Farmers' reaction upon receiving economic information in controlling somatic cell count

H Hogeveen[1,2], MAPM. van Asseldonk[3], RJ Renes[4] and TJGM Lam[5]

[1]Department of Farm Animal Health, Faculty of Veterinary Medicine, Utrecht University, Utrecht, The Netherlands

[2]Chair group Business Economics, Wageningen University, Wageningen, the Netherlands

[3]Agricultural Economics Research Institute, Wageningen University and Research Centre, Wageningen, The Netherlands

[4]Chair group Communication Management, Wageningen University, Wageningen, The Netherlands

[5]Dutch Udder Health Center UGCN, Deventer, The Netherlands

Abstract

Adoption and implementation of efficient somatic cell count (SCC) control practices is an action of behavioral change, which is notoriously difficult to achieve and sustain, even when substantial production and economic gains are to be expected. In the current study, it was tested whether farmers are aware of these potential gains and whether providing farmers additional information on projected economic losses on a regular basis may motivate them to implement enhanced control practices. In-depth interviews revealed that the majority of the dairy farmers perceived cow-specific and herd-specific projected losses, due to elevated SCC levels, as not very relevant to them. Farmers posed that SCC was already monitored regularly at cow-level and provided them adequate information to support decision making. Actions were rationalized in a specific context comprising the intertwined notions of intentions and efficacy believes. Understanding of these notions is essential when advising farmers, being either veterinarians or others providing agricultural extension, to support farmers implementing enhanced management decisions.

Keywords: economics, behavior, subclinical mastitis, production losses

Introduction

Dairy industries, worldwide, use the bulk tank somatic cell counts (BTSCC) as a quality criterion. By means of bonuses and or penalties, farmers have financial incentives to produce under a certain BTSCC level (Schukken *et al*. 1992; Valeeva *et al*. 2007). Moreover, it is well known that elevated SCC levels deprives milk production and reduces farm profitability (Halasa *et al.* 2007; Hortet and Seegers 1998). These production losses can be a financial incentive too. However, an inherent problem related to financial incentives due to increased SCC is that there are no observable abnormalities in the milk or udder disorders, and stay therefore "hidden". Many farmers are involved in a milk production recording (MPR) scheme including measurement of cow SCC. Given the relation between cow SCC and milk yield, it was hypothesized that incorporating the projected production losses and its economic consequences in the MPR listings might motivate farmers to control SCC more stringently.

The goal of this research was to test the hypothesis whether economic information on the effects of high cow SCC makes farmers more aware and whether it is an incentive to motivate farmers to alter their intent with respect to applied SCC control strategies.

Material and methods

Participants

CRV provides MPR services for Dutch dairy farmers and maintains a historical database on production and other herd specific variables. From this data base, a sample, stratified by BTSCC, of 100 dairy farms was drawn. In total, 19 dairy farmers of this group were interviewed. During the farm visit, a newly developed information tool, focusing on the previous MPR period, was presented. The tool comprised three spreadsheet folders. The first sheet was the standard cover sheet of the MPR list comprising the key rolling herd statistics as well as the

absolute level of BTSCC. Projected production losses (kg per farm per year) and its economic (Euro per farm per year) impacts, that might support farmers in their decision making to control BTSCC, were appended. In the second sheet the impact of hypothetical reduction in BTSCC on production losses and its economic impacts were graphically displayed with a bandwidth of 50,000 cells/ml and 400,000 cells/ml. The third sheet focused on elevated cases in the current lactation including economic information (losses per cow per year).

Milk production losses were calculated using a log-linear relationship between SCC and deprived milk production (Halasa *et al.* 2009):

$$Y = \sum_{j=1}^{J} -1*(0.72 + \ln(SCC_j)*-0.22) + \sum_{k=1}^{K} -1*(1.90 + \ln(SCC_k)*-0.47) \qquad SCC_{\cdot} \geq 100$$

Where Y is the deprived daily yield at farm level as a result of elevated SCC (*1000/ml) beyond and including the level 100,000 cell/ml, SCC_j refers to primiparous cows (j), while SCC_k refers to multiparous cows (k). Thus it was assumed that milk yield reduces by 0.29 kg/day at a level of 100,000 cells/ml for primiparous cows, while at levels of 200,000 cells/ml, 300,000 cells/ml and 400,000 cells/ml the deprived production amounts 0.45 kg/day, 0.53 kg/day and 0.60 kg/day respectively. Given these SCC levels, milk yield is reduced for multiparous cows by 0.26 kg/day, 0.59 kg/day, 0.78 kg/day and 0.92 kg/day respectively.

Assumed costs related to a milk production decrease were set at 0.12 Euro per kg for an intensive farming system, 0.10 Euro per kg for an extensive farming system, 0.08 Euro per kg for a very extensive farming system (Huijps *et al.* 2008).

Data collection and data analysis

Perceived values, awareness, intentions end efficacy believes were elicited via five-point Likert Scales during in-depth farm interviews of about 1.5 hours. The perceived value of information for these four approaches, were rated in according to how much it was appreciated. Furthermore it was elicited how much the objective amounts deviated from the farmers' believes. Open-ended

questions focused on the impact that these projections would have on the preferred control strategy. This part of the dialogue concentrated therefore on explaining the action / behavioral change of the farmer in specific situations. The aspiration level, in terms of the desired level, was asked to clarify motivation to change management practices to control (BT)SCC. The perceived probability of penalties was ascertained. Additionally, the perceived managerial efforts made to control SCC is self-rated by comparing the farmers' efforts with those of colleagues.

Results and discussion

Descriptive statistics

The average herd seize, production level and BTSCC on the 19 farms was respectively 76 cows, 8,394 kg/cow/305 days and 210,000 cells/ml. Across farms, substantial differences between BTSCC levels were observed. The average BTSCC in the sub-sample comprising farms below the median was 137,000 cells/ml, while for the farms above the median this was 276,000 cells/ml (Table 1). Across farms, a broad bandwidth BTSCC levels were observed thus the original stratification was maintained and is moreover a good representation of the actual population.

In line with observed BTSCC levels, substantial differences in production losses across farms were estimated. The estimated average annual production loss was 6,218 kg milk per farm, and 83 kg milk for cows with a SCC exceeding 100,000 cells/ml (Table 1). On average, an annual loss of 4,885 kg milk per farm was estimated in the BTSCC group below the median (i.e., 67 kg milk per cow), while for the BTSCC group above the median this was 7,417 kg milk per farm (i.e., 97 kg milk per cow). Production losses on farms with a more homogeneous herd exceed those of more heterogeneous herds, although BTSCC do not differ. This originates from the fact that farms with identical bulk BTSCC and herd size can have different yield deprivation levels. The average annual loss amounted 850 Euro per farm per year and 11 Euro per cow per year, with substantial differences between and within groups.

Table 1. : Statistics of rolling herd averages and production losses of subclinical mastitis due to SCC in surveyed herds, subdivided into a high and low BTSCC

	All	Low BTSCC (<175.000/ml)		High BTSCC (≥175.000/ml)	
	n=19	n=9		n=10	
		Mean	StD	Mean	StD
Herd statistics					
BTSCC (1000/ml) *	210	137	29	276	88
Herd size (number of milking cows)	76	73	24	78	24
Milk (kg/cow)	8,394	8,727	841	8,095	897
Fat (kg/cow)	372	386	43	359	46
Protein (kg/cow)	297	307	31	288	32
Lifetime of cows (days)	1,540	1,524	209	1,554	146
Intensity of production (kg/ha) *	16,490	19,088	6,776	14,152	4,509
Loss projection					
Production loss (kg/farm/year)*	6,218	4,885	1,575	7,417	2,676
Production loss (kg/cow/year))*	83	67	9	97	24
Economic loss (Euro/farm/year)	850	703	249	982	432
Economic loss (Euro/cow/year)*	11	10	2	13	4

* Statistical significant difference between sub-samples P<0.10

Perceived value of information

The majority of the dairy farmers interviewed didn't perceive the cow-specific projected losses as valuable; their average rating was 1.84 on a five point scale ranging from "not valuable" up to "valuable" (Table 2). In general, respondents did not question the validity of the estimated projections. Although projected losses were decomposed into yield loss and monetary loss (both being farm-specific), farmers found it difficult to discriminate between these two alternative units of measurement and thus rated them always identical. However, farmers could easier express losses in terms of physical units than framing it into monetary losses. The presence of

more room for improvement on a farm was not associated with an increased appreciation of the revealed information, as can be seen by comparing the BTSCC group ratings.

Table 2. Evaluation of the information tool on economic losses due to elevated SCC

	All	Low BTSCC (<175.000/ml)		High BTSCC (≥175.000/ml)	
	n=19	n=9		n=10	
		Mean	StD	Mean	StD
Perceived values					
Information at farm level [1]	2.32	2.44	1.23	2.20	1.47
Information at cow level [1]	1.84	2.11	1.45	1.60	0.84
Awareness					
Deviation from perceived production loss [2]	2.74	2.67	0.71	2.80	0.42
Perceived deviation from other farmers [3] *	3.00	3.89	0.60	2.20	0.79
Absolute deviation SCC from herdbook average (1,000/ml) *	-1	-65	36	36	87
Intention					
Aspiration level SCC, (1,000/ml) *	149	116	24	178	48
Actual minus aspiration SCC (1000/ml) *	49	28	28	68	46
Efficacy belief					
Perceived probability of penalties [4]	2.55	2.22	0.87	2.85	0.88
Perceived efforts made to control SCC [5]	3.26	3.44	0.68	3.10	1.19

[1] 1=not valuable; 3=somewhat valuable; 5=valuable.

[2] 1=much lower than expected; 3=in line with expectation; 5=much higher than expected.

[3] 1=much higher than other farmers; 3=in line with others; 5=much lower than other farmers.

[4] 1=never occurs; 2=very unlikely; 3=unlikely; 4=possible.

[5] 1=much less than other farmers; 3=in line with others; 5=much more than other farmers.

* Statistical significant difference between sub-samples P<0.10

Awareness

Only supplementary information adds to the knowledge and thus the *awareness* of the person receiving it. Projected losses were mostly in line with their approximations (2.74; Table 2). Farmers were often lacking confidence and were reluctant to disclose their "guesstimates". There was however a tendency of relief since projected losses did not exceed their approximations. Deviations between projections and the perceived production loss were not statistically different between BTSCC groups. Almost all farmers anticipated that losses are absent if the SCC is below 100,000 cells/ml. A complementary variable showed that farmers were well aware of their achievements compared to those of colleagues. The low BTSCC herds rated themselves as such, as did the high BTSCC herd. For example, the low BTSCC group – with an actual average deviation of -65,000 cells/ml – consistently rated themselves as having better results than other farms (average score of 3.89 and standard deviation of 0.60) compared to the high BTSCC group (average score of 2.20 and standard deviation of 0.79).

Intentions

A farmer who knows the impact that elevated SCC levels have on production, might have a more ambitious intention to reduce it. Aspiration levels were expressed as feasible levels according to the farmers and differed across them. Average aspiration levels amounted 149,000 cells/ml with a difference between actual and aspiration level of 49,000 cells/ml (Table 2), while for the high BTSCC group this was 178,000 cells/ml (68,000 cells/ml difference). None of the farmers made efforts to achieve lower levels than 100,000 cells/ml. In an open dialogue it was enquired what the justification was of exceeding BTSCC levels from a production wise more attractive level of 100,000 cells/ml. Provided statements were condensed into three main themes, with declining importance, referred to as cost effectiveness, expansion plans and technical limitations. This part of the elicitation focused on exploring and describing a spectrum of views,

rather than quantifying the opinions with respect to all the underlying and complex sub-themes. Farmers in the high BTSCC group justified their moderate aspiration levels because alternations would affect the overall farm management strategy preferred. Moderate aspirations were also rationalized by linking projected gradual herd expansion plans to less restrictive culling strategies. Ultimately, the justification was, at least to some point, to decrease the unit production cost (economies of size). In case of an investment shock, the expansion would require new housing facilities and milking equipment, facilitating more challenging aspiration levels. Some of the farmers, with relative high BTSCC levels, pinpointed technical limitations, such as outdated housing facilities, to justify relative moderate aspiration levels. Without having intentions or financial resources, strategic investments were not considered.

Belief in efficacy

The belief in efficacy of the current approach towards SCC management was discussed in relation to the perceived risk of penalties and efforts made to control SCC given the current control strategy applied. Farmers with higher cell counts were also well aware of the probability of adverse outcomes with respect to milk payments (Table 2). They rated the probability of penalties as unlikely (2.85) while the respondents with lower SCC perceived it as very unlikely (2.22). However, none of the farmers were confronted actually with a penalty in the past five years.

Culling of notorious high SCC cows was regarded by farmers with high BTSCC levels as a last option, but at the same time as a very effective way to avoid penalties.

In this research, we focused on perceived effort (and the farmers' belief in them) in line with the conceptual model of Ajzen (1991) and not actual effort since we did not elicit actual time and money spent. Therefore the association between the perceived effort/behavioral control, given the mastitis treatment strategy applied, and behavior could be quantified. Both groups perceived that they were more motivated to control subclinical mastitis by comparing their efforts with

those of colleagues. Some farmers might have overstated their efforts either by providing social desired answers or that information about the efforts made by others was lacking or not appropriate valued. The cow-specific loss information did hardly alter their intent to change their mastitis management. Perhaps showing farmers efficient options available to them and support decision making may alter their intent and ultimately behavior.

Farmers' choices were shown to be coherent, in the way that actual behavior was associated with stated intentions together with perceived behavioral control. However their decisions often seem to differ from the standard recommendations by veterinarians and agricultural extension workers. Farmers with relative high BTSCC levels were well aware of their situation; therefore, providing specific information on the economic consequences did hardly alter their actions. Their actions can be rationalized in a specific context comprising the intertwined notions of intentions and efficacy believes. Notwithstanding positive intentions but a lack of feeling of control endows farmers' capacity to deal with the real situation (Jansen *et al.* 2009). Understanding of these notions is essential when advising farmers in implementing effective decisions at farm level.

Based on this small scale study, we can conclude that the majority of the dairy farmers perceived cow-specific and herd-specific projected losses, due to elevated SCC levels, as not very relevant to them. Farmers posed that SCC was already monitored regularly at cow-level and provided them adequate information to support decision making. Actions were rationalized in a specific context comprising the intertwined notions of intentions and efficacy believes. Understanding of these notions is essential when advising farmers.

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