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Repeat Breeding among Artificially Bred Cattle in Mid Country Smallholder and Up Country Large Multiplier Farms of Sri Lanka

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ABSTRACT. *The incidence and causes of "repeat breeding" (unable to conceive after 3 successive services) among a sample of animals in mid country smallholder and upcountry large multiplier farms were studied. A total of 500 randomly selected artificially inseminated (AI) cows from smallholder farms in seven veterinary ranges and all the cows in two large multiplier farms were examined and classified into three categories based on number of services per conception (1 = less than 3 services; 2 = pregnant but >3 services; and 3 = non-pregnant and >3 services). Among the cows in smallholder farms, the occurrence of categories 1, 2 and 3 were 82.4%, 3% and 14.6%, respectively while the occurrence among cows in large farms were 88.7%, 6.7% and 4.6% respectively. Categorical data analysis showed that cow factors such as breed, body condition score, age and parity, days open (interval from calving to conception in previous pregnancy), previous lactation length and yield, and management factors such as herd size, hygienic status of housing, source of labour had a significant effect ($P<0.05$) on repeat breeding in smallholder farms. However, out of the above factors, only previous lactation length had a significant effect ($P<0.05$) on repeat breeding in large multiplier farms. Other factors such as management system, knowledge of farmer on animal reproduction and breeding, commitment of the farmer, breeding method, nature of last calving did not show any significant effect on repeat breeding. Visual, vaginal and rectal findings of repeat breeders suggested that around 78% in smallholdings and 71% in large farms were clinically normal. Among the cows with clinically detectable*

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abnormalities, most of them were found to be suffering from uterine infections (81% in smallholdings and 86% in large farms).

INTRODUCTION

Many national development programmes have recognized the need to improve the livestock sector as a means of rural development and concurrently to achieve self-sufficiency in livestock products, particularly in milk. Over the past 50 years attempts have been made to improve the productivity of cattle and buffaloes through natural breeding with superior sires and artificial insemination (AI) using semen from progeny tested bulls (Soni *et al.*, 1991). AI services are provided by the state through its field veterinary offices and the inseminations are carried out by both state-employed and private inseminators (Abeygunawardena and Amarasekara, 1995).

The Central Province (CP) of the country, which extends over most part of mid and hill country wet zone regions, relies heavily on AI for cattle breeding. It has been estimated that in 1997, out of the estimated total calvings of the region, over 56% were resulted from AI. However, low fertility rate following AI, because of high incidence of "repeat breeding" (unable to conceive even after 3 successive services), has reduced its impact and compromised farmers' confidence (Alexander *et al.*, 1997; Abeygunawardena *et al.*, 1999). Due to repeat breeding, calving interval increases and thus the aim of obtaining one calf per year from a cow, which is a prerequisite for optimum economic returns from farming enterprises, has not yet been accomplished by many farmers of the region. Similar situation prevails in large state farms too (Alexander *et al.*, 1998).

The incidence and causes of repeat breeding in the region in smallholdings as well as for large state farms have not been studied adequately. Previous studies, which were of limited scope, suggested ovarian disorders, management problems, problems related to semen quality and insemination technique, and infectious agents as possible causes of repeat breeding (Mohamed *et al.*, 1990; Abeygunawardena *et al.*, 1995; Alexander *et al.*, 1997; Alexander *et al.*, 1998). As infectious agents are an important cause of repeat breeding, a proper understanding of the micro-flora of the genital tract of the 'repeat breeders' and the sensitivity of the micro-flora to antimicrobials and antiseptics are of paramount importance in minimizing postpartum infections and repeat breeding. Therefore, a study was undertaken with the objectives of determining the incidence and most likely causes of

"repeat breeding", in relation to cow and management, among artificially bred animals in smallholder and large multiplier farms in hill and mid country wet zone region. This study was conducted as a prelude to detailed studies on microbiology of the genital tract of repeat breeder cows including sensitivity data and clinical trials.

MATERIALS AND METHODS

Field survey of smallholder farms

A survey on repeat breeder animals was carried out within a sample of smallholdings in the Central Province. Initially a total of 500 artificially inseminated cows were included in the study and the number of animals to be examined within each veterinary surgeon's (VS) range was calculated in proportionate to the number of first AIs performed in the range during the previous year. A list of smallholder farmers having recently inseminated cows was obtained from AI register of each VS office and the farms to be visited were selected randomly from this list. A questionnaire was used in the survey to collect data related to farmer's knowledge, their commitment and management practices. Breeding history of cows in the farm were obtained and per rectal examination was performed to determine pregnancy or non-pregnancy status.

Survey of large multiplier farms

A survey on repeat breeder animals was carried out in Ambewela and New Zealand state farms with the help of databases maintained using "Dairy Champ" computer software programme. Data related to cow factors were collected along with management information of the particular farm.

Detailed study on repeat breeder animals

Once a repeat breeder cow (*i.e.* a non-pregnant animal which has received more than 3 services and with or without detectable uterine infection) was identified, a detailed clinical examination was carried out on the animal. Along with the breeding history and management condition, information related to conditions of vulva, vagina, cervix, uterus and ovary were collected. Detailed examination of vaginal vault was carried out by visual inspection. Tightness and conformity of vulval lips, presence of wound, tears or fibrous

tissue, presence and nature of discharges were recorded. Detailed examination of vaginal vault was carried out with the help of a vaginal speculum. Appearance, colour, texture and discharges were observed and recorded. Detailed examination of cervix was carried out in two ways; *i.e.*, first, the appearance of the cervix was examined using the vaginal speculum and colour, appearance of rings and patency, and secondly, the size, shape and consistency of the cervix were determined by rectal palpation. Detailed examination of uterus was carried out by rectal palpation upon which size, shape and consistency of uterine body and horns were recorded. Ovarian bursa, fallopian tubes and ovaries were also examined by rectal palpation. Size of the ovaries and size, type, stage and location of ovarian structures were recorded. By corroboration of history and clinical findings, an attempt was made to establish a diagnosis as regard to most likely reason(s) for repeat breeding.

Analysis of data

The data were recorded in a computer database using Excel software package. Cows were classified into three categories based on number of services carried out and the pregnancy status (1 = less than 3 services; 2 = pregnant but >3 services; and 3 = non-pregnant and >3 services). Thereafter, categorical data analysis (Chi-square) was carried out in SAS (Statistical Analysis System) computer software package.

The effects of (a) management factors like herd size, housing status, farmer's knowledge on animal reproduction and breeding, farmer's commitment, management system and (b) cow factors like breed, age, milk production, parity, nature of the previous calving (normal/abnormal) and body condition score on occurrence of repeat breeding was determined using categorical data analysis.

RESULTS

Smallholder farms

Incidence of repeat breeding

As shown in Table 1, 82.4%, 3.0% and 14.6% of the cows belonged to categories 1, 2 and 3, respectively. The percentage of occurrence of repeat breeding among the cows in the sample was 17.6% (Categories 2+3).

Table 1. Incidence of repeat breeding among 500 artificially bred cattle in smallholder farms.

Category	Number of observations (n)	Percentage
1 = less than 3 services	412	82.4
2 = pregnant but >3 services	15	3.0
3 = non pregnant and >3 services	73	14.6

Effect of breed on repeat breeding

The categorization of breeds was made on the basis of (a) phenotypic characters and (b) body size with respect to the expected characters of each breed. Chi-square test showed that the breed of cow has a significant effect ($P<0.05$) on repeat breeding (Table 2). The incidence of repeat breeding was zero in animals of pure indigenous type. In contrast, the incidences of repeat breeding were 16.7%, 17.7% and 11% among crosses of Ayrshire, Fresian and Jersey, respectively. It was also a noteworthy finding that all the Sahiwal crossbred animals were in the category of repeat breeding.

Table 2. Percentage occurrence of repeat breeding with different genotypes.

Breed or cross	No. of observations	Category		
		1 = less than 3 services	2 = pregnant but >3 services	3 = non pregnant and >3 services
Fresian[1]	238	81.09	1.26	17.65
Jersey[1]	209	83.25	5.74	11.00
Sahiwal[1]	04	0.00	0.00	100.00
Indigenous[2]	25	100.00	0.00	0.00

[1] Cross-bred, designated by most dominant phenotypic characters
[2] Pure indigenous

Effect of body condition score on repeat breeding

A body condition score (BCS) ranging from 1 (emaciated) to 5 (very fat) was given to each cow by judging on the degree of fat deposition over the transverse processes of lumbar vertebrae and also over the pin bone and perineum region. Results are given in Table 3. Statistically, there was a significant ($P<0.05$) effect of BCS on the incidence of repeat breeding. A majority of animals (>80%) in the study were found to be in BCS between 2.5 and 3.0 and the highest incidence of repeat breeding was recorded among the animals who were in BCS of 3.0. The incidence increased as the BCS decreased from 2.5, but the number of animals found in these levels of BCS was too small to make any firm conclusions.

Table 3. Percentage occurrence of repeat breeding with different levels of BCS.

BCS	No. of observations	Category		
		1	2	3
1.5	10	80.00	0.00	20.00
2.0	70	81.43	0.00	18.57
2.5	253	86.96	4.35	8.70
3.0	155	74.19	2.58	23.23
3.5	4	100.00	0.00	0.00

Effect of age and parity on repeat breeding

Cows were grouped according to age with class interval of 6 months. The percentage incidences of repeat breeding at each age category are shown in Figure 1. According to statistical analysis, the age had a significant effect ($P<0.05$) on the incidence of repeat breeding. High incidence of category 3 was recorded in young animals (<2.5 years). The occurrence of repeat breeding decreased with increase in age till 5 to 6 years of age with a tendency

to increase thereafter. However, as the number of observations beyond 6 years was very low, it is not shown in the graph.

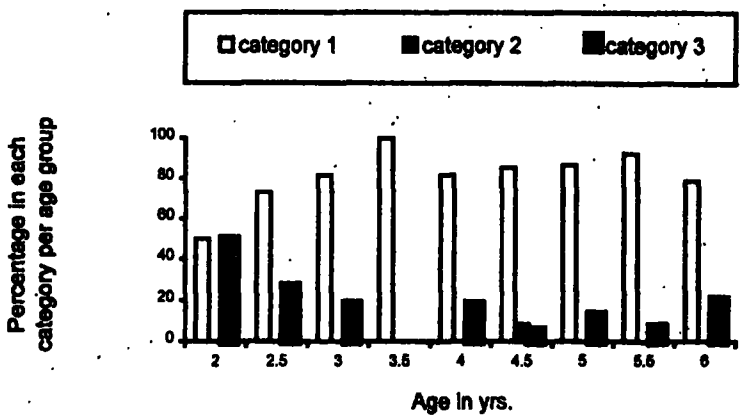

Figure 1. Percentage occurrence of repeat breeding with different age groups.

There was a significant effect ($P<0.05$) of parity on incidence of repeat breeding. The pattern was similar to that with age, because parity has a confound effect with age (Figure 2). Accordingly, high incidence of repeat breeding was found in animals at parity one and decreased in parity 2 and then gradually increased thereafter (data shown only up to parity 4).

Effect of days open on repeat breeding

Duncan's mean comparison revealed that repeat breeder animals had a higher mean number of days open (*i.e.* interval from calving to conception in previous pregnancy) than animals in other categories (Table 4).

Effect of previous lactation length and maximum yield on repeat breeding

The length and the maximum yield of previous lactation had a significant effect ($P<0.05$) on the number of occurrence of repeat breeding. As the length of previous lactation increases, the cow tends to become a repeat

breeder at the next postpartum period. Similarly, repeat breeders gave a higher maximum yield than the animals in other categories during previous lactation.

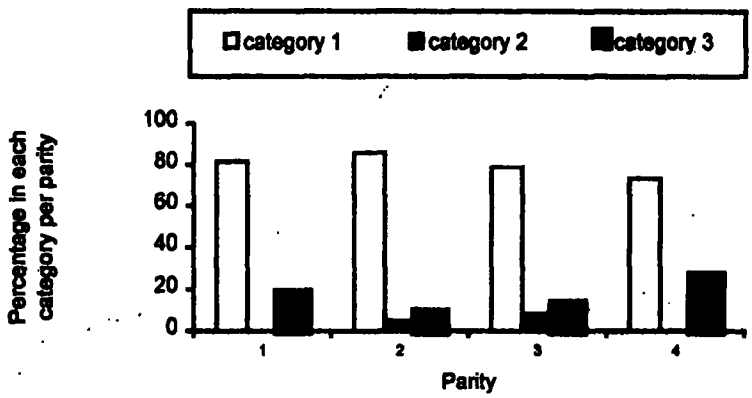

Figure 2. **Percentage occurrence of repeat breeding with parity.**

Table 4. **Variation in mean number of days open[1] among the three categories of cows.**

Category	No. of observations	Mean number of days open[2]
1 = less than 3 services	315	179.40[b]
2 = pregnant but >3 services	7	214.86[b]
3 = non pregnant and >3 services	64	400.41[a]

[1] Previous pregnancy
[2] Values with similar superscripts are not significantly different

Effect of housing on repeat breeding

On the basis of sanitation, condition of the floor and ventilation of the cattle shed, overall status of housing was categorized as 'poor', 'average' or 'good'. As shown in Table 5, incidence of repeat breeding tends to increase ($P<0.05$) with poor housing conditions.

Table 5. Percentage occurrence of repeat breeding with different status of housing.

Housing status	No. of observations	Category		
		1 = less than 3 services	2 = pregnant but >3 services	3 = non pregnant and >3 services
Poor	51	70.59	0.00	29.41
Average	262	83.97	4.20	11.83
Good	160	82.50	2.50	15.00

Effect of source of labour on repeat breeding

With different sources of labour, the incidence of repeat breeding tends to vary. Table 6 indicates that incidence of repeat breeding increased with increasing number of family members involving in dairy farm activities.

Table 6. Percentage occurrence of repeat breeding with different sources of labour.

Source of labour	No. of observations	Category		
		1	2	3
Chief of household only	203	87.68	1.97	10.34
Husband and wife	109	81.65	2.75	15.60
Whole family	142	73.24	5.63	21.13
Hired labour	42	88.10	0.00	11.90

Other factors

The size of the herd was significantly ($P<0.05$) associated with incidence of repeat breeding, but there was no observable trend. The other factors such as management system, knowledge of farmer on animal reproduction and breeding, commitment of the farmer, breeding method, nature of last calving did not show any significant effect on repeat breeding.

Large multiplier farms

Incidence of repeat breeding

As shown in Table 7, 88.7%, 6.7% and 4.6% of the cows belonged to categories 1, 2 and 3, respectively. Among the two large farms studied, New Zealand farm showed a higher incidence of repeat breeding compared to Ambewela farm.

Table 7. Incidence of repeat breeding among large multiplier farms.

Farm	Category 1		Category 2		Category 3	
	n**	%*	n**	%*	n**	%*
Ambewela	267	91.8	14	4.8	10	3.4
New Zealand	194	84.7	21	9.2	14	6.1
Total	461	88.7	35	6.7	24	4.6

* - Percentage of cows in each category within a farm
n** - No. of observations

Effect of previous lactation length on repeat breeding

As in smallholder farms, with increase in previous lactation length (>305 days), the cow tends to become a repeat breeder at the next postpartum period.

Other factors

Unlike in small holders, within the two large farms, factors like age, breed, parity and previous milk production did not show a significant relationship with incidence of repeat breeding.

Detailed study on repeat breeder animals

Visual, vaginal and rectal findings of repeat breeder cows in smallholder farms

Of the 73 animals in the repeat breeding category, 78.1% (n = 57) were without any detectable abnormalities, while 21.9% (n = 16) were with detectable abnormalities. Within the abnormal category, 81.3% (n = 13) of the animals had inflamed uteri (50% were in first degree endometritis[1] while 31.3% were in second degree endometritis[2]). Two animals (12.5%) had anatomical defects (fibrosed cervix) and 7 had cystic ovaries.

Visual, vaginal and rectal findings of repeat breeder cows in large farms

Of the 24 animals in the repeat breeding category, 70.8% (n = 17) were without any clinically detectable abnormalities, while 29.2% (n = 7) were with detectable abnormalities. Within the abnormal category, 85.7% (n = 6) of the animals had inflamed uteri (57.1% were in first degree endometritis and 28.6% were in second degree endometritis) and 14.3% (n = 1) had cystic ovaries.

DISCUSSION

The results of the present study showed that 18% of the animals in the smallholdings and 11% of the animals in the large state farms were in repeat breeding category. The values reported in Israel, Sweden, Britain and

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1 First degree endometritis – No visual discharges but per rectally appreciable changes such as edema and thickening of uterine wall, suggestive of inflammatory changes in the uterus.

2 Second degree endometritis – Visual discharges on palpation and per rectally appreciable uterine changes such as enlargement, fluid, *etc.*

USA were 5% (Frankos, 1974), 10.1% (Hewett, 1968), 11.9% (Boyd and Reed, 1961) and 22.1% (Pelissier, 1976), respectively. Value obtained in this study is close to what was reported by Pelissier (1976), but higher than what was reported by others. The studies by Frankos (1974), Hewett (1968) and Boyd *et al.* (1961) did not include the animals with detectable uterine pathology into the repeat breeding category.

Clinical examination of the repeat breeder cows revealed that 78% of the cows did not show any clinically detectable abnormality. This value is higher than what was reported in India (50%) (Khasatiya *et al.*, 1998) and Netherlands (48%) (De Kruif, 1975 cited by Call and Stevenson, 1985). Possible reasons for relatively high incidence of repeat breeding among clinically normal animals could be the poor heat detection by smallholder farms and the high environment effect on embryonic survival. A previous study conducted in the same area by Alexander *et al.* (1997) showed that 20% of the animals presented for AI had high progesterone levels indicating they were not in oestrus at the time of AI and even in those with low progesterone levels at the time of AI, only half of the animals have had a normal ovulatory oestrus.

Among the cows within clinically abnormal group in the present study, the most prevalent defect was uterine pathology (81%) compared to anatomical defects reported by others (Khasatiya *et al.*, 1998; De Kruif, 1975 cited by Call and Stevenson, 1985). High incidences of uterine inflammatory condition suggest the contamination of uterus at calving and perhaps at insemination. Another contributory factor may be the inadequacy of veterinary attention to cows with postpartum complications.

The incidence of repeat breeding among cows in large farms was relatively low compared to smallholder farms. This may be most likely due to relatively better standard of management including frequent culling of cows with conception failures. A previous study (Alexander *et al.*, 1998) showed that only 9.5% of the cows in large farms, compared to 20% of cows in smallholdings, at the time of AI, had measurable quantity of progesterone in their milk indicating they were not in oestrus. The relatively better rate of efficiency of heat detection may explain partly the difference in incidence of repeat breeding between two production systems and reiterate the contribution of farmer and herdsman to higher incidence of repeat breeding among the cows, particularly among the cows in smallholder farms.

The results of the present study suggest a relationship between the genetic composition of the animal and incidence of repeat breeding. With

increase in pure Bos taurine phenotypic characteristics, there is a tendency of an animal becoming a repeat breeder. Similar results were reported by Linares *et al.* (1974 cited by Galina and Arthur, 1990) for cross-bred cows in Venezuela. This may probably be due to poor ability of Bos taurine phenotypes, under tropical conditions, to overcome genital infections. In contrast to these reports, many studies have reported that Bos taurine or their crosses have had better conception rates than Bos indicus counterparts under tropical conditions (Rudder *et al.*, 1976; Anand and Balaine, 1981). It is well known that upgrading of local genotypes with Bos taurine genotype is the goal of animal breeding activity in the mid and hill country. The fact that more animals with high composition of Bos taurine genotype becoming repeat breeders suggests that these cross breeding programmes demand better and improved management and hygiene practices.

As reflected by body condition score, more than 80% of the animals in the study were in a satisfactory nutritional status, particularly with respect to major nutrients. Yet rarely one fifth of animals with good BCS have been found to be repeat breeders. Though there were many confounding factors contributing to repeat breeding, this finding tends to support the arguments of many who believe the possible link between infertility and deficiency of macro (Na, Ca, P, *etc.*) and trace (Se, Co, Mn, *etc.*) minerals (Pugh *et al.*, 1985; Morrow, 1969; Galina and Arthur, 1990). This also emphasizes the need of including analysis of mineral status of animals in future studies aimed at determining exact causes of infertility and development of remedial measures for fertility improvement.

The age and parity of an animal have a bearing on its ability to reproduce successfully. In the present study, animals both too young as well as too old found to become more prone to repeat breeding. The reason for high incidence of repeat breeding among too young animals is obscure. But reduction in fertility with age has been well demonstrated (Hewett, 1968; Studer and Morrow, 1978). It is very conceivable that as a cow gets older and parity increases, the uterine tissue become senile and the organ becomes more prone to infections.

The long length of days open and lactation in the previous parity were found to be associated with high incidence of repeat breeding. This suggests that once the animal has become a problem breeder, there is a tendency to recur again in the subsequent parities. High degree of recurrences suggests that some of the animals may be suffering from structural defects, which limit their reproductive capacity. This highlights the need of regular culling programmes in these herds on the basis of fertility aspects, if high

fertility to be maintained among animals of smallholder farms. The low incidence of repeat breeding in large farms could be related to regular culling practices. However this could be confounded with difference in management and environment.

In this study, high milk yield in previous lactation showed a positive relationship with incidence of repeat breeding. Some authors have highlighted this relationship between milk production potential and fertility (Peters, 1996; Carman, 1955; Hewett, 1968). Peters (1996) reported a decrease of reproductive performance of dairy cattle in USA and he argued that this well could be due to ever-increasing milk yield resulting from genetic selection for high productivity. Lamming (1982, cited by Peters, 1996) hypothesized that by selecting cattle exclusively for milk yield together with other implications of domestication, farmers have unknowingly selected animals with lower potential for fertility. Any relationship between genetic selection, milk yield and decreasing fertility is currently hypothetical as the heritability of fertility has classically been regarded as low. However, evidence is now beginning to emerge that specific mechanism in reproductive function may indeed be under genetic control. These include the pattern of hormonal changes controlling ovulation and luteal function and the propensity for embryonic survival (Peters, 1996).

Though there was a significant effect of herd size on the incidence of repeat breeding, there was no distinct relationship between the two. Studies carried out in other countries (Hewett, 1968) have shown that as herd size increases, there is high incidence of repeat breeding and it may be due to the fact that animals get a lesser attention as the herdsman has to look after a higher number of animals, coupled with poor record keeping.

Many reports highlighted that, when the general status of housing and hygienic standards are low, the cows become more prone to genital infections (Youngquist *et al.*, 1985; Hartigan, 1980). The findings of the present study, in which there was a relatively lower incidence of repeat breeding among animals in large farms (where the hygienic conditions were relatively better) tend to support this. The importance of committed and skillful management is further reiterated by the findings that the incidence of repeat breeding tends to become greater as the number of family members getting involved in managing the herd becomes larger.

CONCLUSIONS

The results of the present study revealed a high incidence of repeat breeding among animals in smallholder farms. The incidence of repeat breeding among animals in large state farms was relatively low. More than two thirds of the repeat breeder animals in smallholdings have not had any clinically detectable abnormality, while the rest were with clear signs of an abnormality. Though the reason for high incidence of repeat breeding are speculative at this point, the findings of the present study in corroboration with the findings of previous studies carried out at our laboratory suggest that poor heat detection, absence of regular culling and inadequacy of veterinary attention to problem cows as possible causes for high incidence of repeat breeding and hence low fertility among cows in smallholder farms.

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