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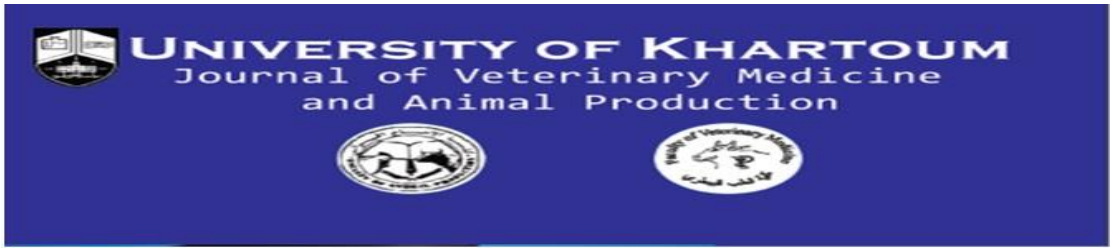

Risk Factors Associated with Lambs Mortality in Different Production Systems in Gadarif State, Sudan

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Abstract

The present study was conducted to investigate the mortality rate of lambs and associated risk factors in different production systems in Gadarif State. A total of 15,009 lambs from 300 herds were observed using Multi –Stage sampling methods. About 300 respondents were selected based on willingness and support of the owners for questionnaire survey. The results revealed that the mortality rate of the lambs were 31.5% (n = 1578), 33.4% (n = 1936) and 34.4% (n = 1453) in Central and West Gadarif, South Gadarif and East Gadarif , respectively. The difference was statistically not significant ($\chi 2$= 3.11, p-value= 0.53). The overall or crude mortality rate was 33% (n = 4967). While, the others mortality measures were as follow: the mortality rate of diarrhea was 53.3% (n = 2673) with case fatality of 18%. (n = 2673). Pneumonia gave 45% (n= 2389) for mortality rate with case fatality of 15% (n = 2389). The age specific death rate was 43.2% (n= 3992), 31.6% (n= 1213), 15.2% (n= 190) and 10% (n= 65) for age groups 0 - 2 months,2 – 4 months, 4 - 6 months and > 6 months, respectively. On the other hand, the risk factors associated with education level of the owners reveled that illiteracy was very high 50 % (n= 150), In contrast, the graduated owners were very low 1.30% (n=4), statistically, the difference was not significant ($\chi 2$=0.88, p-value= 0.99). A percentage of 67.30% (n=202) followed by 24.7% (n=74) were recorded for experience of the owners for (0 – 20 years) and (20 -40 years) respectively and no significant difference was observed ($\chi 2$=6.72p-value =0.34). Moreover, the breed was statistically significant ($\chi 2$=11.3,p-value=0.02), the mortality rate was high in Shagour breed 46.7% (n=7005), followed by Garage 31.7% (n=4757) , and Watish12 % (n=1801) .High significant level was also observed for lamb birth weight ($\chi 2$=22.7, p-value=0.001), the mortality rate was high in emaciated lambs 46 % (n=6904) but was low in over weight and average birth weight given a percentage of 0.30% (n=45) and 20.3% (n=114) respectively .Risk factors associated with management and husbandry revealed that mortality rate was high in rainy season 73.30% (n=11001) and less in winter 16.30 %(n=2446) and summer 10 .30% (n=1545), and difference was highly significant ($\chi 2$=11.7, p-value=0.001). Furthermore, the mortality was very high in pastoral production system 63% (n=9455) rather than in semi-intensive production system 24.7% (n=3707) and intensive production system 12.3% (n=1846), A high significant difference was also recorded ($\chi 2$=10.26,p-value=0.03). More

owners stated presence of veterinary services 87.7% (n=253) and only 12.3% (n=37) of the owners stated a limited access to veterinary services, and no significant level was observed ($\chi 2$=0.53, p-value=0.7). In conclusion the mortality rates of lambs was found very high with diarrhea and pneumonia were the main causes of it. Hence, effort should be made to increase lambing supervision, improve management of newborn lambs, and prevent diarrhea and respiratory diseases.

Keywords: Lamb mortality, Production system, Gadarif State, Sudan

الملخص

اجريت هذه الدراسه لتقصى معدل نفوق الحملان وعوامل الخطر المرتبطه بها في انظمه الانتاج المختلفه فى ولايه القضارف. وقد تم اختبار 15009 حمل من 300 قطيع باستخدام طريقه الاختيار المتعدد . في حين ، تم استطلاع 300 مستطلع بناء علي رغبتهم ودعمهم للاستبيان .اظهرت الدراسه ان معدلات نفوق الحملان كانت 31.5%(n=1578)، 33.4% (n=1936) و34.4% (n=1453) في اواسط وغرب القضارف وجنوب القضارف وشرق القضارف ، علي التوالي .الفرق لم يكن معنويا ($\chi 2$=3.11p=0.53) وكان معدل النفوق العام 33% (n=4967) في حين ، ان قياسات النفوق الاخري كانت علي النحو التالي: معدل النفوق بسبب الاسهال 53.3% (n=2673) ومعدل النفوق القاتل للاسهال 18%(n=2389) ومعدل النفوق بسبب الالتهاب الرئوي 45% (n=2389) ومعدل النفوق القاتل للالتهاب الرئوى 15% (n=2389) . كان معدل النفوق فى اعمار محدده 43.2% (n=3992) ، 31.6% (n=1213)، 15.2% (n= 190) و10% (n=65) للفئات العمريه (0 -2 اشهر) ،(2 - 4 اشهر) ،(4 – 6 اشهر) و(6 < اشهر)، علي التوالي . اظهر المستوي التعليمي للمستطلعين ان الاميه كانت عاليه جدا 50% (n=150) ، بينما نسبه خريجي الجامعات منخفضه جدا 1.3% (n= 4) ولم يكن الفرق معنويا ($\chi 2$=0.88 p= 0.99) وسجلت نسبه 67.3% (n=202)، تليها 24.7% (n=74) لخبرة المالكين من (0 – 20 سنه) و(20 – 40 سنه) علي التوالي ، بدون فروق معنويه ($\chi 2$=6.27 p=0.34) . اظهرت السلاله فروق معنويه ($\chi 2$=11.3 p=0.02) وكان اعلي نفوق في سلاله الضان الاشقر 46.7% (n=7005) ، تليها القرج 31.7% (n=4757) ، ثم 12% للوتيشي (n =1801) وكان لوزن الحملان عند الولاده تاثير كبير علي معدل النفوق ($\chi 2$=22.7 p=0.001) حيث كان معدل النفوق عاليا في الحملان الهزيله 46% (n=6904) ومنخفضا في الحملان المولوده بوزن زائد والحملان ذات الوزن المتوسط عند الولاده 0.30% (n=45) و20.3% (n=114) علي التوالي. اظهرت عوامل الخطر المرتبطه باداره وتربيه الحيوان ان معدل النفوق مرتفع في موسم الامطار 37.3% (n=11001) واقل في فصل الشتاء 16.3% (n=2446) والصيف 10.3% (n=1545) بفروق معنويه ($\chi 2$=11.7 p=0.001). وكان النفوق عاليا جدا في نظام الانتاج الرعوي 63% (n=9455) مقارنه بنظام الانتاج شبه المكثف 24.7% (n=3707) ونظام الانتاج المكثف 12.3% (n=1846) وكان الفرق معنويا (x2=10.36 p=0.03). ذكر كثيرون من اصحاب القطعان ان الخدمات البيطريه متوفره بنسبه 87.7% (n=253) بينما 12.3% (n=37) ذكروا ان الخدمات البيطريه محدوده وكان الفرق غير معنوي ($\chi 2$ 0.07p=0.53)خلصت الدراسه الي ان معدلات نفوق الحملان عاليه جدا وكان الاسهال والالتهاب الرئوى من الاسباب الرئيسيه لذلك وعليه يوصي ببذل الجهود لزياده الرقابه علي النعاج في موسم الولادات وتحسين اداره الحملان حديثه الولاده ومنع الاسهال وامراض الجهاز التنفسى.

Introduction

The issue of great concern within sheep industry worldwide is the lamb mortality and number of lambs born per ewe is certainly an economically important trait in a commercial sheep enterprise. However, profitability is largely determined by the number oflambs sold per ewe. Therefore, a great deal of effort should be put toward the care of pregnant ewes and their lambs before, during, and after birth (Ameghino*et al.*, 1984 andRadostits*et al.*, 1994). Lamb mortality not only represents a considerable financial loss, it has also been high highlighted as an area of poor welfare and may affected public perception of sheep industry (Green *et al.*, 1994).

Mortality in lambs is complex problem which may result from a variety of climatic, nutritional, management, infectious, genetic and other factors. Various studies have reported how lamb mortality is influenced by fixed effects such as age of lamb , sex of lamb, lambing season and parity of the dam, birth weight, and rearing system (Morris *et al*., 2000and Sawalha*et al*., 2007) .

The world wide lamb mortality averages from 9 to 20% (Mousa-Balabel, 2010).The information about lamb mortality in Gadarif State are scanty. Causes and risk factors of lamb losses were investigated among Shagour and Dubasi Sudanese sheep breeds under farm condition .The overall lamb mortality was 40.5% and for two sheep breeds were 44.3% and 36.7% , respectively for the Shagour and Dubasi . The main causes of losses were respiratory infections. Risk factors were type of birth, and lamb age while lamb sex and season of lambing had no effect on lamb mortality (Suleiman *et al*, 1983). Therefore the objectives of the study are to estimate lamb mortality rate and some mortality measures inaddition toidentify some of the risk factors that associated with lamb mortality in different production systems in Gadarif State, Sudan.

Materials and Methods

Study Area

Gadarif State is located in the eastern part of the Sudan, bordering Ethiopia. It has an area of 75,263 square km and latitude 13°- 15°N, longitude 34° – 37° E. It has a rainfall ranging from: 75 mm—1500 mm. Other sources of water include bore-holes, deep wells, hafiers, dams (*Suddud*), water pumps and seasonal streams (Sulieman, 2010). The study was conducted in South Gadarif, East Gadarif and Central and west Gadarif

Questionnaire survey

Questionnaire survey was used in order to obtain information on risk factors thatassociated with lamb mortality in different production systems in Gadarif State. Information related to education and experience of the owner, herd structure and size, management and husbandry and veterinary services and biosecurity measures were recorded. Questionnaire was modified from previous study on causes and associated risk factors of calf mortality in Khartoum State.

Target population and respondent

The target populations that were investigated were lambs with different age groups, sex and breeds. While the target respondents were the owners of sheep herds.

Production system

The study was conducted in different production systems in Gadarif State such as: 1) The pastoral production system, which comprises of nomadic, semi-nomadic,and transhumance which are all based on range

2) Semi- intensive system, which is based on, irrigated fodder and industrialbi-products and located near the big towns.

3) Intensive system, located around livestock markets where animals are drawnfrom the traditional production system and subjected to concentrate feedingto support export and local consumption after fattening and reconditioning.

Criteria of selection and sample size

Selection of respondents was done according to willingness and support of the owners,while selection of target animals was done using Multi –stage sampling method (site, herd, animal) as described by Thrusfield (2007). With regard to sample size, a total of 15.009 lambs from 300 herds were investigated ,with a the total number of respondents of 300.

Data management and analysis

Calculation of some mortality measures were done as described by Thrusfield (2007):

Crude mortality rate =

No of animals that die from all diseases during a period of time (100)
Average population at risk at that same period of time

Mortality rate =

No of deaths due to disease in a population during a particular period (100)
The sum (over all individuals) of the length of time at risk of dying

Case fatality rate =

$$= \frac{\text{No of deaths due to specific disease during a period of time}}{\text{Total number of diseased animals at the same period}}(100)$$

Age specific death rate =

$$= \frac{\text{No of deaths in specified age group during a period of time}}{\text{Average population in that age at the same period}}(100)$$

Cause specific mortality rate =

$$= \frac{\text{No of deaths due to specificcause during a period of time}}{\text{Average population at risk at that time}}(100)$$

Data related to the risk factor that associated to lamb mortality were analyzed using IBM, SPSS version 20, descriptive statistics such as count and percentage was used for different variables .Analytic statistics such as Chi-square was used for the association between variables and lambs mortality.

Results

The results revealed that the mortality rate of the lambs in different production systems in Gadarif State were 31.5% (n = 1578), 33.4% (n = 1936) and 34.4% (n = 1453) in Central and West Gadarif, South Gadarif and East Gadarif, respectively. The differences was statistically not significant ($\chi 2$= 3.11, p-value=0.53).The overall or crude mortality

rate was 33% (n = 4967). While, the main cause of lambs mortality was diarrhea 53.3% (n = 2673) with case fatality 18% (n =2673), followed by pneumonia 45% (n = 2389) with case fatality 15% (n =2389).The details of lambs mortality in different sites and production systems and lambing seasons are summarized in table (1).

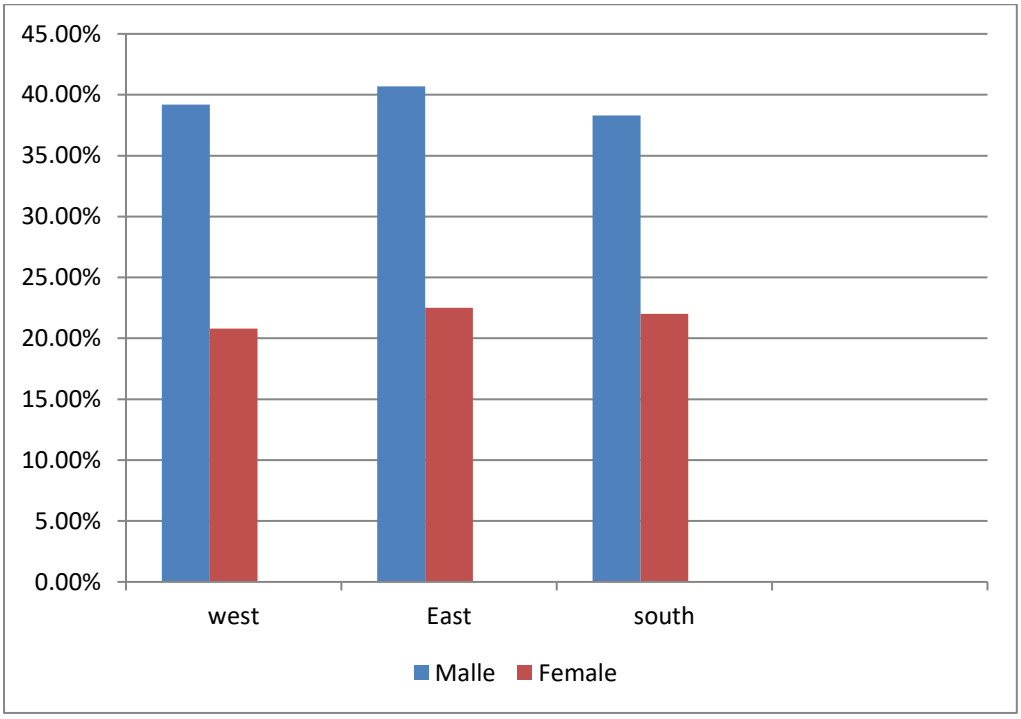
The study showed that lamb age significantly ($\chi2$= 12.94, p- value=0.04) affect the mortality rate and the age specific death rate was 43.2% (n = 3992), 31.6% (n = 1213), 15.2% (n = 190) and 10% (n = 65) for age groups (0 - 2 months), (2 – 4 months), (4 - 6 months) and (> 6 months), respectively. The mortality rate in male lambs was 21% (n = 3298) and in female was 10% (n = 1567) but statistically there was no significant difference ($\chi2$=7.47, p-value=0.11) figure (1). On the other hand, lamb birth weight was found to have highly significant difference ($\chi2$=22.7, p-value= 0.001), high mortality was observed in emaciated lambs 46% (n = 6904) and low mortality for average weight lambs and overweight lambs given a percentage of 20.3% (n = 114) and 0.30% (n =45), respectively. Mortality in Shagour breed was 46.7% (n = 7005), followed by Garage 31.7% (n = 4757),Watish 12 % (n = 1801) and 9.7% (n = 136) for other crosses. There was a significant difference ($\chi2$=11.3, p-value = 0.02).

The results of parity of ewes and flock size are shown in figure (2) and figure (3). High significant level ($\chi2$=11.7, p=0.001) was observed for lambing season, the mortality rate was high in rainy season 73.30% (n = 11001) and less in winter 16.30% (n = 2446) and summer 10.30% (n = 1545). Furthermore, the mortality rates was high in pastoral production system 63% (n = 9455) rather than in semi-intensive production system 24.7% (n =3707) and intensive production system 12.3% (n = 1846), a significant difference was also recorded ($\chi2$=11.26, p-value=0.03).Other risk factors associated with education level of the owners revealed that illiteracy was very high 50% (n = 150), in contrast, the graduate owners were very low 1.30% (n = 4) and the primary and secondary education levels was 37.7% (n = 113) and 11.2% (n = 33), respectively statistically the difference was not significant ($\chi2$=0.88, p-value=0.99). A percentage of 67.3% (n = 202), 24.7% (n = 74), 7% (n = 21) and 1% (n = 3) for the experience of the owners for (0 – 20 years), (20 -40 years), (40 – 60 years), (> 60 years), respectively and no significant difference was recorded ($\chi2$=6.72, p-value=0.34).More owners stated that presence of veterinary services 87.7% (n= 253) and only 12.3% (n= 37) of the owners stated a limit access to veterinary services, and no significant level was observed ($\chi2$= 0.53, p-value=0.07). Most of the owners used vitamins and salt 88.3% (n= 265), however less of them used concentrate 38.30% (n= 115). Regarding disposal of dead lambs, most of the owner doing nothing 91.7% (n=275) and percentage of 7% (n=21) and 0.7% (n= 2) were recorded for burn and bury, respectively. Moreover, other risk factors associated with management and husbandry are summarized in table (2)

Table 1: Relationship between production systems ,lambing season and lambs mortality in different sites of Gadarif State, Sudan

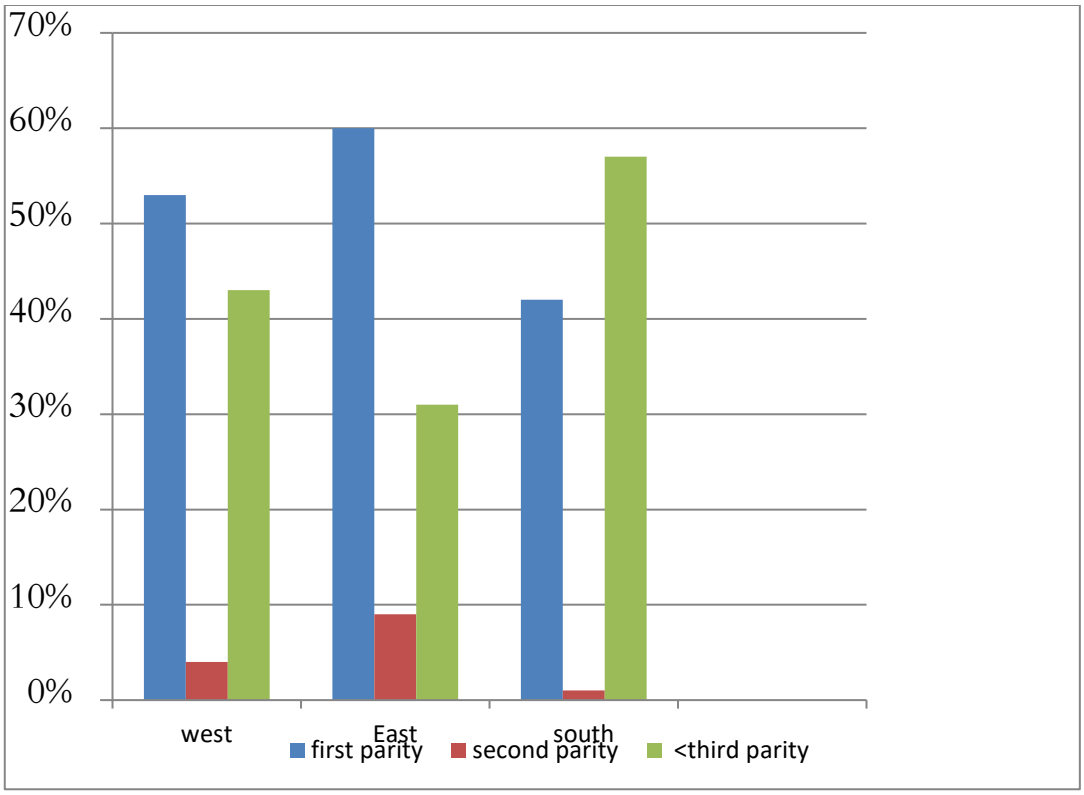
Site Risk factors	Central and West Frequency (%)	South Frequency (%)	East Frequency (%)	χ2	p-value
Productionsystems					
Pastoral	165(55%)	195(65)	213(71%		
Intensive	60(20%)	21(7%)	30(10%)	10.28	0.03*
Semi-intensive	75(25%)	84(28%)	57(19%)		
Lambing season					
Summer	45(15%)	30(10%)	24(8%)		
Winter	72(24%)	45(15%)	45(15%)	11.79	0.01*
autumn	183(61%)	225(75%	231(77%)		

* Significant^{NS} Not significant



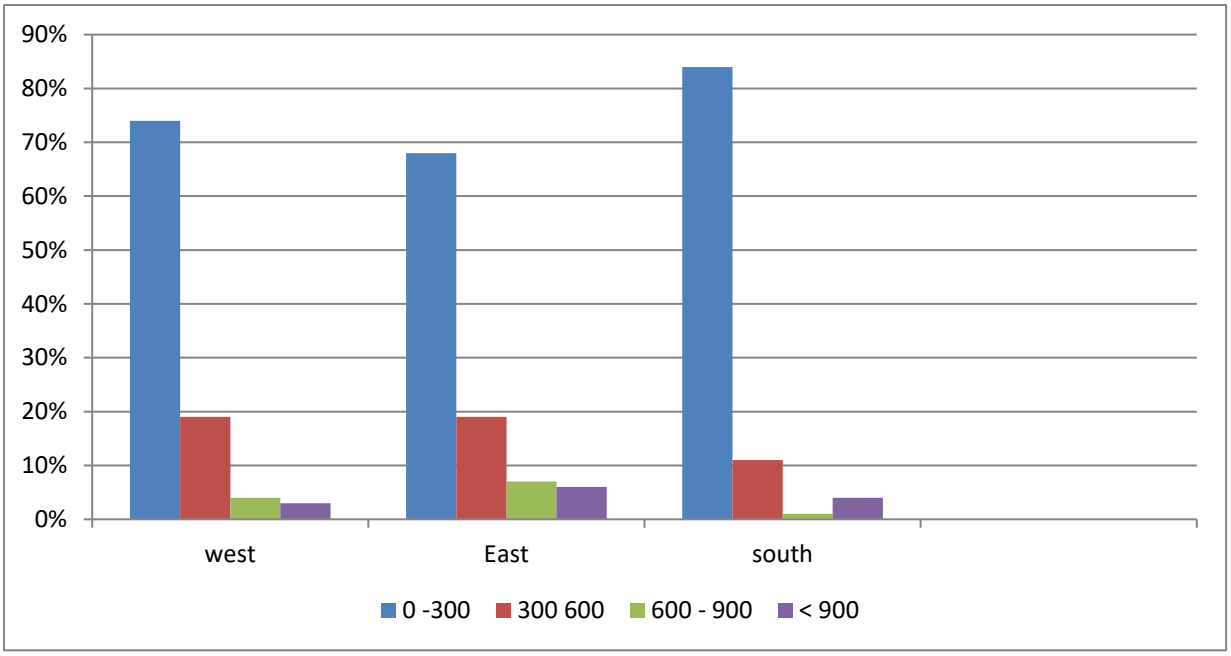
(χ2=7.47, p-value=0.11)

Fig: 1: Association between lamb mortality and sex in Gadarif State, Sudan



($\chi 2$= 12.56, p-value=0.001)

Fig: 2: Association between lamb mortality and ewe Parity in Gadarif State, Sudan.



($\chi 2$=49.5, p-value=0.001)

Fig :(3) Association between herd size and lamb mortality in Gadarif State, Sudan.

Table :(2) Risk factors associated with management and husbandry with regard to lamb mortality in Gadarif State, Sudan.

Factors	Frequency (%)	$\chi 2$	P-value
Vitamin and salt			
Yes	265 (88.30%)	2.24	0.32^{NS}
No	35 (11.70%)		
Concentrates			
Yes	115 (38.3%)		
NO	185 (61.70%)	11.13	0.005^{*}

Umbilical disinfection Yes No	9 (3%) 291 (97%)	0.87	0.84^{NS}
Present of other animals Yes no	234 (78%) 66 (22%)	3,33	0.50^{NS}
Quarantine Yes No	151 (50.30%) 149 (49.70%)	5.94	0.43^{NS}
Veterinary services Yes No	263 (87.7%) 37 (12.3%)	0.53	0.78^{NS}
Hygiene Yes no	91(30.3%) 209 (69.7%)	0.19	0.90^{NS}
se of milk replecer es No	3(1%) 297 (99%)	0.85	0.65^{NS}
Colostrum hours – 12 Hours 4 hours	22 (7%) 101 (33%) 177 (59%)	10.39	0.03*
Disposal of dead lambs Bury urn o nothing ther	2 (0.7%) 21 (7.00%) 275 (91.7%) 2 (0.7%)	14.48	0.02*

* Significant ^{NS} Not significant

Discussion

This study revealed high crude mortality rate (33%) in different production system in Gadarif State. Similarly, Suleiman *et al*. (1983) reported 40.5% of lamb mortality. High mortality in the present study could be attributed to the nutritional and environmental factors in Gadarif State, which leads to scarcity of feeds particularly in the long dry season. Alternatively, it could be due to low temperatures during wet season, as well as low quantity of milk from primiparous ewes which are also prone to mismothering due to inexperience among such ewes.

In the present investigation lamb diarrhea was the main cause of mortality in lambs 53.3% and pneumonia was the second cause of mortality (45%).These finding agree with many studies, which reported diarrhea and pneumonia as the first and second causes of lambs mortality (Smith and Sherman, 1994 and Maksimovic*et al*., 2013). In the current study, 43.3% of mortalities occurred in the lamb between (0 - 60) days of life. This was in accordance with the findings of earlier reports by Sharif *et al.* (2005); Khan *et al.* (2006) and Ahmed *et al.* (2010). Hence, the mortality declined in older age lambs (31.6%), (15.2%) and (10%) for age groups (2 – 4 months), (4 - 6 months) and (> 6 month), respectively. Similarly Muskasa-Mugerwa *et al*. (2000) and Mustafa *et al*. (2014) reported that the mortality declined as the survival lambs grew older. More male mortality (21 %) was observed as against (10 %) for female lambs in this study. This agrees with the works of Berger (2000) who reported 10.5% for males and 9.5% for females This significant difference attributed to sex linked determinants (Mandal *et al.*, 2007).

The variation in lamb mortality between breeds was recorded in Nigeria by Ahamed *et al.(*2010) who reported more lamb mortality in Uda lambs (35.37%) than in Balani lambs (23.17%) and amongst Sudanese breeds (20.73%) whilst in Yankas (12.19%) and (8.54%) lambs of various crosses. Furthermore, in Pakistan study by Mustafa *et al* (2014) showed high mortality in pure bred (Kacchi and Thali) than in cross-bred Pak-Karakul .

As seen from the results, lamb birth weight was a significant risk factor, as lambs with low birth weight had (46 %) mortality compared to those with medium (.30 %) or (20.30%) high birth weights. This, in general, is in agreement with previous reports (Morris *et al*., 2000; Dwyer and Lawrence, 2005; Sawalha*et al*., 2007 and Oldham *et al.*, 2011).

Our results revealed that the lamb mortalities were affected by the lambing system (Indoor or outdoor); this may be attributed to outdoor lambing sheep and the newly born are exposed to different environmental circumstances specially humidity and temperature. Similar results were obtained by Metawi *et al*. (1999) which showed higher (17.4%) lamb mortality in the extensive (transhumant herding system, THS) systems than (7.44%) in semi-intensive production (mixed crop/livestock farming system, MCLFS) systems. Macedo *et al*. (2010) reported 30.3% of lamb mortality in the extensive production system and 3.4% of lamb mortality in the intensive production system. Mousa-Balabel (2010) found that the mortality in the extensive system was 30,96% where as in the intensive system was 4%. The high lamb mortality rate in autumn in this study agree with Woldemeriam (2009); Ahmed *et al*. (2010) and Belay and Haile, 2011) who reported high lambs mortality in wet season during(June-September). The rainy, cool temperature wet environment exposed the young lambs to hypothermia, pneumonia and coccidiosis.

Regarding the parity of ewes; total lamb mortality tended to be higher in the first parity and declined until the fourth parity. This was partly accounted by birth weight which was significantly lower for born lambs to the first parity dams. In addition, the parity had an influence on lamb mortality due to the incidence of negative maternal behavior,

such as rejection (butting and abandoning the lamb) fear-like behavior (withdrawing from the lamb, moving as the lamb attempts to suck .The same results were obtained in different studies (Nash *et al*., 1997: Mandal *et al*., 2007; Mousa-Balabet, 2010 and Belay and Haile, 2011). On the other hand, the results disagreed with Khan *et al*. (2006) who stated that parity of the ewe did not affect the mortality rate, and with Butswat *et al. (*1995) who reported that lamb mortality increased with parity.

The level of passive immunity acquired from the colostrum by a lamb during 6 hours after birth was associated with low 7% lamb mortality and the mortality increased 33% and 59% when the ingestion of closturm was after 12 and 24 hours. This was in agree with different studies that demonstrate the importance of the ingestion of adequate amount and high quality colostrums immediately after birth (Ahmad *et al*., 2000; Khan *et al*., 2006).

The availability of veterinary services (87.7%) and high experience (67.3%) of respondent associated with the high mortality in this study. This agree with (Gokce and Erdoğan, 2009 and Holmoy *et al*., 2012) who reported experience and the acknowledgement of the stock person lead reduce lamb mortality and disagree with ((Rook *etal*., 1990 and Mellor and Stafford, 2004) who reported high mortality despite improvement in management, veterinary services and farmer's knowledge .Supplying feed with vitamin and salts was found not significant in reducing lamb mortality this result disagree (MousaBalabel and Salama, 2003) who reported that it is possible to save more than 15% of lamb mortalities by applying modern methods of husbandry such as feed supplementation of pregnant ewe at late stage of gestation.

Conclusion

The results of the study revealed that the mortality rate in lambs was very high in different production systems in Gadarif State as well as diarrhea and pneumonia were the main causes of lambs mortality and many risk factors were observed. Hence it is recommended that e-Effort should be made to increase laming supervision, improve management of newborn lambs, and prevent diarrhea and respiratory diseases. Also the concerned authority should implement lamb vaccination programs to protect lamb diarrhea caused by viruses. Extension services among sheep flocks owners and labors are urgently needed on proper husbandry practices such as record keeping, sanitary practices.

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