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Behavioral responses and reproductive performances of cross bred dairy cows on soil and concrete bedded floors in small holders' production system in Assam

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Abstract
The behavioral response to the selected micro environment is one of the important tools for scientific assessment of welfare of the dairy animals. The study was conducted in 5 number of soil bedded sheds and 5 number of concrete bedded sheds in Kamrup (Metro) District of Assam to assess the behavioral responses of the cross bred dairy cattle in small holders' production system. From each shed 5 number of dairy cows were selected preferably of 1-2 months of lactation stage. The selected animals were observed for three occasions at 30 days interval for 3 hours daily on 12 hours basis. The time spent (Mean±SE) for rumination, resting and sleeping were recorded as 184.60±1.54, 262.70±0.87 and 53.78±1.38 minutes and 190.40±1.50, 265.60±0.72 and 49.40±1.26 respectively. There was a highly significant difference between both the types of floor ($P \leq 0.01$) for rumination and resting time. The overall prevalence of post parturition problems were higher (40%) in soil bedded floor than that of concrete bedded floor (20%). The animal welfare issues were compromised on the soil bedded floor type in comparison to concrete bedded floor type of shed.

Keywords: Behavior, dairy cattle, floor type, welfare

Introduction
India is the power house of milk production, occupying the first position in the World by producing 187.75 million tonnes (BAHS, 2019) [1] of milk with an average per capita availability of 394 gm/day. The average yield of milk per animal is very low with 7.95 kg/day by exotic/ cross bred animals and 3.01 kg/day by indigenous/non-descript animals. The state of Assam is far behind from the National average with annual production of 882.27 thousand tones (BAHS, 2019) [1] of milk and per capita availability of 71 gm/day. Comfortable housing is one of the most important parameter to enhance productivity of dairy animals which is also an indicator of animal welfare allowing the animal to respond to its natural behavior. Behavior plays a key role in the scientific study of animal welfare for two main reasons, first, it is one of the most easily observed indicators and essential information can often be obtained from it using experience and a systematic approach without the use of sophisticated equipment. Secondly, behavior forms a bridge between the narrower concept of clinical health and the wider concept of animal welfare (Buchwalder *et al*., 2000) [2]. It is necessary to have a detailed knowledge of the normal behavioral characteristics of that species of animal. A number of vices are present in dairy cows due to poor management systems like wind sucking, bar biting, stereotype, route tracing, tongue rolling etc. (Mason, 1991; Fraser and Broom, 1990) [3, 4]. The behaviour of stepping during milking may be considered an indicator of agitation, whereas kicking is more related to aggressiveness in dairy cows (Hemsworth *et al.* 2000 and Munksgaard *et al.*, 2001) [5, 6]. Behavioral measures are of particular value in welfare assessment (Wiepkema, 1992) [7]. The fact that an animal avoids strongly an object or event, gives information about its feelings that are evoked when it encounters this object or event and hence about its welfare (Rushen, 1986) [8]. The dairy farmers in this region use different floor materials like concrete, wooden plank etc. based on the economic condition. The economically weaker sections of the farming community normally rear the animals on soil bedded floor. The reproductive parameters like inter-calving period, number of service per conception and incidence of post parturition problem are also associated with farm animal welfare.

There are strong motives for including reproduction in selection programs, both for the economic improvement and welfare of the animals. In the context of animal welfare, cows should have good calving ability and give birth to viable calves (Berglund, 2008) [9]. There is a need to understand the animal welfare in this production system in terms of behavioral responses and reproductive performances of the dairy animals.

Materials and Methods

The experiment was carried out at the commercial small holders' dairy farms in and around Guwahati under Kamrup (Metro) District of Assam, India. A preliminary survey was made prior to actual study for selecting apparently similar shed and animals for the proposed study. Recordings of the data were done in 5 number of soil and concrete bedded sheds each. From each shed 5 numbers of dairy cows were selected preferably in the first 1-2 months of lactation stage. The study was carried out from October, 2017 to March, 2018. The primary data collection and behavior study was carried out by direct observation to assess the welfare of the animals using an ethogram prepared for the purpose. The observations were made continuously for 3 hours daily on 12 hours basis from 6am to 6pm. The whole 12 hours was divided into four different time frames *viz*. 6am-9am, 9am-12 noon, 12 noon-3pm and 3pm-6pm. The selected animals were observed for three occasions at 30 days interval for each time frame. Alteration in feeding behavior was observed for rumination, feeding, resting and sleeping. The behavior before and during milking was also observed. Rumination was recorded by observing the duration of time, a cow spends in chewing a regurgitated bolus until swallowing it back as described by (Ambriz-Vilchis *et al*., 2015) [10]. The feeding behavior was recorded by direct observation in regards to time spent for taking cultivated green fodder (para, nepier, guinea and maize), paddy straws, concentrated feed mixture and other activities performed during feeding and interaction with other animals. The resting behavior was recorded when the animal was in standing or lying position and not involved in feeding or rumination. The sleeping behavior was recorded when the animal was in lying position without any responses to external stimuli. The behavior of lactating animals in the milking shed were observed at each farm during the afternoon milking. Observations were designed to measure the restlessness of cow during milking. During the study the animals were observed from behind and the number of stepping and kicking movements from starting to completion of milking as described by Rushen *et al*. (2001) [11] were recorded. A step was defined whenever one hoof was lifted less than 15 cm off the ground. Kicking was recorded whenever one hoof was raised at least 15 cm off the ground, even though a clear kick was not visible. In addition, defecation, urination and vocalization were recorded as a single behavioral activity, but this activity was observed so rarely that it was not included in the statistical analysis. The reproductive parameters *viz*. inter-calving period, number of service per conception, incidence of post parturition problems were also recorded using a questionnaire by face to face interview of respondents. The data obtained during the study were statistically analyzed using SAS version 9.3.

Results and Discussion

Behavior study

Rumination time, resting time and sleeping time: The time spent (Mean±SE) for rumination, resting and sleeping were recorded as 184.60±1.54, 262.70±0.87 and 53.78±1.38 minutes and 190.40±1.50, 265.60±0.72 and 49.40±1.26 minutes for soil bedded shed and concrete bedded shed respectively on 12 hours basis (Table:1). Highly significant differences were observed between the types of shed ($P \leq 0.01$) for rumination and resting time. There was significant difference between sleeping time in both the types of shed ($P \leq 0.05$). The findings from this study indicates that behavioral activity was better in concrete bedded shed in comparison to the soil bedded sheds, which may be due to good management practices in concrete bedded sheds as the animals were more comfortable on concrete bedded floor type of housing which ensures good herd health management specially in hot and humid weather conditions. Results of this study was in close agreement with Thomas and Shastry (1991) [12] who reported that cattle roughly spent 4 to 9 hours in rumination on 24 hours basis. Ruminating time also depended on the quality of fodder. Resting behavior of cow is related to comfort level of the cow. In this study it was observed that cow spent 4.42 hours on resting on12 hours basis, which is supported by Fraser (1974) [13], who reported that cattle rest for 9 to 12 hours of the 24 hours period and favor lying on one side rather than on either sides.

Feeding

The time spent (Mean±SE) on feeding green fodder, dry fodder & concentrate mixture were found to be 47.73±0.66, 94.20±0.84 and 17.38±0.11 minutes and 52.23±0.63, 96.84±0.80 and 20.18 ±0.35 minutes for soil bedded shed and concrete bedded shed respectively (Table: 1). Significant differences were observed in feeding time of green fodder and concentrates between the two types of shed ($P \leq 0.05$).

Feeding time spent by a cow was an important indicator in assessing the welfare of cattle. In the present study 2.63 hours and 2.82 hours feeding time has been observed in soil bedded floor and in concrete bedded floor respectively on 12 hours basis which is in close agreement with Krawczel *et al*. (2012) [14], who found that feeding management should accommodate 5 hours per day of feeding time per cow. This availability should reduce aggressive interactions and prevent slug feeding. Feeding time may also depend on softness of the fodder, type of fodder, presentation of fodder (i.e. chopping/without chopping).

Table 1: Time spent (Mean±SE) for different activities by cross bred dairy cows

Activity	Floor type		t-value	P-value
	Soil bedded	Concrete bedded		
Rumination time	184.60±1.54	190.40±1.50	2.69	0.009
Resting time	262.70±0.87	265.60±0.72	2.53	0.01
Sleeping time	53.78±1.38	49.40±1.26	2.34	0.02
Green fodder	47.73±0.66	52.23±0.63	4.92	0.0001
Dry fodder	94.20±0.84	96.84±0.80	2.28	0.03
Concentrate mixture	17.38±0.11	20.18±0.35	7.66	0.0001

Milking behavior

The number of animals that showed stepping, kicking, defecation, urination, vocalization at the time of milking were 64%, 36%, 8%, 8%, 32% and 44%, 8%, 0%, 4%, 16% (n=25) respectively for both the soil bedded and concrete bedded sheds (Fig.1).There were no significant differences for stepping, defecation, urination and vocalization in both the type of sheds. However, the number of animals showing

kicking during milking was recorded highest in soil bedded shed in comparison to concrete bedded shed. There was significant difference for kicking ($P \leq 0.05$). Behavior during milking is another important criteria to evaluate welfare assessment of the dairy cows. In the present study behavioral recording at milking showed that the repeatability of stepping was high, whereas kicking was less repeatable. Previous studies showed that stepping may be considered an indicator of agitation, whereas kicking is more related to aggressiveness (Hemsworth*et al.*, 2000; Munksgaard *et al.*, 2001) [5, 6]. Animal restlessness at milking is a possible source of injury and may be caused by many different factors, such as pushing of adjacent cows, lameness, low mineral intakes, presence of hematophage insects, inefficiency of milker etc. In this study it was observed that during milking, there was significant difference in kicking ($P < 0.05$) between the two different types of floor. In particular, Napolitano *et al.* (2005) [15] observed that the loud harsh vocalizations and quick movements had negative effects on animal calmness, whereas the use of soft and quite vocalizations and movements produced opposite results.

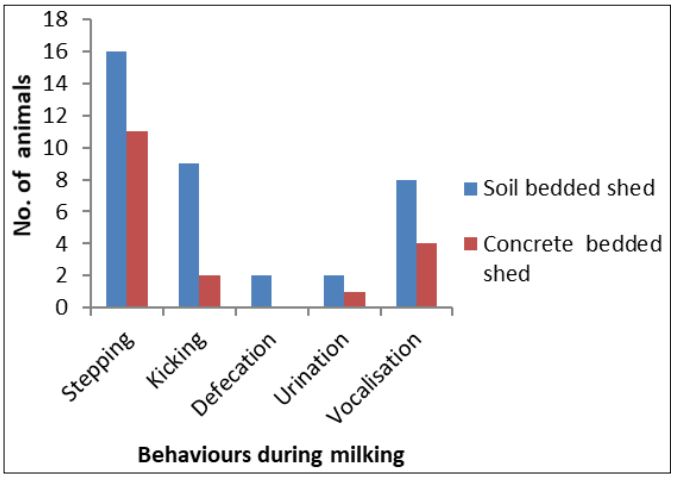

Fig 1: Numbers of animals showing different behaviour during milking

Reproductive parameters

Inter-calving period

In the present study, the inter-calving period between 12-13, 13-14, more than equal to14 months were found to be 4%, 44%, 52% and 12%, 72%, 16% for soil bedded and concrete bedded sheds respectively (Fig. 2). However, there was no significant difference between both the types of shed ($P > 0.05$). This study revealed that most of the animal (52%) of soil bedded shed had inter-calving period more than 14 months, which is in agreement with the Renata and Vukovi (2013) [16] who reported extended inter- calving period of 15.60 month in Holstein-Friesian cows in Serbia. Findings of this study showed longer inter-calving period than the economically acceptable value for herds with intensive milk production. From economic perspective, long calving intervals mean fewer calves born during the productive lifetime of the cow. Maximal milk and calves production is enabled by 12-13 months calving interval (Walker, 1997) [17]. However, recent research shows that a reproductive management strategy with extended calving intervals of 15 months or more seems to offer significant advantages for the welfare of high yielding dairy cows, without reducing overall milk production (EFSA, 2009) [18]. This is because of the cows with high genetic merit for milk production has a greater predisposition for losing body condition to support milk production. This leads to a greater negative energy balance in early lactation, with more rapid loss and a slower recovery of body condition that, in turn, affects her ability to conceive. It is also suggested by EFSA(2009) [18] that extending calving intervals for high yielding cows from 12 to 15 or 18 months may improve welfare by giving time for the cow to recover.

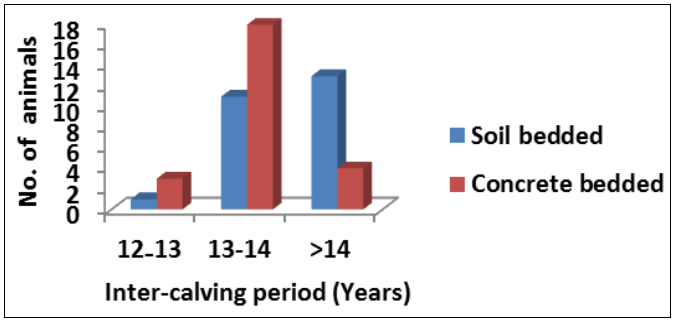

Fig 2: Inter-calving period (months) of the experimented animals

Number of services per conception

The percentage of animals that required services 1, 2, ≥ 3 per conception were 4%, 48% and 48% and 16%, 68% and 16% respectively for soil and concrete bedded sheds (Fig. 3). There was significant difference between both the types of shed at ($P \leq 0.05$). Findings from the present study revealed that most of the cows in the two types of floor required at least two or more service per conception which is in agreement with Renata and Vukovic (2013) [16] who reported that the average number of inseminations in Holstein- Friesian cows in Serbia was 2.6. Similarly, (Vukovic *et al.*, 2013, Gvozdic *et al.*, 2011) [19, 20] also reported the higher number of services per conception (3 and 3.5, respectively). In relation to the welfare of dairy cows, the number of services per conception is important as it is one of the indicators of animal's reproductive health. Mordak (2008) [21] reported that around 2 number of services per conception was acceptable, but values exceeding 3 were indicative of considerable organizational and/or health problems with reproduction.

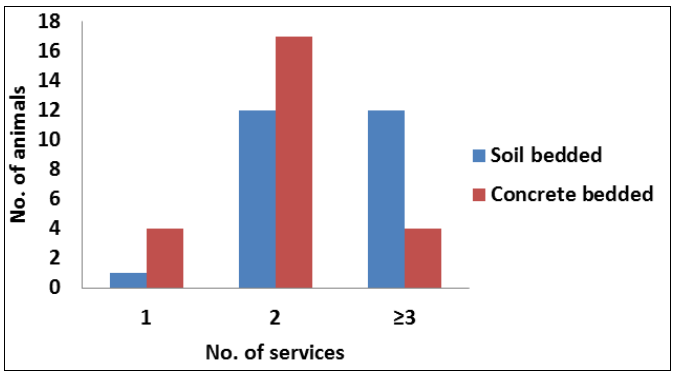

Fig 3: Number of services required per conception

Incidence of post parturition problem

In the present study, the prevalence of post parturition problems were found to be 20% retained placenta, 8% uterine prolapse, 12% uterine infection for soil bedded shed, whereas 4% uterine prolapse, 8% retained placenta and 8% uterine infection were found in concrete bedded shed (Fig. 4). In the present study, the prevalence rate of retained placenta in concrete bedded shed was 8% which is in agreement with the Haile *et al.* (2014) [22], who reported 7.18% cases of retained

placenta in dairy cattle in urban and peri-urban area of Hosanna, Southern Ethiopia. Similarly, low prevalence of retained placenta in dairy cattle was reported by Markusfeld (1984) [23]. However, the prevalence was found high (20%) in soil bedded shed which may be due to the predisposing factors such as poor nutritional status and management. In the present study the prevalence of uterine prolapse was found to be 8% in both the floor types of shed. However, Haile *et al.* (2014), Bitew and Shiv (2011), Dawit and Ahmed (2013) and Gashaw *et al.* (2011) [22, 24, 25, 26] reported prevalence of uterine prolapse as 0.76%, 0.65%, 0.43% and 0.50% respectively which is very low in comparison to the information recorded during the present study. In the present study the prevalence rate of uterine infection was found to be 12% and 8% for soil bedded shed and concrete bedded shed respectively, which is in agreement with the Kumari *et al.* (2016) [27], who reported the prevalence of uterine infection around 10.32% in Zebu cattle in India. However, higher incidence rate of 18.5% to 21% was reported by Drillich *et al.* (2006) and Benzaquen *et al.* (2007) [28, 29] respectively. The variation in the prevalence of uterine infection compared to the above-mentioned report was probably due to differences in the management system in each of the above studies under which the animals were maintained. Gilbert *et al.* (2005) [30] reported that among all uterine infections of dairy animals subclinical endometritis is the most prevalent factor affecting about 30% of animals.

This study also revealed that the overall prevalence of post parturition problems were high (40%) in soil bedded shed than that of concrete bedded shed (20%). This may be due to the housing condition and poor sanitation of the barn, resulting in contamination during calving in the soil bedded shed. This indicates low welfare in soil bedded floor type of shed in terms of ensuring freedom from pain, injury and diseases.

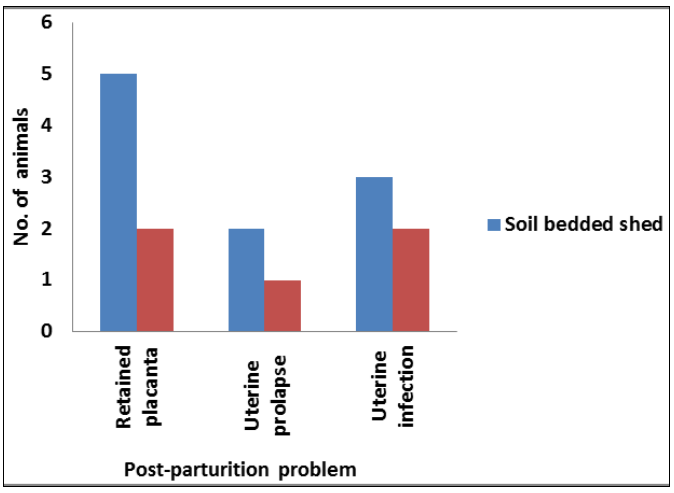

Fig 4: Incidences of post-partum problems in experimented animals

Conclusion

The success of small holders' commercial dairy farming is dependent on inclusive economic herd management and application of the farmers' skill. The awareness among the farming community regarding adoption of scientific management practices is the key instrument for dairy welfare. From the present study, it can be understood that the behavioral response towards rumination time, resting time and feeding time are better in concrete floor shed due to better managemental practices followed by the dairy farmers. The adoption of proper scientific management can also reduce the reproductive problems in dairy cows resulting in shorter inter-calving period, reduced number of services per conception and the incidences of post-partum problems in concrete floor shed. It is also reflected that the aggressive behavior of cows are less in concrete bedded floor in comparison to soil bedded floor. From this study, it can be concluded that the type of floors significantly influences the welfare of dairy cows reared among the small holder farming community and rearing of dairy animals in soil bedded floor type compromised the welfare issues of dairy cows in Kamrup (Metro) district of Assam.

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Conflict of Interest Statement

Authors declare no conflict of interest.

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