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Housing Management Practices and Microclimate of Cattle Shed in Cauvery Delta Region of Tamil Nadu

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ABSTRACT

Background: In India, most of the farmers are shifting towards organized dairy cattle farming system from paddy cultivation and extensive system of rearing due to scarcity of water resources and intense variance in climatic conditions. Hence, the present study provided valuable information about the existing dairy cattle housing in Cauvery delta region of Tamil Nadu.

Methods: The study on existing management practices of dairy cattle was conducted randomly among 90 farmers of Cauvery delta region, Tamil Nadu. A structured interview schedule was developed and pre-tested and the data on existing management practices were collected with the help of a pre-tested interview schedule. The data were collected by personal interview of the respondents individually at their animal house. The information on dairy production system and management practices were collected and the micro climate of different dairy cattle shed were recorded and analyzed.

Result: In Cauvery delta region, the majority of farmers (48.89%) engaged in rearing crossbred dairy cattle were in the middle age group and educated. Further, animal husbandry is either the primary (25.56%) or secondary (74.44%) profession of the farmers. From the study, it is understood that more than 70 per cent of farmers housed their dairy cattle in loose type of housing, adjacent to their home with east-west orientation. The most common roofing pattern adopted for their cattle sheds is gable type (54.45%), with a roofing material of galvanized iron sheet (30.00%). The black globe humidity index (BGHI) and heat load index (HLI) calculated for dairy cattle shed with different roofing structures showed significant difference ($P<0.05$) between thatched and tiled shed.

Key words: Housing, Heat load index, Management practices, Temperature humidity index.

INTRODUCTION

Livestock plays a major role in the agricultural sector in developing nations and the livestock sector contributes around 40 per cent to the total agricultural GDP. Due to the continuous growth in global demand for livestock products and the reliance of many people on livestock for their livelihoods, there is an urgent need to enhance the efficiency of natural-resource use in the sector and to reduce the environmental footprint of livestock production (FAO, 2009).

India's livestock sector is one of the largest in the world. The total livestock population in the country is 536.76 million out of which dairy cattle alone accounts for 193.46 million, explicitly 12.5 per cent of world's dairy cattle population. The crossbred cattle population in India is around 51.36 million, giving rise to an increase of 29.30 per cent to the pervious Census (2012). In Tamil Nadu, the total dairy cattle population is 10.04 million in which crossbred dairy cattle alone contributes to 6.89 million (All India Report, 2019).

Crossbreeding programme of dairy cattle has played significant role in attaining India's top position as highest milk producer country of the world, increasing its production from 17.0 million tonnes in 1950-1951 to about 198.40 million tonnes in 2019-2020 (Annual Report, 2021).

In India, most of the farmers are shifting towards organized dairy cattle farming system from paddy cultivation and extensive system of rearing due to scarcity of water resources and intense variance in climatic conditions. Consequently, it is high time to provide valuable information about the management practices of dairy cattle under field conditions and assist in evaluating the problems and constraints faced by dairy farmers in order to improve their livelihood. Therefore, the main objective of the present study was to analyze the current status and management practices of crossbred cattle followed in Cauvery delta region of Tamil Nadu.

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MATERIALS AND METHODS

The study on existing housing practices among farmers was conducted in the Cauvery delta region of Tamil Nadu mainly Tiruchirappalli, Thanjavur and parts of Pudukkottai districts. A structured interview schedule was developed and pre-tested in a non-sampling area for exclusion and modification, if any. The data on existing management practices were collected with the help of a pre-tested interview schedule.

In the Cauvery delta region, 30 farmers from each district, totaling 90 farmers were randomly selected. The data were collected by personal interview of the respondents individually at their dairy farm during February 2019 to July 2019.

The information on socio-economic status of farmers and housing management practices followed were collected in the study area. The data thus collected were coded, tabulated and analyzed. The relationship between socio - economic status of dairy farmers and their housing management practices were studied using Pearson's correlation coefficient based on the housing infrastructure and adoption of management practices. Further, the meteorological parameters (microclimate of shed) were recorded between 12.30 p.m. to 2.30 p.m. in the dairy cattle shed of 90 farmers with different roofing structures such as thatched, tiled, asbestos and galvanized iron sheet. The meteorological parameters such as ambient temperature, relative humidity, air velocity, black globe temperature, dew point and wet bulb globe temperature (WBGT) were recorded using SD card real time datalogger heat index WBGT meter (Model: WBGT - 2010SD, Lutron) and SD card real time data recorder Anemometer (Model: AM - 4237SD, Lutron). The recorded meteorological values were substituted in the corresponding index provided below to analysis the thermal comfort of the dairy cattle shed.

Temperature humidity index (THI) is calculated by applying the ambient temperature and relative humidity readings recorded in the given formula (Mader *et al.,* 2006).

$$THI = (0.8 \times AT) + \{[(RH/100) \times (AT - 14.4)] + 46.4\}$$

Where,
AT= Ambient temperature/dry bulb reading.
RH= Relative humidity.

Black globe humidity index (BGHI) is calculated by applying the black globe temperature and dew point readings recorded in different type of dairy cattle shed in the following formula (Buffington *et al.,* 1981).

$$BGHI = Tbg + (0.36 \times Tdp) + 41.5$$

Where,
Tbg= Black globe temperature (°C).
Tdp= Dew point temperature (°C).

Heat load index (HLI) is calculated by applying the relative humidity, wind speed and black globe temperature readings recorded in the following formula (Gaughan *et al.,* 2008).

$$HLI\ BG > 25 = 8.62 + (0.38 \times RH) + (1.55 \times BG\ temperature) - (0.5 \times WS) + [e2.4 - WS] \text{ and}$$

$$HLI\ BG < 25 = 10.66 + (0.28 \times RH) + (1.3 \times BG\ temperature) - WS.$$

Where,
e = The base of the natural logarithm (approximate value of e = 2.71828).
RH= Relative humidity.
WS= Wind speed or air velocity.
BG= Black globe temperature.

The calculated value of THI, BGHI and HLI for different types of cattle shed in farmers field of Cauvery delta region were statistically analyzed using IBM SPSS Statistics Version 20.0 by using statistical tools one-way ANOVA and the significance were tested by using Tukeys HSD test.

RESULTS AND DISCUSSION

The socio- economic profile of farmers rearing crossbred dairy cattle in Cauvery delta region is presented in Table 1. The majority of farmers (48.89 per cent) in the Cauvery delta region, engaged in rearing crossbred dairy cattle were in the middle age group (36-50 years), followed by 38.89 per cent of farmers in the old age group (above 50 years), and only 12.22 per cent farmers were in the young age group (less than 35 years). The findings were in contrast with the study by Rajeev *et al.* (2016), which reported that a majority

Table 1: Socio- economic profile of farmers in Cauvery delta region.

Characteristics	No. of respondents (90)	Percentage (%)
Age		
Young (Less than 35 years)	11	12.22
Middle (36 to 50 year)	44	48.89
Old (above 50 years)	35	38.89
Education status		
Illiterate	03	03.33
Can read	01	01.11
Can read and Write	16	17.78
Primary	07	07.78
Middle	17	18.89
Higher secondary	20	22.22
Graduate and above	26	28.89
Main occupation		
Agriculture	55	61.11
Animal Husbandry	23	25.56
Business	07	07.78
Others	05	05.55
Subsidiary occupation		
No subsidiary occupation	10	11.11
Agriculture	13	14.45
Animal Husbandry	67	74.44
Land holding		
Landless	01	01.11
Marginal (Up to 2.5)	40	44.44
Small (2.6-5.0)	23	25.56
Large (above 5.00)	26	28.89
Herd size of animal		
Small (1-5 animals)	31	34.44
Medium (6-10 animals)	27	30.00
Large (above 10 animals)	32	35.56
Experience in dairy cattle rearing		
Below 10 years	35	38.89
11-20 years	17	18.89
Above 20 years	38	42.22

(46.66 per cent) of farmers in the old age group were engaged in animal husbandry practices in Shamli district of Indo-Gangetic Plain zone. Regarding the education status of farmers, nearly 28.89 per cent and 22.22 per cent of dairy farmers had completed their graduation and higher secondary studies respectively. The illiterate among dairy farmers in the present study area is only 03.33 per cent which is in accordance with the study of Senthilkumar *et al.* (2005) and Desai *et al.* (2012).

Further, in Cauvery delta region, 61.11 per cent and 25.56 per cent of farmers have agriculture and animal husbandry as their main occupation. Similarly, 74.44 per cent and 14.45 per cent farmers have animal husbandry and agriculture as subsidiary occupation. The findings were supported by the observations of Gopi *et al.* (2016). The majority of dairy farmers (44.44 per cent) in present study were marginal land holders and only a minimum of 1.11 per cent farmers were landless which is in contrast to the study by Nisha (1996) in Modakurichi block of Periyar district, Tamil Nadu. The variation in the land holding in Cauvery delta region compared with other findings may be due to the farmers having agriculture as either main or subsidiary occupation in addition to animal husbandry activities. The herd size of animal in the present study is nearly equal in all groups with large (above 10 animals) 35.56 per cent, small (1-5 animals) 34.44 per cent and medium (6-10 animals) 30.00 per cent.

In this region, 42.22 per cent of farmers have more than 20 years of experience, 38.89 per cent have less than 10 years of experience and just 18.89 per cent have 11 to 12 years of experience, which is comparable with Rajadurai *et al.* (2018), who found that the majority of the farmers (40 per cent) in his study had 20-30 years of experience.

The housing management followed by farmers in Cauvery delta region for their crossbred dairy cattle is summarized in Table 2. In the study, 73.33 per cent of farmers in the Cauvery delta region practice loose type of housing, while the remaining 26.67 per cent use conventional dairy barn type of housing. However, according to the study conducted by Singh *et al.* (2015) among dairy farmers in Ranchi district, Jharkhand, a slightly higher proportion (95%) of farmers practice loose type of housing. Most of the farmers (76.67 per cent) rearing crossbred cattle in present study have constructed their animal house adjacent to their home and 74.44 per cent of cattle shed structure is Kutcha type. Similar findings were reported by Rathore *et al.* (2010) on housing pattern of crossbred cattle owners in Rajasthan who showed that majority of the farmers (65%) housed their cattle near to their home and that 86.33 per cent of cattle shed structures in his study were kutcha type, which is slightly higher than the present study.

Most of dairy cattle sheds in the Cauvery delta area were constructed in East-West orientation (70.00 per cent) and the remaining 30 per cent of farmers have built their animal houses in North-South orientation. However, according to Sinha *et al.* (2009), 56.6 percent of rural dairy

Table 2: Housing management practices of crossbred dairy cattle in Cauvery delta region.

Characteristics/practices	No. of respondents (90)	Percentage (%)
Type of housing		
Conventional dairy barns	24	26.67
Loose	66	73.33
Location of shed		
Adjacent to home	69	76.67
In separate area away from house	20	22.22
Others	01	01.11
Structure of shed		
Kutcha	67	74.44
Pucca	23	25.56
Orientation of shed		
East-West	63	70.00
North-South	27	30.00
Feed manger		
Stone	03	1.11
Basket manger	58	64.44
Constructed manger	29	32.23
Watering		
Bucket	17	18.89
Basin	52	57.78
Constructed Tank	21	23.33
Periodicity of cattle shed cleaning		
Once per day	39	43.33
More than one time per day	45	50.00
Once in two days	06	06.67
Roofing pattern		
Lean to type roof	36	40.00
Gable roof	49	54.45
Monitor roof	02	2.22
Gothic arch	03	03.33
Roofing structure		
Thatched	21	23.33
Tiled	14	15.56
Asbestos sheet	25	27.78
Galvanized iron sheet	30	33.33
Flooring material		
Cement concrete floor	24	26.67
Stones	24	26.67
Gravel	42	46.66
Manure details		
Frequency of dung collection		
No collection	01	01.11
1 time per day	04	04.45
2 times per day	67	74.44
3 times per day	14	15.56
4 times per day	02	02.22
5 times and above per day	02	02.22

Table 2: Continue...

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Method of manure storage		
Manure pit	89	98.89
No Manure pit	01	01.11
Disposal of manure		
Own farm use	76	84.44
Sale	05	05.56
Both	05	05.56
Biogas	02	02.22
Unutilized	02	20.22
General condition and cleanliness of the shed (Range between 1 to 5)		
1= Very poor	00	00
2= Poor	15	16.67
3= Fair	55	61.11
4= Good	19	21.11
5= Very good	01	01.11

Table 3: Pearson's correlation analysis of socio- economic status with housing management practices adopted by dairy farmers (n=90).

Socio- economic status	Housing structure for animal comfort ('r' value)	General condition and cleanliness of the shed based adoption scorecard (1 to 5) ('r' value)
Age	-0.174^{NS}	- 0. 148^{NS}
Education status	0.397**	0.370**
Occupation	0.166^{NS}	0.091^{NS}
Land holding	0.410**	0.519**
Herd size of animal	0.300**	0.440**
Experience	-0.184^{NS}	-0.101^{NS}

**Significant at 1 per cent level and NS- Non-significant.

animal houses in the Bareilly region of Uttar Pradesh were oriented in east-west direction. To feed and water their crossbred dairy cattle, the farmers commonly use basket type mangers (64.44%) and basin type waterers (57.78%) in Cauvery delta region. In the study area, the most common roofing pattern adopted by farmers for their cattle sheds is gable type roof (54.45 per cent), followed by lean to type roof (40.00 per cent), Gothic arch roof (3.33 per cent) and monitor type roof (2.22 per cent). However, the percentage of farmers using various roofing structure for their cattle shed were thatched (23.33 per cent), tiled (15.56 per cent), asbestos (27.78 per cent) and galvanized iron sheet (33.33 per cent), respectively which was in contrast to the findings of Sabapara *et al.* (2010) among tribal dairy farmers of Gujarat.

Nearly, half of the farmers selected for the study have gravel type (46.66 per cent) of flooring in their cattle shed, followed by stone flooring and cement concrete flooring (26.67 per cent) each. Large number of farmers (74.44 per cent) in the study used to collect dung from their cattle shed twice a day regularly. Most of the farmers (98.89 per cent) store the collected manure in the manure pit and around 84.44 per cent of them utilize the manure for their own farm use. Based on the score on general condition and cleanliness of the dairy cattle shed in Cauvery delta region, the housing condition for animals was fair (score-03) in 61.11 per cent cattle shed, followed by good (score-04) in 21.11 per cent cattle shed, poor (score-2) in 16.67 per cent shed and very good (score-5) in only 1.11 per cent cattle shed.

Pearson's correlation study of socio- economic status with housing management of dairy farmers in Cauvery delta region is presented in Table 3. The age and experience of farmers had a negative and non-significant relationship with dairy housing structures for animal comfort, adoption of general condition and cleanliness of dairy cattle shed. This may be due to the fact that older people with traditional knowledge were reluctant to take up the newer ideas or changes in housing management system arising to the variation in climatic condition. Education status, land holding and herd size had a positive and significant relationship at 1 per cent level whereas occupation had a positive non-significant relationship with dairy housing infrastructure and adoption of housing management practices. The result shows that educated farmers with animal husbandry as main occupation having more land holding and rearing a greater number of dairy cattle trends to adopt suitable housing management practices to the maximum.

The mean±SE of microclimate of dairy cattle shed with different roofing structure in Cauvery delta region is given in Table 4. The black globe temperature of thatched (34.17±0.65°C) and tiled (37.87±1.13°C) roof structures in dairy cattle shed differs significantly (P<0.05). The overall mean of black globe temperature recorded inside different dairy cattle shed of Cauvery delta region ranges from 32.82°C to 40.32°C. The mean±SE of temperature humidity index (THI), black globe humidity index (BGHI) and Heat Load Index (HLI) of dairy cattle shed with different roofing structure in Cauvery delta region are presented in Table 5. The higher value of THI was recorded in tiled type cattle shed (83.48±0.41). The overall mean of THI value in dairy cattle shed with different roofing structure is 82.76±0.23 which falls under moderate heat stress condition (THI 79 to 88) as categorized by Armstrong (1994). In the present study, the lower THI value was noticed in thatched shed (82.06±0.49), which is in accordance with the findings of Jat *et al.* (2002).

BGHI and HLI showed significant difference (P<0.05) between thatched cattle shed and tiled shed. The value of BGHI and HLI in thatched shed was 83.52±0.36 and 87.32±1.36 respectively, which is considered to be low among all the other roofing structures. The overall mean HLI value of different types of cattle sheds was 89.34±0.49 which is below the threshold level for *Bos indicus* (HLI -96) and on par with the threshold level for white coat colour (HLI-89) developed by Gaughan *et al.* (2008).

Table 4: Mean±SE of microclimate of dairy cattle shed with different roofing structure in Cauvery delta region.

Microclimate	Roofing structure				Overall	F value	P value
	Galvanized iron sheet	Asbestos	Tiled	Thatched			
Ambient temperature (°C)	34.49±0.52	34.65±0.59	36.00±1.06	33.31±0.62	34.49±0.33	2.211	0.093
Relative humidity (%)	45.79±1.84	43.77±2.03	40.17±3.04	48.77±1.92	45.05±1.08	2.260	0.087
Air velocity (m/s)	0.31±0.04	0.20±0.03	0.18±0.04	0.31±0.08	0.26±0.03	1.827	0.148
Black globe temperature (°C)	35.26±0.56^{ab}	36.11±0.75^{ab}	37.87±1.13^{b}	34.17±0.65^{a}	35.65±0.38	3.516*	0.019

*Significant mean values bearing different superscripts (a and b) within the row vary significantly (P<0.05).

Table 5: Mean±SE of THI, BGHI and HLI in different roofing materials of dairy cattle shed in Cauvery delta region.

Thermal index	Roofing structures				Overall	F value	P value
	Galvanized iron sheet	Asbestos	Tiled	Thatched			
THI	82.95±0.37	82.73±0.41	83.48±0.72	82.06±0.49	82.76±0.23	1.295	0.281
BGHI	84.25±0.54^{ab}	84.87±0.72^{ab}	86.49±1.07^{b}	83.17±0.64^{a}	84.52±0.36	2.981*	0.036
HLI	88.85±0.61^{ab}	90.25±0.86^{ab}	91.81±0.89^{b}	87.32±1.36^{a}	89.34±0.49	3.390*	0.022

*Significant mean values bearing different superscripts (a and b) within the row vary significantly (P<0.05).

CONCLUSION

According to a study on socio- economic status and housing management practices in Cauvery delta region of Tamil Nadu, majority of the farmers were marginal land holders having animal husbandry activities as either main or subsidiary occupation with good experience and traditional knowledge on crossbred dairy cattle rearing. Most of the farmers in the region housed their animal in loose kutcha type of housing, close to their habitation with gable roof pattern in East-West orientation.

The relationship between dairy farmers socioeconomic status and housing management practices reveals that farmers with higher education, more land holding, a larger herd size and animal husbandry as their primary occupation had better dairy housing infrastructure for animal comfort and were more involved in the effective adoption of housing management practices. Further, it is concluded that thatched shed provides more comfort to the animal in terms of heat load index in spite of the hot and humid climatic condition prevailing in the region.

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Conflict of interest

All authors declared that there is no conflict of interest.

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