

Retrospective Study

Evaluation of the Causes of Culling and How They Affect Age in Dairy Cows in and Around Mekelle City, Tigray, Ethiopia

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ABSTRACT

Background

Culling is defined as the departure of cows from the herd because of sale, slaughter, salvage, or death. Culling is an important cost for dairy farms. At the same time, culling is a way to increase herd productivity and profitability, as keeping diseased and unproductive cows might result in lower herd milk production and deteriorated reproduction. In order to maximize profitability, the proportion of voluntary culling (selling for dairy purposes or culling due to low production) should be highest among the total culling rate. Previous studies indicate an ascending trend in the proportion of involuntary culling. This observational study used registry data of all cows from herds with ≥ 5 cow-years in 2016-2017.

Objective

This study was conducted to assess the reason for culling a dairy cow and its association with age at culling in and around Mekelle using a structured questioner format and direct observation. Visits were performed to each farm to collect data directly from owners or animal attendants and using direct observation.

Materials and Methods

The cross-sectional study was conducted in and around Mekelle city dairy farm from November, 2016 to April, 2017.

Results

The most common causes of culling were disease and economic reasons. The most common causes of voluntary culling were economic reasons (17.39%), low milk yield (20.29%), and aging (8.70%). The common causes of involuntary culling were diseases (34.78%), injury (7.25%), and infertility (5.80%). In this study rates of culling increased with parity. The highest rate of culling was in animals between parity 2 and 5, increased from (14.49%) to (21.74%) and slightly decreased from parity 6 to 7, i.e. (13.04%) to (8.70%), respectively. The highest rates of culling were between 3 and 5-years, (17.39)% and (23.19)%, respectively.

Conclusion

This study indicated animals were culled at premature age because of involuntary culling, which is economically not feasible, diseases were the most common causes of involuntary culling and voluntary culling was the most type of culling in dairy cattle farms and animals mostly culled for decreased production and economic reasons.

Keywords

Culling; Dairy cattle; Milk yield; Parity.

INTRODUCTION

Ethiopia is believed to have the largest livestock population in Africa. The livestock sector has been contributing a considerable portion to the economy of the country and still promising

to rally around the economic development of the country. The Ethiopian total cattle population is estimated to be about 56.71 million. Out of this the female cattle constitute about 55.45% and the remaining 44.55% are male cattle and 98.66% of the total cattle in the country are local breeds and the remaining are hybrid and

exotic breeds that accounted for about 1.19% and 0.14%, respectively. The livestock sector plays a vital role as a source of food, income, services, and foreign exchange to the Ethiopian economy.¹

Moreover, Ethiopia has diverse animal genetic resources and its relatively large livestock population is well adapted to and distributed among diverse ecological conditions and management systems.² Despite the huge number of cattle and their economic importance, productivity is low due to the constraints of disease, nutrition, poor management, and poor genetic potential. These constraints result in poor reproductive performance of dairy cattle.³ Through intensive management practices and progress in genetics, the dairy industry has been rapidly changing over the years. To meet the increasing demand for a growing population, the smaller number of cows is producing more milk. Trends also show a decrease in the number of farms, but an increase in herd size per farm. These changes have created many new challenges in the industry, one of which is the decline in fertility and reproductive efficiency.⁴

Maintenance and optimization of a dairy herd profit and avoidance of economic losses are a continuous challenge to dairy herd farmers especially when dairy cattle are reared under stressful conditions. To achieve this goal, farmers have to imply good dairy management practice for their herd by improving the overall health indices and increasing milk yield and reproductive performance. One of these practices is culling. Culling is the removal and disposal of an individual from the herd due to sale or death. It is classified as either voluntarily, when the farmers have the choice to remove the animal for example for low milk yield or aging, or involuntary when the farmers have no choice to remove certain individuals from the herds for example due to infertility or infectious diseases.⁵ Culling is one of the important management practices to be adopted in dairy herds to maximize profit and minimize economic losses. However, culling will not be effective when it is made in non- systematic and non-programmed models.⁶

The decision to remove a cow from the herd is based on economic considerations. Optimum herd profitability is achieved by minimizing the proportion of the herd culled for health (involuntary culling) reasons and by maximizing the proportion culled for voluntary or economic reasons.⁷ A high number of involuntary culling indicates potential health and welfare problems in a herd. The rate of profitable culling is varying with regard to many considerations. Farmers should make strategies to minimize the rate of involuntary culling at expense of voluntary culling which, the latter, is important and is used as a positive economic tool to make a balance between inputs and outputs of a farm.⁸

Identifying causes for culling is important and can help define the management status of a herd. Involuntary culling, which is often due to diseases or poor reproductive performance, is one of the factors which negatively affect the profitability of a dairy herd particularly when it is being at a high rate.⁹ Several studies were conducted to identify the extent and possible reasons for culling worldwide. However, there are no studies conducted so far in the study area that showed the extent and possible reasons for culling both voluntary and involuntary culling. Therefore, the objective of

this study was: to assess the reasons for culling and its association with age at culling.

MATERIALS AND METHODS

Study Area

The study was conducted in and around Mekelle, the capital city of Tigray Regional State of Ethiopia. Mekelle is found at 39° 33'E East and 13° 32'N north of the equator which is 783 kms away from Addis Ababa, the capital city of Ethiopia. The altitude of the area ranges from 2000-2200 meters above sea level. The mean annual rainfall of the study area is 579-650 mm. The annual minimum and maximum temperature is 11.8 °C and 24.9 °C, respectively in 2013.

Study Population

The study populations were dairy cattle kept in intensive dairy farms in and around Mekelle.

Study Design

A cross-sectional study design was conducted using a structured questionnaire and direct observation methods of collecting data to collect data on the possible reasons for culling a dairy cow and its relation to age.

Methods of Data Collection

Structured questionnaire was prepared and used to collect information from 69 dairy farm owners in one visit interview and the reason for the culling of their dairy cattle was studied. The questionnaires were checked for clarity of the questions prior to the interview. Prior to the interview, respondents were briefed on the objective of the study by using the local language. Following that, the actual questions and questionnaires were presented. Accordingly, information about the disease, age, decreased milk yield, injury, aggressiveness, infertility, and financial need were collected.

Data management and Statistical Analysis

The data collected was entered into a Microsoft Excel sheet (version-2010) and the data were analyzed using SPSS statistics version-20. Descriptive statistics such as frequency and percentage were used to summarize the collected data regarding reasons for culling.

RESULTS

Respondent's Background

Most of the respondents were with a primary level of education 30 (43.48%), followed by those who attended secondary education 25 (36.23%). Of the total respondents, only 7 (10.14%) attended level of education above secondary and the remaining were illiterate 7 (10.14%) (Table 1).

Table 1. Respondent's Educational Background

Variables	Category	Frequency	Percent
Educational status	Illiterate	7	10.14
	Primary education	30	43.48
	Secondary education	25	36.23
	Above secondary	7	10.14
	Total	69	100

Farms Background Information

Most of the farms in and around Mekelle were established between 6 and 10-years 38 (55.07%). A significant number of farms were established between 1 and 5-years 21 (30.43%). The rest 10 (14.49%) were established 10 years ago (Table 2).

Table 2. Duration of the Farm Since Establishment in Years

Variables	Category	Frequency	Percent
When the farm was established	1-5 yrs	21	30.43
	6-10 yrs	38	55.07
	>10yrs	10	14.49

In this study 24 (34.78%) farms had 6-10 heads of dairy cows and 5 (7.25%) had 30-100 heads of dairycows (Table 3).

Table 3. Number of Dairy Cow Feeds per Farm

Variables	Category	Frequency	Percent
Numbers of dairy cows	1-5	15	21.74
	6-10	24	34.78
	11-15	9	13.04
	16-20	8	11.59
	20-25	1	1.45
	26-30	7	10.14
	30-100	5	7.25

Parity

In this study culling rate of dairy cows increased with increasing parity. The highest rate of culling was in cows with parity 4 and 5, followed by cows with parity 2 and 3 which accounted for 10 (14.49%) to 15 (21.74%), respectively (Table 4).

Table 4. Parity Level of Dairy Cows

Variables	Category	Frequency	Percent
Parity	Parity 0	1	1.45
	Parity 1	2	2.90
	Parity 2	10	14.49
	Parity 3	11	15.9
	Parity 4	15	21.7
	Parity 5	15	21.7
	Parity 6	9	13.0
	Parity 7	6	8.70

Age at Culling

The highest rates of culling were recorded in cows at the age of 5 years (23.19%) followed by cows at the age of 4-years (21.74%). In this study, most of the animals were culled at premature and productive age (Table5).

Table 5. Age at Culling

Variables	Category	Frequency	Percent
Age at culling	2-years	8	11.59
	3-years	12	17.39
	4-years	15	21.74
	5-years	16	23.19
	6-years	11	15.94
	7-years	3	4.35
	8-years	4	5.80

Reason for Culling

In this study the most frequent reasons for culling were disease conditions (34.78%) followed by decreased milk yield (20.29%) and financial needs (17.39%) (Table 6).

Table 6. Reason for Culling

Variables	Category	Frequency	Percent
Reason for culling	Disease	24	34.78
	Age	6	8.70
	Decreased milk yield	14	20.29
	Injury	5	7.25
	Aggressiveness	4	5.80
	Infertility	4	5.80
	Financial needs	12	17.39

Disease condition was the most common cause that contributed to culling. Culling due to mastitis increased linearly with parity and reached nearly 21.74% at 6-years of age. Lameness accounted for 7.25% of the disposals, which increased with age from 0% in three-year-old animals to 33.33% in seven-year-old animals. Rates of culling due to decreased milk yield and financial needs were 20.29 % and 17.39 %, respectively. Further 5.80% and 5.80% of the recorded culling was for aggressiveness and infertility reasons, respectively. In terms of the cow's age, this type of culling was highest at the age of three-years (5.80%) which then became 0% in older ages (Table 7).

DISCUSSION

To make the right decision to remove an animal from the herd, many factors should be taken into considerations. The most important factors considered in culling decisions are age, health status, fertility status, stage of lactation and level of milk production, as well as the value of the replacement animal and its cost.¹⁰ The probability of a cow being culled differs, depending on the age of

Table 7. The Degree of Association between the Reason for Culling and Age at Culling Using Chi- square (2) Test

Age at Culling	Reason for Culling							Total
	Disease	Age	Decrease Milk Yield	Injury	Aggressiveness	Infertility	Financial Need	
2-years	5	0	0	0	2	0	1	8
	62.50	0.00	0.00	0.00	25.00	0.00	12.50	100.00
3-years	3	0	1	0	2	3	2	12
	25.00	0.00	8.33	0.00	16.67	33.33	16.67	100.00
4-years	8	0	0	2	0	1	5	15
	53.33	0.00	0.00	13.33	0.00	0.00	33.33	100.00
5-years	7	0	5	1	0	1	3	16
	43.75	0.00	31.25	6.25	0.00	0.00	18.75	100.00
6-years	1	0	8	1	0	0	1	11
	9.09	0.00	72.73	9.09	0.00	0.00	9.09	100
7-years	0	2	0	1	0	0	0	3
	0.00	66.67	0.00	33.33	0.00	0.00	0.00	100.00
8-years	0	4	0	0	0	0	0	4
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Total	24	6	14	5	4	4	12	69
	34.78	8.70	20.29	7.25	5.80	5.80	17.39	100

Pearson χ^2 (36)=115.032 pr=0.00

the animal; in a study by, the risk of culling was highest in cows between 3 and 5-years of age and also in cows over 7-years of age. This age dependency of culling rate is in agreement with the result of the present study, in which most cows are culled at the age of 3-5-years.¹¹

The rate of overall culling in this study is near to that reported by Elimam et al¹² in Sudan (11.95%),¹³ in Ireland (19.6%), and Mohammadi et al¹⁴ in Iran (13.1%); however, this rate is slightly different from rates reported by others,⁷ reported (25.1%), including death cases, as overall culling rate in dairy cows in Shiraz, Southern Iran. In this study, death cases were not considered, the fact which might contribute to the low culling rate in this study.

The proportions of voluntary and involuntary culling in this study constituted 71.8% and 28.2%, respectively. These proportions were in agreement with reports by who reported that voluntary culling was the most prevalent type of culling in New South Wales, Australia and which is in agreement with the results of Rajala-Schultz et al¹⁵ who reported that a total replacement percentage was 26% with the highest frequency of voluntary culling in Finish dairy herds. However, Mohammadi et al¹⁴ reported an overall culling rate of 13.1% with 98.5% for involuntary culling and 1.5% for voluntary culling in 23 Holstein dairy herds in Iran. It also reported 74% for involuntary culling and 26% for voluntary culling.⁷

The increased percentage of voluntary culling, in general, is considered as a sign of good management practice. However, the high rate of voluntary culling in this study can be explained by the non-systematic and non-programmed culling practice in these farms as the owner's just cull cows to be sold to maintain the finan-

cial needs. More than half of all culling was associated with health disorders. The morbidity of a health disorder plays a significant role in culling decisions. In addition, indirect effects of diseases on culling are manifested through decreased milk yield and/or fertility of a cow. Many diseases can reduce milk production¹⁵ and it might be the low yield that triggers the decision to remove the cow rather than the disease occurrence itself.

In the present study, the reproductive status of a cow was the most important factor in the farmer's culling decisions. This is in agreement with several other studies, which have indicated that a failure to conceive at first service or a longer period of days open increases the risk of culling reported that conceiving decreases the risk of culling.⁵ In contrast to other studies, reasons for involuntary culling such as infectious diseases constituted a considerable proportion of culls in this study. This is likely to be related to the diseases present in the herd or the region, as there is a strong relationship between the existing diseases in a herd and the culling rate.¹⁶

CONCLUSION AND RECOMMENDATIONS

The most common cause of culling in the present study was diseases and economic reasons. Most cows were removed from the herd at premature age because of disease; some of them are because of infertility and injury. It can also be concluded that voluntary culling was the most prevalent type of culling in dairy cattle farms in and around Mekelle during the period from November to April 2017 and animals were mostly culled for low milk yield and economic reasons.

Based on the above conclusion the following

recommendations are forwarded:

- More detailed epidemiological studies are needed to plan and implement healthcare programs.
- These programs targeted toward diseases that lead to culling would be prerequisite for a profitable farming.
- Further studies are needed to critically evaluate and describe the strategies of culling in dairy farms in and around Mekelle by studying the reproductive and productive characteristics of culled animals.

STATUTORY DECLARATION

We declare that this thesis presents the work carried out by ourselves and does not incorporate without the acknowledgement of any material previously submitted for a degree or diploma in any university; and to the best of our understanding, it does not contain any materials previously published or written by another person except where due reference is made in the text; all substantive contributions by others to the work presented including jointly authored publications, is clearly acknowledged

The Mekelle University, College of Veterinary Medicine ethical review committee had critically reviewed and concludes that there was no ethical misconduct. The approval of ethical committee was taken for conducting this study and followed all the animal ethics and welfare guidelines.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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