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Climate change adaptation strategies for sheep production in range land of Kordofan Region

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ABSTRACT : Climate changes had great impact on livestock production systems in semi-arid zone. The effect of climate change on the stock raised under traditional nomadic system, that involving to extensive seasonal migratory movements for search of water and pasture, the stock of thus subjected of combination of stress such as long journeys, extensive of heat, insufficient water supply, an scarcity and low nutritive quality of pasture particularly during the long dry season. This study was carried out to decrease the effect of long dry season on sheep productivity in north Kordofan state. A total of 340 ewes and 18 rams of desert sheep were selected from the nomadic herds, animals were divided randomly into four groups, group one was as farmer's practice (not supplement) and the other three groups were supplemented. The breeding is controlled with application of "Kunan" during the breeding season (February to March). Supplementation in the dry season had improved the reproductive and productive performance of the ewes. Lambs borne from group one had less body weight gain. These results of the study indicated the importance of the nutritional status of the animals to adapt the effect of climate chances on rangeland by supplementation strategies during the long dry season, also the application of breeding control increased lambing % in the rainy season and growth rate of lambs was improved. The sududy showed that, supplementation and application of *Kunan* during breeding season are very important strategies to adapt climate change in the rangeland of Kordofan.
Keywords: Climate change, desert sheep, supplementation strategies, productivity, North Kordofan State

INTRODUCTION

Livestock system play an important role in livelihoods in many rural communties in the Sudan. The desert sheep and their crosses make about 80 % of the sheep found in Sudan and mainly predominant north of 12º N (Devendra and Mcleroy, 1982), they are raised mainly under harsh dry land farming conditions for meat production (Khalafalla and Sulieman, 1992). The nutritional limitation, low nutritive value of the range, high ambient temperature, scarcity of feed and water are have great effect on the production of the sheep in semi arid area of Kordofan states as compared to that in temperate regions.

The most critical period for grazing sheep in the semi desert zone of Sudan is from February to June, when the ambient temperature becomes hot and range grazing is scanty and depleted of nutrients. Shortage of feed in mating season is the main factor, that effect to sheep production in the range land of Kordofan, taking into account that natural pasture by product are poor in their quality and most the range exposed to over grazing, especially near the water recourses. Seasonal nutritional status and husbandry affect sheep production characteristics (El Hag et al 2001). Nomadic sheep flocks spend the dry season near watering yards. During winter months, when ambient temperature is mild and the range contains some green fodder, herds can extend the watering intervals from 10 to 15 days. After winter grazing when climatic conditions becomes harsh, so the watering interval is reduced to between 3 to 5 days (Mukhtar 1985).

Livestock are particularly important for increasing the resilience of vulnerable, poor people, how are subject to climatic, market and desiease shocks, through diversifying risk and assets (Krisna etal,2004, freeman etal, 2008). There are many ways in which climate change may effect the livelihood, food security and health of vulnerable people through its effects on livestock and livestock systems. Such as changes in water and feed availblity changes in biodiversity and animal health (Thorntan etal, 2007,2009). climate changes could impact the economic viability of livestock production systems worldwide. Surrounding environmental conditions directly affect mechanisms and rates of heat gain or loss by all animals. Lack of prior conditioning to weather events most often results in catastrophic losses in the domestic livestock industry. This study was undertaken to reduce the impact of climate change on ewe's production and reproductive performance in rangeland of kordofan. The main ultimate objective was to introduce supplementation concept to nomadic herd owners in the dry season.

MATERIAL AND METHODS

Study area

The study was carried at Agricultural Research station, El-Obeid, North Kordofan state,(latitude11˚:15̀-16˚:30̀ N and longitudes 27˚-32˚ E), Sudan.

Experimental work

A total of 340 desert ewes (1 to 6) years old reared in natural range condition were selected during the normal breeding season (February-March). Ewes were divided into four groups. One group (60 ewes) was used as a control (CTL) (like in farmer traditional practice). The second group (92 ewes) was supplemented with ration A (GNC), the third group (97 ewes) was supplement with ration B (GNC-M) and the fourth group (92 ewes) was supplemented with ration C (RS-M) (Table1). Supplementary feeding practices were imposed on ewes prior to mating (flashing) for 45 days and during late pregnancy (Steaming-up) for 45 days in the long dry season. Mature 18 rams introduced to all experimental ewes, the ratio of the sex were 1:20. All Rams were divided to 3, 5, 6 and for the first, second, third and fourth group respectively, and they were supplemented with same ration B (GNC-M). Rams were allowed to mix with the ewes twice daily: at 6:00 and 18:00 h.

Animals were then allowed to graze normally under range conditions. Ewes were offered 450 g / head of the ration every three days at the watering periods and the rams 600 g / head for three days, ewes fed in small groups in the watering points in period from 6:00 am to 9:00 am and rams were fed individually in the same period. Ewes were monitored for signs of behaviour estrous and those detected were serviced naturally, those returned to estrous were serviced again, ewes demonstrating were naturally mated twice daily at 6:00 and 18:00 h. The experiment extended to 330 days, including 15 days of adaptation period and feeding supplementation period 90 days.

Weight of dams was recorded during mating, mid-pregnancy and late-pregnancy time. The body condition score (BCS) was determined according to 1 to 5 scale (Russel 1991) and recorded in breeding, mid pregnancy and lambing period. The lambs were weighed after birth, then at 15, 30, 45,60,75,90,105 and 120 days of age. Born lambs were identified by ear tag to follow lamb growth rate every 15 days till 120 days of lamb age.

Control breeding by application of (Kunan)

The control of breeding is by tied the reproductive organs of the ram *(Kunan),* this is a common practice to control breeding which is usually carried out during (February -March) with subsequent lambing during autumn (July-September).This practice would ensure good grazing for lambs. However, weaned lambs may be exposed to long dry winter and summer period when agricultural by products and residues, especially groundnut seed cake and hay are widely used by sheep owners.

Statistical analyses

Data were analyzed by least square mixed model (Harvey 1990).

Analytical procedures

The analysis performed to experimental rations according to A.O.A.C. (1995) and Goering and Van Soest (1991). The content of the metabolizable energy (ME, MJ / kg DM) was calculated from table values of energy content of the components according to A.O.A.C. (1995).

RESULTS

All treatments improved (P < 0.05) ewes BCS in mid pregnancy and at birth compared with farmers practice (Table 2). Ewes in first, second and the third parity number loss more (P < 0.05) condition in parturition than of their fourth and fifth parity. Sex of lamb and birth type had significant (P < 0.05) effect on ewes BCS, ewes born male lambs were lost more BCS than ewes born female lamb, dams born twins lost more BCS compared with that born single.

Table1. Chemical composition (g/kg dry matter) of the supplements and calculated energy content

Ingredients	Ration A (GNC)	Ration B (GNC-M)	Ration C (RS-M)
Molasses	–	10	10
Roselle seeds	99	89	–
Groundnut seed cake	–	–	89
Common salt	0.75	0.75	0.75
Salt lick	0.25	0.25	0.25
Nutrient (g/kg DM)			
Dry matter	941	940	942
Crude protein	557	504	303
Crude fibre	72	65	144
Crude fat	72	66	212
Ash	52	55	101
NFE	247	310	240
NDF	129	116	244
ADF	95	86	169
ADL	15	13	61
g Ca/ kg DM	0.73	0.74	2.16
g P/ kg DM	5.42	4.87	4.42
Energy density (ME, MJ/kg DM)	12.5	12.4	13.1
In vitro OM digestibility (%)	80.9	87.7	62.2

ME metabolizable energy calculated from literature values.

GNC Ground nut cake; GNC-M Ground nut cake and Molasses; RS-M Roselle seeds and Molasses; CTL Control

Pre-partum supplementation of the dams had significant (P<0.05) effect on lamb daily growth rate (Table 3). In general, ewes' pre-partum supplementation improved lambs daily growth rate and there were significant (P< 0.05) difference in lamb growth before and after weaning. lambs whose dams were supplemented with RS-M had slightly higher growth rates, also the study revealed that supplementation had no significant (P> 0.05) effect on lambs growth rate in the intervals 90-120 days of age(after weaning). Type of birth and sex had significant effect on daily lamb growth rate (figure 1 and 2), also dam parity had significant effect on lamb growth rate (figure 3).

Table 4 presents the effect of pre-partum supplementary feeding on lamb weight from birth to 120 days of age. During long dry period, supplemented dams had heavier (P<0.05) lambs weight than the farmer practice (control), dams supplemented with GNC significantly had (P<0.05) heavier lambs at 120 days than those supplemented with GNC-M and RS-M. Dam parity had significant effect on lamb birth weight; late parties were significant difference from the other parties'. Type of birth had significant (P < 0.05) effect on birth weight and over all age period, single lambs were significantly heavier than twins. Male lambs recorded significantly (P < 0.05) heavy weight at birth to 120 days of age than female lambs.

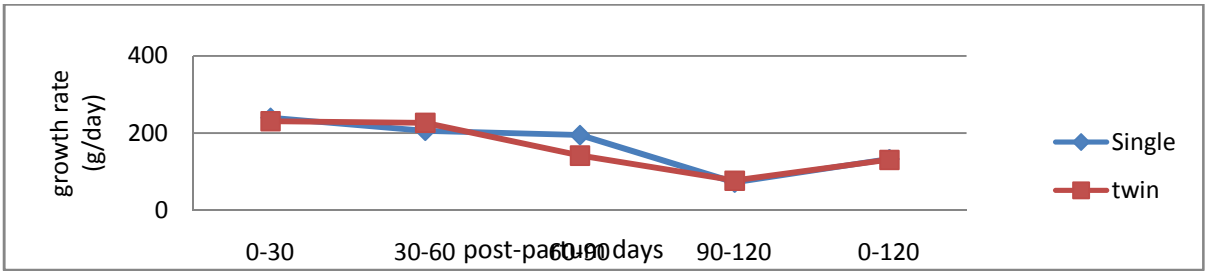

Figure 1. Effect of birth type on lamb growth rate (g⁄day).

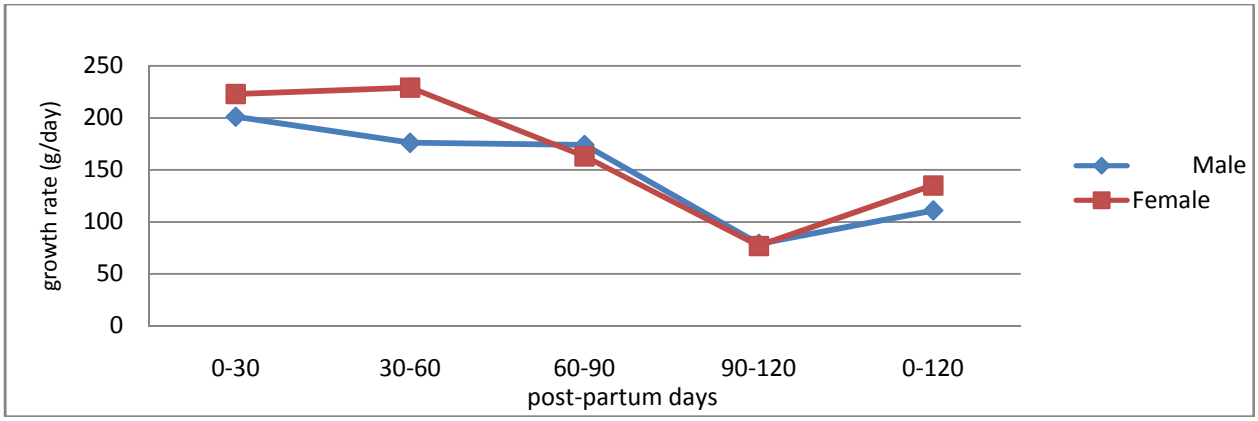

Figure 2. Effect of sex on lamb growth rate (g/day).

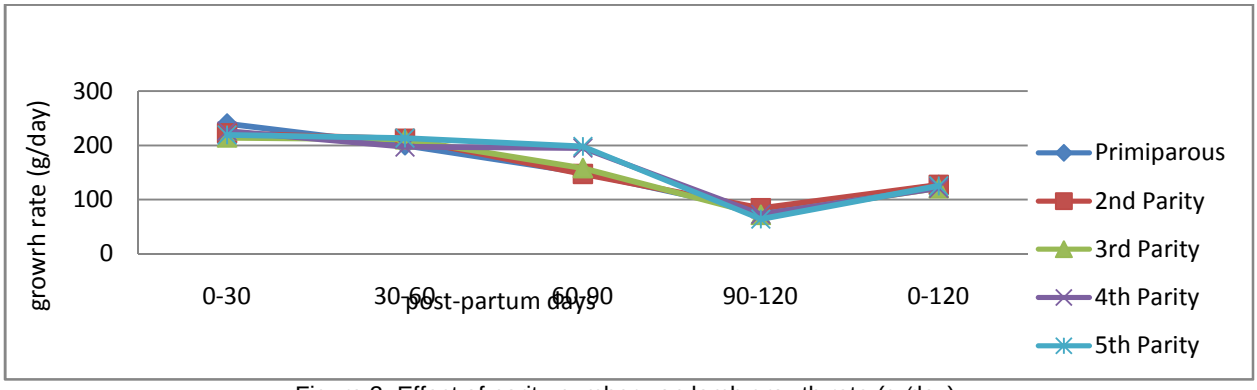

Figure 3. Effect of parity number on lamb growth rate (g/day).

DISCUSSION

In lambing season, the BCS was reduced in the animals. During this period the nutritive value of the forage are low and the supplements are not enough for ewe maintenance and fetal growth .Under such conditions, it would be expected that the ewes would have used their body reserves to meet the increased nutrients demand for final fatal growth. Concentrate supplementation might also decrease the loss of body reserves. These are similar with results of Sairanen *et al* (2006) and. In late gestation, ewes on farmer's practice were grazed on fibrous forage of low nutritive value without any concentrate supplementation.

Inadequate feed intake during late pregnancy has been found to cause a reduction in birth weight, mammary gland development and milk production. Similar results were obtained by Mellor and Murray (1985). Lambs whose mothers were treated with supplementation had higher body weight than lambs suckling control ewes; this explanation is in line with findings of Rafiq *et al* (2006). Dam parity had an influence on lamb birth weight, lambs born on fifth parity recorded heaviest weight than the other parities and ewes on fourth parity born had lightest lambs. The results also indicated that, dam parity had no significant effect ($P > 0.05$) on lamb weight in the interval, 15 days to 120 days; this may be due that lactation curve.

In this study sex of lamb had significant ($P < 0.05$) effect on lamb weight, single lambs recorded heavier weight than twins and male lambs were heavier than female lambs, these results are in general agreement with research workers, Hassen *et al* (2002). On the contrary El-Toum (2005) indicated that, Lambs sex had no significant effect on lamb weight at birth, 45, 60 and 75 days of age. Similar results were obtained by Schoeman *et al* (1993). Type of birth had significant effect on lamb weight at birth and over all age period, similar results were obtained by Cloete *et al.* (2007). Ewes' pre-partum supplementation improved lambs growth rate before weaning (0-90). Hence lambs born to ewes with supplementation had highest growth rate than those suckling non supplemented ewes (framer's practice), Supplementation of pregnant ewes during late gestation may provide adequate energy and protein to support maintenance of animal.

Table 2. The main effect of supplementation and Parity Number on body condition score (mean± S.E) of desert ewes at different physiological states.

Factor		BSC at mating	BSC at mid pregnancy	BSC at lambing
Treatment	GNC	2.6±0.04 [c]	2.6 ±0.05 [a]	2.3±0.07 [a]
	GNC-M	2.9±0.04 [ab]	2.7±0.05 [a]	2.2±0.06 [a]
	RS-M	2.9±0.04 [ab]	2.6±0.06 [a]	2.0±0.08 [b]
	CTL	2.8±0.05 [bc]	2.5±0.07 [b]	2.1±0.10 [b]
Dam parity	Primiparous	2.9±0.04 [a]	2.7±0.07 [ab]	2.1±0.07
	2nd parity	2.7±0.05 [bc]	2.5±0.06 [c]	2.2 ±0.08
	3rd parity	2.8 ±0.03 [b]	2.6±0.04 [ab]	2.0±0.05
	4th parity	2.7±0.04 [c]	2.5±0.06 [c]	2.1±0.07
	5th parity	2.7±0.07 [bc]	2.6±0.09 [ab]	2.3±0.12
	overall mean	2.8±0.01	2.6±0.02	2.2±0.02

[abc] means in the same column bearing different superscripts are significantly different (P<0.05)

GNC Ground nut cake; GNC-M Ground nut cake and Molasses; RS-M Roselle seeds and Molasses CTL Control. N; Number of animals

Table 3. Effect of pre-partum supplementary feeding on lamb growth (mean ±S.E) g⁄day.

Treatment	0–30 days	30–60 days	60–90 days	90–120 days	0–120 days
GNC	229 ± 16 [a]	204 ± 22 [b]	182± 16 [a]	71 ± 13	127 ± 6 [a]
GNC-M	225 ± 17 [a]	204 ± 23 [b]	173 ± 17 [ba]	79 ± 14	125 ± 6 [a]
RS-M	226 ± 18 [a]	229 ± 25 [a]	156 ±18 [c]	70 ± 15	130 ± 7 [a]
CTL	217 ± 19 [b]	189 ± 26 [c]	168 ±19 [abc]	77 ± 16	116 ± 7 [c]

[abc] means in the same column bearing different superscripts are significantly different (P<0.05)

GNC Ground nut cake; GNC-M Ground nut cake and Molasses ; RS-M Roselle seeds and Molasses ; CTL Control

[abc] means in the same column bearing different superscripts are significantly different (P<0.05)

GNC Ground nut cake; GNC-M Ground nut cake and Molasses; RS-M Roselle seeds and Molasses; CTL Control.

Table 4. The effect of treatments, dam parity, Birth type and the sex on weight growth of the lambs (mean ±S.E) Kg.

Treatment	Birth weight	15 days	30 days	45 days	60 days	75 days	90 days	105 days	120 days
GNC	3.6 ± 0.1 [a]	7.2 ± 0.27 [a]	10.5 ± 0.64 [a]	13.2 ± 0.6 [a]	16.1 ± 0.6 [a]	19.2 ± 0.8 [a]	22.1 ± 0.7[a]	26.0 ± 0.8 [a]	28.3 ± 0.9 [a]
GNC-M	3.6 ± 0.1 [a]	6.9 ± 0.3 [a]	10.5 ± 0.7 [a]	13.2 ± 0.6 [a]	16.5 ± 0.6[a]	18.9 ± 0.7 [a]	21.2 ± 0.7 [a]	23.2 ± 0.8[a]	26.4 ± 0.9 [b]
RS-M	3.6 ± 0.1 [a]	7.0 ± 0.3 [a]	10.2 ± 0.7 [a]	13.6 ± 0.6 [a]	16.8 ± 0.7[a]	19.6 ± 0.8 [a]	21.2 ± 0.8 [a]	23.9 ± 0.8 [a]	26.1 ± 0.8 [b]
CTL	3.0 ± 0.2 [b]	5.8 ± 0.4 [b]	9.0 ± 0.9 [b]	11.1 ± 0.9[b]	13.4 ± 1.0[b]	16.4± 1.1[b]	18.8 ± 1.1[b]	21.7 ± 1.1[b]	24.1 ± 1.0 [c]
Dam parity									
Primiparous	3.6 ± 0.2 [abc]	6.8 ± 0.3	10.6 ± 0.7	12.6 ± 0.6	15.8 ± 0.7	18.6 ± 0.8	21.0 ± 0.8	23.4 ± 0.8	26.0 ± 0.9
2nd Parity	3.6 ± 0.2 [ac]	7.0 ± 0.3	10.0 ± 0.8	13.7 ± 0.8	15.7 ± 0.8	18.5 ± 1.0	20.5 ± 0.9	23.5 ± 1.1	26.3 ± 1.1
3rd Parity	3.3 ± 0.1 [ab]	6.7 ± 0.2	9.6 ± 0.6	12.6 ± 0.5	15.8 ± 0.6	18.9 ± 0.7	20.9 ± 0.7	23.2 ± 0.7	25.6 ± 0.7
4th Parity	3.4 ± 0.1 [b]	7.0 ± 0.3	10.4 ± 0.7	13.0 ± 0.6	16.0 ± 0.7	18.6 ± 0.8	21.0 ± 0.9	23.9 ± 0.8	26.3 ± 0.9
5th Parity	3.5 ± 0.2 [c]	6.2 ± 0.5	9.7 ± 1.1	12.1 ± 1.0	15.3 ± 1.1	18.1 ± 1.3	20.7 ± 1.3	24.5 ± 1.3	27.7 ± 1.2
Birth type									
Single	3.6 ± 0.08 [a]	7.2 ± 0.2[a]	11.1 ± 0.4 [a]	14.1 ± 0.3[a]	17.3 ± 0.4 [a]	20.4 ± 0.4 [a]	23.4 ± 0.4 [a]	25.5 ± 0.4 [a]	27.9 ± 0.40[a]
Twin	3.3 ± 0.18 [b]	6.2 ± 0.4 [b]	9.0 ± 0.9 [b]	11.5 ± 0.8[b]	14.1 ± 0.9[b]	16.6 ±1.0[b]	18.3 ± 1.0[b]	21.9 ± 1.1[b]	24.7 ± 1.2 [b]
Sex of lamb									
Male	3.7 ± 0.14 [a]	7.1 ± 0.3 [a]	10.5 ± 0.7 [a]	13.5 ± 0.6 [a]	16.7 ± 0.7 [a]	19.2 ± 0.9 [a]	21.6 ± 0.9 [a]	24.8 ± 0.9 [a]	27.4 ± 0.9 [a]
Female	3.3 ± 0.12 [b]	6.4 ± 0.3 [b]	9.6 ± 0.6 [b]	12.1 ± 0.6[b]	14.8 ± 0.6[b]	17.9 ±0.7[b]	20.0 ± 0.7[b]	22.6 ± 0.7[b]	25.2 ± 0.7 [b]

[abc] means in the same column bearing different superscripts are significantly different (P<0.05.)

GNC Ground nut cake; GNC-M Ground nut cake and Molasses; RS-M Roselle seeds and Molasses; CTL Control.

Physiological needs mammary gland growth, colostrums and milk yield. This result was in line with findings of Oeak et al (2005). In this study, higher growth rates in lambs suckling supplemented ewes are expected to increase milk production as supported by observations by Rafiq et al (2006). Supplementation had no effect on lambs' growth rate after weaning (90-120 days of age). This may be due to the short lactation period of the desert sheep. The sex had no effect on lambs' growth rate in the intervals 90-120 days of age. Similar results were obtained by El-Hag et al (2001). Male lambs indicated higher growth rate only in the interval 60–90 days.

CONCLUSION AND RECOMMENDATION

The study indicated that, flushing and steaming-up during breeding period improved the body condition and lambs born from supplemented ewes recoded better production characteristic compared with farmer's practice. The study indicated the importance of the nutritional status of the nomadic ewes at mating and supplementation reduced the effect on the climate chance on productive and reproductive performance. Supplementation and application of Kunan during breeding season are very important strategies to adapt climate change in the rangeland of Kordofan.

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