and maintain social licence. Disasters in one small component can impact all players up and down the supply chain and across the agriculture sector.

Alberta has many of the beef cattle in Canada, about 5.5 million cattle and calves along with about 1.5 million hogs. We slaughter about 2 million each of hogs and cattle each year. Here is an estimate of Alberta livestock numbers along with a 2013 estimate of manure that they produce and the nitrogen and phosphorus in that manure by quantity and value.

	Number of animals[z]		Manure[y]	N[y]	P[y]
	2012	2013	(kg yr^{-1})	(kg yr^{-1})	(kg yr^{-1})
Cattle and calves	5,460,000	5,535,000			
Bulls	91,700	91,200	1,401,196,800	8,217,120	2,225,280
Milk cows and dairy heifers	121,100	120,300	2,321,802,030	12,475,110	2,740,434
Beef cows and beef heifers	1,847,900	1,867,600	25,108,014,400	147,166,880	39,779,880
Calves	1,756,900	1,767,800	7,638,663,800	44,725,340	12,197,820
Slaughter steers and heifers	1,642,400	1,688,100	15,030,842,400	88,118,820	23,802,210
Pigs	1,395,000	1,420,000	1,827,540,000	12,070,000	4,544,000
Sheep and lambs	201,000	207,000	137,034,000	1,449,000	289,800
Totals			53,465,093,430	314,222,270	85,579,424
Value of nutrients in manure				$375,700,540	$288,201,296

[z] Alberta livestock on farms on July 1. Livestock numbers from Alberta Agriculture Statistics Factsheet, 2014, Agdex 853.

[y] Manure, N, and P coefficients from: A geographic profile of manure production in Canada, 2001. Cat # 21-601-MIE-No.077. Appendix A, Table 1. (dairy coefficient adjusted to reflect heifer mix). Calculations based on 2013 livestock numbers.

[x] Based on urea priced at $550 per tonne; phosphate at $750 per tonne; P x 2.29 = P_2O_5.

If one could capture all the nutrients within manure without losing any of it, there is hundreds of thousands of dollars' worth of value waiting to be captured. Manure handling processes need to capture as much value as possible in the stockyards and when applied to fields. Don't waste money.

Along with nutrients there can be pathogens, pharmaceuticals, and hormones present in manure. Farms need to pay attention to stockpiled manure and potential losses in the piles as well as appropriate application rates on different land types. Care must be taken to let soil do its role in metabolizing manure to harvest the embedded nutrients and clean up any undesirable compounds. The Agriculture Operations Practices Act provides guidelines to prevent buildup of salinity and nitrogen from repeated manure applications. Science informs farmers how to deal with other compounds and how to efficiently harvest or retain the most nutrients.

Is simply following regulations enough? Will that keep the public happy and generate trust of farmers? Farm reputation gains public trust. Market trust is also at stake. There are various movements at play, mostly initiated by the retail sector and non-government organizations that develop and retain social licence. One example is the national Round Table on Sustainable Beef. All members of the supply chain come together to discuss risk, assurance, public trust, and related issues. It is in everyone's interest to reduce risks in production and markets. Retailers are experimenting with labeling, segregated product lines, marketing. Governments, non-government organizations, and research organizations are experimenting with foot printing, life cycle analyses, and nutrient flow systems.

The Public still trusts farmers the most, surveys continue to indicate that. What can farm and commodity organizations do to maintain that trust and build social licence? Is it independent initiatives or collaboration? Does it involve a larger scope of players that convert commodities into food? We live in an interesting time where we will likely see some significant changes and opportunities.

Influence of Feedlot Manure Type and Bedding Application on Feed Barley Agronomy and the Environment

Jim Miller[1], Bruce Beasley[1], Craig Drury[2], Frank Larney[1], and Xiying Hao[1]

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Key Points

- The influence of application of feedlot manure type (composted vs. stockpiled), bedding material (wood-chips vs. straw), and application rate (13, 39, 77 Mg ha^{-1}) on feed barley agronomy, leaching, soil physical and chemical properties, and surface runoff, was studied at a long-term (since 1998) field experiment on a clay loam soil at Lethbridge.
- Manure type, bedding material, and application rate may be possible BMPs to manage agronomic and environmental aspects of feed barley production. Producers shifting from land application of stockpiled to composted manure application, or from straw to wood-chip bedding, should not experience any reduction in feed barley yields.

Introduction

Stockpiling (SM) of fresh feedlot manure where it is temporarily stored in stockpiles or stacks either inside or outside feedlot pens is a common practice in western Canada feedlots. Composting (CM) of feedlot manure has also increased as a viable option for handling the large volumes of manure generated by Alberta's beef cattle feedlot industry. Although straw (ST) is the most common bedding material used in feedlots, the use of wood-chips (WD) has increased since the 1990s due to restrictions on incineration of wood residuals by the forest industry. The impact of long-term application of feedlot manure with CM vs. SM with WD or ST bedding treatments has not been studied.

Methods

The long-term field experiment was initiated in the fall 1998 on a clay loam Orthic Dark Brown Chernozemic soil at Lethbridge, Alberta. Details of the randomized complete block experimental design and all treatments with four replicates have been previously reported (Miller et al. 2009). The 12 amendment treatments included a complete factorial arrangement of two manure types (stockpiled and composted beef cattle manure), two bedding materials (unchopped barley straw and wood-chips), and three application rates (13, 39, and 77 Mg ha^{-1} yr^{-1}, dry-weight basis). A unamended control (CON) treatment and an inorganic mineral fertilizer treatment (IN) were also included in the study, resulting in a total of 14 treatments. The material and methods used for agronomic studies (Miller et al. 2009; 2015b), vertical transport and leaching potential studies (Miller et al. 2011; 2013a; 2013b; 2013c), and soil physical and chemical property studies (Miller et al. 2012a; 2012b; 2014a; 2014b; Sharifi et al. 2014) have been previously reported.

Results and Discussion

Long-term application of CM or use of WD bedding resulted in similar dry matter yields, nutrient uptake, and feed quality compared to SM or use of ST bedding. There was no evidence of decreased crop yields due to N immobilization from WD and was attributed to high inherent N already in the soil and the low concentration of WD in the manure (4 parts manure:1 part wood-chips). Vertical transport and leaching potential of soluble salts, total elements, and metals were generally greater for CM compared to SM, but was similar for residual N and P. Vertical transport and leaching potential of water-soluble organic C and N fractions was generally greater for ST than WD. Cumulative denitrification for surface soil was greater for SM than CM, but daily denitrification was similar for WD and ST. Manure application increased wind erodible fraction of soil and was attributed to increased organic matter making the soil aggregates more friable. Cumulative N deficits after 12 yr occurred for CON (-1140 kg N ha^{-1}) and IN (-678 kg N ha^{-1}), and an N surplus for amended treatments (689 to 12,200 kg N ha^{-1}). The N balance after 7 and 12 yr was lower for CM-WD than CM-ST, SM-ST, and SM-WD at 39 and 77 Mg ha^{-1} rates. Application of SM and ST increased readily available and intermediate mineralizable N, and rate of N turn-over (k), compared with CM and WD.

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Unit conversion

1 megagram (Mg) = 1000 kiolgrams (kg) = 1 tonne

Alternative P-based Manure Applications Evaluated

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Yearly application of livestock manure based on crop nitrogen (N) requirements will result in an accumulation of phosphorus (P) in the soil. A concern with high soil P levels is the nutrient could move off the land in run-off and enter lakes and rivers. Applying manure at a rate to match crop P requirements would reduce the potential off-site effects, but such a manure application strategy could be more costly.

An economic analysis, for a medium sized beef feedlot, of two alternative P-based manure application systems was compared to an N-based system. The two P-based systems were to apply manure annually at a rate to meet crop P requirements, and to apply three times the annual crop P requirement but apply manure to the land once every third year. The systems were evaluated using models of crop production and manure transport. Manure was transported from the feedlot to individual quarter-sections of land, with adequate land to accept all of the manure produced. The cost of manure application included the loading of trucks, hauling to the field (a distance cost), and applying manure to the field.

The system that limited P application to meet annual crop requirements increased the cost of manure hauling and application by $8.70 per head (63%). The higher cost included increased hauling distance and application to the field was more costly because the application rate was lower. A system of applying three times the annual P rate triennially increased costs by $2.74 per head (20%). Increased hauling distance cost was the primary factor for the higher cost. The three times rate also was very close to the N requirement for the crop following manure application. As the cost of P fertilizer increased, the added cost of a P-based system declined. This model showed that moving to a P-based manure application system for beef feedlot manure will be more costly than the current N-based system, and that applying three times the annual rate P requirement triennially was less costly than an annual P-based rate.

The Fate of Antimicrobial Residues in Livestock Manure

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Key Points

- Antimicrobials administered to beef cattle in feed were detected in manure.
- Antimicrobial concentrations in manure decreased during stockpiling and windrow composting.
- Antimicrobials were transported in simulated rainfall runoff from feedlot pens, composting windrows, and from soil amended with beef cattle manure.
- Antimicrobials were detected in feedlot catch basins and water from supply canals in irrigation districts in Alberta.

Introduction

Most feedlot cattle in western Canada are administered veterinary antimicrobials therapeutically to treat, control, and prevent disease and sub-therapeutically to promote growth through improved feed efficiency. A portion of the administered veterinary antimicrobials is excreted in urine and feces either unchanged or as metabolites, some of which may still have biological activity. Veterinary antimicrobials undergo degradation in feedlot pens, during stockpiling, windrow composting, and after land application of manure. However, the antimicrobials may move from feedlots, manure storage locations, and manure-amended crop and pasture land in rainfall or snowmelt runoff. Further, runoff from such locations may contaminate surface and ground water with antimicrobials. Beef cattle manure from feedlots in Alberta has been shown to contain veterinary antimicrobials such as chlortetracycline, sulfamethazine, and tylosin (Cessna et al. 2011; Sura et al. 2014). In addition, commercial feedlot soil (Aust et al. 2008), runoff from feedlots (Sura et al. unpublished), manure-amended soils (Amarakoon et al. 2014), and surface and ground water near confined animal feeding operations (Campagnolo et al. 2002; Watanabe et al. 2010) have been shown to contain veterinary antimicrobials. To thoroughly understand the fate of veterinary antimicrobials fed to feedlot cattle, various studies were undertaken. The transport of veterinary antimicrobials in runoff from feedlot pens and their presence in catch basins have been studied, as well as their dissipation during composting and stockpiling of feedlot manure, and their transport in runoff after land application of manure. In addition, irrigation water from selected supply canals in several irrigation districts in Alberta was analyzed for the presence of veterinary antimicrobials used in Alberta feedlots.

Methods

Field studies were conducted in a research feedlot at the Lethbridge Research Centre, Lethbridge, Alberta during a period of 3 years (2010 to 2013). Cattle were administered one of four antimicrobials in their diet: chlortetracycline (CTC), chlortetracycline + sulfamethazine (CTCSMZ), tylosin (TYL), or no antimicrobials - control (CON). Accumulated manure in the pens was used to investigate the dissipation of veterinary antimicrobials during stockpiling, windrow composting, and after land application of manure (60 tonnes per hectare). In addition, concentrations of veterinary antimicrobials in catch basin water, in simulated rainfall runoff from pens, composting windrows, and manure-amended soil, and in irrigation water were also quantified.

Results and Discussion

Results indicated that feedlot cattle manure contained the administered veterinary antimicrobials. Mean concentrations in raw dry-weight manure during the 3-year study were: chlortetracycline in CTC (2340 $\mu g\ kg^{-1}$), chlortetracycline in CTCSMZ (2790 $\mu g\ kg^{-1}$), sulfamethazine in CTCSMZ (500 $\mu g\ kg^{-1}$), and tylosin in TYL (70 $\mu g\ kg^{-1}$). Antimicrobial concentrations in manure decreased significantly during stockpiling and windrow composting. Dissipation half-life (half-life is the time period for an antimicrobial to decrease to 50% of initial concentration and is a measure of persistence of antimicrobial in the manure) values during stockpiling were 20.8 d (sulfamethazine) > 6.0 d (chlortetracycline in CTCSMZ) > 4.7 d (tylosin) > 1.8 d (chlortetracycline in CTC). These half-lives were significantly lower than those observed during windrow composting; 31.9 d (tylosin) > 26.8 d (sulfamethazine) > 20.9 d (chlortetracycline in CTC) > 15.2 d (chlortetracycline in CTCSMZ). These studies show that the manure management options of stockpiling and windrow composting are effective in significantly decreasing veterinary antimicrobial concentrations before land application. Antimicrobial concentrations in simulated rainfall runoff were much higher from feedlot pens (e.g., chlortetracycline, 2600 $\mu g\ L^{-1}$) than those from composting windrows (chlortetracycline, 1060 $\mu g\ L^{-1}$) or from manure-amended soils (chlortetracycline, 30.1 $\mu g\ L^{-1}$). Antimicrobials were detected in irrigation water from some irrigation districts, but at concentrations much lower (e.g., chlortetracycline, 0.069 $\mu g\ L^{-1}$) than those in runoff from manure-amended cropland and lower than maximum safe levels in food (e.g., chlortetracycline, 200 $\mu g\ kg^{-1}$ in meat; Health Canada 2014). Antimicrobials (e.g., tetracycline, 0.11 $\mu g\ L^{-1}$; tylosin, 0.056 $\mu g\ L^{-1}$; monensin, 0.31 $\mu g\ L^{-1}$) were also detected in catch basin and holding pond water in commercial feedlot facilities. Findings from these studies offer manure management options to aid cattle producers in mitigating environmental contamination with veterinary antimicrobials.

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Manure Application Equipment and Alberta Road Regulations

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Key Points
In this presentation, the following topics will be covered:

- What is a commercial vehicle and where a farm vehicle fits into the mix
- Cargo securement
- Over dimensional units
- Legal weights
- Road bans
- Bridge compliance
- Floatation tires
- Farm wagon trailers
- Slow moving vehicles
- Hoses/draglines on roads
- Public Highways Development Act
- Depositing material on a highway (mud, etc.)
- Example of permit conditions

For More Information
For general information: http://www.transportation.alberta.ca/
For legislation: http://www.transportation.alberta.ca/3.htm
Vehicle weights and dimensions: http://www.transportation.alberta.ca/3870.htm
Vehicle weights and dimensions: http://www.qp.alberta.ca/

Handout
Cargo securement requirements
17 (4) A driver, a carrier or an owner of a commercial vehicle shall ensure that cargo transported by a commercial vehicle is contained, immobilized or secured **<u>so that it cannot</u>**

(a) **leak, spill, blow off, fall** from, fall through or otherwise be dislodged from the commercial vehicle, or
(b) **shift upon or within the commercial vehicle** to such an extent that the commercial vehicle's stability or manoeuvrability is adversely affected.

Cargo – means all articles or material carried by a vehicle, including those used in the operation of the vehicle.

Legal weights for Commercial Vehicles:
- Steering axle: 5500 kg power unit or 7300 kg truck
- Single axle: 9100 kg
- Tandem axle: 17 000 kg
- Tridem axle: 24 000 kg

Legal weights for Farm Trailers:
- Farm trailers fall under quantum axle groups
- 9100 kilograms for a quantum axle group consisting of 2 axles
- 17 000 kilograms for a quantum axle group consisting of 3 or more axles with 12 or more tires
- 15 000 kilograms for a quantum axle group consisting of 3 or more axles with fewer than 12 tires

Note: all weights are subject to tire capacities and specific measurements for each respective grouping.

Floatation Tires: (Commercial Vehicle Safety Regulation AR 121/2009)

Sec. 32(1) In this section and sections 33 to 36

(h) "self-propelled floater implement of husbandry" means a motor vehicle that is designed, adapted or modified exclusively for the field application of fertilizers.

Sec. 36 Self-propelled floater implement of husbandry

No person shall operate a self-propelled floater implement of husbandry on a paved highway at any time during which the implement is carrying a load.

Slow Moving Vehicles: (Commercial Vehicle Safety Regulation AR 121/2009)

Sec. 3(2) (Schedule 1)

A commercial vehicle shall not be operated on a highway if it is

(c) a piece of machinery or equipment used at or designed for a maximum speed not exceeding 40 kilometres per hour, unless a slow moving vehicle sign is displayed on the vehicle.

Slow Moving Vehicles: (Use of Highway Rules of The Road Regulation AR 304/2002)

Sec. 3(1) If a person driving a vehicle is driving the vehicle on a highway at a speed that is less than the normal speed of the traffic on the highway at that time and place and under the conditions then existing, that person shall drive the vehicle

(a) in the right traffic lane then available for traffic, or

(b) as close as practicable to the right curb or edge of the roadway

Obstruction of or injury to highway: (Public Highways Development Act)

Sec. 43(1) A person who, without justification or excuse,

(a) obstructs or deposits any material on a highway, or

(b) interferes with, breaks, cuts or otherwise injures a highway, is guilty of an offence.

Exemptions for Farmers:

- Air brake endorsement while operating a farm vehicle with air brakes.
- Written trip inspection reports
- Log books, when travelling within the province
- CVIP's (Annual mechanical inspections)

Contact Information:

Provincial Road Ban: 1-855-ROADBAN (1-855-762-3226)

Alberta Central Permit Office: 1-800-662-7138

(For provincial highways only)

Under Pressure: Managing Manure Application and Field Compaction

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Key Points
Avoid soil compaction from manure application equipment by:

- Limiting axle loads to 9.1 tonnes (10 tons) and preferably 5.4 tonnes (6 tons) to prevent subsoil compaction.
- Keeping tire pressures as low and tire footprints as large as possible to prevent topsoil compaction.
- Using a drag hose system instead of liquid manure tankers for field application.
- Using an automatic air inflation deflation (AAID) system on heavy equipment.

Agricultural equipment has increased in size over the years due to increased farm sizes and increased efficiencies. A major concern with the larger and heavier equipment is soil compaction. Some operations such as manure application sometimes have to be performed when soils are moist. Increased soil moisture results in increased soil compaction with heavy agricultural equipment. It is important to avoid soil compaction during operations such as manure application. This article will discuss methods to manage agricultural equipment to avoid soil compaction.

Axle load is very important to consider when avoiding soil compaction. Axle load is the total load supported by one axle. Agricultural equipment with high axle loads will cause soil compaction in the topsoil and the subsoil. Low axle loads will usually cause soil compaction in the topsoil and the upper part of the subsoil. Higher axle loads cause the pressure gradient to penetrate deeper into the soil. Soil compaction in the subsoil is very difficult to correct. Research has shown that axle loads should be limited to 9.1 tonnes (10 tons) and preferably 5.4 tonnes (6 tons) to prevent subsoil compaction. The number of axles can also be increased to reduce the load on each axle.

Contact pressure is the pressure that is exerted by a tire or track on the soil surface. Surface contact pressure is 7 to 14 kilopascals (1 to 2 pounds per square inch) higher than tire pressure with agricultural tires. Higher surface contact pressures will result in more topsoil compaction. Tire pressures should be reduced to the minimum allowable pressure for the tire size and load to prevent topsoil compaction. Other methods to reduce topsoil compaction are by using flotation tires, radial-ply instead of bias-ply, and by using larger diameter tires to increase the tire footprint. Tractors with four-wheel drive, front-wheel assist, tracks or duals will also spread the load over a larger area and result in lower surface contact pressures. Tractors should also be properly ballasted for each operation to minimize tire pressures.

Using a tractor with low-pressure radial tires will result in similar soil compaction as a tractor with tracks. Belts on track tractors are flexible and there are pockets of high pressure under the axles of the belt that result in pressures similar to tractors with tires.

Other management methods to avoid soil compaction are to travel over a lower percentage of the field, concentrate repeat traffic in travel lanes, and to drive faster to shorten the load dwelling time.

Equipment management methods specific to manure application to avoid soil compaction include using side discharge or vertical beater solid manure spreaders instead of horizontal beater solid manure spreaders. Side discharge and vertical beater spreaders spread solid manure over a wider area and result in less of the field travelled. These spreaders also allow the use of travel lanes for repeat traffic. Using a hose drag system for liquid manure prevents heavy loads such as tankers from operating on fields. A hose drag system consists of a field applicator, which is usually pulled by tractor, and a drag hose, which supplies manure to the applicator. A pump at the liquid manure storage unit transports the manure through a hose to the applicator in the field. Booster pumps are sometimes used for long distances of hose.

AgriBrink manufactures an automatic air inflation deflation (AAID) system specifically for agriculture (AgriBrink 2014). The system consists of an air compressor, air tank, control box and hoses, and swivels to connect to the tires. The system can inflate tires for road transport and deflate tires for field operation from the tractor cab. For instance, the tires on a large tanker system for liquid manure use 100 kilopascals (15 pounds per square inch) in the field to reduce soil compaction and 240 kilopascals (35 pounds per square inch) on the road to allow for higher road speeds. The system is different from conventional AAID systems because of the fast deflation time and the ease of moving the system to other pieces of equipment.

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Manure Book Values: To Sample or Not To Sample

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A Tri-Provincial Review of Manure Book Values

The three Prairie Provinces, Alberta, Saskatchewan, and Manitoba, have existing book values that producers utilize to meet their manure management planning requirements. Having current manure characterization information is fundamental to manure management in order to provide sound practice solutions. These values are not always consistent among published book values used by the provinces and what the livestock industry and producers claim. A tri-provincial report reviewed historically published information, and where possible, compared the formation to current information gathered from industry. This work provided a collection of values and subjective comparisons identifying further areas of work. This presentation will identify the challenges of obtaining comparable data and the inconsistences with existing data and industry information.

Alberta Phosphorus Watershed Project

Janna P. Casson[1], Jennifer L. Kerr[2], Trevor D. Wallace[3], Ron Axelson[4], and Barry M. Olson[1]

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Key Points

- Two agricultural watersheds were chosen to evaluate the Alberta Phosphorus Management Tool, implement BMPs, and monitor environmental effectiveness.
- In addition to water quality monitoring, land cover, winter livestock management, and soil information are being collected.
- Riparian health inventories will be conducted in the treatment watersheds in 2015.

Introduction

Phosphorus (P) from manure or inorganic fertilizers is essential for crop production. Though, if not managed effectively, excess P can be transported to water bodies via surface runoff. Beneficial management practices (BMPs) have been developed to manage nutrient losses from crop and livestock production. However, there is no provincial assessment tool to evaluate the risk of P loss from agricultural operations. Alberta Agriculture and Rural Development, the Alberta Livestock and Meat Agency, and the Intensive Livestock Working Group initiated a 3-yr study to develop and evaluate a P risk assessment tool. In partnership with Red Deer, Kneehill, and Mountain View counties, two watersheds were selected in which to test and evaluate the tool. The Alberta Phosphorus Management Tool (APMT) assesses the risk of phosphorus loss based on environmental, landscape, and management factors, and identifies potential BMPs to address those risks.

Methods

Four agricultural watersheds (Figure 1) were selected: two treatment watersheds (Tindastoll Creek, 14,113 ha; Acme Creek, 13,735 ha) and two control watersheds (Threehills Creek, 19,919 ha; Lonepine Creek, 17,342 ha). Water quality and flows are being monitored to determine if the APMT and the adopted BMPs will affect water quality in the treatment watersheds. Sampling of the treatment watersheds commenced in 2013 and sampling in the control watersheds started in 2014. Surface water samples were collected during snowmelt and rainfall runoff and analyzed for nutrient, sediment, and bacteria concentrations. Land cover, winter livestock management information, and soil nutrient data were also collected. Riparian health inventories and rangeland assessments will be carried out in 2015.

Results and Discussion

Water quality analysis, to date, indicated high levels of nutrients particularly during snowmelt in Tindastoll Creek and during snowmelt and rainfall in Acme Creek, although concentrations fell within ranges expected for the Parkland and Grassland natural regions of the province, respectively (Lorenz et al, 2008). The majority of water quality parameters increased in concentration as water flowed towards the outlet in Tindastoll Creek, especially during April and May in 2013 and 2014; whereas, water quality parameters in Acme Creek did not have as strong of an upstream-to-downstream increase in either year. Changes in water quality with time, identified through the monitoring study, will help develop and evaluate the APMT's effectiveness in reducing P loss from agricultural watersheds through the adoption of BMPs, particularly in critical source areas of P loss.

For more information on the Alberta Phosphorus Watershed Project, please refer to the project website: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/irr14541

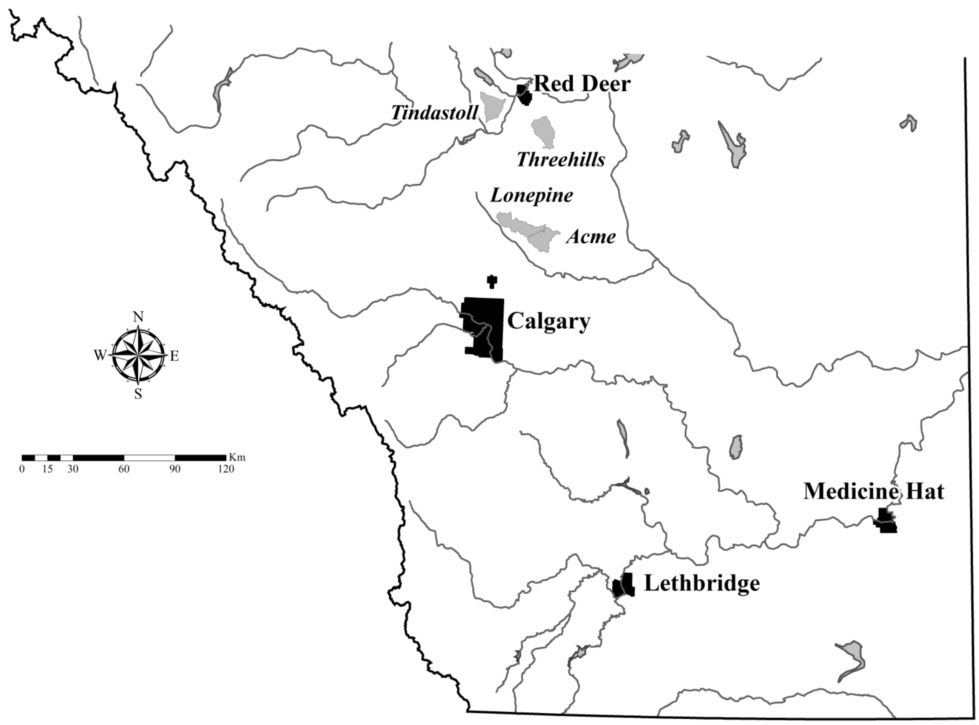

Figure 1. Location of the Tindastoll Creek, Threehills Creek, Acme Creek, and Lonepine Creek watersheds. Based on a map adapted from Alberta Agriculture, Food and Rural Development (AAFRD 2005).

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Lorenz, K.M., Depoe, S.L., and Phelan, C.A. 2008. Assessment of Environmental Sustainability in Alberta's Agricultural Watersheds Project. Volume 3. AESA Water Quality Monitoring Project. A summary of surface water quality in Alberta's agricultural watersheds: 1995-2006. Alberta Agriculture and Rural Development, Edmonton, Alberta, Canada. 487 pp.

Alberta Phosphorus Management Tool

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Key Points

- The Alberta Phosphorus Management Tool (APMT) is currently being developed as part of the Alberta Phosphorus Watershed Project.
- The APMT is a risk assessment tool to help minimize environmental risk associated with the management of phosphorus (P).
- The risk assessment tool evaluates flooding, run-on and run-off surface water flow, nutrient accumulation, and facility management to determine the risk of P loss.
- The APMT evaluates a farming operation's management practices, facilities and their landscape factors to determine how they may be impacting the potential for P loss and it then identifies beneficial management practices (BMPs) that can be adopted to reduce the opportunity for loss.

Introduction

Phosphorus (P) from manure or inorganic fertilizers is essential for crop production; however, if not managed effectively, P can be transported to water bodies via surface run-off. Phosphorus is generally the limiting nutrient for plant and algal growth in fresh-water systems. Increased aquatic plant and algal growth can significantly deplete oxygen levels when these organisms die and decompose, negatively affecting aquatic animals. Blooms of blue-green algae (cyanobacteria) can also release toxins that are harmful to aquatic life, livestock, wildlife, and humans if they ingest the water.

Beneficial management practices have been developed to manage nutrient losses from crop and livestock production. However, there is no provincial assessment tool to evaluate the risk of P loss from agricultural operations. Alberta Agriculture and Rural Development (ARD), the Alberta Livestock and Meat Agency, and the Intensive Livestock Working Group initiated a 3-yr project (Alberta Phosphorus Watershed Project) to develop and evaluate a phosphorus risk assessment tool.

The APMT is currently an Excel-based risk assessment tool developed to help minimize environmental risk associated with the management of P. The purpose of the APMT is to identify and assess, at a farm operation-scale, current management practices, facilities, and landscape factors contributing to P loss. Ultimately, the tool will identify BMPs that can be adopted to improve nutrient-use efficiency and/or reduce the opportunity for P loss.

APMT Development

The tool was developed using key elements of existing nutrient management resources in Alberta. These resources included the Environmental Farm Plan, the Nutrient Management Planning Guide, Natural Resources Conservation Board's Environmental Risk Screening Tool, the Wintering Site Assessment Tool, the Manure Management Planner, and the Alberta Farm Fertilizer Information and Recommendation Manager. It also incorporates elements from the Alberta Soil Phosphorus Limits Project as well as phosphorus indices and risk assessment tools from a variety of other jurisdictions in North America. Subject matter experts were consulted to ensure questions used in the tool were appropriate and sufficiently addressed P loss in Alberta.

The APMT evaluates the potential risk of flooding, run-on and run-off surface water flow, nutrient accumulation, and facility management on the loss of P. It also evaluates farm facilities and practices with questions grouped into a number of different sections. Some sections are applicable to all types of agricultural operations, while others are relevant to specific livestock or cropping activities. The producer only completes sections that are relevant to his or her operation. Risk is assessed based upon the answers to the questions, which fall into either a yes/no or low-to-high risk category ranking. Each answer has an assigned level of risk. How a producer answers a question will influence whether or not they are required to answer subsequent questions. Each question also includes a listing of potential BMPs to address the identified risk, as well as a description of the 'potential concern' of the question, i.e., why is the question being asked with respect to P loss.

APMT Testing and Delivery Process

Two pilot watersheds were selected in which to test and evaluate the AMPT: Tindastoll Creek Watershed and Acme Creek Watershed. We have been working in partnership with Red Deer, Kneehill, and Mountain View counties to pilot the APMT with producers. We have been meeting with producers to go through the assessment to evaluate their P loss risk and discuss BMP implementation. Based on the farm visits and producer feedback, the assessment tool is updated.

A delivery process, which includes several key steps, has been developed to build a relationship with producers in order to pilot and evaluate the APMT:

- Project team members meet with producers to explain the project, the risk assessment tool, and the APMT process. Fields and facilities managed by the producer are identified and a quick risk assessment of P loss is conducted. The producer is then made aware of the information needed for the follow-up meeting.
- Team members follow up with the producer to complete the APMT. Feedback collected from the interviews is used to improve the APMT and delivery process.
- A summary of the APMT risk assessment findings is provided to the producer on a third visit. The summary identifies risks, and potential BMPs to address the risks. The team then, if the producer is interested, discusses potential BMPs and assists with BMP implementation.

We are currently at the mid-way point of this project and the Excel-based tool is being tested by users, and improvements are identified and implemented as the tool is used. We hope to get more people involved with testing and evaluating the APMT in 2015.

For more information on the Alberta Phosphorus Watershed Project, please refer to the project website: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/irr14541

Realities of Spreading Manure on Snow

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It is recognized that spreading manure on frozen or snow-covered ground poses a greater risk to water quality during snowmelt then other times of the year. Provincial legislation manages these risks through Section 24, Manure Application Limits, Standards and Administration Regulation of the Agricultural Operation Practices Act (AOPA), which grants authority to the Natural Resources Conservation Board (NRCB). This authority is administrated through two methods. When weather conditions prevent manure spreading in a geographic area, the Board can post a notice to producers in the area that allows spreading. As well, inspectors can grant permission to individual producers. If either permission has been granted or the Board has issued a notice then the regulations state conditions that are to be followed in the application of manure on snow and frozen land.

The prohibition of application on frozen or snow-covered ground is not always an option for the industry as recognized in other jurisdictions. There are two main reasons why producers might ask for permission to spread on frozen or snow-covered land. The first is a shortage of manure storage. This can occur due to several factors including weather conditions restricting application on bare ground, availability of custom manure applicators, and emergency situations. The second is the management of snow loads in feedlot pens for animal production and health.

If a situation arises that producers and custom manure applicators need to spread manure on frozen or snow-covered ground, care and due diligence needs to be taken to minimize environmental risks.

Getting the Most out of your Short-term Manure Storage

Cody Metheral

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Land application is still the most effective means of managing livestock manure, but how should solids be handled when crops are growing or if the soil is frozen and covered with snow? Understanding regulation options and enforcement policies, plus the benefits of short-term storage can reduce the stress of managing accumulated manure stockpiles.

The Agricultural Operation Practices Act (AOPA) allows producers to store solid manure at a livestock facility (either in a pen or on a pad) or at a short-term solid manure storage site. A producer utilizing short-term storage must consider the following AOPA's requirements:

(1) "Short term" means an accumulated total of not more than 7 month over a period 3 years, and
(2) Meet setbacks from residences and common bodies of water.

It is important to understand why producers may choose to short-term stockpile their solid manure (access to labour and equipment, economics, field conditions, and weather, etc.). The legislation was written to allow flexibility and options to manage manure. Producers are encouraged to understand the manure handling legislation and take advantage of manure storage opportunities.

Reducing the Risk of In-field Feeding Systems: Wintering Site Assessment Tool

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The practice of feeding cattle in the field during winter months, known as extensive winter-feeding, has been steadily increasing throughout the prairies, mostly due to reduced yardage, and feeding and manure handling costs. Before winter, farmers should consider their wintering site location and runoff. The greatest environmental risk from wintering sites is the potential of water contamination from runoff carrying nutrients, pathogens, and sediments.

Careful site selection and good site management are essential in ensure the full benefits of extensive winter-feeding while addressing potential environmental concerns. For example, choosing an optimal wintering site and applying the right feeding strategy helps reduce overall production costs by minimizing feeding and manure transportation costs while preventing excessive nutrient accumulation and runoff.

The Wintering Site Assessment and Design Tool (WSADT) can help livestock producers select and manage a wintering site, while addressing potential environmental risks. The WSADT can assist producers in identifying the environmental risks associated with their in-field wintering sites and provides beneficial management practices to addressing the risk. This tool evaluates five main wintering site factors: site characteristics, feeding strategies, bedding and shelter management, water source management, and post-wintering site management.

For more Information
Wintering Site Assessment and Design Tool: A guide to selecting and managing a wintering site in western Canada. Agdex 420/580-3.

This publication is available through Alberta Agriculture and Rural Development's publication office by calling 1-800-292-5697.

Also available online at:
www.agriculture.alberta.ca/manure

Monitoring Remote Livestock Watering Systems

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Key Points

- Remote livestock watering system reliability has been identified as a barrier for livestock producers to adopt the technology.
- Alarm systems can monitor remote watering sites to make the systems more reliable.

Introduction

Livestock producers use remote watering systems to provide an alternative to watering directly out of creeks, dugouts, and springs. These systems are often far from the power grid and use batteries to power the watering system. Producers can be reluctant to adopt this technology because of a lack of trust in the technology, and the need to check the systems for battery recharge and pump functionality. Failure of these two components can leave livestock without water for extended periods of time.

Alberta Agriculture and Rural Development, with funding from the Growing Forward 2 Stewardship Program, identified existing alarm systems that could be installed on remote livestock watering sites and evaluated a small selection of the systems on remote watering sites.

Methods

Three alarm systems were chosen to install on remote watering sites. Producers using remote livestock watering systems were identified and asked to participate in the evaluation of the alarm systems. The alarm systems were installed at the remote watering sites and configured to notify the producers in the event of low water levels in the trough and/or low battery voltages. The producers were then asked to provide feedback on the effectiveness of the monitoring systems.

Results and Discussion

Initial feedback from producers has been favorable. Producers appreciate the fact that the monitoring system alerts them when problems occur. This gives the producers more confidence in their remote watering systems and allows them to reduce the frequency of site visits required to check their remote watering systems.

Alberta Agriculture and Rural Development will continue to demonstrate the monitoring systems on livestock watering systems and collect producer feedback. A factsheet is currently being developed to provide producers with information on monitoring systems for remote livestock watering sites.

Getting Value from In-field Feeding Systems: Nutrient Loading Calculator

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Key Points

- This is an Excel-based calculator that does not require additional software to operate on your computer.
- The calculator was designed to estimate nutrient loading from bale grazing, rolled out or processed feed deposited on the ground.
- By knowing the amount of nutrients being imported onto a site, a producer can better manage the feeding system and the animals to take advantage of those nutrients as well as reduce nutrient loss to the environment.

The nutrient loading calculator (NLC) was designed to help livestock producers plan and manage in-field winter feeding systems and to get the most value from their chosen feeding system. This Excel-based calculator estimates the amount of nutrients (nitrogen, phosphorus, potassium, and sulphur) being added to the landscape by winter feeding systems, such as bale grazing, that import feed onto a site. It was designed to help producers manage wintering sites and animal density to minimize the environmental impacts of the feeding system, quantify the benefit of the winter feeding system, assist with site selection, and subsequent site and crop management.

This calculator was developed by Agriculture and Agri-Food Canada in consultation with technical experts from provincial agriculture departments in Alberta, Saskatchewan, and Manitoba.

A significant portion (70 to 90%) of the nutrients brought onto a site to feed a herd are left behind on the land as manure and un-eaten feed. Excessive nutrient additions can negatively impact the growth and quality of subsequent crops and increase the risk of nutrient loss to the environment. This tool was created to quantify the potential nutrient impacts of a given winter feeding system. Built into the calculator are several threshold warnings that notify the user if livestock density, feed density, or nutrient loading are extremely high. By knowing the amount of nutrients being imported onto a site, a producer can better manage the feeding system and the animals to take advantage of those nutrients as well as reduce excessive nutrient loading and loss to the environment. The calculator can be used to help determine the amount of nutrients that the feeding system is leaving behind. This allows the producer to plan spring operations to take advantage of those nutrients.

The calculator can be used to run ‘what if’ scenarios comparing various winter feeding systems and feeds. It can also be used to determine the amount of feed required to meet the needs of an identified number of animals for a designated number of feeding days. It gives the producer the ability to plan and lay out a bale grazing site by providing bale spacing distances. The program will supply the number of bales required to be fed per day or the number of feed wagon loads needed per day to feed the size of herd being managed.

The user inputs into the program include the number of animals being fed, the size of animals, the size of the feeding area, and the anticipated number of feeding days. Up to three different feeds can be used in the calculator at one site. The user can select, from drop-down menus, the feed types being used. The program contains book-value protein and nutrient content for a wide selection of feed options. These are the same book values used in the 'Cowbytes' software. The user can input their own feed analysis information if they have it. This information will then over-ride the book values for all calculations. Based on the nutrient content of the feed, the amount of feed being fed and the size of the feeding site, the program estimates the amount of nitrogen, phosphorus, potassium, and sulphur being deposited at the site.

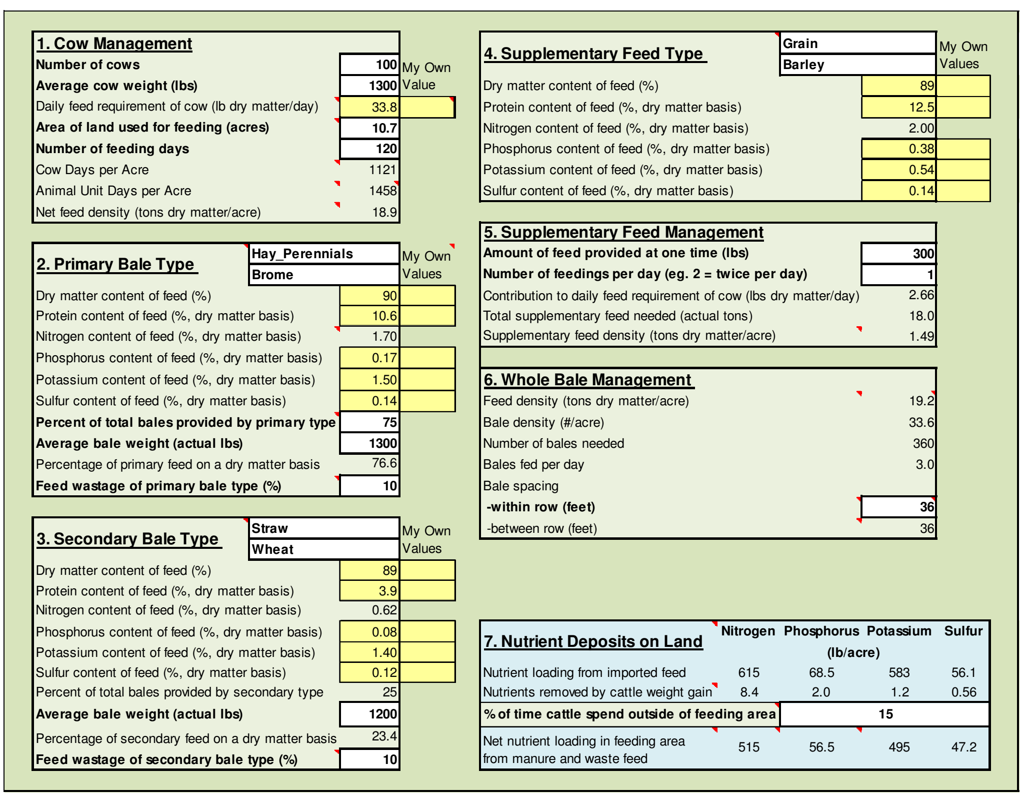
The calculator assumes that all nutrients, with the exception of nutrients removed as livestock weight gain, calf development, or milk production, are deposited on the landscape in the form of manure, urine, and waste feed. The calculator does not estimate how the nutrients are deposited across the feeding site. Distribution is a function of the size of the site and the amount of time animals spend at the shelter/bedding areas, watering sites, and other land outside the feeding area.

There are two versions of this calculator: a feed-to-cow version and a cow-to-feed version. The feed-to-cow version asks for feed-management factors first and then cow-management factors. The cow-to-feed version (Figure 1) starts by inputting the cow-management factors first and then the feed-management factors. Both versions will provide the same outputs and information they just approach data input from different angles.

For more information on the Nutrient Loading Calculator go to:
http://www1.agric.gov.ab.ca/$Department/softdown.nsf/main?openform&type=NLC&page=information

Or, go to www.agriculture.alberta.ca – select Decision Making Tools Tab then Livestock and then Nutrient Loading Calculator.

In addition, there is a pdf user manual available for download that walks the user through both versions of the calculator.



1. Cow Management		My Own Value
Number of cows	100	
Average cow weight (lbs)	1300	
Daily feed requirement of cow (lb dry matter/day)	33.8	
Area of land used for feeding (acres)	10.7	
Number of feeding days	120	
Cow Days per Acre	1121	
Animal Unit Days per Acre	1458	
Net feed density (tons dry matter/acre)	18.9	

2. Primary Bale Type	Hay_Perennials / Brome	My Own Values
Dry matter content of feed (%)	90	
Protein content of feed (%, dry matter basis)	10.6	
Nitrogen content of feed (%, dry matter basis)	1.70	
Phosphorus content of feed (%, dry matter basis)	0.17	
Potassium content of feed (%, dry matter basis)	1.50	
Sulfur content of feed (%, dry matter basis)	0.14	
Percent of total bales provided by primary type	75	
Average bale weight (actual lbs)	1300	
Percentage of primary feed on a dry matter basis	76.6	
Feed wastage of primary bale type (%)	10	

3. Secondary Bale Type	Straw / Wheat	My Own Values
Dry matter content of feed (%)	89	
Protein content of feed (%, dry matter basis)	3.9	
Nitrogen content of feed (%, dry matter basis)	0.62	
Phosphorus content of feed (%, dry matter basis)	0.08	
Potassium content of feed (%, dry matter basis)	1.40	
Sulfur content of feed (%, dry matter basis)	0.12	
Percent of total bales provided by secondary type	25	
Average bale weight (actual lbs)	1200	
Percentage of secondary feed on a dry matter basis	23.4	
Feed wastage of secondary bale type (%)	10	

4. Supplementary Feed Type	Grain / Barley	My Own Values
Dry matter content of feed (%)	89	
Protein content of feed (%, dry matter basis)	12.5	
Nitrogen content of feed (%, dry matter basis)	2.00	
Phosphorus content of feed (%, dry matter basis)	0.38	
Potassium content of feed (%, dry matter basis)	0.54	
Sulfur content of feed (%, dry matter basis)	0.14	

5. Supplementary Feed Management	
Amount of feed provided at one time (lbs)	300
Number of feedings per day (eg. 2 = twice per day)	1
Contribution to daily feed requirement of cow (lbs dry matter/day)	2.66
Total supplementary feed needed (actual tons)	18.0
Supplementary feed density (tons dry matter/acre)	1.49

6. Whole Bale Management	
Feed density (tons dry matter/acre)	19.2
Bale density (#/acre)	33.6
Number of bales needed	360
Bales fed per day	3.0
Bale spacing	
-within row (feet)	36
-between row (feet)	36

7. Nutrient Deposits on Land	Nitrogen	Phosphorus	Potassium	Sulfur
	(lb/acre)			
Nutrient loading from imported feed	615	68.5	583	56.1
Nutrients removed by cattle weight gain	8.4	2.0	1.2	0.56
% of time cattle spend outside of feeding area	15			
Net nutrient loading in feeding area from manure and waste feed	515	56.5	495	47.2

Figure 1: An example of the cow-to-feed whole bale calculator screen.

Growing Forward 2: Confined Feeding Operation (CFO) Stewardship Program

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Advancing Innovation
The Confined Feed Operation (CFO) Stewardship program is one of many programs under Growing Forward 2, which is a five year federal-provincial-territorial initiative that helps Alberta livestock operations and commercial manure applicators assess and implement improvements that minimize their impact on water quality and the environment. The program will operate from 2013 to 2018, or if all available program funds have been spent, the program will close prior to 2018.

The Growing Forward 2 – CFO Stewardship Program helps the industry in three key areas:
1. Less agricultural impact on water quality: The program funds improved infrastructure that reduces the risk of agricultural contaminates entering water sources. This boosts the economic viability of the industry while responding to public demand for good environmental practices.
2. Improved business outcomes for livestock producers: The program enables producers to make informed business decisions that take into account economics and the environment. This ensures that sustainable business decisions can be made that support future efficiency and profitability.
3. Improved market opportunities: The program helps producers with CFOs, regardless of age, meet the present day legislated environmental standards. This demonstrates that the livestock industry is adaptive and resilient and can grow in an environmentally responsible manner.

Who can participate?
Individuals or businesses that own and operate a CFO in Alberta can participate in this program. The operation must have completed an Environmental Farm Plan (EFP) or a CFO Site Assessment prior to applying for funding. Commercial manure applicators must provide a certificate of completion from the Commercial Manure Applicator Workshop offered by Alberta Agriculture and Rural Development.

How are costs shared?
Grant funding cost share of 30 to 70% of eligible expenses is dependent on the project activity code. The program provides a maximum of $100,000 per applicant, though some categories have project maximums between $15,000 and $70,000. For Commercial Manure Applicators, Growing Forward 2 will cover 50% of eligible project expenses to a maximum grant of $70,000.

A producer that owns multiple CFOs may submit multiple applications for each CFO, and each CFO is eligible for the maximum amounts. However, each CFO that submits an application must be located on different premises with its own separate Premises ID Number.

For More Information on the CFO Stewardship Program, please refer to the Growing Forward 2 website: www.growingforward.alberta.ca or call 310-FARM (3276).

Notes