An Economic Impact Study of the Forage Industry in Ontario

Literature Review:
According to Statistics Canada (2006), there are 1,862,387 acres of pasture including both tamed and natural land, and 2,500,000 acres of tame hay in Ontario. With an average yield of 2.70 tonnes per acre, the quantity of the Ontario forage production is relatively straight forward to calculate. The value per unit of forage is, however, difficult to determine. The majority of Canada's forage production is used on-farm while off-farm sales represent only 10-15% of the total production (Agriculture and Agri-food Canada, 2007). The price of forage represented in this marginal market overstates the value than if all forage crops were traded in the market.

Quality of forage also determines the unit value of forage. "Forage quality is defined as the sum total of the plant constituents that influence an animal's use of the feed…factors affecting quality are maturity, species, harvest and storage methods"(Cherney & Hall). Nutritional values are reflected by the quality and they can accurately represent the forage value. "Energy, protein and fibre contents are three key nutritional value indicators of forage (Agriculture and Agri-food Canada, 2007)."

Indirect economic benefits of forage are very difficult to measure, and are beyond the scope of this study. Forage and pasture crops are used in rotation, for the conservation of soil and can be valued for carbon sequestering. For example, Bouton (2006) estimated that the amount of nitrogen fixed by growing a legume-grass mixture (at a current nitrogen price of $0.88/kg) would potentially result in a savings of US$98 per hectare per year.

There are several methods to put an economic dollar value on forage production despite the difficulties.

Substitute approach

Value of forage can be estimated by a comparison of nutrient contents between forage and its substitute feeds. Assuming that home-grown forage and a crop of a known value substitute perfectly, then value for forage can be derived by: $V = P * (ME_F / ME)$ where V = dollar value/ kg for forage, P = dollar value/kg for its substitute, ME_F and ME = energy concentration in forage and alternative feed (MJ kg^{-1} DM) (Doyle & Elliot, 1983). However, this formula ignores handling cost and it is naïve to assume perfect substitution between the two. A similar approach was applied by Fisher et al (1999) who estimated the value of pearl millet and grain sorghum grains. In their study, the evaluation was based on the content of net energy of lactation (NE_L), crude protein (CP), and phosphorus (P). The best equation was derived by performing regression analysis on these three nutrient contents. Price = $-49.83 + 53.12 * NE_L + 0.46 * CP + 216.05 * P$

Peterson's Equations are widely recognized and used to calculate the value of other feeds based on their protein and energy contents in comparison to the nutritive value and cost of corn and soybean meal. Rodenburg (1997) evaluated feedstuffs with Peterson's

Equations using grain corn as the standard energy feed and soybean meal as the standard protein feed. Using similar ideas, Stevens and Garret (1994), applied simultaneous equations as a method by using cracked corn, 48% soybean meal, limestone and di calcium phosphate to calculate the unit value of net energy of lactation, crude protein, calcium, and phosphorus. By imputing these values on the nutrient content of a forage crop such as alfalfa, the unit value of this crop can then be calculated.

It is also recognized that the forage and its substitute feeds share similar inputs. Thus, to obtain an extra unit of forage, a certain amount of capital, such as a piece of field, must be used. Certain potential benefits of growing other feeds from the same capital will be lost. This is commonly referred to as opportunity cost. The opportunity cost of the extra unit of forage varies depending on the amounts of other products using the same inputs. This relationship makes the development of iso-cost map possible.

Development of an iso-cost map (Lin, 2003) is appropriate to determine the relationship between forage and its substitute. An iso-cost map shows the combination of forage and its substitute at a given cost. Such maps reflect whatever degree of competitiveness may exist in the production of forage and one of its substitutes. Once the cost relationship is mapped between forage and its substitute, the marginal cost of forage can be determined by knowing the marginal cost of its substitute. In a price taker industry, such as agriculture, marginal value is equal to marginal cost in the long term. The marginal value of forage may be determined this way. The iso-cost method was first suggested to be used on forage by Lowell Hardin and Glenn Johnson (1955).

Contribution approach

Forage can be seen as an intermediate product that adds value to the livestock. It will be making contribution to the value of the livestock over the years regardless of the way forage is transferred in the market (i.e., sold, purchased, or used on farm). A procedure called ‘residual imputation’ can be used to determine the value of an intermediate good (Houk et al, 2007). The total value product is calculated; in this case, it’s the revenue from the livestock sales including beef, dairy, etc. The accounting costs of all inputs, except feed cost of using forage, are subtracted from the revenue. The residual, what is left, is the value attributed to the amount of forage production used in that year. This method was first mentioned by Nelson et al (1957) to be used on forage. This method has also been used to evaluate grass:

> “Grass is not a traded commodity and its value as a feed has to be imputed from its contribution to livestock production. Since the value placed on grass is estimated from the residual profits after the deduction of all other costs…” (Doyle & Elliott, 1983)

Pricing approach

The market price of hay is the marginal value of the small percentage of forage traded on the market, as opposed to the average value of forage. This framework had been

developed by Lowell Hardin and Glenn Johnson (1955) to best estimate the value of forage:

1. Not less than the highest net price realizable through off-farm disposal or salvage value. Some examples of off-farm disposal are cash receipts from renting pasture out and cash receipts from the sale of hay.
2. Not more than the cost of acquiring, by the most economical means available, the same quantity and type of feed units or their equivalents. Some examples of acquisition include off-farm acquisition price, on farm acquisition cost, cost of emergency crops, and opportunity cost to convert lands to pasture.

The marginal value can be either of the two values discussed above depending on the individual farm. If a farmer values his forage above the cost of acquiring, he would acquire more until the marginal value equals the cost. If a farmer values his forage below the salvage value, he would dispose more of his forage until the marginal sale equals the salvage value. The marginal value of forage can also fall between the limits of the first and second situations above and can be approximated by individual farmer assessment.

Each approach to value has its advantages and disadvantages. The substitute approach is easy to compute, but is subject to imperfect substitution. The contribution approach is very difficult to calculate due to the complexity of cost-of-production. The pricing approach assumes the marginal value is between the salvage value and acquisition cost. Thus it is a less reliable, but easy to obtain from farms.

References

Agribrands Purina Canada. 2007. Retrieved [date].

Agriculture and Agri-food Canada, 2007. Canada's Forage Industry. Accessed July 2007, available at http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1174594338500&lang=e#stat.

Bouton, J., 2006. The Economics of Forage Improvement in the United States. Euphytica, Volume 154, Number 3, April 2007, pp. 263-270(8)

Cherney, J.H., & Hall, M.H. Pennsylvania State University. Accessed July 2007, available at http://www.forages.psu.edu/agfacts/agfact30.pdf.

Doyle C.J., & Elliott J.G., 1983. Putting an Economic Value on Increases in Grass Production. Grass and Forage Science (1983) Volume 38, 169-177.

Fisher J.W., Gurung N.K., Sharpe P.H. 1999. Estimating the Value of Pearl Millet and Grain Sorghum Using a Nutrient Component Value Approach Vis-à-vis Competing Feed Grains (for Dairy Rations). Kemptville College.

Houk E., Frasier M., Taylor R. 2007. Evaluating Water Transfers from Agriculture for Reducing Critical Habitat Water Shortages in the Platte Basin. J. Water Resource Planning and Management, Volume 133, Issue 4, pp. 320-328 (July/August 2007)

Lin J. 2003. Development Strategy, Viability, and Economic Convergence. *Economic Development and Cultural Change*, volume 51 (2003), pages 277–308, University of Chicago.

Lowell S. Hardin, & Glenn L. Johnson, 1955. Economics of Forage Evaluation. Journal of Farm Economics, Vol. 37, No. 5.

Nelson M., Castle E.N., Brown W.G, 1957. The Use of the Production Function and Linear Programming in Valuation of Intermediate Products. Land Economics, Vol. 33, No. 3.

Rodenburg, J. 2000. Boosting the Protein Content of Corn Silage. Ontario ministry of Agriculture, Food and Rural Affairs, Ontario.

Sample Size Calculator. 2003. Creative Research Systems. Accessed July 2007, at http://surveysystem.com/sscalc.htm

Statistics Canada CANSIM, 2006. 2006 census of agriculture. Accessed July 2007, available at http://www.statcan.ca/english/freepub/95-629-XIE/2007000/tables_menu.htm.

Steevens, B.J. & Garrett J.L. 1997. Comparative Values Calculated from Crude Protein, NE lactation, Calcium and Phosphorus. University of Missouri-Columbia, Missouri.

Torell, L.A., Rimbey, N.R., Tanaka, J.A., 2006. On Why Grazing Permits Have Economic Value. University of Wyoming, Department of Agricultural and Applied Economics. Accessed July 2007, available at http://agecon.uwyo.edu/WAEA/2006AssnMtg/Proceedings/Torell_IB.pdf