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Economic Losses Resulted from Fertility Problems in Holstein Crossbreed Dairy Cows in a Commercial Dairy Farm

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ABSTRACT

The aims of this study were to evaluate the economic losses caused by infertility in Holstein crossbreed dairy cows raised in a cattle farm in Kırşehir province. Data recorded from 294 Holstein crossbreed dairy cows between 2009-2017 were used in this study. A total of 1077 lactation records from these cows were used as study material. Age at first service (AFS), age at first calving (AFC), calving interval (CI) and number of inseminations per pregnancy (PI) parameters were evaluated. The values of AFS, AFC, CI, and PI were 491.83 days, 766.86 days, 432 days and 2.64, respectively. There were 41.83 days, 36.86 days, 67 days and 0.99 of difference from ideal reproduction values. When calculating economic losses, all detail was provided from farm zootechnician and veterinarian. The difference between the AFS and AFC (4.97 days) caused 16.189.9 TL economic cost. Economic costs of the AFC, CI, andPI were 450 162.3 TL, 1 307 852.7 TL, and 135 729 TL, respectively. As a result, it was understood that this farm had significant deviations from ideal values for fertility traits between 2009-2017 and these deviations caused 581.41 TL daily, and 1 909 933.9 TL total cost.

1. Introduction

Dairy production is an important sector all over the world since it contributes to the economy of the country and enables the production of staple foods that are essential for community health. The principal aim of such farms is to get maximum yield at minimum cost. Milk yield and reproductive traits are two main factors that determine the profitability of the dairy cattle farm (Ensminger, 1980). Low reproductive traits or infertility is described as called an extension of duration between two calving of a cow (Alaçam, 1994). It is stated that reasons of infertility may not only be an increase on milk production, but also be other factors such as environment, feeding, and genetics. (Lucy, 2001; Roche, 2006). Farms cannot reach the ideal production levels, if reproductive traits negatively affected, which causes significant economic losses to farmers (Gill, 1973; Kliewer, 1981; Gökçen, 2013).

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Reproductive traits that are important for the calculation of economic losses are; age of first calving (AFC), calving interval (CI), and number of inseminations per pregnancy (PI) (Kumuk et al., 1999; Yalçın, 2000; Kaygısız et al., 2008; Sarıözkan et al., 2012). In addition to these traits, age at first service (AFS) was used in our study.

AFS was described as first insemination age resulting in pregnancy (Ata, 2013). Ideal AFS values were reported as 14-16 months and 15-18 months by Ata (2013) and Keser (2016), respectively. AFC was described as the age at which the cow gave the first calf (Ata, 2013). Ideal AFC values were reported as 23-25 months by Ata (2013) and Keser (2016). CI was described as the duration between the two calving of a cow (Ata, 2013). Ideal CI values were reported as 365 days and 12-13 months by Ata (2013) and Keser (2016), respectively. PI was described as number of inseminations needed to achieve a pregnancy (Ata, 2013). Ideal PI values were reported as 1.65 (Ata, 2013). In some previous studies, reproductive traits (AFS, AFC, CI and PI values) in farms were studied (Halıcıoğlu, 1989; Özçakır and Bakır, 2003; Sehar and Özbeyaz, 2005; Akkaş and Şahin, 2007; Swai et al., 2007; Kopuzlu et al., 2008; Parlak and Kandır, 2015;

Keser, 2016). Some of the environmental issues, limiting reproductive traits are natal and postnatal reproductive disorders, misdetection estrous, timing of inseminations, quality of sperm, insemination technique, milk yield, feeding, age and genetic structure of animal (Smith et al., 2012). Low reproductive traits may cause significant economic losses for the farms.

The aim of this study was to calculate the economic losses resulted from delays of AFS, AFC, CI and increase of PI in animals raised in commercial dairy cattle farm located in Kırşehir province.

2. Material and Method

Data recorded from 294 Holstein crossbreed dairy cows reared between 2009 and 2017 in Tekyön dairy farm in Kırşehir province were used in this study. The herd management program and veterinary records were used to obtain data.

A total of 1077 lactation records from these cows were used to calculate economic losses from fertility problems. Animal numbers, lactation numbers, and values of reproductive traits are reported extensively in Table 1. In order to calculate economic losses from fertility problems, ideal values for AFS, AFC, CI and PI were 450 days, 730 days, 365 days and 1.65, respectively (Ata, 2013). Also, standard deviations and differences from ideal values were calculated for reproductive traits. Differences between AFS and AFC were calculated using by followed formula: AFC deviated from ideal values (41.83 days) - (36.86 days) AFS deviated from ideal values (Table 1). The difference between these parameters was 4.97 of days.

Table 1
Mean values of AFS (days), AFC (days), CI (days) and PI (number) of current dairy farm

1. Mean AFS and AFC values according to animal and lactation numbers

Animal Number	Lactation no*	AFS	AFC
148	3	489.01±74.08	762.92±74.56
97	4	490.40±95.14	767.57±95.57
49	5	503.18±99.62	777.37±95.28

2. Mean CI values according to animal and lactation numbers

Animal Number	Lactation no*	Lactation 2	Lactation 3	Lactation 4	Lactation 5
148	3	439.94±108.36	432.78±110.15	450.86±107.42	-
97	4	440.69±81.48	455.40±90.48	436.30±87.84	437.61±73.01
49	5	395.65±72.72	401.27±68.16	400.61±73.95	394.29±63.72

3. Mean PI values according to animal and lactation numbers

Number of Animals	Lactation no*	Heifer	Lactation 1	Lactation 2	Lactation 3	Lactation 4	Lactation 5
148	3	1.27±0.73	3.03±2.13	3.07±2.16	3.66±2.99	-	-
97	4	1±0	2.59±1.72	3.10±1.99	3.19±1.88	3.72±2.47	-
49	5	1±0	1.80±1.36	2.39±1.35	2.45±1.92	2.57±1.62	2.47±1.95

4. Reproductive trait values of farm, ideal values and differences between ideal and farm values

Reproductive traits	Values	İdeal Values	Differences
Age at first service (AFS)	491.83±86.19 days	450 days	41.83±86.19 days
Age at first calving (AFC)	766.86±85.74 days	730 days	36.86±85.74 days
Calving interval (CI)	432±66.51 days	365 days	67±66.51 days
Number of inseminations per pregnancy (PI)	2.64±1.04 number	1.65 number	0.99±1.04 number

*Lactation no: Shows the animals completed its lactations.

Farm reproductive values, technical and financial parameters were used to calculate total economic losses (Table 2). For technical and financial parameters we used current records (from 2017) of farms conducted, since these parameters can vary for every of dairy cattle farm. The feed costs and other expenses of the farm are considered as 65% and 35%, respectively. Feed costs for all animals were calculated according to values presented in Table 2. For example, it was [(2 kg straw*0.23 TL) + (5 kg clover fodder*0.53 TL) + (2 kg concentrated feed*0.94 TL) + (3 kg other* marble powder, bicarbonate, soy hulls etc. prices)] for heifers. In addition, we calculated other costs using followed formula: 7.2 TL*35/100.

Table 2
Technical and Financial Parameters

1.Technical Parameters	Values and Explanations
Average daily milk yield (L/cow)	33 L/cow
**Average daily milk yield of lactation end (L/cow)	19 L/cow
The amount of feed consumed by dairy cow	43 kg: 23 kg corn silage+5 kg clover fodder+4 kg concentrated feed+11 kg other
The amount of feed consumed by cow in dry period	23 kg: 12 kg corn silage+5 kg straw+3 kg concentrated feed+3 kg other
The amount of feed consumed by 2 years old heifer	23 kg: 12 kg corn silage+5 kg straw+3 kg concentrated feed+3 kg other
The amount of feed consumed by 15 months old heifer	12 kg: 2 kg straw+5 kg clover fodder+2 kg concentrated feed+3 kg other
2.Financial Parameters	**Values and Explanations**
Milk sale price (TL/L)	1.12 TL/L
Concentrated feed price (TL/kg)	0.94 TL/kg
Straw price (TL/kg)	0.23 TL/kg
Clover fodder price (TL/kg)	0.53 TL/kg
Corn silage price (TL/kg)	0.17 TL/kg
Total feed cost for 1 L milk produce (TL)	0.62 TL
*Milk-feed margin (TL)	0.5 TL
Calf price (TL/calf)	2500 TL/calf
Artificial insemination price (TL/dosage)	100 TL/dosage

*Milk-feed margin: Shows the differences between 1L milk price and total feed cost for 1L milk production.

** This parameter was described as average daily milk yield in last month of lactation before dry period.

Other: Marble powder, bicarbonate, soy hulls, bypass fat etc.

3. Results and Discussion

In the current study, deviations of AFS and AFC from ideal values were 41.83 days and 36.86 days, respectively. At the same time, differences between AFS and AFC were 4.97 days and this value was used to calculate the economic losses resulted from delaying of AFS for the farm studied. Because of deviation of this parameter, we calculated that total and daily economic losses were 16.189,9 TL and 4.93 TL, respectively (Table 3). Previous studies only reported a direct effect of AFS on AFC (Sarıözkan et al., 2012; Kaygısız et al., 2008; Yalçın, 2000; Kumuk et al., 1999; Parlak and Kandır, 2015). However, it was obviously observed that 4.97 days of difference between AFS and AFC caused significant financial losses for farm evaluated. About 5 days' difference between these two parameters most likely resulted from shortening gestations. Özçelik (1994) reported that duration of gestation was 278 days in Holstein dairy cattle and stated that 260-310 days of gestation period was satisfactory for suficient production. As for our study, it is implied that an increase of gestation period lead to economic losses. However, this finding does not agree with results reported by Özçelik (1994), who founded 260-310 days of gestation period. Hence, the results obtained in this study clearly shows that farmers need to pay attention to the duration of gestation to achieve the desired level of economy on dairy cattle farms. According to Akkaş and Şahin (2008), the AFS directly affects AFC, whereas Parlak and Kandır (2015) reported longer duration of AFS rather than AFC in their studies, indicating that it was in agreement with finding achieved by the present authors. In other words, a shorter AFC period is more appropriate for the farm's economic situation than AFS. Norman et al. (2009) extensively summarized the factors affecting the duration of gestation in their study.

Deviation of AFC from ideal values in this study was 36.86 of days, total and daily economic cost resulted for this parameter was 450 162.3 TL and 41.54 TL (11.9 $, 37.09 L milk price), respectively (Table 3-4). Kaygısız et al. (2008) and Sarıözkan et al. (2012) reported that the economic losses caused by AFC were 15.6 TL/day (10.4 $) and 3.54 TL/day (8 L milk price), respectively. The values obtained regarding with economic losses in that study were low when compared with results in the present study, showing that there were an increase in the prices of input of farm conducted over years. When previous studies in different years were evaluated, it was observed that the deviation of AFC on our study is lower than previously reported AFC values (Koçak et al., 2008; Bakır and Çetin, 2003; Sehar and Özbeyaz, 2005; Keser, 2016; Parlak and Kandır, 2015). Accordingly, it is clearly claimed that deviation of AFC from standardized values in the dairy cattle farms is a serious problem for effective dairy production. On the other hand, factors such as feeding herd management, diseases, AFS, and the live weight of cow may affect the incomes of AFC (Heinrich et al., 1993; Tekin and Daşkın, 2016).

In this study, we founded that value of CI for farm conducted was 432 days and the deviation of standardized values was 67 of days. Total and daily cost of this difference to farm was 1 307 852.7 TL and 24.93 TL,

respectively (Table 3-4). Sarıözkan et al. (2012) and Kaygısız et al. (2008) reported that the economic losses caused by CI were 11.3 TL/day and 4.1 TL/day, respectively. It is assumed that these economic losses can be increase with higher feed and other inputs costs. Additionally the value obtained for CI in this study was higher than the values reported by Pryce et al. (2003), Biffani et al. (2005), Akkaş and Şahin (2008), Parlak and Kandır (2016), Keser (2016). But, it was lower than the findings reported by Halıcıoğlu (1989) and Chonkasikit (2002). Additionally, our findings for CI were similar with the results of Ajili et al. (2007), Kaya and Bardakcıoglu (2016). It was observed that CI values obtained in this study were generally higher than compared to the results reported by previous studies. Keser (2016) reported that feeding, cow herd management, and the following estrus can affect CI. Also, the same researcher found the significant effect of the size of the herd on CI, indicating that dairy cow farms at herd size of 5-10 cows have the lowest CI values. In the current study, it is believed that the one reason for high CI of farm conducted was problem of estrus expression and insemination timing (Walsh, 2011)

Table 3

Calculation of Daily Economic Losses from AFS, AFC, CI and PI

1. Calculation of Daily Economic Losses from AFS

Excess of AFS	Difference between AFS and AFC (days)	Current expenses of 15 months heifer (TL)	Number of cows	Total costs (TL)
	4.97	11.08	294	(4.97*11.08*294)=16 189.9
***Total daily costs				(16 189.9/9*365)=4.93 TL

2. Calculation of Daily Economic Losses from AFC

Current expenses of 2 years heifer	Feed costs (TL/day)	Other costs (TL/day)	Daily costs (TL)
	11.82	6.37	(11.82*6.37)=18.19
Calf loss	Calf price (TL/day)	365 days	Daily costs (TL)
	2500	365	(2500/365)=6.85
Milk loss in next lactation	Average daily milk yield (L)	Milk-feed margin (TL)	Daily costs (TL)
	33	0.5	(33*0.5)=16.5
*Total daily costs			41.54 TL/day

3. Calculation of Daily Economic Losses from CI

Milk loss in next lactation	Average milk yield (L/day)	Milk-feed margin (TL)		Daily costs (TL)
	33	0.5		(33*0.5)=16.5
Excess dry period cost	0.4 day**	Current expenses of dry cow (TL)		Daily costs (TL)
	0.4	18.19		(0.4*18.19)=7.28
Calf loss	Calf price (TL)	365 days		Daily costs (TL)
	2500	365		(2500/365)=6.85
	0.6 day**	Milk yield in lactation end (L)	Milk-feed margin (TL)	Daily income (TL)
Extra milk income	0.6	19	0.5	(0.6*19*0.5)=5.7
*Total daily costs				(16.5+7.28+6.85-5.7) =24.93 TL

4. Calculation of Daily Economic Losses from PI

Excess of PI	Total pregnancy number	The amount of extra sperm used	1 dosage sperm cost (TL)	Total costs (TL)
	1371	0.99	100	(1371*0.99*100)=135 729
***Total daily costs				(135 729/9*365)=41.32 TL

*Total daily costs: This parameter shows the difference between the sum of daily costs and daily income.

** It was assumed that 0.6 days of extended lactation was spent in lactation and 0.4 days in dry period (Esslemont and Spincer, 1993).

***Total Daily costs: Total costs/9 years*365 days.

In our study, we also detected that value of PI in farm studied was 2.64 and this value was 0.99 above ideal values. Total and daily economic losses resulted from by differences of PI parameters were 135 729 TL and 41.32 TL, respectively (Table 3). Sarıözkan et al. (2012) reported that the economic losses caused by PI were 19 070 TL. The higher sperm price increases, the higher these economic losses can be. Our findings for PI were higher than the results reported by Keser (2016), Bayrıl and Yılmaz (2010), Salem et al. (2006) and Şahin and Ulutaş (2011), whereas it was lower that of Alkoyak (2016). When compared previous studies, it was found that our findings for PI was quite high. Several factors such as wrong insemination timing, quality

of sperm, and misdetection eostrus can affect the different levels of PI in dairy cow farms.

In the present study, percent effects of AFS, AFC, CI and PI on total economic losses were 0.8%, 23.6%, 68.5% and 7.1%, respectively (Table 3). We detected that the economic losses caused by CI was the highest when compared with other parameters. For this reason, some suggestions are presented by researchers in cow herd management to prevent these economic losses. According to Smith et al. (2012) natal and postnatal reproductive disorders, misdetection estrous, the timing of inseminations, quality of sperm, insemination technique, milk yield, feeding, age and genetics of the animal are the reasons of economic losses. In order to eliminate fertility problems and reduce financial losses, Walsh et al. (2011) suggested to reduce negative energy balance, prevent postpartum infections**,** occurrence and determination of estrous, and use of quality sperm.

Table 4

Calculation of Total and Daily Economic Losses from Fertility Problems

	Number of cows	Current expenses of 15 months calf	Difference between	Total costs (TL)
Delay of AFS		(TL)	AFS and AFC (days)	(294*11.08*4.97)
	294	11.08	4.97	=16 189.9
	Number of cows	Differences from ideal values (days)	Daily costs (TL)	Total costs (TL)
Delay of AFC	294	36.86	41.54	(294*36.86*41.54)
				=450 162.3
	Pregnancy number	Differences from ideal values (days)	Daily costs (TL)	Total costs (TL)
Delay of CI	783	67	24.93	(783*67*24.93)
				=1 307 852.7
	Pregnancy number	The amount of extra sperm used	1 dosage sperm cost	Total costs (TL)
Excess of PI	1371	0.99	100	(1371*0.99*100)
				=135 729
[1]Total costs				1 909 933.9 TL
[2]Daily costs				581.41 TL

[1]Total costs: Total economic losses resulted from delays of AFS, AFC, CI and PI.

[2]Daily costs: Total costs/9 years*365 days.

4. Conclusion

As a result, the deviations of standardized values for the AFS, AFC, CI and PI values in farm conducted were significant and these deviations caused the important economic losses. Total and daily economic losses causing these differences were 1 909 933.9 TL and 581.41 TL, respectively. It is recommended that farmers reorganize their businesses in order to reduce their costs for effective dairy cow production. At the same time, it was thought that values of AFS, AFC, CI and PI in dairy cow production should be near 15 months, 24 months, 365 days and 1.65, respectively. In fact, farmers should notice to catch the closer values of these parameters to reduce costs. Because, even low differences between standardized values and values obtained in this study may cause high economic losses.

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