An investigation into the causes of low calving percentage in communally grazed cattle in Jericho, North West Province

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ABSTRACT

The communal grazing system is generally understood to have a low input, low output type of management. However, the actual inputs and outputs of the farmers are not well known and the farmers are often unaware of their problems. Although the causes of low calving percentage are well understood in commercial beef farming enterprises in South Africa, the same is not true for communal farming systems. The aim of this study was to determine the reproductive performance of beef cattle on a communal farming system in Jericho, North West Province. Ten farmers from five villages with a total of 265 cows and 13 bulls were purposively selected. The selection criteria were that each farmer had to have a minimum of 10 breeding cows and a bull and be willing to participate in the study. This was followed by a 12-month longitudinal study with monthly herd visits where cows were examined rectally and bulls (n = 13) were subjected to a single breeding soundness evaluation. The calving percentage was found to be 37.7 %. This is lower than the recorded percentages for commercial beef cattle on extensive grazing. The factors playing a role in low calving percentage were ranked using field data. From this it appeared that failure of cows to become pregnant was the main cause of poor calving percentage as opposed of loss of calves through abortion or resorption. Sub-fertility of the bulls was found to be of great significance and it is proposed that this be included in extension messages and that bulls be fertility tested routinely. Poor body condition score of cows, mainly caused by poor management, was also considered to play a major role in reducing pregnancy rates. Infectious diseases like trichomonosis, campylobacteriosis and brucellosis played a much leser role than anticipated.

Key words: beef cattle, calving percentage, communal grazing system, fertility, pregnancy loss, pregnancy rate.

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INTRODUCTION

The fertility of beef cattle in communal farming systems is said to be low, taking calving percentage as a measure of production. Studies involving structured interview techniques estimated the calving percentage of beef cattle in communal farming systems in South Africa at 41 % and 14.9 %[6,31]. Studies done in communal grazing areas of Zambia recorded calving percentages of 44 %, 88 % and 27.9 %[34]. In Botswana a survey that combined the structured interview technique with rectal pregnancy diagnosis and monthly recording of calving estimated the calving percentage of cows on communal farms at 36–50 %[37]. The optimal level of performance in the commercial sector should yield a calving percentage of 95–99 % and the target should be 98 %[36]. In South Africa, the Brahman Cattle Breeder's Society has set a target calving percentage of 70 % for stud herds[16].

Calving percentage is the number of calves born per number of female cattle exposed to a bull expressed as a percentage[11,30,58]. This is also called effective calving percentage[30]. Calving percentage does not relate to the dates of birth or when calves were born during the calving season. All full-term calves are included in the number of calves born, even if they are dead on arrival. Calving percentage is a good indicator of breeding performance and herd fertility[14,58].

Calving percentage is influenced by pregnancy rate and pregnancy loss percentage. A low calving percentage indicates that a problem exists in a herd, but does not indicate the cause of the problem and where it occurs. A low calving percentage may indicate that bull fertility is inadequate, the nutritional programme is inadequate, that there is disease causing pregnancy loss, or that there is a mismatch between herd genetics and the environment (i.e. feed resource and management style)[28,53]. Calving percentages of the herds will vary from year-to-year due to environmental stresses such as droughts, severe winters and high environmental temperatures[14,29,36,58].

Under communal farming systems, breeding and calving are uncontrolled and occur throughout the year[54]. This factor necessitates monitoring of pregnancies and recording of calving as they occur, because previous studies conducted in South Africa were structured interviews which relied on memory, as the farmers did not have written records[6,31].

The major factors lowering reproduction in communal beef cattle in South Africa are thought to be low fertility of cows due to poor nutrition caused by overgrazing and lack of supplementary feeding, poor disease control, a high burden of ticks and tick borne diseases [6,20,31,33,37]. Fertility is said to be 5 times more important to the beef producer than growth rate and ten times more important than carcass quality[27]. It has been shown in the commercial sector that the greatest obstacle to optimal beef cattle production under extensive conditions is the failure of cows to conceive. However, the same conclusion has not been reached from studies published on communal grazing systems[6,30,31,34,37]. The influence of bulls, pregnancy losses, brucellosis, trichomonosis and campylobacteriosis on calving rate has not been well studied on a herd basis in the communal farming systems[28,35,42,56].

The serological prevalence of brucellosis in communal farming systems in South Africa is low, estimated at 1.5% to 2%[1,8]. However brucellosis remains one of the most important diseases resulting in loss of pregnancies in cattle and has to be taken into consideration when investigat-

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ing causes of pregnancy loss. A study done in a communal area in South Africa showed that the prevalence of trichomonosis and campylobacteriosis on communal farms is high. It was estimated at 26.4% and 28.7%, respectively[32]. These diseases are expected to contribute significantly to lowering the fertility of cattle in communal farming systems.

The aim of this study was to determine the calving percentage of beef cattle kept in a communal grazing area and the relative importance of the various points at which reproductive failure occurred.

MATERIALS AND METHODS

Purposive selection was used to select farmers, herds and villages[48]. Criteria for selection were that each farmer had a minimum of ten breeding cows and a bull. All bulls from the age of 2 years, present in a herd, were included in the study. The cows were of breeding age (over the age of 2 years) as determined from a history of pregnancy or completion of at least 1 pregnancy.

A total of ten farmers, 265 cows and 13 bulls from 5 villages were included in the study. Cows were identified using numbered ear tags and grouped by owner and village. The reproductive performance of the herds was monitored for a period of 1 year (March 1999 to February 2000) by doing monthly herd visits. Reproductive performance was assessed during herd visits by qualitative observations and unstructured interviews with farmers. Pregnancy status of the cows was established and monitored during herd visits by rectal palpation as described in the literature[18,58]. Body condition score was done on cows using the score of 1 to 9[13,19,47]. The farmers recorded data according to cow number on breeding dates, repeat breeders, calving, abortion, dystocia, mortality of cows, off-take and diseases. Data collected from farmers, together with results of pregnancy diagnosis and body condition score, were recorded on a data capture sheet during monthly herd visits.

Cows were sampled for brucellosis by collection of blood from the coccygeal blood vessels. The sera were forwarded to the Onderstepoort Veterinary Institute for testing using conventional methods[7,50]. Animals with a CFT titre of 30 IU/mℓ or higher were regarded as positive.

Thirteen Brahman and Brahman crossbred bulls of 2–6 years old, from the ten herds were tested for venereal diseases. Sheath wash samples were collected in phosphate buffered saline, kept in ice-cooled cooler boxes and transported to the laboratory within 6 hours of collection.

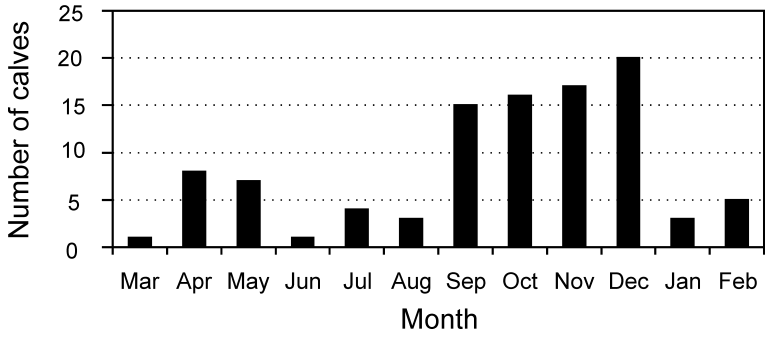

Fig. 1: **Number of calves born to cows from March 1999 to February 2000.**

The samples were processed and tested for trichomonosis and vibriosis as described in the literature [5,40,41]. The bulls were also subjected to a single breeding soundness evaluation using a system recommended in the literature[2,4,29,51]. Breeding soundness evaluation of bulls was done during November. Semen was collected on the farm by with an electro-ejaculator and evaluated for motility using bright-field microscopy at ×100 magnification. Eosin-Nigrosin stain was used to prepare semen for spermiogram. Semen smears stained with Eosin-Nigrosin were prepared on-farm labelled and stored. From each semen sample an unstained smear was also prepared on-farm, labelled and later stained with Diff-Quick stain in the laboratory. The smears were evaluated for the presence of foreign bodies (Diff-Quick) and morphology (Eosin-Nigrosin) using bright-field microscopy by first scanning at ×400 magnification and then by ×1000 magnification under oil immersion. For each smear (Eosin-Nigrosin) 200 sperm cells were evaluated and differential counting was performed at ×1000 magnification under oil immersion. Sperm cells with at least 1 abnormality were recorded for each bull. After determining the percentage of normal sperm cells, experimental sperm morphology categories were assigned using the system recommended in the literature for sperm morphology[10,44,45,46,51].

Quantitative data were entered into Microsoft Excel® (Microsoft Corporation, Redmond, WA) and then transferred to the SAS statistical program (SAS Institute Inc., Cary, NC) for analysis. Data were presented as frequency tables and histograms[48]. Variables that lowered the calving percentage were evaluated and compared using data from the investigation and the literature.

RESULTS

From a total of 265 cows, 100 calves were born. This represents an overall calving percentage of 37.74 %.

The mean of the calving percentages of all the herds was 38.16 % (median = 37.70; SD = 10.52) with a range of 22.4 % to 59.4 %. The coefficient of variation for calving percentage was 27.58 %. Table 1 shows data on calving, abortion, repeat breeders and mortality of the individual herds.

One hundred and fourteen (43.02%) of the 265 cows remained open (not pregnant) for the duration of the study (Table 2). From the results of pregnancy diagnosis, which were done at the beginning of the study, it is estimated that these cows were open for at least 400 days, taking into consideration that there was no history of calving on these cows for at least 3 months before the study began. Table 2 gives more details on the pregnancy outcomes of all the cows (n = 265) investigated.

Of the 114 cows that did not become pregnant for the duration of the study, 41 remained in poor body condition score (<5), 71 were in fair body condition score (5–7) and 2 cows had a high body condition score (>7).

The histogram in Fig. 1 shows the number of calves born per month.

Two cows (0.75 %) from a single herd (E) tested positive for brucellosis. It was recorded during herd visits by the State Veterinary Service which is responsible for the control of brucellosis in the area, and which vaccinates heifers from the ages of 3–8 months annually. One bull from herd D tested positive for trichomonosis. All bulls were negative for campylobacteriosis.

Management by the farmers was considered to be poor. The most important deficiencies in herd management noted from informal interviews and observations made during herd visits were:

- Herd composition was skewed: farmers did not apply the policy of culling and weaning. Oxen, bullocks and old cows were not removed from the herds. Cows with poor fertility were not culled.
- It was also noted that there is no selection of best genetic material and all heifers born are kept as replacements. This practice resulted in sub-fertile

Table 1: **Data on calving, abortion, repeat breeders, mortality and body condition score of cows.**

Herds (n = 10)	Cows/herd (n = 265)	Bulls/herd (n = 13)	Calving (n = 100)		Abortion (n = 22)	Repeat breeder (n = 4)	Deaths (n = 13)	Average BCS of cows
			n	**%**				
A	31	3 (2, 4, 9)	13	42.0	4	1	1	5.6
B	27	1 (3)	8	29.6	0	0	5	4.8
C	26	1 (6)	10	38.4	0	0	3	4.8
D	17	1 (5)	8	47.0	3	1	0	5.6
E	49	1 (*)	11	22.44	2	0	2	5.2
F	14	1 (8)	5	35.8	1	0	1	5.0
G	27	2 (2, 7)	10	37.0	6	1	0	5.0
H	18	1 (13)	5	27.8	4	0	1	5.0
I	37	1 (10)	22	59.4	0	0	0	5.6
J	19	2 (11, 12)	8	42.2	2	1	0	5.0

Key: BCS = body condition score; ( ) bull serial numbers; *bull not tested (died).

heifers joining the breeding herds.

- Farmers did not keep adequate records of their cattle and relied mostly on memory. Farmers did not practise management such as monitoring of calving, selection, bull testing, disease control and pregnancy testing.
- Parasite control (especially ticks) was poor. This led to many cattle developing abscesses that caused damage to the teats, udder, prepuce and scrotum.
- Management of nutrition was also inadequate and that led to mortality of both the pregnant and non-pregnant cows. Supplementary feeding was lacking, especially during the months when grazing was poor. Failure of cows to conceive due to poor body condition was associated with 41 cows. When considered together with cows that died due to drought (n = 8), this accounted for 21.14 % of loss of potential calves from cows (n = 265).

Thirteen bulls from 9 herds were each subjected to a single breeding soundness evaluation and the results are shown in Table 3.

Scrotal abnormalities were recorded in 5 (38.46 %) of the 13 bulls tested (see Table 3). The abnormalities recorded on the scrotum were abscesses, nodules or lumps due to tick bites. The scrotal circumference measurements and ages of bulls are also presented in Table 3. Five (38.46 %) bulls had abnormal consistency of the testis on physical palpation. Four of these bulls also had lumps and abscesses on the scrotum. The abnormalities recorded were decreased consistency of one or both testis and asymmetry of the testis due to a reduction in size on one of the testis. Preputial abnormalities were recorded in 11 (84.62 %) bulls. The most common preputial abnormalities were long and pendulous prepuces. The prepuces, like the scrota, showed small nodules and/or abscesses caused by tick bites. Ticks were also present on the prepuce and scrotum in all of the bulls.

The motility of the semen of bulls was poor (Tables 3, 4). The progressive motility of 5 bulls was zero. The mean (48.125) and the standard deviation of (±32.507) were calculated from the semen of bulls (n = 8) with progressive motility. The semen were characterised by the absence of sperm cells in 3 (23.08 %) bulls and a high percentage of immobile or dead sperms cells in 6 bulls (46.1 %). Two bulls aged 2 and 8 years also had spermatogenic cells in the semen. The percentage abnormal sperm cells in the semen of bulls ranged from 28 % to 92 %. The most prominent sperm defects were loose heads (40.6 %), degenerate acrosome (19.5 %), abnormal base (9.3 %), protoplasmic droplets (4.2 %), bent midpiece (3.4 %), abnormal head shapes (3.4 %), bent principal piece (2.8 %) and others (16.8 %).

Table 2: **Pregnancy outcomes in all cows** (n = 265)**.**

Group	Frequency (n)	Percentage of cows
Cows never diagnosed pregnant over 12 months	114	43.02
Cows diagnosed pregnant	151	56.98
Cows that calved from the herd	100	37.74
Cows still pregnant at the end of study	17	6.41
Cows that lost pregnancies	34	12.83
Pregnancy loss due to abortion	22	8.30
Cows that lost pregnancies as a result of mortality caused by drought	8	3.02
Loss due to pregnant cows that disappeared (these pregnancies could not be accounted for)	4	1.51
Cows that calved, became pregnant again and were still pregnant at the end of the survey	6	2.26

Table 3: **Results of breeding soundness evaluation of bulls** (n = 13)**.**

Trait	Bull No.												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Age (Years)	2	3	4	3	5	5.5	2.5	4	4	4	8	3	3
BCS (1–9)	6	6	7	6	5	6	6	5	6	6	6	6	6
SC (cm)	24	31	38	32	42	40	32	30	40	31	32	27	34
Volume (mℓ)	2	3.5	3	3	3	5.5	6	6.5	2.5	5	0.5	3.5	5
pH	8	7	6.5	6.5	6.8	7	7.5	8	6.5	7	6.8	6.5	6.8
Mass motility (1–5)	0	4	3	2	3	0	1	0	1	1	0	0	2
Progressive motility (0–100%)	0	90	75	40	80	0	10	0	20	10	0	0	60
Sperm concentration ($\times 10^9$/mℓ)	0	2	0.5	0.2	0.5	0	0.5	0.75	0.2	0.2	0	0	0.5
Total abnormal sperms (%)	N/A	56	54	57	28	N/A	83	92	56	45	N/A	N/A	87
Abnormalities seen	*	*****	*****	*****	*****	***		*****	****	***	*	**	**
						**			*****	**	**	*****	***
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Key: BCS = body condition score; SC = scrotal circumference.
*Spermatogenic cells in semen; ** abnormal testis; *** testis and scrotum abnormal; **** abnormal scrotum, ***** preputial abnormalities.
N/A = no sperm seen.

DISCUSSION

The overall calving percentage recorded in this study (37.7 %) was low, but is comparable to an average calving percentage of 41.08 % determined on communal grazing in South Africa[6]. The calving percentage of cattle on communal grazing is low compared with the average calving percentage of 70 % in Brahman stud herds[16]. The calving percentage that was determined in this study is higher than the value of 20 % that was estimated in the area during a rapid rural appraisal (C Stewart, Medical University of Southern Africa, pers. comm., 1998). The difference in these findings could be due to lack of record keeping by farmers. There was also high variation in calving percentage amongst the herds investigated (Table 1).

The lowest calving percentage recorded was 22.4 % from a herd infected with brucellosis belonging to farmer E (Table 1). Brucellosis in this herd could probably not have been the only cause of low calving percentage because only 2 cows aborted in the 2nd half of pregnancy although the cause of abortion was not determined. The calving percentage in this herd was low but comparable to the calving percentage of 27.8 % and 29.6 % in herds B and H, respectively (Table 1). Bull subfertility is suspected to be have been the main cause of low pregnancy and calving percentage in herd E because the bull had a large number of cows (n = 49) to serve. The bull in this herd was also in poor condition and died before breeding soundness was done, and was replaced with a younger bull of about 18 months of age from the same herd. To achieve high pregnancy rates, a bull of high quality would be expected to settle 49 cows in 1 season[29,36].

A single farmer (I) had a calving percentage of 59.4 %, which was above the mean (38.16 %) of all the herds together. The reason for this could be the fact that the farmer had introduced new cattle into the herd, which were probably of high fertility. The cattle in this herd were maintained in good body condition throughout the year with an average BCS of 5.6, which was higher than that of most of the herds (see Table 1).

Table 4: **Combined results of breeding soundness evaluation of bulls** (n = 13)**.**

Trait	Mean	SD	Range
Age (Years)	3.900	1.598	1.700–8.000
BCS (1–9)	5.923	0.474	5.000–7.000
SC (cm)	33.308	5.120	24.000–42.000
Volume (mℓ)	3.769	1.660	0.500–6.500
Mass motility (1–5)	1.308	1.323	0–4.000
Progressive motility (0–100)	29.615	33.423	0–90.000
Sperm concentration ($\times 10^9$/mℓ)	0.373	0.437	0–0.175
Total abnormal sperms (%)	50.615	33.813	28–92.000

SC = scrotal circumference; BCS = body condition score; SD = standard deviation.

Calvings occurred year-round, but a higher calving frequency occurred from September to December. During that period, 68 % of the calves were born (Fig. 1). Cattle in the study showed a seasonal pattern of calving which corresponded with the beginning of the rainy season. The seasonality of calving in the present study was probably due to the rapid increase in the grazing value from October to March, which also results in improvement in the body condition of cattle. The increase in body condition results in more cattle coming into oestrus cycles from January to April. There is no specific breeding and calving season in communal grazing systems and cattle can breed and calve during all months of the year[6,18]. However, the results of this study are comparable to those of other studies that showed that cattle in communal areas have a tendency to breed and calve seasonally[11,33,34,37,39].

A large proportion of the cows (n = 114) were open for the entire period of the study (Table 2). This indicates a high level of infertility or subfertility in the cows and/or bulls although other factors could also have played a role. Therefore failure of cows to become pregnant was considered to be the main area where interruption to establishment of pregnancy occurs, resulting in a low calving percentage. Forty-three per cent of cows did not become pregnant while only 8 % lost their pregnancies. The greater proportion of the lost pregnancies (n = 34) was due to abortion (n = 22). The causes of abortion were not determined except in one 5-month-old foetus where *Arcanobacterium pyogenes* was isolated. Mortality of cows that accounted for 8 of the lost pregnancies was probably associated with poor body condition as a result of poor grazing.

Although only 1 bull tested positive for trichomonosis, the impact of this disease in the area was probably underestimated in the present study because the bulls tested were few and the test was done only once. It has been reported that the test should be repeated 3 times at intervals of 7 days to increase its sensitiv ity[40]. It should be considered that cattle were

kept on communal land, which is an important risk factor for the spread of trichomonosis. It can be reasonable to assume a more widespread occurrence of trichomonosis and campylobacteriosis in the area due to a high number of risk factors.

As mentioned above, there is not a specific breeding season and bulls are left with cows throughout the year. It is expected that in the absence of disease, the fertility of bulls would remain the same throughout the year and the bull would cover any cows that came on heat. Seasonal variations in the quality and fertility of semen of bulls, mainly influenced by environmental temperatures, have been reported[3,21,22,55]. This study showed that most of the cows breed from January to April (Fig. 1). The sperm morphological abnormalities recorded are similar to those recorded on bulls after increased intratesticular temperature following scrotal insulation[3,9,22,55]. It should also be considered that the lesions on the scrota of bulls could also have had an impact on the intratesticular themoregulation. Thickenings of the scrotal wall can interfere with testicular thermoregulation in bulls. Interference with testicular thermoregulation, especially when ambient temperatures are high, can lead to a high number of morphologically abnormal sperm cells in semen[9,22,51].

The decreased consistency of the testis could have been due to testicular degeneration or heat stress as previously stated, or ticks damage to the scrotum[51]. It is suggested that tick damage plays a significant role in causing testicular damage, considering the level of scrotal damage and high infestation by ticks.

All the bulls studied were of poor breeding potential and this probably contributed to the low (37.7 %) calving percentage. A bull with lowered semen quality may require more than 1 service to get a cow pregnant. This can result in some cows requiring more than 1 oestrus cycle to become pregnant. This situation is worse under extensive farming conditions such as found in communal grazing systems, because the bulls may not be able to detect and serve some of the cows that are in oestrus. When the grazing becomes poor (especially in winter months) some of these cows may lose body condition, enter nutritional anoestrus phase and have prolonged interoestrus periods[11,35,42]. The interaction of all these factors is believed to have contributed to the low calving percentage found.

Except for bull number ten (Table 2), all other bulls were born from the same herd. This suggests a degree of inbreeding within the herds, which can lead to poor fertility of the herd. Under communal grazing systems there is no selection of bulls and bulls with poor breeding potential will be kept if they survive.

Although several bulls had a long prepuce, this defect on its own does not cause infertility or interfere with coitus[51,57]. The long prepuces predispose the bull to traumatic chronic prolapse that can lead to pain, stenosis of the prepuce, phimosis of the penis and resultant inability to copulate. The prolapsed prepuce may be secondary to preputial lacerations, preputial abscesses or haematoma of the penis[26,38,51].

An excessively long prepuce is a highly heritable condition in certain *Bos taurus* and *Bos indicus* breeds such as the Angus, Polled Herefords, Brahman and Santa Gertrudes, as well as their crosses[23,49]. The lack of bull selection criteria and the fact that the area under study is bushveld with a lot of thorns, grass awns and poor tick control by farmers, makes this condition very important. The breeding potential of bulls with this preputial conformation will remain questionable because of the increased likelihood of chronic prolapse. The high prevalence of this condition in bulls tested was possibly due to the fact that farmers are not aware of its importance and, in fact, some farmers deliberately want bulls with a long prepuce as they associate it with it with high fertility and libido. The farmers were not aware that this condition is heritable. This information was established during informal interviews with the farmers during monthly visits.

A positive correlation between testicular measurement and female reproductive traits has been demonstrated in cattle. Management decisions for genetic improvement of reproductive efficiency should always take scrotal measurements (especially scrotal circumference) into consideration[49]. The measurement of scrotal circumference is easy, cost effective, and can be done easily and rapidly. It is a technique that can be used to select for reproductive efficiency of bulls in communal areas.

The minimum recommended scrotal circumference of bulls at the age of 24 months is 33 cm. This scrotal circumference was determined from the *Bos taurus* breeds (Simmental, Aberdeen Angus, Charolaise, Hereford, Shorthorn and Limousine) which are known to mature early[46,51]. *Bos indicus* breeds mature late and if SC is measured at an early age in these bulls, many of them are likely to record a figure below the recommended minimum. However it has been shown that the scrotal size differences between *Bos indicus* and *Bos taurus* breeds after the age of 20 months are less evident[12]. Breed differences must always be considered when interpreting scrotal circumference measurement[15]. Breed differences did not have influence on the size of the scrotal circumference of the bulls (Table 3). The scrotal circumference of most bulls were small (Table 3) and this probably played a major role in lowering the fertility of bulls and resultant low pregnancy rates. It has been reported that small testicles in Brahman and Brahman-cross bulls are the main cause of the male contribution to lowered fertility[11]. *Bos Indicus* bulls are characterised by low and variable fertility and this may be one of the main limiting factors to cattle production in the tropics[25,43].

Some of the cows ($n = 71$) that did not become pregnant over the entire period of the study were probably associated with subfertility of the bulls as these cows were in a fair body condition (score 5–7). It must also be considered that other factors not investigated in this study could have also contributed to failure of these cows to conceive.

The relationship between body condition and reproduction in cattle is well-documented[17,24,38,42,47,52]. Of the 114 cows that did not become pregnant 41 were in poor body condition and each one recorded an average body condition score below 5. It was concluded that poor body condition of cows ($n = 41$) due to inadequate nutrition or poor dentition of old cows as well as poor bull fertility was probably the main reason for these cows not getting pregnant.

It has been reported that maintenance of adequate records by farmers is critical to cattle production[14,27,36]. Management was poor especially the lack of adequate record keeping. This situation is serious as any livestock intervention programme will have to be based records of the performance history of the herds. Management was considered to be the major constraint to production leading to poor conception and calving rates.

CONCLUSION

Calving percentage of the cows in the area was low. Failure of cows to become pregnant was the main cause of poor calving percentage as opposed to pregnancy loss through abortion or resorption.

Sub-fertility of the bulls was found to be of great significance during this study and it is proposed that this be included in extension messages and that bulls be fertility tested routinely. It is possible that damage to the reproductive organs of communal bulls, by long-mouthed tick species, could be of aetiological impor-

tance. The role of bulls in causing low pregnancy rates in communal cattle should be investigated in more detail and on a wider scale.

Poor body condition score of cows, mainly caused by poor management, was also considered to play a major role in reducing pregnancy rates. Infectious diseases like trichomonosis, campylobacteriosis and brucellosis probably played a lesser role than anticipated. It is possible, however, that the level of trichomonosis and campylobacteriosis could have been underestimated, as the sensitivity of the test is relatively low. In order to improve production in communal grazing areas some aspects of management such as herd composition, selection and culling practice, record keeping, tick control and nutrition need to be corrected.

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