Ontario Beef Producers' Attitudes about Artificial Insemination

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ABSTRACT

ARTIFICIAL INSEMINATION IN THE ONTARIO BEEF INDUSTRY: CHARACTERISTICS AND ATTITUDES OF BEEF PRODUCERS

Characteristics and attitudes of Ontario beef producers who us artificial insemination (AI) and those who use natural breeding wer compared. Natural breeders are characterized as larger and more commercia and profit oriented. Time, convenience, and problems with heat detectio are the main problems natural breeders associate with AI.

ONTARIO BEEF PRODUCERS' ATTITUDES ABOUT ARTIFICIAL INSEMINATION

The dairy, swine, and poultry sectors have made large gains in productivity in part due to genetic selection through artificial insemination (AI). The beef sector has not kept pace with this rapid genetic improvement. Beef producers use AI, but not to the extent that other livestock producers do. For example, the Ontario AI Centres estimate that over 95% of the dairy producers in their areas use AI, but only 5-10% of the beef producers do (O'Connor).

The primary advantage of AI over natural breeding is the faster spread of genetic improvement throughout a herd (Lasley). There also can be cost advantages from AI. For an average-sized (30 cow) Ontario cow-calf operation (Howard and Filson 1995), an ampule of semen from a high quality bull usually costs less than the per-head annualized cost of owning and maintaining that bull. Hence, AI can help smaller operations to access better genetics at a lower cost. There can be difficulties associated with AI. Cows in heat need to be identified, collected and inseminated, which requires more managerial ability and labour time than does natural breeding. More facilities to work and hold cows are also required with AI. However, AI is generally regarded as both efficient and beneficial. Given the relative advantages of AI in the beef industry, the question is why do so few beef producers use AI on their herds?

This paper an analysis of characteristics and attitudes of Ontario beef producers about AI. In particular, AI users and non-users are identified in terms of farm and personal characteristics, and attitudes about breeding objectives, ease of AI, and business strategy. It is hypothesized that beef producers who use AI may receive more marginal utility from owning and working cows and from the prestige associated with herd improvements than from profits from their beef operations; i.e., a beef enterprise may have an aspect of "hobby enterprise" even on otherwise commercial farms. Results from this analysis provide insights about technology adoption and "hobby farm" enterprises, as well as insights that can help AI centres increase the marketing of their services to beef producers.

THEORETICAL MODEL

Genetic improvement can be viewed as a form of technical change; in effect, an improved genetic trait is a modification of the existing beef production technology. Beef producers implicitly know the value of a specific genetic trait, and bid up the price of a bull possessing that trait (Kerr). This scenario assumes that beef producers have perfect information about a bull's genetic traits and that their objectives are economic; e.g., profit maximization, cost and/or risk minimizing. However, non-economic objectives, such as social and personal factors, have not been rejected for small, part-time beef operators (Young and Shumway). Hence, it may be reasonable to assume that the objective of some beef producers is utility maximization, where utility is a function of several economic, social and personal factors.

Ontario beef producers can be assumed to behave as if they maximize utility, specifically:

(1) $$U = U(\_, l, E|Z),$$

(2) $$\_ = PF(NB, AI, L, K|Z) - C_{ai}AI - C_{nb}NB - w(t_{ai}AI + t_{nb}NB + L) - C(K)$$

(3) $$l = l[B(Q(AI, NB)), R|Z]$$

subject to

(4) $$T = L + l + t_{ai} + t_b$$

where U is a well-behaved utility function, _ is net profit from the beef operation, l is leisure time, E is other income, and Z is a vector of social and personal characteristics. Beef is produced with a well-behaved production function, F(.), by AI cr natural breeding (NB), operator labour L, and other fixed and variable inputs K, including cows, land, equipment, feed, etc. Beef is sold at price P. Breeding has positive non-labour costs C_{ai} and C_{nb} and requires time t_{ai} and t_{nb}, for AI or natural breeding, respectively. Breeding time is valued at the farmer's opportunity cost wage rate w, and other costs are a function of other inputs, C(K).

Leisure, l, is a function of the beef enterprise, B(Q), and other activities, R, where Q is an indicator of "quality", as determined by the show ring, genetic potential, or some other attribute that provides "bragging rights" for the farmer. The relationship between the quantity of beef produced and B(Q) is indetermanent, but $B(Q) > 0$ if $F(.) > 0$, $B(Q) = 0$ otherwise, and $dB/dQ > 0$. Quality (Q) can be obtained through either AI or NB.

Available time, T, is limited, and is allocated among productive (i.e., income generating) labour L including beef activities (not including breeding), leisure (which may include beef activities), and beef breeding.[1]

Solving equation (1) with constraint (4) and re-arranging yields:

$$(4) \qquad MVP_i = C_i + wt_i - (U_l/U\_)\,(dl/dB)(dB/dQ_i)$$

where i refers to AI or NB. If $MVP_{ai} > MVP_{nb}$, the producer will use AI rather than NB; otherwise, NB will be used. However, the decision is not based entirely on the costs and returns of the breeding method. If the producer receives utility from having and working with cows, and AI provides more
"quality" than NB does, then it is possible that the leisure aspect of AI, the "bragging rights" associated with high quality beef, are more important than the profits received from the beef enterprise. Hence, it is reasonable to hypothesize that the decision to use AI or NB may be based on the relative costs and returns from AI and NB, the time required for breeding, whether or not owning and working cows enters the producer's utility function directly, and the producer's relative marginal utility from leisure and profit.

METHODS

Equation (4) can not be directly estimated; the expected MPV from AI or NB are difficult if not impossible to obtain and it is not possible to directly observe and quantify a farmer's marginal utilities from profit and leisure. However, the decision to use or not use AI is observable and farm and farmer characteristics, attitudes, objectives and strategies can be used as indirect proxies for the factors that lead to the breeding decision. Hence, the breeding decision (AI use or non-use) can be modeled as a function of farm and farmer characteristics and attitudes. A discussion of these characteristics and attitudes expected to affect the breeding decision follows.

Farm size, facilities, and type of operation were thought to directly affect MVP of AI or NB, and to indirectly affect the marginal utility received from having and working cows. Acres owned and rented/leased, size of herd as indicated by number of females calving, and what percent of the herd was purebred were expected to affect the breeding decision. Types of restraint facilities were expected to be associated with the breeding decision, as it is easier to inseminate a cow restrained by a squeeze chute than one restrained by a head gate or a tie rail.

Previous studies indicate that a farmer with a high level of human capital, as indicated by education, experience, and industry knowledge and involvement, is better able to seek out, process, and use information about a new process or technology (Kahldi 1975, Rahm and Huffman 1984, Zepdea 1990). Age can also be an important factor, as older farmers may not have a long enough time horizon to full benefit from a new process or technology. Hence, age, education, years farming, and attendance at extension/farm meetings and membership in community organizations were included as explanatory variables.

Relative marginal utilities of profit and beef cows as a leisure activity can not be directly estimated, but information about farm and family income, perceived debt levels, and a self-description of the beef enterprise as either a hobby, part-time, secondary, or full-time enterprise, indicate the relative importance of the beef enterprise as a profit generating operation. Amount of time spent with cows by season indicates the attention given to the cow enterprise. Additional information about the relative importance of profit in the beef enterprise can be gather by direct questioning.

Willingness to pay for AI is an indication of the importance of relative prices and costs of AI in the breeding decision. Additionally, producers were asked rank the importance of various breeding decision criteria, the usefulness of several information sources for breeding decisions, and their reasons for choosing AI or NB and their general level of satisfaction with their local AI centres.

Farm and personal characteristics, business strategies, attitudes and breeding objectives were compared between the AI users and non-users to see if the two groups could be differentiated. T-statistics were used to determine if the mean values of the characteristics and attributes of the AI users and non-users were significantly different.

A censored Tobit regression model was used to estimate the relationship between AI use and farm and farmer characteristics and attitudes:

(6) $AI^* = f$(farm and farmer characteristics and attitudes).

The dependent variable AI^* was percent of the herd bred using AI, which ranged from 0% to 100% The Tobit model censors the predicted dependent variable AI^* such that:

(7a) $AI^* = B'X + e$,

(7b) $= 0$ if $AI^* < 0$, and

(7c) $= 1.0$ if $AI^* > 1.0$,

where X is an nxn matrix of independent variables, B is a conformable vector of paramters, and e is a normally distributed error term, $E[e] = 0$ and $E[e'e] = v^2$. Maximum likelihood procedures yielded consistent parameter estimates and "asymptotic" t-values (Judge et al. 1982).

Parameter estimates from a Tobit model can not be evaluated directly, as in an OLS or GLM regression. Given a Tobit model as in equation (7), the affect of a change in an independent variable X on AI^* can be obtained from

(8) $dE[AI^*_i|X_i]/dx_i = BF_i[(B'X_i)/v]$,

where F_i is the cummulative distribution function of a standard normal random variable evaluated at $Z_i = X_iB/v$ (Greene 1993, p.695).

RESULTS

Data

Ontario beef producers were surveyed by mail in summer,

1993. The initial purpose of the survey was to determine differences between AI users and non-users in order to improve marketing of AI to non-users. Fifteen hundred randomly selected participants in the Ontario Beef Herd Improvement Program plus an additional 385 producers who had an account with one of three Ontario AI Centres funding the study were surveyed. This latter group did not necessarily use AI exclusively, but they had had contact with an AI Centre in the past two years. This non-random sample was mixed with the random sample to increase the number of AI user responses. Initial estimates from the AI Centres were that only 5-10% of Ontario beef producers used AI; a small response rate would have made statistical comparison of AI users and non-users difficult.

The response rate was 25%, which is low considering that Dillman's Total Design Method was used.[2] Given the sampling procedure, the results are expected to be biased towards AI use: 49% of the respondents said they used AI, which is thought to be much higher than the frequency of AI use by Ontario beef producers. However, the sample allowed for comparison of the characteristics and attitudes of AI users and non-users.

Few respondents used 100% AI breeding. Farmers who consider themselves AI users will often have a "clean-up" bull to breed those cows not bred by AI. Similarly, many farmers who use a bull for most of their cows may use AI on selected cows or heifers. To include these farmers who were "mostly AI using" or "mostly non-using", farmers were classified as AI users if they used AI on at least 85% of their herd, while non-users used AI on less than 15% of their herd.[3] Within the AI user group, 57% used AI on all their animals, with 40% indicating use of a clean-up bull. Within the non-user group, 60% said they had never used AI; 40% had used AI at one time but no longer did. The sorted sample was 130 AI users and 160 non-users

Farm and Personal Characteristics

Farm size and facilities of the two groups are reported in Table 1. The non-users' operations were approximately twice the size of AI users' operations in terms of acres owned and acres rented/leased and females calving. Ownership of restraining equipment was mixed. AI users had significantly more tie stalls/headrails, but non-users had more head gates and squeeze chutes than did non-users. Only 4% of the AI and 2% of the non-users did not report any type of restraint. Non-users were less likely to have a purebred herd, or conversely, non-users were more likely to have a cross-bred, commercial herd.

There was only one significantly different demographic characteristic: on average, AI users were three years old than non-users (Table 1). There was no significant difference in years farming, off-farm work by self or spouse, or level of education (education reported in Table 2.)

The producers were asked to estimate the amount of time they spent with their cows at different times of the year (Table 1). Artificial insemination users reported spending twice as much time with their cows during breeding season as did non-users. This difference is not surprising given that AI requires handling and restraining a cow, while NB only requires putting a bull in a pasture with one's cows. Not so easily explained is that non-users reported spending more time with their cows during calving season than did AI users. It is possible that AI users select for breeds and specific bulls for calving ease, especially with first-calf heifers. Non-users would likely have only one bull for the entire herd, and may select for a characteristic other than calving ease. Subsequently, they would have to spend more time assisting with calving. The time spent with cows is not significantly different the rest of the year.

Non-users appeared to be more socially active than AI users. Non-users attended significantly more extension/farm meetings per year, and were more likely to be a member of a community organization. However, there was no significant difference in membership in professional organizations.

Questions on farm and off-farm family incomes were categorical, as reported in Table 2. Both groups had mean farm incomes in the $0-15,000 category, but non-users had significantly more producers in higher income categories. Non-users also had more off-farm family income. Self-assessed debt levels were also categorical (i.e., "My debt level is none, low, moderate, high"). Both groups had means in the "moderate" category, but non-users had significantly more producers who thought that they had higher levels of debt.

The producers were asked to classify their farms as either a hobby, part-time, secondary enterprise, or full-time operation. The mean response for both groups was "secondary enterprise", but

AI users were more likely to have "hobby" or "part-time" beef enterprises. Producers were also asked a number of questions about their business strategy. Using a Likert scale (1 = agree, 4 = disagree), there was no difference between the two groups about definitions of success, wish to pass the family farm to the next generation, or the importance of recommended business practices. However, significantly more non-users agreed that "profit maximization is my top priority" than did AI users.

Attitudes and Breeding Objectives

Not surprisingly, AI users stated a greater willingness to pay for AI, but the amount was not significantly different from the amount stated by non-users, as reported in Table 1. The variance around the AI users' response was significantly larger than the non-users' response, possibly indicating the wide range of semen prices.

All producers were asked to rank (1 = very important to 5 = not important) their decision criteria for a breeding decision and/or buying a bull. Both AI users and non-users ranked in order of importance breed, temperament, calving ease, and maternal ability. There were no significant differences between the rankings of the top four criteria. However, there were significant differences between the top for criteria and second tier criteria: weaning weight, yearling weight, and EPD[4]. Cost (of AI or a bull) was significantly ranked as least important. Even though productivity indicators were second tier criteria, when all producers were asked in a separate question to rank the benefits of AI, known ratings on calving ease, weight gain, etc., were ranked second to superior genetics. Added genetic alternatives was ranked third.

Both non-users and AI users who had a bull for selected cows ranked convenience and difficulties with heat detection as the most important reasons for using natural breeding. Cost of semen, total AI costs, and lack of facilities were ranked as not important reasons for using natural breeding. Convenience, time required for AI, and difficulties with heat detection were also cited as reasons for producers who had used AI in the past but stopped.

Users and non-users had different rankings for the usefulness of sources of information for breeding and management decisions. For breeding decisions, users ranked, in order of usefulness, leading breeders, veterinarians, and AI technitions. For non-users the order was veterinarians, leading breeders, and magazines/newspapers. Both groups ranked veterinarians as their second most important source of management information, but users ranked magazines/newspapers first and extension agents third, while non-users reversed the rankings.

Not surprisingly, AI users were more satisfied with the service and information provided by their AI technicians than were non-users. In fact, non-users cited superior genetics, improved service, and more complete information about AI bulls as the most important factors that AI Centres can provide in order to make AI more attractive. However, non-users preferred pictures and videos tapes of a bull to a page of statistics on that bull's production indices. There was no significant difference in demographics between the two groups, other than age, but this preference for pictures and videos over statistics indicates that AI users may have a higher level of human capital than the NB producers.

Tobit Model

Only 115 surveys reported all the variables listed in Tables 1 and 2. There were 40 limit observation (i.e., 0 or 1) and 75 non-limit observations (i.e., between 0 and 1). Indepdendent variables were the continous variables reported in Table 1, which entered the model at their value, and the categorical variables reported in Table 2, which entered as integers corresponding to the category level (e.g., for farm income, 1 = less than $0, 2 = $0-15,000, etc.). The model was estimated using LIMDEP 6.0, which allows both upper and lower limit truncation (Greene 1987). The log likelihood function was relatively large large (-91.28), and seven of the 23 independent variables had asymptotic t-values significant at the 0.10 level or better, as reported in Table 3.

The results of the Tobit model indicate that large, commercial beef producers do not use AI, and that the producers who do use AI are not as commercially oriented as non-users. Acres owned, number of females calving, farm income, and profit as a priority have negative parameters. Percent of herd purebred was positive and significant. The common a priori belief that producers with higher levels of human capital (proxied by age, education, and experience) are more likely to adopt a new technology such as AI is not supported by these results. Age was positive and significant, but education and years farming were negative.

Types of restraint facilities appears to affect the breeding decision. Having a head gate, which is used mainly for administering medications, was negative, while having a squeeze chute, which can be used to restrain an animal for both medication and AI, was positive. The magnitude on the slope of the head gate was more than twice that of the squeeze chute, but neither parameter was significant.

The amount of time spent with cows during the breeding season is positive and significant. It is questionable if this is truely an independent variable. AI users would naturally spend more time with their cows during breeding season than non-users would.

These results are not inconsistent with the hypothesize that the use/non-use of AI may be based as much on the marginal utility of "bragging rights" as on the relative costs and returns from AI and NB. Social characteristics appear as important as business characteristics in explaining AI use. Membership in a community organization negatively and significantly affected the percent of herd AI. Stating that profit in the beef enterprise is a high priority was also negative and significant, but the slope of the community organization variable was more than twice the magnitude of the slope of the profit variable.

SUMMARY AND DISCUSSION

A survey of AI users and non-users in the Ontario beef industry indicates that there are several significant differences between the two groups. Beef producers who prefer natural breeding to AI can be characterized as having larger operations, are more likely to have cross-breeding strategies, and are more commercially oriented than their AI-using counter parts. Non-users also have higher farm and off-farm incomes than users (even though both users and non-users work about the same number of weeks off-farm), spend less time breeding their animals, and attend more extension/farm meetings and are more likely to be members of community organizations.

The hypothesis that beef producers who use AI may receive more marginal utility from owning and working cows than from profits from their beef operations can not be rejected based on the results of this study. Non-users had larger herds than did AI users, which indicates that AI users may not be exploiting economies of size. Nor are AI users primarily producing for the slaughter market: non-users were more likely to have cross-bred herds, which are often preferred over pure-bred animals by slaughter houses. Moreover, AI users compared to non-users were more likely to have beef has a secondary, part-time, or hobby enterprise. Lastly, non-users were more often in agrement that "profit maximization" was their top priority.

The Ontario AI Centres can use the information from this survey to improve their marketing of AI to non-users. First, time, convenience, and heat detection were all important factors cited for preferring natural breeding. Decreasing the time required for AI, and hence increasing its convenience, will increase its attractiveness to non-users. Second, veterinarians are important sources of breeding and management information for all beef producers. Forming strategic alliances with veterinarians could be very beneficial to the AI Centres. Third, the AI Centres could target the greater attendance at extension/farm meetings and membership in community organisations through sponsorship of events and organizations. Lastly, the preference of non-users for pictures and videos indicates that visuals may be more effective advertising than a complete list of expected genetic gains.

FOOTNOTES

1. Labour is restricted to operator labour only. This restriction simplifies the analysis, but is also consistent with Ontario beef production. Additional labour, either family or hired, is generally limited to seasonal casual labour (e.g., haying) or to professional services, such as for AI or veterinary activities.

2. Similar surveys in Ontario using Dillman's techniques have had response rates of 60-80%. However, the higher response rates were from surveys distributed in the winter. The low response rate may have been due to being distributed in the summer.

3. A reviewer questioned this separation. Categorizing into producer groups who mostly used AI and mostly used NB was necessary to compare the characteristics and attitudes of AI and NB breeders. The 15/85% separation was somewhat arbitrary, but the frequencies did cluster in those ranges.

4. Estimated Progeny Difference in an indicator of how much larger a bull's offspring will be.

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Table 1.Descriptive statistics of AI users and non-users in the Ontario Beef Industry.

Characteristic	Unit	AI User	Non-User
Acres Owned	acres	134*** (113)	220*** (206)
Acres Rented/Leased	acres	47*** (96)	128*** (224)
# of females calving	head	18*** (17)	39*** (32)
Restraint Facilities:			
tie/headrail	percent	47%*** (0.50)	22%*** (0.41)
head gate	percent	53%*** (0.50)	79%*** (0.40)
squeeze	percent	40%** (0.49)	57%** (0.49)
% of herd purebred	percent	46%*** (0.45)	30%*** (0.39)
Age	years	51** (13)	48** (13)
Years farming	years	25 (16)	25 (14)
Extension/farm meetings	# of meetings	3.5*** (6.3)	5.6*** (7.2
Community Organization	% members	63* (0.49)	75* (0.43)
Off-Farm work:			
self	weeks	32 (25)	28 (25)
spouse	weeks	43 (42)	40 (42)
Time spent w/ cows:			
breeding season	hrs/day	3.4*** (5.0)	1.7*** (2.2)
calving season	hrs/day	4.5**(4.1)	5.9**(5.2)
rest of year	hrs/day	2.2 (1.8)	1.8 (1.8)
Amount willing to pay for AI	$	17.47 (20.11)	14.30 (7.72)

Standard deviations are in parentheses.
Means are significantly different from one another at the
*** = 0.01 level, ** = 0.05 level, and * = 0.10 level.

Table 2. Descriptive statistics of categorical responses of AI users and non-users in the Ontario Beef Industry.

Characteristics	% Frequency of	
Category	AI User	Non-User
Farm Income* **		
1. less than $0	14%	11%
2. $ 0 - 15,000	53	36
3. 15,001 - 30,000	21	27
4. 30,001 - 50,000	3	12
5. 50,001 -100,000	5	9
6. over 100,000	2	5
Family Income* **		
1. less than $0	3%	1%
2. $ 0 - 15,000	10	11
3. 15,001 - 30,000	30	19
4. 30,001 - 50,000	24	27
5. 50,001 -100,000	27	10
Debt Level* **		
1. none	50%	33%
2. low	31	34
3. moderate	16	23
4. high	4	10
Description of Beef Operation* **		
1. hobby	9%	5%
2. part-time	28	17
3. 2nd enterprise	15	24
4. full-time	49	54
"Profit is my highest priority." **		
1. agree	24%	37%
2. somewhat agree	58	51
3. somewhat disagree	13	8
4. disagree	6	4
Highest level of education		
1. elementary	13%	12%
2. some high school	23	23
3. completed high school	21	17
4. some college/univ.	10	11
5. college diploma	14	19
6. university degree	9	7
7. grad. or prof. degree	10	12

Mean categorical responses significantly different from one another at the *** = 0.01 level and ** = 0.05 level.

Table 3. Mean values, parameters estimates, asymptotic t-values, an slopes from a truncacted Tobit model of percentage of herd bre using AI.

Variable	Mean	Parameter	t-value	Slope
constant	na	0.2153	0.256	na
acres owned	197.96	-0.0005	-1.036	-0.0004
acres rented/leased	119.27	0.0002	0.335	0.0001
# females calving	31.68	-0.004	-1.281	-0.0031
restraint facilities:				
tie/headrail	0.32	-0.0966	-0.473	-0.0679
head' gate	0.72	-0.3415	-1.495	-0.2400
squeeze chute	0.55	0.1436	0.719	0.1009
% of herd purebred	55.04	0.0066	3.044**	0.0047
farm income	2.74	-0.2247	-2.686***	-0.1579
family income	4.29	0.0810	0.846	0.0569
debt level	1.99	0.0404	0.370	0.0284
type of beef oper.	3.17	0.0286	0.248	0.0201
profit priority	1.90	-0.2334	-2.020**	-0.1641
age	46.71	0.290	2.544***	0.204
education	4.20	-0.0518	-0.940	0.0145
off-farm work				
operator	28.52	-0.0036	-0.995	-0.0025
spouse	25.40	-0.0008	-0.211	-0.0005
years farming	20.77	-0.0182	-1.877*	-0.0128
time spent w/cows:				
breeding season	2.57	0.1418	2.877***	0.0996
calving season	5.49	-0.0190	-0.981	-0.0133
rest of year	1.92	-0.0288	-0.640	-0.0202
AI - willingness to pay	15.61	0.0163	1.537	0.0114
extension meetings	6.64	0.0102	0.993	0.0071
community organization	0.77	-0.5397	-2.426**	-0.3793

Significant t-value at the *** = 0.01 level, ** = 0.05 level, and * = 0.1 level.