

## 4.OBSERVATIONS

### 3.1 Time & Duration of Observations:

All 30 mother – calf pairs were observed between 5pm to 6 pm on daily basis as this was the only time period when the calf & mother were released to interact with each other in order to facilitate manual milking by caregivers. Therefore, display of maternal behavior was only during milking hour.

### 3.2 Types of Behaviors during Mother – calf interaction period:

Each activity was assigned a code to facilitate quick filling of the focal sampling data sheets. The following 9 types of behaviors were displayed by mothers and 2 types of behaviors by calves:

<b>Mother 's Activity</b>	<b>Activity code</b>
1) Feeding	F
2) Licking	L
3) Rumination	R
4) Tail wagging	T.W
5) Neck movement	N.M
6) Body movement	B.M
7) Urination	U
8) Milking	M
9) Defecation	D

<b>Calf's interaction with mother</b>	<b>Activity code</b>
1) Pre - milking suckling	Pre. M.S.
2) Post - milking suckling	Post.M.S.

### **3.3 Time Budget of activities**

In each site, mothers displayed all the above stated behaviors but for different durations. The unit of time measurement was in seconds, as the shortest duration of any behavior was displayed for few seconds only by an individual, though it was repeated after intervals. Total seconds invested in every activity by all individuals of a site were calculated (Table 1) and the average percentage of time invested in each activity is shown in Table 2.

#### **3.3.1 Feeding**

At all 3 sites, maximum time was invested in feeding by the mothers. Some mothers engaged in simultaneous feeding and suckling the calf . (Plate – 1a&b)

#### **3.3.2 Touching and Licking**

Mothers touched their nose to their calf's back to recognize own calf through smell.( Plate 2 )  
Calf also recognized its ownmother through sight and smell, since mothers did not produce any vocalization to call or acknowledge their calves. Active licking of their calves was displayed by cows. (Plate 3)

#### **3.3.3 Rumination**

This was done during idling by the cows but less time was spent compared to feeding by cows of all three sites.(Plate 4)

#### **3.3.4 Tail Wagging**

Tail wagging was done as an isolated activity while sitting or standing and also during suckling which was accompanied frequently by wagging of the tails both by mother and calf.(Plate-5)

#### **3.3.5 Neck Movement**

Cows moved their necks in all possible directions largely during feeding and rumination. (Plate-6)

### **3.3.6 Body Movement:**

Limited limb movements were displayed by cows while standing and moving in circles around the pegs to which they were tied. (Plate-7)

### **3.3.7 Urination**

Just before pre milking suckling the cows of all three sites often urinated.

### **3.3.8 Milking**

Manual milking of each individual cow usually took 3-6 minutes at all three sites. During this period the cows co-operated with the caregivers. (Plate-8a) In rare instances, i.e by one out of 10 cows at each site, kicking behavior was displayed. Anti – kicker chains were then used to tie both hind legs of milking cows to protect the caregiver. (Plate-8b)

### **3.3.9 Defecation**

During the observation period, rare instances of defecation were observed at all three sites, i.e by 2 out of 10 cows at each site. (Plate-9)

### **3.3.10 Calf's interaction with mother**

The interactions were focused entirely on suckling by the calves and being the receiver of touch and licking by their mothers.

**3.3.10.1 Pre - milking suckling:** All calves assumed a crouched stance with spread out hind legs and pectoral girdle lowered and squeezed in, allowing to bend their necks and strain upwards to capture the udder. (Plate-10) After 1.5 - 2 minutes of suckling, calves were taken off the udder by caregivers and manual milking was done.

#### **3.3.10.2 Post - milking suckling:**

After milking, the caregivers left the calves free with their respective mothers. Calves invariably continued their Post milking suckling. This was for a longer duration compared to pre-milking suckling at all three sites, i.e. 4 - 6.5 minutes. (Plate-11)

Figures 2a, 3a and 4a depict the percentage of time invested in different activities by *Bosindicus* mother – calf pairs in DayalbaghGoshala, Smallholders – Kheragarh and DUVASU Dairy farm, Mathura respectively.

Figures 2b, 3b and 4b depict comparative activity budget of *Bosindicus* mother – calf pairs in each of the 3 sites - DayalbaghGoshala, Smallholders – Kheragarh and DUVASU Dairy Farm, Mathura respectively.

# Time activity budget of all three sites

<b>ACTIVITY</b>	<b>Time budget (in seconds)</b>		
	<b>DayalbaghGoshala</b>	<b>Small Holders</b>	<b>Mathura Dairy Farm</b>
Feeding	10974	9994	11313
Licking	206	258	160
Rumination	1610	2333	1957
Tail Wagging	877	1287	486
Neck Movement	324	472	244
Body Movement	218	355	254
Urination	179	150	161
Defecation	113	146	87
Milking	3532	3086	3492
Pre Milk Suckling	1560	1198	1848
Post Milk Suckling	3754	3990	3600

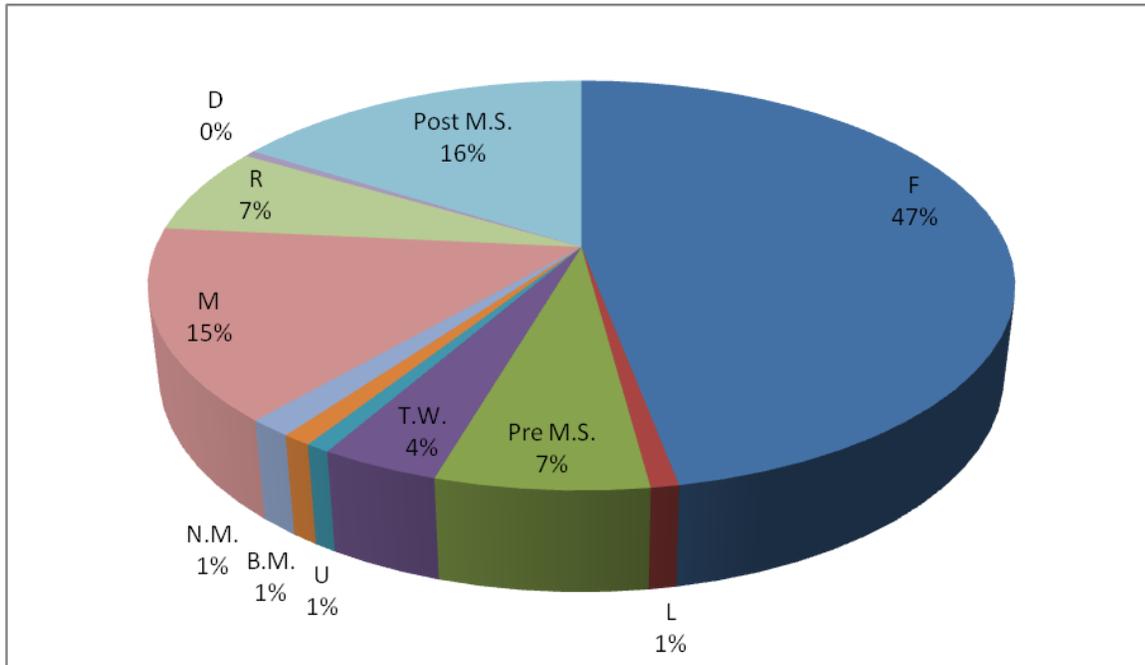
**Table 1**

**Site- wise comparative time (in seconds) invested in all activities by all mother- calf pairs**

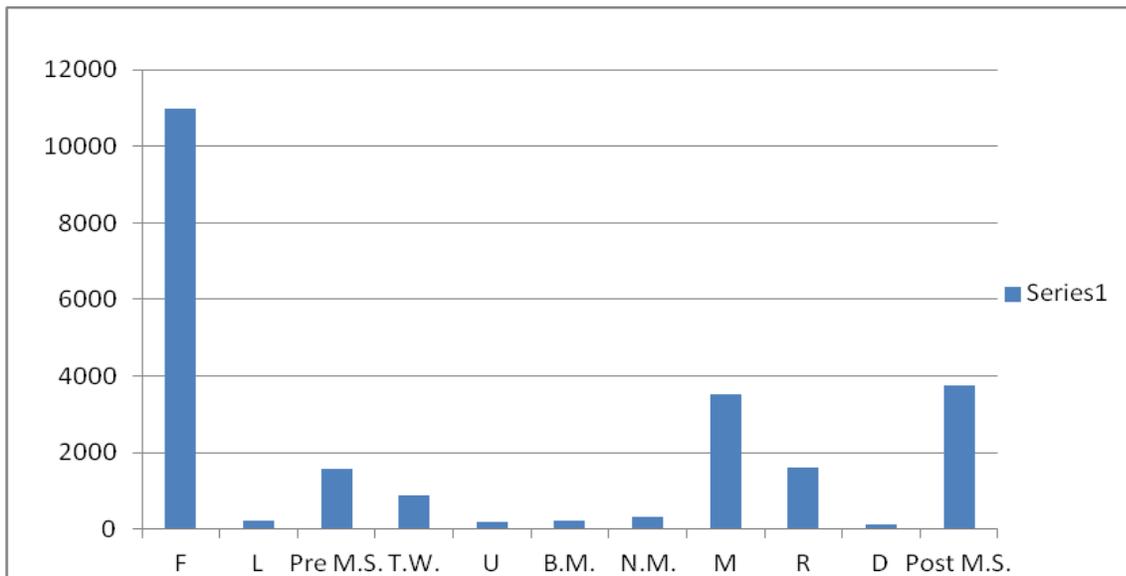
<b>ACTIVITY</b>	<b>Time budget (in %)</b>		
	<b>DayalbaghGoshala</b>	<b>Small Holders</b>	<b>Mathura Dairy Farm</b>
Feeding	47	43	48
Licking	1	1	1
Rumination	7	10	8
Tail Wagging	4	6	2
Neck Movement	1	2	1
Body Movement	1	1	1
Urination	1	1	1
Defecation	0	1	0
Milking	15	13	15
Pre - Milking Suckling	7	5	8
Post - Milking Suckling	16	17	15

**Table 2**

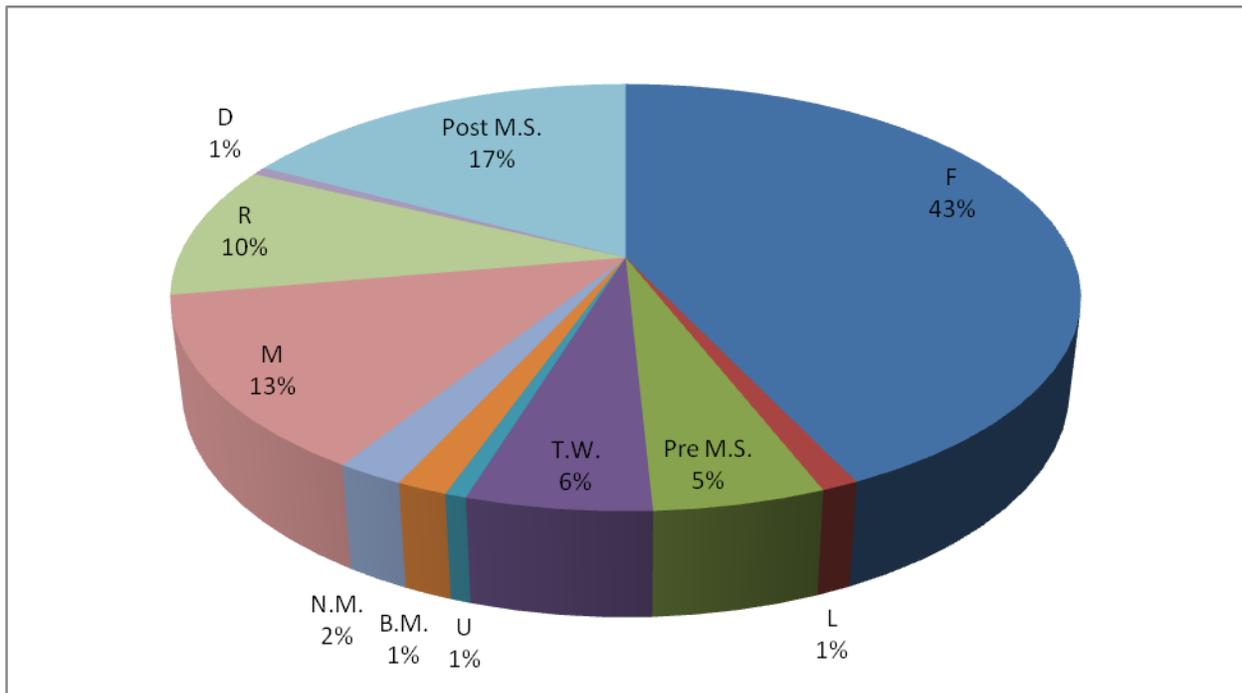
**Site- wise comparative percentage of time invested in all activities by all mother- calf pairs**



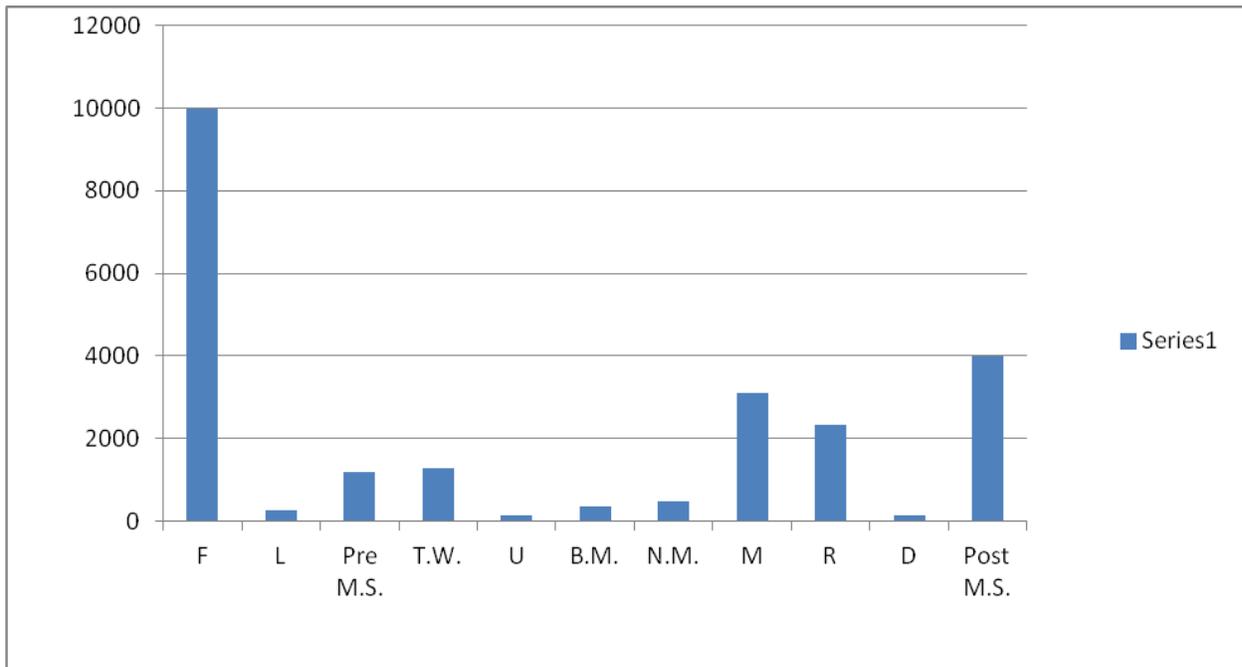
**Figure 2(a)** Percentage of time invested in different activities by *Bos indicus* mother – calf pairs in Dayalbagh Goshala



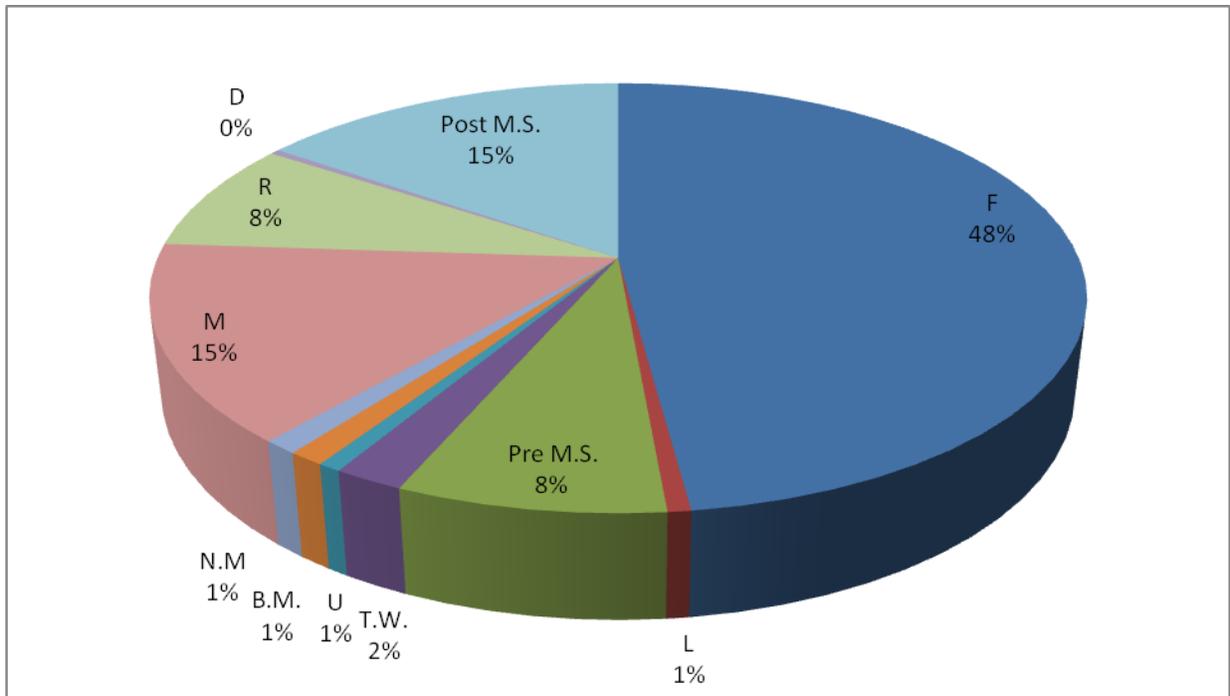
**Figure 2(b)** Bar diagram showing activity budget (in seconds) of *Bos indicus* in dayalbagh Goshala



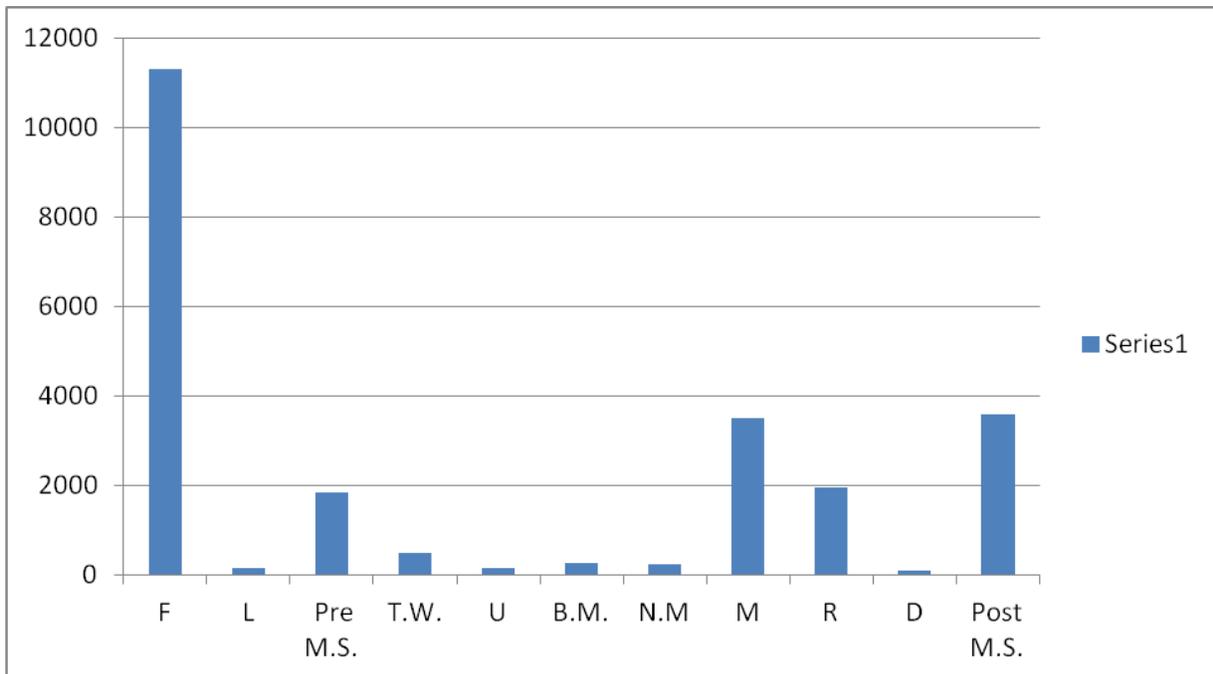
**Figure 3 (a)** Percentage of time invested in different activities by *Bosindicus* mother – calf pairs in Smallholder sites, Kheragarh



**Figure 3(b)** Bar diagram showing activity budget (in seconds) of *Bosindicus* in small holders sites, Kheragarh



**Figure 4(a)** Percentage of time invested in different activities by *Bos indicus* mother – calf pairs in DUVASU Dairy Farm, Mathura



**Figure 4(b)** Bar diagram showing activity budget (in seconds) of *Bos indicus* in Mathura Dairy Farm, Mathura

#### **4.4 Vocalizations**

The cows vocalized rarely and only 4 individuals displayed vocalization; 3 cows of Mathura and 1 cow of Dayalbagh. None of the Smallholder cows vocalized during the observation period. The calves of all three sites did not display any vocalization at all during the observation period.

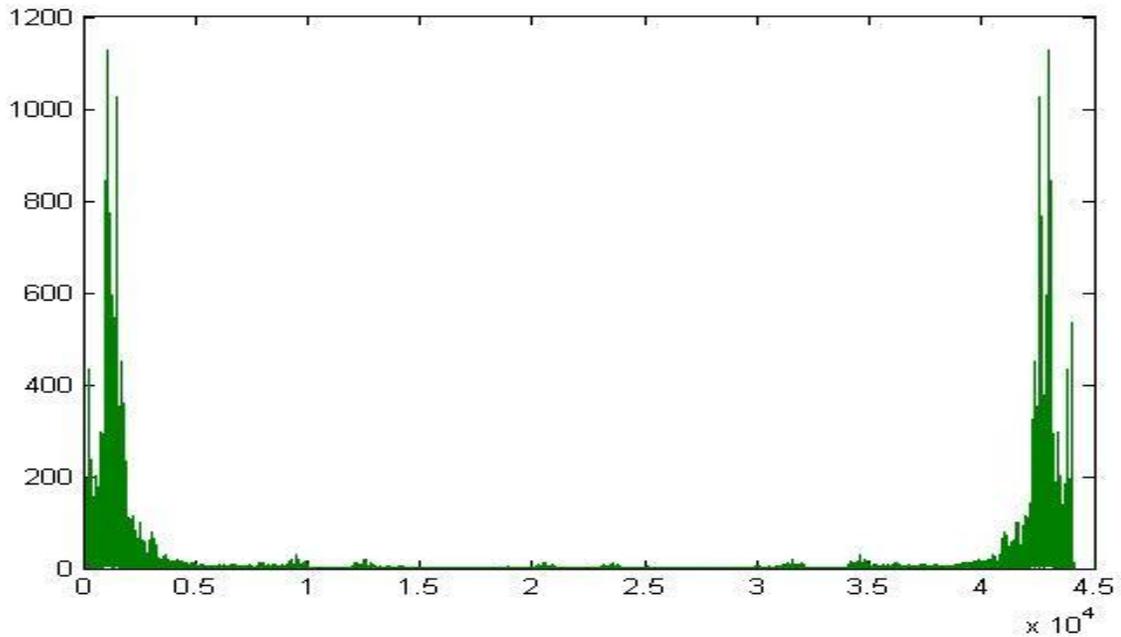
Figures 5, 6, 7 and 8 depict the Fourier transform 2D plots of the spectrograms with sampling rate ( frequency in K. Hertz, fixed range in Matlab is 0 to  $4.5 \times 10^4$  Hz) on the horizontal axis and the sampling data (amplitude) on the vertical axis which shows variation form of different peaks. The patterns of peaks generated by vocalizations of 3 cows were very similar to each other,. These cows were in close proximity to their calves.

The peaks generated by vocalization of one cow showed a much lower limit of highest peak – at 1170. This cow's calf had not arrived in her close proximity.

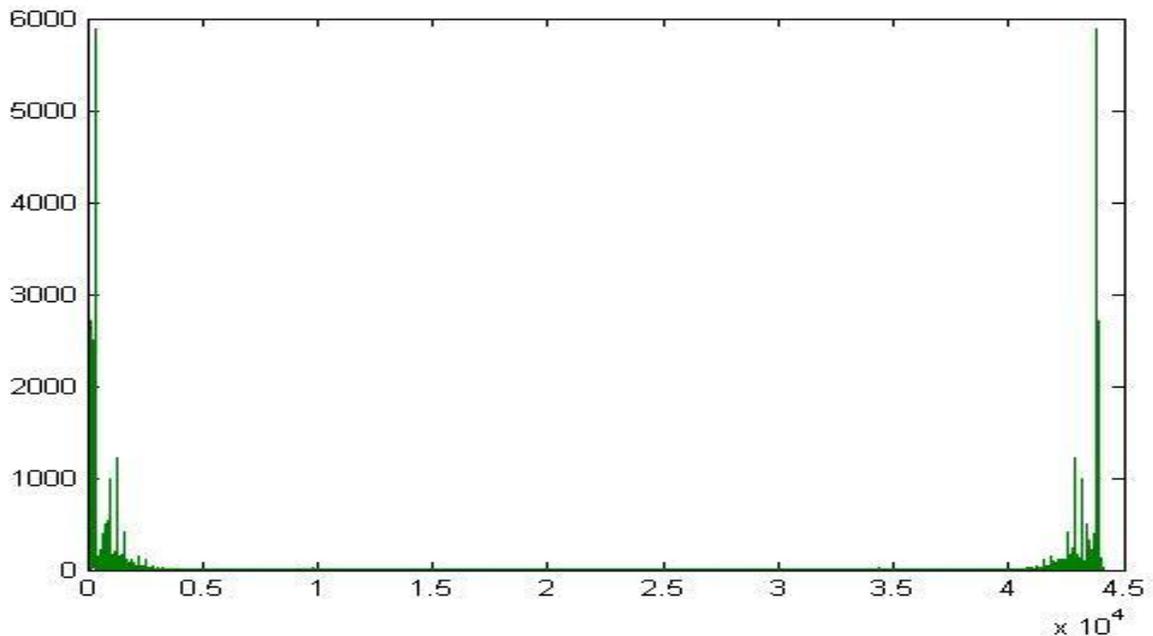
No pain vocalizations were recorded.

#### **4.5 Use of Injection Oxytocin / Oxytocin in diet of cows**

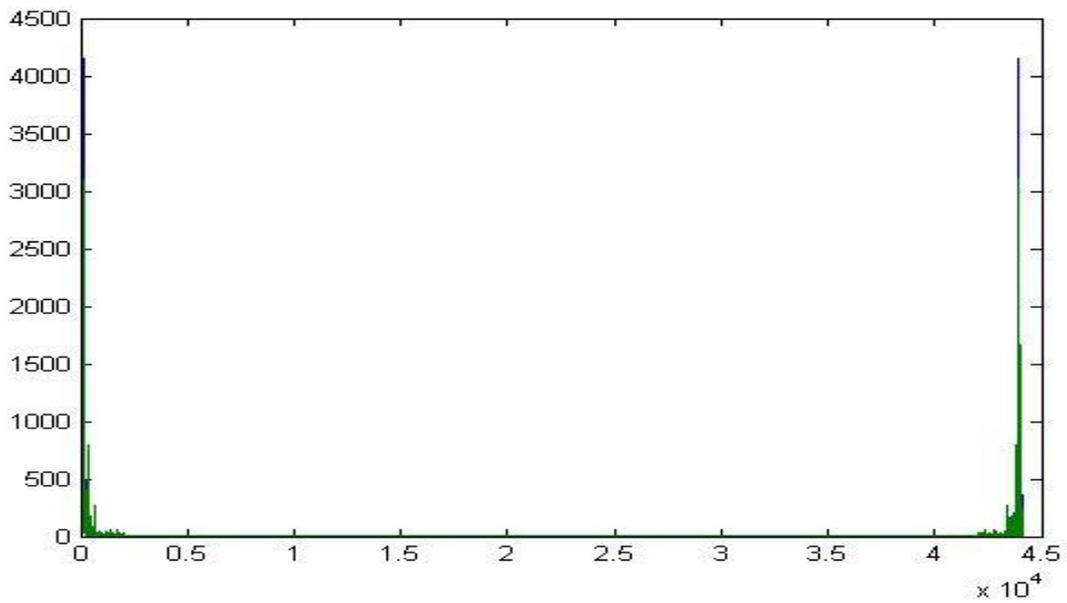
Mathura and Dayalbagh sites were not reported or observed to administer Injection oxytocin or its inclusion in the diet of cows. However, it has been reported to be a common practice by smallholders though they categorically denied its use. It was difficult to ascertain or observe such a practice as the visits were carried out for a pre-set time of evening every day. It was not possible to monitor the activities of smallholders at all other times of the days and nights.



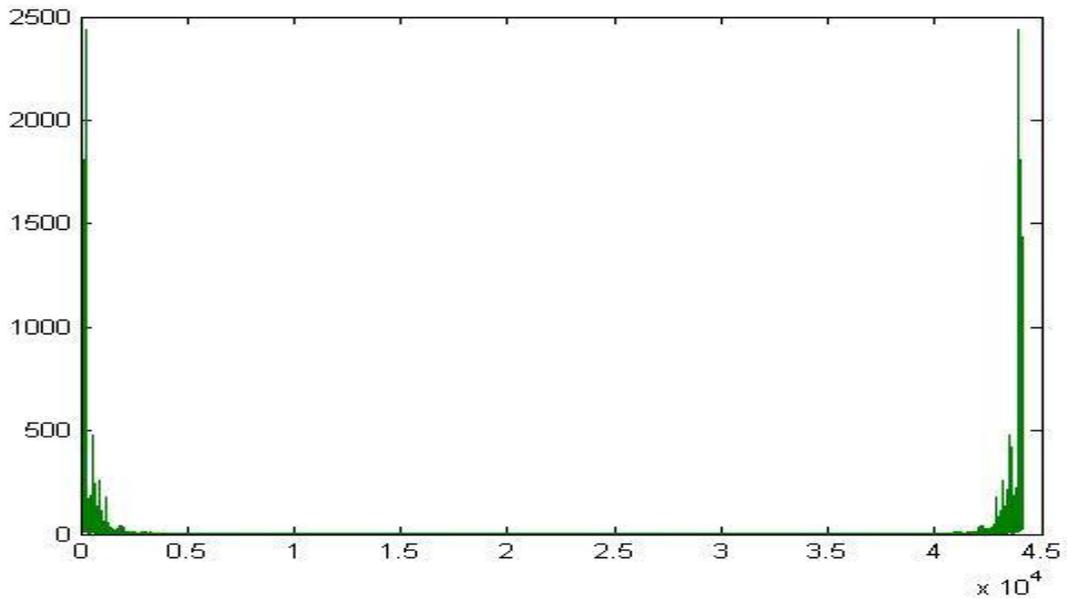
**Figures 5** Depict the Fourier transform 2D plots of the spectrograms with sampling rate ( frequency in K. Hertz, fixed range in Matlab is 0 to  $4.5 \times 10^4$  Hz) on the horizontal axis and the sampling data (amplitude) on the vertical axis. (*Bosindicus*)



**Figures 6** Depict the Fourier transform 2D plots of the spectrograms with sampling rate ( frequency in K. Hertz, fixed range in Matlab is 0 to  $4.5 \times 10^4$  Hz) on the horizontal axis and the sampling data (amplitude) on the vertical axis. (*Bosindicus*)



**Figures 7** Depict the Fourier transform 2D plots of the spectrograms with sampling rate ( frequency in K. Hertz, fixed range in Matlab is 0 to  $4.5 \times 10^4$  Hz) on the horizontal axis and the sampling data (amplitude) on the vertical axis. (*Bos indicus*)



**Figures 8** Depict the Fourier transform 2D plots of the spectrograms with sampling rate ( frequency in K. Hertz, fixed range in Matlab is 0 to  $4.5 \times 10^4$  Hz) on the horizontal axis and the sampling data (amplitude) on the vertical axis. (*Bos indicus*)



Plate 1a: showing feeding behavior of *Bos indicus*



Plate 1b: showing feeding behavior of *Bos indicus*



Plate2 : Nosing by mother



Plate 3: Licking the calf



Plate 4: showing rumination by *Bosindicus*



Plate 5: Tail wagging



Plate 6: showing neck movement



Plate 7: showing body movement



Plate 8a: showing milking of *Bosindicus*



Plate 8b: showing antikicker chain are used for kicking behaviour



Plate 9a: showing defecation



Plate 9b: showing defecation



Plate 10: showing pre milking suckling



Plate 11: showing post milking suckling

## 5. Discussion

Studies on maternal behavior in cattle increase the basic understanding of this behavior and provide insights into practical problems in *Bos indicus* welfare. Behavior associated with maternal care in domesticated *Bos indicus* were for the most part similar to those observed in wild counter parts by Marina et al., 2007.

Providing milk to the calf is perhaps the most important and obvious maternal behavior. Cows typically suckled their calf within the first few hours after birth as also reported by Edwards and Broom, 1979. These behaviors allow the cow to bond with her calf, protect and provide it with nourishment. Most dairy cattle production discourages all aspects of maternal behavior with the exception of milk production but changing consumer demand will make understanding of maternal behavior in this system a priority in years to come (Marina et al., 2007). The expression of the maternal behavior included licking, nursing and protection from potential predators. (Grandinson, 2005) In this case, it included human strangers other than the caregivers.

Cows spent much of the first few hours after birth licking the calf, a behavior that is important in stimulating calf activity and may have physiological effects including stimulating breathing, circulation, urination and defecation (Metz and Metz, 1986).

All thirty individual cow and calf pairs displayed the enlisted behaviors in Table 1 during the mother and calf interaction time permitted by care givers which was only during milking hours.

At all three sites, maximum time was devoted to feeding, followed by rumination. Tail wagging was more in Smallholder cows. Body movement, licking and urination in each site constituted of only 1% of total activity. Neck movement & rumination was greater in Smallholder cows while feeding was least compared to Dayalbagh Goshala & Mathura. Rare instance of defecation during the mother calf interaction period were observed in Small holder cows. Milking was lesser percentage of activity in Smallholders cows as compared to Dayalbagh Goshala & Mathura cows. Enhanced tail wagging is a sign of peaceful suckling. More peaceful suckling was observed in Smallholders cows. The neck movement was displayed more in Smallholder cows because of more space. During milking, calf remained tied beside mother & tactile, visual & vocal contact

were possible. Premilking suckling was greatest in Mathura and least in Smallholders, whereas post milking suckling was greatest in Smallholders cows & least in Mathura cows.

The possible explanation for this could be an effort by the calf to compensate for lesser pre milking sucking permitted by care givers.

Cows' routine vocalizations were recorded by a few random samplings. The recorded sound had waveforms represented as amplitude (y-axis) and time (x-axis). To understand the different frequencies and their amplitude, Fourier transform was done on the sound waveforms by using Matlab. The resultant waveforms have amplitude (y-axis) and frequencies & constituent frequencies (x-axis). Certain individual differences are evident among different animals cow1, cow2, Cow3 at Mathura Farm and cow4 from Smallholder. These were anticipatory calls given to their calves who had not arrived yet. We did not observe any DayalbaghGoshala cow vocalizing because the calves would usually arrive near mother well in time each day. An important observation is the frequency range from very low to 4.5 KHz. The frequencies are clustered towards lower end of amplitude spectrum & higher end of amplitude spectrum.

The amount of time cattle spend resting depends on environmental conditions, time spent ruminating and grazing, and on breed. Studies on Zebu cattle showed individual preferences for particular resting areas, which could be traced throughout 12 months. (Reinhardt et al., 1978)

Excess of oxytocin in milk may cause headache, nausea, abdominal pain and drowsiness to the user (Collin drollery, therapeutic drugs, 2<sup>nd</sup> edition. The reported methods for oxytocin in milk are very few (Kumar et al. 2010). The proximity of calf during milking is strongly recommended to discourage the use of oxytocin as let down of milk in cow becomes difficult after separation of calf.

Future plans include examining of milk samples from smallholders in Agra region for presence of oxytocin to create better awareness by the consumer. We also suggest that highest level of welfare can be provided by discouraging the use of anti-kicker chains by allowing prolonged mother-calf proximity as an alternative to the chains.

We also propose provision of larger free ranging space so that they can express different types of behavior and loss of any behavioral trait due to intensive domestication and 24x7 caregiving.