

# CULLING IN DAIRY CATTLE FARMS OF KHARTOUM, SUDAN

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**ABSTRACT:** The study aimed to determine the causes and rates of voluntary and involuntary culling in dairy cattle farms in relation to some management factors in five dairy cattle farms with an average farm size of 264.8±153.1 cow/farm in Khartoum State over one year. Monthly visits were performed to each farm to collect data either by reviewing the farm records or directly from animal owners or attendants. The overall culling rate was 15.0% (71.8% voluntary and 28.2% involuntary). The most common causes of voluntary culling were economic reasons (29.1%), low milk yield (23.0%) and aging (19.7%). The common causes of involuntary culling were infertility (17.7%), chronic mastitis (8.5%) and foot injuries (2.0%). In farms where the veterinary supervision was practiced, the overall culling rate (26.4%) was higher than the rate (11.3%) in farms which did not. The highest culling rate (41.9%) where the veterinary supervision was practiced was due to aging, whereas, where the veterinary supervision was not practiced, economic reasons (38.9%) were prevailing. In farms where houses were constructed from fixed materials with adequate shade, the overall culling rate was 13.6% and almost due to low milk yield (35.5%). However, in farms where houses were constructed from local materials the overall culling rate was 17.7% with prevalent culling rate due to economic reasons (53%). In farms where feed was provided from expert companies, the most culling cases were due to economic reasons (53%) whereas when using feed which was prepared within the farm, the most cause of culling was low milk yield (35.5%). It can be concluded that the voluntary culling was the most prevalent type of culling in dairy cattle farms and animals mostly culled for economic reasons.

**Key words:** Voluntary and Involuntary Culling, Dairy Cattle, Khartoum, Sudan

ORIGINAL ARTICLE  
 pii: S222877011700001-7  
 Received 20 Sep. 2016  
 Accepted 10 Jan. 2017

## INTRODUCTION

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 involuntarily when the farmers have no choice to remove certain individuals from the herds for example due to infertility or infectious diseases (Dohoo and Dijkhuizen, 1993; Gröhn et al., 1998). Culling is one of the important management practices to be adopted in dairy herds to maximize the profit and to minimize the economic losses. However, culling will not be effective when it is made in non-systematic and non-programmed models (Lehenbauer and Oltjen, 1998). The decision to remove a cow from the herd is based on economic considerations (Van Arendonk et al., 1988). Information about the reasons for culling in dairy cattle farms is abundant (Pinedo et al., 2010; Ahlman et al., 2011; Lari et al., 2012; Pinedo et al., 2014). 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 (Stevenson and Lean, 1998; Lari et al., 2012). A high number of involuntary culling indicates potential health and welfare problem in a herd. The rate of the profitable culling is varying with regard to many considerations. Farmers should make strategies to minimize the rate of involuntary culling in 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 (Stevenson and Lean, 1998; Weigel et al., 2003). Studies suggested that profit would be increased with culling rates below the approximate average of 35% (Allaire, 1981). Other studies suggested 25-

40% as profitable culling rates (McCullough and Delorenzo, 1996). Identifying causes for culling is important and can be helpful in defining management status of a herd (Penido et al., 2014). The involuntary culling, which is often be 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 in a high rate. Beaudeau et al. (1993) reported that more than 50% of culling cases were due to health problem. Mastitis as a cause for culling of dairy cows has been reported by many authors (Bascom and Young, 1998; Whitaker et al., 2004; Lari et al., 2012; Penido et al., 2010). Rajala-Schultz et al. (2000) reported that a total replacement percentage was 26 with the highest frequency of voluntary culling in Finish Dairy herds. Mohammadi and Sedighi (2009) reported 13.1% (98.5% voluntary and 1.5% involuntary) as an average culling rate in 23 commercial Holstein dairy cows in Neishaboor area in Iran. Lari et al. (2012) found infertility (32.6% of all culls) was the most prevalent reason of culling followed by mastitis (6.5%). In Sudan, Elimam et al. (1999) reported overall culling rate of 11.95% in Elneshesheba dairy farm at Medani, Sudan. Saeed and Fadel Elseed (2015) reported that 79% of farmers were culling their animals on the basis of aging and decline of production. It is important to link the causes of culling with Farm management practices and individual characteristics as these factors can help explain why and when cows are culled (Bascom and Young, 1998; Whitaker et al., 2004). In Sudan, there are very few descriptive studies that have examined culling and its reasons in dairy farms (Elimam et al., 1999; Saeed and Fadel Elseed, 2015).

Therefore, limited information is available about culling and reasons for culling in dairy farms in Sudan. This available information did not critically describe the rates of voluntary and involuntary culling, so that the objectives of this study were to determine the rates and causes of voluntary and involuntary culling in five dairy herds in Khartoum State in relation to some farm management factors.

## **MATERIALS AND METHODS**

### **Dairy farms and animals**

The study was conducted in dairy cattle farms (N = 5) with a total number of 1324 dairy cows (milking or dry) and primiparous heifers in three localities in Khartoum State. The average farm size was 264.8±153.1 cow

### **Experimental design**

Monthly visits were performed to each farm during the period from October 2009 to September 2010 to collect data by reviewing the records of these farms, by direct observations or directly by asking the farm owners or animal's attendants. The data included some management practices such as adoption of veterinary supervision, the type of houses, the type of provided feed and the information regarding the disposal of milking cows or primiparous heifers from the farm and the reasons behind this disposal. Culling due to economic reasons, aging or low milk yield was identified as voluntary culling, whereas, the involuntary culling involved culling cases due to health problems (Chronic mastitis, infertility and foot injuries). The term, economic causes, was used when the primiparous heifers were sold to maintain the expenses of the farm. Death cases were not considered. The causes and rates of culling were interpreted with regard to different management data.

## **RESULTS**

### **Management practices:**

Number of cows in each farm, adoption of some management practices, the overall percentages of culling (voluntary or involuntary) on the selected farms are shown in Table1. A total of 199 cows or primiparous heifers out of 1324 (15.0%, ranged from 5.7% to 45.1%) were culled due to different causes. 10.8% was voluntary culling and 4.2% was involuntary culling.

### **Causes and rates of voluntary and involuntary culling:**

The most common causes of voluntary culling reported in this study were economic reasons (29.1%), low milk yield (23.0%) and aging (19.7%). The most common causes for involuntary culling were infertility (17.7%), chronic mastitis (8.5%) and foot injuries (2.0%), (Figure1). The highest overall percentage (29.1% of total culled) in this study was due to economic reasons and the lowest percentage (2.0% of total culled) of culling was due to foot injuries.

### **Causes and rates of culling in the different selected farms:**

The causes and rates of voluntary and involuntary culling are shown in Figure 2. The highest rates of overall, voluntary and involuntary culling rates were reported in farms No. 3, 4 and 3 respectively.

### Culling rates in relation to some farm management factors:

The overall, voluntary and involuntary culling rates in relation to some farms management factors are shown in Figure 3. The rates of voluntary culling and involuntary culling were higher in farms which practiced the veterinary supervision (18.7% and 7.7% respectively) than the rates in farms which did not (8.2% and 3.1% respectively). The voluntary and involuntary culling rates in farms constructed from fixed materials with adequate shade were lower (10.6% and 3.0% respectively) than the rates in farms which constructed from local materials (11.1% and 6.6% respectively). The voluntary and involuntary culling rates (10.6% and 3.0% respectively) were lower in farms used feed which was prepared within the farm than the rates (11.6% and 6.1% respectively) in farms which purchased feed from a feed company.

### Causes of culling with regard to some farm management factors

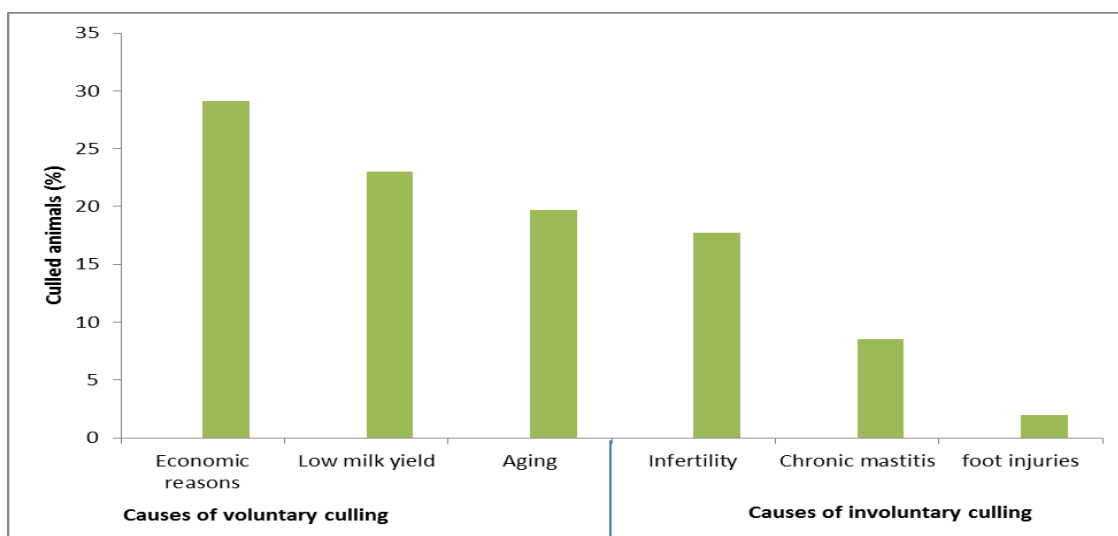
**Rates of causes of culling with regard to veterinary supervision:** The causes of culling in relation to practice of veterinary supervision are shown in Figure 4. The highest rate of causes of voluntary culling in farms where the veterinary supervision was practiced was 41.9% for aging, whereas, the highest rate in farms which did not practice the veterinary supervision was 38.9% for economic causes and no case of involuntary culling due to foot injuries in farms which practiced the veterinary supervision.

**Rates of causes of culling with regard to type of houses:** The rates of causes of culling in relation to type of houses are shown in Figure 5. The prevalent causes of voluntary and involuntary culling in farms where the houses were constructed from fixed materials with adequate shade were aging (31.0%) and infertility (17.3%) respectively. Whereas, the prevalent causes of voluntary and involuntary culling in farms where the houses were constructed from local materials with inadequate shade were economic reasons (53.0%) and infertility (18.1%) respectively.

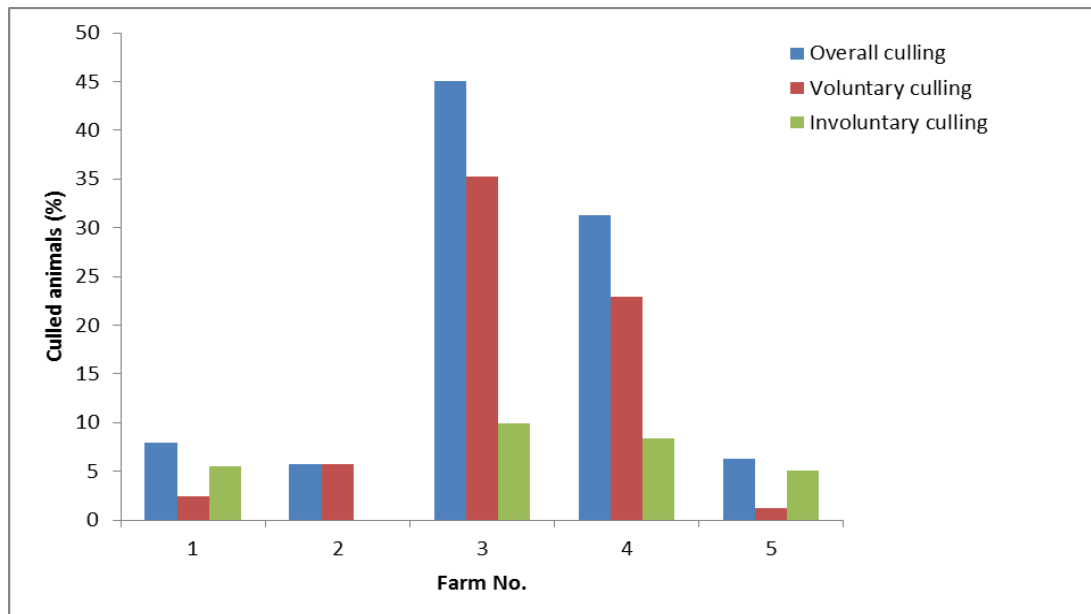
**Rates of causes of culling in relation to type of feed:** The rates of causes of voluntary and involuntary culling in relation to type of feed are shown in Figure 6. Culling due to low milk yield (35.3%) and infertility (17.2%) was prevalent in farms which used farm made feed, whereas, culling due to economic reasons (35.0%) and infertility (18.1%) was prevalent in farms used feed which purchased from feed companies.

**Table1 - Some management practices adopted in dairy cattle farms in Khartoum State**

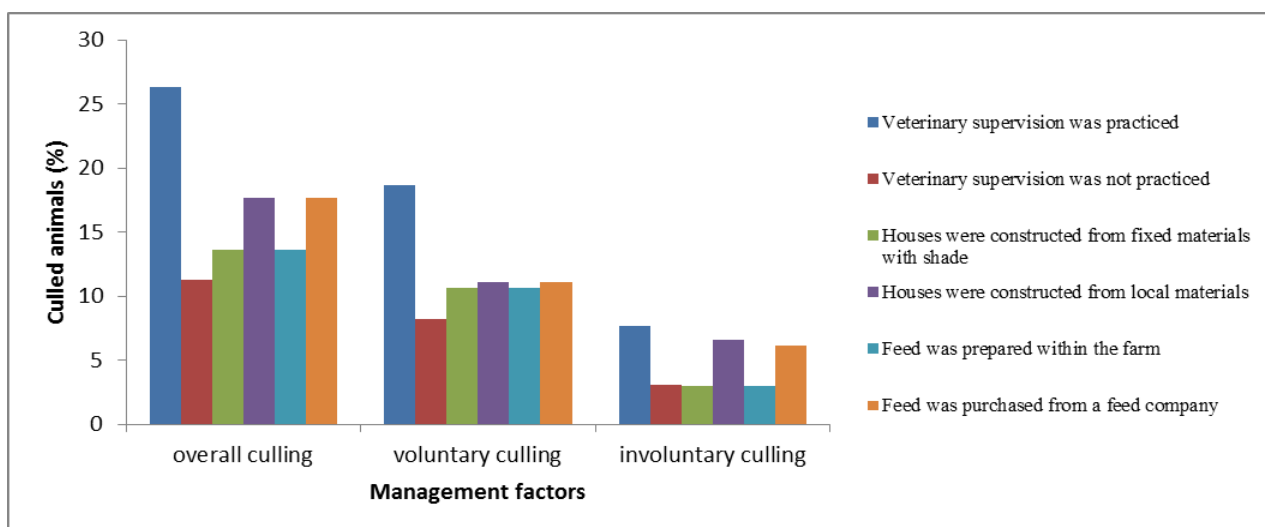
Farm number	No. of animals	Veterinary supervision	Type of houses	Type of feed	% Culling		
					Overall	Voluntary	Involuntary
1	164	Practiced	Fixed materials with shade	Prepared within the farm	7.9	2.4	5.5
2	530	Not practiced	Fixed materials with shade	Prepared within the farm	5.7	5.7	0.0
3	162	Practiced	Fixed materials with shade	Prepared within the farm	45.1	35.2	9.9
4	214	Not practiced	Constructed from local materials	Purchased from a feed company	31.3	22.9	8.4
5	254	Not practiced	Constructed from local materials	Purchased from a feed company	6.3	1.2	5.1
Total	1324				15.0	10.8	4.2



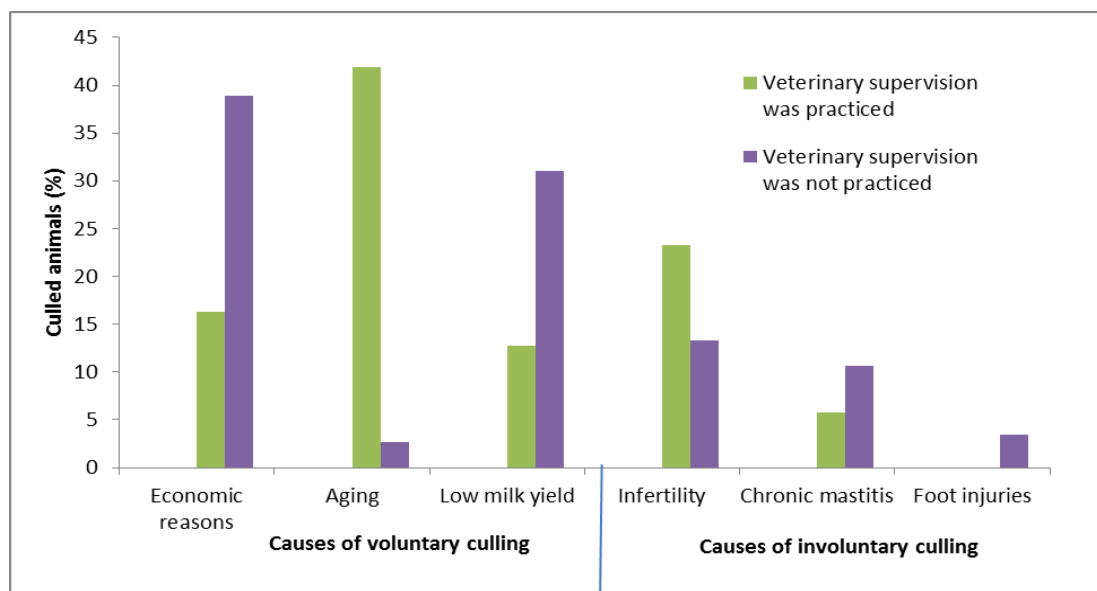
**Figure 1 - Causes and rates of voluntary and involuntary culling in dairy cattle farms in Khartoum State, Sudan**



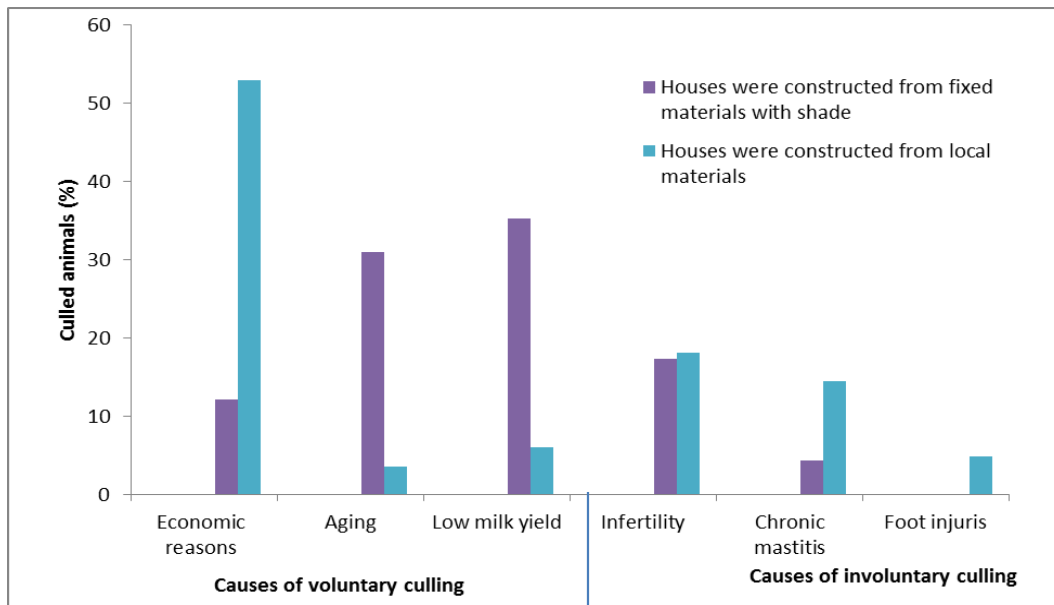
**Figure 2 - Overall, voluntary and involuntary culling rates in different dairy cattle farms in Khartoum State, Sudan**



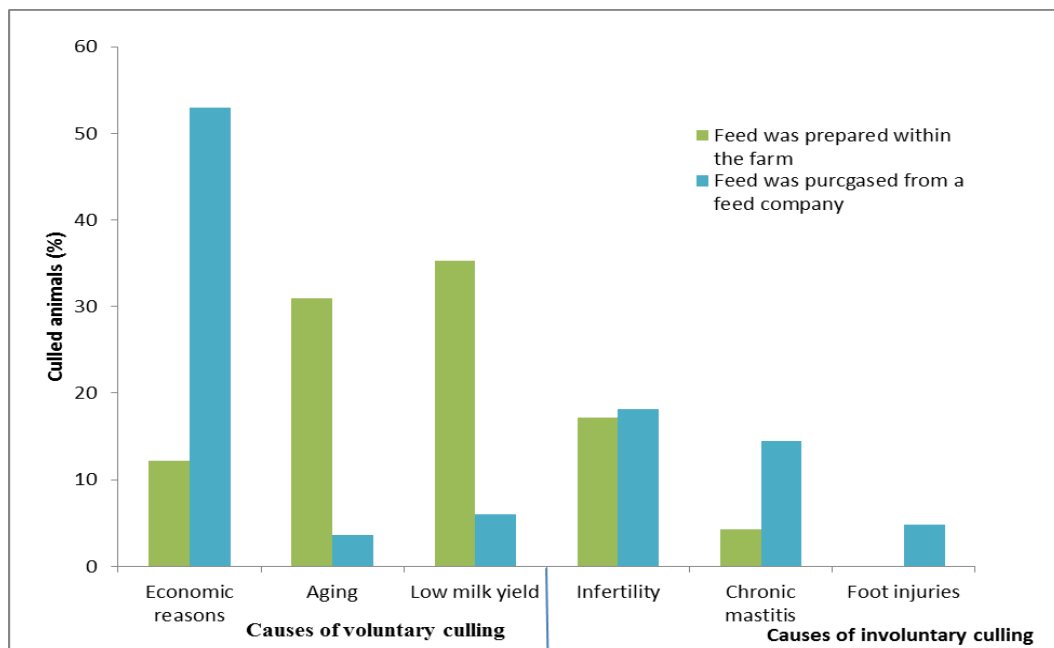
**Figure 3 - Overall, voluntary and involuntary culling rates in relation to some farm management factors in cattle dairy farms in Khartoum State**



**Figure 4 - Causes of culling in relation to practice of veterinary supervision in dairy cattle farms in Khartoum State**



**Figure 5 - Causes and rates of voluntary and involuntary culling in relation to type of houses in dairy cattle farms in Khartoum State**



**Figure 6 - Causes and rates of voluntary and involuntary culling in relation to type of feed in dairy cattle farms in Khartoum State**

## DISCUSSION

To make a right decision to remove an animal from the herd, many factors should be taken into considerations. These factors are the health status, age, reproductive performance, milk yield and stage of lactation (Allaire et al., 1977). The overall culling rate in this study was 15.0%. Voluntary culling represented 10.8% and involuntary culling represented 4.2%. The overall rates of culling and the proportions of voluntary and involuntary culling were varying in the five farms. This can be explained by the attitude of farmers towards culling process in different farms. The rate of overall culling in this study is near to that reported by Elimam et al. (1999) in Sudan (11.95%), Maher et al. (2008) in Ireland (19.6%) and Mohammadi and Sidighi (2009) in Iran (13.1%), however, this rate is slightly different from rates reported by others. Lari et al. (2012) 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 may 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 Stevenson and Lean (1998) who reported that the voluntary culling was the most prevalent type of culling in New South Wales, Australia

and in agreement with the results of Rajala-Schultz et al. (2000) who reported that a total replacement percentage was 26 with the highest frequency of voluntary culling in Finish dairy herds. However, the findings disagreed with those of Mohammadi and Sidighi (2009) who reported 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. Also this result disagreed with the results of Lari et al. (2012) who reported 74% for involuntary culling and 26% for voluntary culling. The increased percentage of voluntary culling as general is considered as a sign of good management practice (Stevenson and Lean, 1998; Lari et al., 2012). 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 owners just cull cows to be sold to maintain the financial needs. This explanation can be indicated by the high rate of culling (29.1% of total culled) due to economic reasons (sale of primiparous heifers to meet the financial needs) reported in this study. The reasons for voluntary culling reported in this study represented the most common reasons reported by many authors (Beaudeau et al., 1993; Mohammadi and Sidighi, 2009; Pinedo et al., 2010; Lari et al., 2012). Age has been reported by many authors as a factor which increases the risk of culling in dairy herds (Mohammadi and Sidighi, 2009; Saeed and Fadel Elseed, 2015; Gross et al., 2016). Saeed and Fadel Elseed (2015) reported that 79% of farmers in Sudan were culling their animals on the basis of aging and decline of production. Gross et al. (2016) reported that 15.5% were culled in Switzerland due to high age. Culling due to low milk yield is categorized with the voluntary type of culling, but low milk can be the end result of many factors like metabolic diseases, infertility and subclinical mastitis. These factors are interrelated and the discrimination between them is difficult. Low milk yield was the second most prevalent cause of culling in this study and was responsible for culling of 23.0% of total culled animals. This rate is relatively higher compared to rates reported by many authors. Anderson (1985) reported 3.7% culling rate due to low milk production. Mohammed and Sidighi (2009) reported 0.4% culling rate due to low milk yield and 1.1% due to aging. These low rates reported by these authors can be explained by the fact that owners keep the cow with low milk yield if it is fertile to complete the lactation cycle and then culled to benefit from their calves. High milk yield is always associated with deteriorated health and fertility and consequently, decreased milk yield and an increased culling rate (Espesito et al., 2014; Raboisson et al., 2014). Therefore, this high rate of culling due to low milk yield can be attributed to interrelations and strong links between low milk yield, infertility and health problems.

The most common causes of involuntary culling reported in this study were infertility (17.7%), chronic mastitis (8.5%) and foot injuries (2.0%). These reasons are common and have been reported by many authors. Beaudeau et al. (1993) reported that more than 50% of culling cases were due to health problems. Gross et al. (2016) reported that 28.4% dairy cows were culled in Switzerland due to infertility, 16.4% due to udder health and 10.4% due to claw health (lameness).

Infertility has been reported as an important cause of culling in dairy cows by many authors (Stevenson and Lean, 1998; Mohammadi and Sidighi, 2009; Lari et al., 2012). Esslemont and Kossaibati (1997) reported that poor fertility was the most important reason for culling of dairy cows in 50 dairy herds in England. Causes of infertility in dairy herds are of multiple origin such as genetic factors (Veerkamp et al., 2001), nutrition and management factors (Dubson et al., 2007), metabolic disorders (Wathes et al., 2009; Esposito et al., 2014). Infertility in this study may be genetic or due to other contributing factors such as reproductive system disorders, metabolic diseases, nutritional deficiencies or management factors. To explain and to define the decision of culling due to infertility as a right decision, it is important to evaluate the time of culling with regard to calving-culling interval, parity, and the fertility traits. Interpretation of culling due to infertility needs more elaborative studies to critically explain the reasons behind culling of dairy cows due to infertility. Farmers may keep highly producing infertile cows for longer time.

Losses due to mastitis can be regarded as a general problem in the dairy sectors worldwide (Bell et al., 2006; Huijps et al., 2008) and in Sudan (Saeed and Fadel Elseed, 2005; Mohammed and El Zubeir, 2015). Chronic mastitis represented 8.5% of total culled in this study. Many studies reported that mastitis is among factors which increase the risk of culling in dairy farms (Lari et al., 2012; Gross et al., 2014).

Lameness is reported as a problem in dairy cattle farms and as a cause for culling by many authors (Bell et al., 2006; Gross et al., 2016). In this study foot injuries represented 2.0% of total culled animals. The rate is fairly close to rates reported by many authors (Lari et al., 2012) who reported 3.5% culling rate due to lameness. Lameness or foot injuries are important detrimental factors of animal health as cows with foot injuries or lameness undergo low milk yield, infertility and other health problems due to restricted or reluctant movement required to achieve the normal daily activities.

Farm characteristics can help explain why cows are culled (Bascom and Young, 1998). The management practice of dairy farms selected for this study was poor as 75.4% (889 out of 1324 dairy cows) did not receive any type of veterinary supervision during the study period (September 2009 to October 2010) and only cows in two farms (326 cows) received the service (24.6%). In 40% of the farms, houses were constructed from local materials

and inadequate shade was provided and only 40% of the farms used feed which was made by expert feed companies. The poor veterinary service provided to dairy farms in Khartoum State has already been reported. Mohammed and El Zubeir (2015) stated that veterinary services in 60.8% of dairy farms in Khartoum State were provided by animal's owners or animal's keepers. Saeed and Fadel Elseed (2015) confirmed the poor veterinary services provided to dairy farms in Khartoum state and they found that, in a questionnaire based study, 63% of the respondents declared poor veterinary supervision in dairy farms in Khartoum State. This poor veterinary services status was, to our opinion, due to high cost of this service as it is provided by a private sector rather than the governmental one. The overall culling rate was higher in farms which received veterinary supervision (26.4%) compared to farms which did not (11.4%). The voluntary culling was most prevalent in the two situations. Culling due to aging represented the most prevalent cause of culling in farms received the veterinary supervision (41.9% of total culled). Whereas, culling due to economic reasons was prevalent in farms which did not. These findings can be poorly explained by the fact that the veterinarian could persuade the farm owners to dispose the senile cows, but as general, the scientific explanation and interpretations are difficult and further detailed studies are needed.

Regarding the type of houses and provided feeds, the findings were not greatly different and the links between these factors and the culling rate, the reasons for culling and rates of reasons of culling were not clear. These results are a true reflection of the fact that culling practice in these farms was not based on systematic or programmed models.

## CONCLUSION

It can be concluded that the voluntary culling was the most prevalent type of culling in dairy cattle farms in Khartoum State during the period from September 2009 to October 2010 and animals mostly culled for economic reasons. Further studies are needed to critically evaluate and describe the strategies of culling in dairy farms in Sudan by studying the reproductive and productive characteristics of culled animals.

### Competing Interest

The authors have declared that no competing interest exists.

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