Use of a proactive herd management system in a dairy farm of northern italy: technical and economic results

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Abstract

Reproductive and economic data were recorded before and one year after the installation of Herd Navigator™ in a dairy farm with AMS (Automatic Milking System) located in a mountain area of Northern Italy. Number of days open reduced from 166 to 103 days, number of days between the first and second insemination decreased from 45 to 28 days, and days for identifying an abortion were 80 % less, from 31 to 6 days. The preliminary results highlight the usefulness of the proactive herd management system installed for the reproduction management. A basic economic model is proposed to evaluate the potential economic benefits coming from the introduction of this technology. The model considers the benefits deriving from the reduction of reproduction problems and, consequently, of days open. Considering the effects related to the above mentioned aspects in a case study involving 60 dairy cows, a return on investment over 5 years has been calculated.

Introduction

One of the major factors influencing the profitability of a dairy herd is reproductive performance. Following mastitis, failure in detection of oestrus is the second largest cause of economic losses to

dairy farmers (Maatje *et al*., 1997). Inefficient detection of oestrus has been found to be the leading cause of extended calving intervals (Rounsaville *et al*., 1979) and the main contributor to the lowering of fertility (Lopez *et al*., 2004). On the contrary, increasing the detection of oestrus reduces days open and increases profitability with a higher impact at lower oestrus detection rates (Pecsok *et al*., 1994).

Farris (1954) first described the increased physical activity of dairy cows during oestrus. Later studies have confirmed that the measurement of the increase in the number of steps is a useful tool for the detection of oestrus, especially if associated with a specific algorithm (Moore and Spahr 1991; Lehrer *et al* 1992; Liu and Spahr 1993; At-Taras and Spahr, 2001; de Mol *et al*., 2001; Firk *et al*., 2002; Roelofs *et al*. 2005).

Many oestrus detection systems are used in attempt to improve conception rates, ranging from the simple visual observation of the animals to more specific systems based on the measurement of the cows' activity through pedometers or collar activity meters (Holman *et al*., 2011). The effectiveness of pedometer-aided detection of oestrus, when compared with visual observation, is quite variable and ranges from 60 to 100%, depending on the study (Lehrer *et al*., 1992). Pennington (1986) reported an efficiency for visual observation of 45% and for pedometers between 78 % and 96%.

Another system for oestrus detection is the analysis of progesterone in milk (Bulman and Lamming, 1978; O'Conner, 1993; Royal *et al*., 2000; Friggens and Chagunda, 2005). In the literature, concentrations less than 3 ng/ml were considered indicative of an oestrus (Lamming and Bulman 1976). In test carried out on Danish dairy herds, an oestrus breakpoint level of 5 ng/ml was determined (Friggens *et al*., 2006).

In 2008 an advanced milk analysis tool (Herd Navigator, DeLaval, Sweden) was developed for heat detection, by measuring progesterone, mastitis detection, by measuring lactate dehydrogenase (LDH), and ketosis detection, by measuring beta-hydroxybutyrate (BHB). This system automatically takes representative milk samples of individual cows from specific milking points during milking and automatically selects, through a specific algorithm called "biomodel", which cows must be monitored and sampled at each milking session, and which parameters should be measured when the animals arrive to the milking parlour (Mazeris, 2010).

Field tests carried out in Denmark between 2008 and 2009 on three farms with more than 150 animals in lactation showed a heat detection rate (HDR) between 95% and 97%, and a conception rate (CR) ranging from 40% to 63%, using Herd Navigator (HN). Moreover, HN reduced the number of days open on an average of 22 days (Blom and Ridder, 2010). Further tests carried out in 2009 on three farms in Denmark and two farms in Holland, with an average of about 180 heads of Holstein Frisian, had showed an HDR between 97% and 100% and an improvement of pregnancy rate (PR) from a minimum of 7.7% to a maximum of 44.4% (Vreeburg, 2010).

The aim of the study was to evaluate the technical and economic benefits on reproductive management deriving from the introduction of HN in a dairy cow farm located in a mountain area of northern Italy and characterized by robotic milking.

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Materials and methods

The study was carried out from September 2011 to September 2012 in a dairy cows farm located in a mountain area of Northern Italy (Trentino-Alto Adige). On average, during the experimental period 60 cows (Holstein Frisian and Brown Swiss) were milked with a Voluntary Milking System (VMS, DeLaval, Sweden) and managed through the integrated herd management software DelPro(DeLaval, Sweden). A HN was installed on September 2011.

- HN is basically composed of:
- a milk sampling station, placed within the VMS, to collect milk samples from individual cows;
- an analysis unit, placed into the milking room, to analyse milk samples for progesterone, LHD, and BHB concentrations.

While cows are being milked, representative milk samples are taken and sent, one-by-one, to the analysis unit. A specific algorithm selects which cow to sample during a certain milking session and which parameters to measure. In particular, the prediction of the reproductive status is driven by the progesterone concentrations in milk. HN takes milk samples for progesterone analysis at varying intervals during the heat cycle, especially on the period up to a new event. After a heat the model asks for samples from day 5 to day 14 to asses if the cow is pregnant or has developed a follicular cyst. Further, the model asks for other samples after day 18 in the heat cycle to find the next heat. In cows that are bred the model follows the development in progesterone: if at day 30 after breeding the progesterone concentration is high, the model assumes that the cow is pregnant and follows the cows for the next 25 days to check for pregnancy.

Basic information describing the farm before the installation of HN such as average number of milking cows over the last 12 months, milk yield per lactation, annual culling rate, etc. were collected through the help of the farmer and the veterinarian of the farm.

During the experimental trial the reproductive status of the cows was monitored using HN. A start time of 20 days before the end of the voluntary waiting period (VWP) was set as start for progesterone measurements and when alarms occurred (follicular or luteal cist, pregnancy attention, abortion, etc.) the cows were examined by the veterinarian at the earliest convenience.

A partial budget analysis was carried out to assess the potential savings on reproductive management of dairy cows, as a consequence of the HN installation. The cash flows changes were identified at the HN introduction, and costs and benefits were evaluated over a period of 8 years from HN installation.

Results and discussion

Table 1 summarizes some basic information of the farm involved in the study, before the HN installation. The milk yield level and the difference in milk yield between 3rd and 1st lactation cows are equivalent to the values of the “Po Valley” intensive dairy farms.

The main reproductive data recorded before and after the HN installation are shown in table 2.

The absence of an electronic oestrus identification before the HN installation was the main responsible for the low HDR (45 %) and PR (18 %), and the high number of days open (166 days) recorded in the farm.

After the HN installation a strong improvement of the reproductive performance was observed. In particular the abortion identification reduced from 31 days to 6 days (-80 %), the days from 1st and 2nd insemination decreased of about 38 % (from 45 days to 28 days), while the average days open changed on average by 63 days (from 166 days to 103 days). As a consequence, the HDR has more than doubled (from 45 to 96 %), the CR increased from 40 % to 64 %, and the PR grew strongly from 18 % to about 61 %.

Main benefits and costs related to the reproductive management, resulting from the HN installation, are summarized in Table 3.

Table 1. Farm overview.

Cows in lactation [n]	60
Milk yield level [kg/lactation]	11,000
Difference in milk yield between 3rd and 1st lactation cows [kg]	1,300
Days per year with reduced attention to heats (harvest, holidays etc.) [gg]	90
Annual culling rate [%]	30
Average salary for own work [€/h]	20.00
Milk price [€/kg]	0,40
Average price for heifers - 24 months [€/heifer]	2,000.00
Slaughter price per cow culled due to reproduction problems [€/cow]	500.00
Price per insemination (semen + labour) [€]	23.00
Cost per pregnancy check [€/day]	4.00
Cost per days open [€/day]	€ 2,00
Voluntary waiting period (VWP) [days]	60

Table 2. Main reproductive data before and after the HN installation.

Reproductive data	Before HN installation	After HN installation
No. of pregnancy check per cow per lactation [n]	3.0	1.0
Veterinarian cost [€]	40.00	-
Surveillance of pregnancy check [h/check]	0.04	0.04
Time spent to heat detection [h/days]	1.0	1.0
Avg. of Days In Milk (DIM) at the first insemination [days]	85	65
Days after latest heat for identify luteal cysts (before typically by the time of pregnancy check) [days]	40	20
Cystic cows culled [%]	35.0	5.0
Days after abortion/1st heat [days]	31	6
HDR [%]	45.0	96.0
CR [%]	40.0	64.0
PR [%]	18.0	61.4
Days from 1st to 2nd insemination [days]	45	28
Average days open [days]	166	103

Table 3. Main benefits and costs related to the reproductive management, resulting from HN installation

Benefits	[euro/year]
Increase in average milk yield and less feed due to reduced days open.	7,560.00
Reduced labour	7,300.00
Reduced veterinarian costs	4,800.00
Reduced insemination costs	2,760.00
Reduced cull cows	2,092.50
Total benefits	24,512.50
Costs	
Service and sticks (130 €/year*cow)	7,800.00
Electrical power	547.50
Other	182.50
Total costs	8,530.00

Considering an initial investment of 70,000 € for the HN, a real interest of 1.5 % (net inflation), an estimated shelf life of 8 years, a recovery value of 10% compared to the initial value, and an extraordinary maintenance after 4 years as 10% of the investment value, the following indexes were calculated:
- a five-year Return on Investment (ROI);
- a net annual value of 48,500 €;
- an Internal Rate of Return (IRR) of 15%.

Up to the time in which the test was ended, the other HD function associated to mastitis and ketosis detection do not have shown their utility in improving the herd status probably due to the fact that this last was initially of a good level.

Conclusions

The test has been carried out in a mountain area farm situation in which the herd initial status was characterized by a limited cows number, good milk yield and quite low reproductive indexes. In this specific situation, the HD has shown its capacity to assure a single cow better control that has leaded to an high improvement of the average reproductive indexes. The enhancement of the economic performances related only on this aspect it has been sufficient to guarantee an acceptable ROI value for the economic investment associated to the HD adoption. It can be supposed that these encouraging results would be further improved in the future when the additional management HN management options (LDH analysis for mastitis detection, Urea and RHR for ketosis detection and feeding improvement) will produce their effect on the herd.

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