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Planning lay out and utilization of housing in specialized dairy farms in two Agro climatic regions of Gujarat

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Abstract
A study was carried out to compare the housing lay out and utilization practices in specialized dairy farm in north and south Gujarat agro-climatic region. The data was collected from 10 dairy specialized farms of north Gujarat region (NG farms) and 10 specialized dairy farms from south Gujarat (SG farms) selected based on possession of more than 40 dairy animals, through personal interview and observation. The data were analyzed by using chi square test and nonparametric Mann Whitney U test in SPSS. It revealed that majority (80%) of the dairy farms were provided Semi-intensive house. More (55%) dairy farms were used lower RCC with upper iron type of pillars to erect the shed. Majority of the farms (70%) had RCC floor in their animal shed while, 30 percent had RCC floors along with earthen floor. Data revealed that majority (65%) of farms had monitor shed followed by gable (35%). Majority farms have used galvanium sheet as roofing material. Majority of dairy farms owners (90%) have adopted advanced water bowl fitting in livestock shed. All farms had drainage facility; however, only 15 percent of them were closed type of drainage. Sixty percent of dairy farms owners were possessed manure pit. As far as quality of concrete floor concern, majority (75%) of farms had even surface, grooved surface with an optimum slope (1:40-60). Mean of manger height was 0.68±0.02 m which was more than standard (0.50 m). Mean width and depth of manger was 0.58±0.01 and 30.87±0.61 m which was near to BIS. In study are 2 NG and 3 SG farms were using feed bunk (feed table) system instead of feeding manger. Mean space provided under roof and open area per adult unit was 5.18±0.10 and 10.49±0.44 square meter (SM) in NG farms, respectively. While in SG farms it was 4.24±0.24 and 10.90±0.91 SM, respectively. Mean length of shed, width of standing area, width of alley and roof height were 44.56±3.31, 8.67±0.37, 1.41±0.05 and 4.49±0.12, respectively and all were nonsignificant between two regions.

Keywords: Components of house, Feed bunk, Manger, Space provided, Specialized dairy farms, Shed dimension, Water bowl, Water trough

Introduction
There are many prerequisites while planning of new farmstead. It includes proper arrangement of buildings, proper spacing, shed height etc. as per standard. While erecting shelter for dairy farm, care should be taken to provide optimum comfort to in housed animals. Proper planned farmstead renders lifelong benefits to farm owners by continuously facilitating easy and efficient execution of routine operations (Rathva *et al.*, 2019) [9]. Well ventilated Shelters with comfortable flooring provides good atmosphere to livestock, thus, have major role on productivity and profitability. Dairy farm mechanization and proper efficient management can run nicely well planned farmstead. Proper housing is utmost important for efficient management of dairy animals particularly to reduce the cases of metabolic disturbances (Reddy *et al.* 2016) [10]. Housing management practices is different from feeding and breeding management, as it needs to be start from planning of farmstead and it cannot be corrected once house is erected. Good farmstead planning preambles knowledge of animal welfare needs, space requirement per animal, size and shape of manger etc. and also developer should have knowledge about availability of resources. In order to guide developers, farm owners and animal keepers there are certain standards developed by scientists for construction of livestock shed in various countries. India has BIS housing standard to guide the dairy farmers. Standard generally guides livestock farm owners about minimum standards of shed height, space needed per animal, manger dimensions, water trough dimensions etc. according to Agro-climatic zones. However, small to medium sized dairy farm operators are constructing shed according to availability of land and other resources. The use of materials, type of house, and provision of space per animal is varying from place to place.

Most of farmers are not referring BIS standard instead they are taking advise of other farmers while planning of farmstead, so sometime it may ignore the standards. The specialized dairy farmers are generally resource rich persons, therefore, they can invest much more money in assets particularly shelter. All farm owners have their own ways, ideas and dreams for livestock shed. Particularly in Gujarat many farm owners were basically real estate developers and master in housing development. So it is expected from specialized dairy farm owners to put little new ideas in shelters for picturesque looking and for supporting in modern management practices. Therefore, present study was planned to study housings particularly adoption of standards in specialized dairy farms in north Gujarat (NG farms) and south Gujarat's farms (SG farms).

Materials and Methods

The dairy farms with use of modern technology which contributed more than 50 per cent in total income of farm owners were considered specialized dairy farms. Present study was focused on comparative aspects among two agro-climatic zones of Gujarat i.e. North Gujarat semi arid region (NG farms) and south Gujarat heavy to medium rainfall zone (SG farms). The sample farms from both regions were collected by following procedure.

Selection of farms: A list was prepared for all such farms in selected districts i.e. Surat, Navsari, Bharuch, Banaskantha and Sabarkantha which were having minimum 40 heads of either white cattle or buffalo. Banaskantha and Sabarkantha districts of north Gujarat was selected from semi arid zone as they were having 30 specialized farms. From this both district 10 farms were selected randomly as a sample of north Gujarat semi arid zone. To study specialized farms in heavy to medium rainfall zone, 10 specialized dairy farms were selected randomly from Surat, Bharuch and Navsari districts of south Gujarat from available 31 farms.

Data collection: The information pertaining to present herd strength was collected by interviewing farm owners of all selected farms by using questionnaire. The data of the animal shed including floor space, manager, water trough, roof height and total area of farm were measured by standard measure tap and compared with BIS housing standards (Anon. 2005) [1]. The required information was collected from dairy farm owners by questionnaire.

Calculations: Herd strength were converted to adult units by multiplying factors 1, 0.67, 0.50 and 0.33 to adults, stock more than 2 years, between 1-2 years and less than 1 year, respectively. BIS have recommended minimum standard for various components like space, height, manger, gutter, space etc. for different species and classes of livestock for different agro climatic regions. The figures given in said BIS standard was used to compare the mean of observed parameter in shed component studied.

Statistical analysis: The collected and derived data were compared between both regions by using IBM SPSS 26 software. Means and standard error of means were worked by using tab compare means in SPSS. Normality in data was tested by Kolmogorov-Smirnov and Snapiro-Wilk test in SPSS. It shows the data of some parameters were not found in normal distribution. Therefore, means were tested for significance across both studied regions by using nonparametric independent samples Mann Whitney U test. Frequency data were tested by using chi square test in cross tab menu in SPSS.

Result and Discussion

Type of housing

The study indicated that majority (80%) of the dairy farm owners provided Semi-intensive house and rest (20%) used closed house (Table 1). Close system type houses were only seen in 40% SG farms. Type of housing was significantly different between farms of both regions. It is in agreement with Rathva *et al.* (2019) [9]. The results are contrary to the result recorded by Khan *et al.* (2010) [6] who have reported that highest percentage of farmers (82%) provided open house. However, use of semi-intensive type of housing was higher in present study because it allows dairy owners to resolve space mismanagement of their animals under the shed by keeping animals in open space during early morning and night in summer season and vice-versa in winter season. Further, Table 1 depicted that majority of NG farms (80%) were used lower RCC with upper iron type of pillars whereas, in SG farms iron pillars were found in 70% farms. The pillar types were significantly different in both region. Pilaniya *et al.* (2018) [8] observed that 12% had wooden pole, 50% had iron pole and remaining 38% had cemented pole. However, use of lower RCC with upper iron pillars was higher in present study than his study. The said study was on small dairy farmers while the present study was on large herd size dairy farms. Majority of the farms (70%) had RCC floor in their animal shed while, 30 percent had RCC floors along with earthen floor. It was statistically similar in both regions. It is more or less in agreement with Rathva *et al.* (2019) [9]. The results are contrary to the result recorded by Tewari *et al.* (2016) [14] who have reported that 79.50 per cent respondents had *kuccha* type of animal housing while, remaining 20.50 per cent farmers had *pucca* type of houses for their animal. It might be due fact that dairy husbandry of study area was semi intensive and concerned good hygiene of the house as it was easier to clean the house with RCC type of floor and RCC floor along with earthen floors reduces incidences of leg injuries to animals. Data revealed that majority (65%) of farms had monitor shed followed by gable (35%). Use of monitor system in livestock houses suggests that farm owners is aware about providing best comfort to their animals by good access of light and ventilation by monitor windows. Tewari *et al.* (2016) [14] have also shown that 17.50% of respondents were using gable type of shed at Tarai region of Uttarakhand. However, in present study use of monitor roof was higher that has two slopes, but one overlaps other at the ridge of the roof with a ventilation gap of one feet that serves the purposes of ventilating and lighting the animal house. It is general truth that construction cost is lower in shed than gabble type houses. All the dairy farms had half walls in their animal houses, whereas 65 percent of the dairy farms owners have half walls made-up of RCC and 55 percent of iron pipe. These findings are not similar with the results of Godara *et al.* (2018) [4] and Rathva *et al.* (2019) [9]. Table 1 showed 75 percent farms have used galvanium sheet as roofing material which is in agreement with Rathva *et al.* (2019) [9]. These Vranda *et al.* (2016) [16] and Sabapara *et al.* (2015) [12] revealed more use of asbestos and GI sheets as a roofing material in livestock shed. The galvanium sheets are expensive but have a greater resale value and they are rust

proof and therefore they are more durable also it provides a reflective insulation that keeps the animal house cool during summer (Anon., 2014) [2]. Majority of dairy farms (90%) have adopted advanced water bowl fitting in livestock shed to ensure free access of water round the clock with minimum wastage. Use of water bowl system considered as unique as only few farms in India is using water bowl at less extent (Rathva *et al.,* 2019) [9]. Among them 72 percent dairy farms were using gravity based water bowl that didn't required any type of electrical power that was very easy and cost effective system. It indicated that all the respondents knew that the good quality water must be provided via adequate, reliable and readily accessible drinking facilities as water is very important for dairy cattle and lack of water will significantly affect milk production. Table 1 revealed that all farms had drainage facility; however, only 15 percent of them were closed type of drainage. Further, 75 percent dairy farms owners were provided U shape at the end that ensure liquid velocity is optimized to allow efficient flow through the drainage system, the main benefits that the fast liquid velocities promote a self-cleaning effect not only during times of heavy rainfall, but also when rainfall is light. Perusal of data in the Table 1 observed that 60 percent of dairy farms owners were possessed manure pit for disposal of solid waste in their dairy farms nearly similar findings were reported by Patbandha *et al.* (2018) [7] and Rathva *et al.* (2019) [9]. It shows that dairy farm owners of both regions aware about the benefits of drainage adoption in terms of hygiene and economic returns of farm wastage.

Table 1: Distribution of dairy farms according to adoption of components in their livestock shed

Practices		NG farms		SG farms		Over all		P (Chi square)
		n	%	n	%	n	%	
Type of Housing	Close	0	0	4	40	4	20	0.02*
	Open	0	0	0	0	0	0	
	Semi-intensive	10	100	6	60	16	80	
Type of Pillars	RCC	0	0	0	0	0	0	0.02*
	Iron	2	20	7	70	9	45	
	Lower RCC, Upper iron	8	80	3	30	11	55	
Type of floor	RCC	7	70	7	70	14	70	1.00
	RCC along with earthen	3	30	3	30	6	30	
Pattern of shed	Gable	4	40	3	30	7	35	0.63
	Monitor	6	60	7	70	13	65	
Wall of shed	RCC	6	60	7	70	13	65	0.63
	Iron Pipe	4	40	3	30	7	35	
Type of roof provided	GI sheet	2	20	3	30	5	25	0.60
	Galvanium sheet	8	80	7	70	15	75	
Drinking system	Water bowl	9	90	9	90	18	90	1.00
	Water trough	1	10	1	10	2	10	
Type of Waterbowl	Gravity based type	6	67	7	78	13	72	0.59
	Electrically mechanized	3	34	2	22	5	28	
Type of Drainage	Close	2	20	1	10	3	15	0.53
	Open	8	80	9	90	17	85	
U shape end of drainage	Yes	8	80	7	70	15	75	0.60
	No	2	20	3	30	5	25	
Manure pit	Yes	7	70	5	50	12	60	0.36
	No	3	30	5	50	8	40	

Adoption of quality standard in CC floor in livestock shed

The data in the Table 2 observed that majority (75%) of the respondents had even surface in their shed. It was evident from the table that 40 percent respondents had optimum distance (80 mm) between two grooves. Table 2 depicts that 75 percent respondents had grooved surface and 30 percent had not grooved. Table also indicated that 65 percent and 35 percent respondents had an optimum (1:40-60) and bad slope, respectively. Majority of farms (75%) were having uniform concrete floor without any crack and crevices. The floor quality is having direct effect on the health of animals and cleanness of shed (Sadharakiya *et al.,* 2019) [13]. If the surface of floor was not proper grooved there might be chance of leg injuries occurred to animals due to slippery floor also urine flushing could not be done easily as the urine collected in the broken pits.

Table 2: Distribution of the dairy farms according to adoption of quality in RCC floor.

Sr. no.	Particulars	NG farms		SG farms		Over all		Chi square	
		n	%	n	%	n	%	F	P
1	**Surface evenness of RCC floor**								
	Even	7	70	8	80	15	75	0.26	0.60
	Uneven	3	30	2	20	5	25		
2	**Distance between two grooves**								
	Optimum (80 mm)	5	50	3	30	8	40	0.83	0.36
	Not Optimum	5	50	7	70	12	60		
2	**Surface smoothness of RCC**								
	Grooved	8	80	7	70	15	75	0.26	0.60
	Not grooved	2	20	3	30	5	25		
3	**Slope in RCC**							0.63	0.00*

	Optimum (1:40-60)	7	70	6	60	13	65		
	Bad	3	30	4	40	7	35		
4	**Integrity of floor RCC**								
	Broken with cracks and crevices	2	20	3	30	5	25	0.26	0.60
	Uniform without crack	8	80	7	70	15	75		

Provision of dimensions in housing components

The manger and feed table are important components in shelter which have maximum variation in different farms. Means of the dimensions of manger and feed bunk in studied livestock shelters is depicted in Table 3. Mean of manger height was 0.68±0.02 m. NG farms were having little more manger height. Rioja-Lang *et al.* (2015) [11] have observed similar manger dimensions. The standard height of manger was 0.50 m. Dairy farm owners were provided little more height in comparison to standard. More manger height was attributed with breed and class of livestock possessed by them. They were keeping large sized cattle and buffalo breeds. Mean width of manger was 0.58±0.01 m. The standard of width was 0.60 m. Dairy farms owners were providing width near to the requirement of the standard. Mean depth of manger was 30.87±0.61 cm. It was 31.50±0.84 cm in NG farms and 30.14±0.93 cm in SG farms. Standard for the manger depth was 40 cm. It indicated that extent of adoption was little less in adopting depth of manger. It shows that farmers adopted shallow manger depth. Mean inner wall height of manger was 41.13±0.53 cm. It was 41.87±0.91 cm in north region and 40.28±0.28 cm in south region. Standard for inner wall height of manger was 50 cm. It indicated that medium extent of adoption was found in inner wall height of manger. The manger dimensions observed in present study is in accordance with Rathva *et al.* (2019) [9]. Further one interesting point came to know in this study is that 2 NG and 3 SG farms were using advance system of feeding instead of traditional method of feeding system in the place feeding manger they were using feed bunk. It helps to keep feed within easier reach of animal and reduces labour for pushing up feed. Data in Table 3 indicated that overall mean of feed bunk height was 21.40±0.97 cm. The standard height of feed bunk was 10-15 cm. Dairy farm owners have provided more height of feed bunk compare to standard, however, their feedback regarding feed bunk height was good. Mean width of feed bunk was 59.00±4.58 cm against standard of width was 71.12 cm. Dairy farms owners were providing feed bunk width near to the requirement of the standard. Mean feeding alley width in feed bunk system was 3.20±0.12 m which was nonsignificant in NG and SG farms. Standard for the feeding alley width was 5.5 to 6 m. because drive-through feed alley must be wide enough to accommodate the drive-through feed equipment. It should be at wide at least 5.5 m to prevent equipment from driving on feed, and should be 6 m if the TMR mixer or other vehicle is parked in the drive-through (Harold, 2018). Be sure to make drive-through doors at least as wide as the drive-through to avoid damage. It shows that farmers adopted very narrow feeding alley width in feed bunk type of feeding system due to lack of space.

Table 3: Provision of dimensions in housing components at specialized dairy farms

Shed components		**Standard**	**Mean dimensions**						**Sig (Man Whitney)**
			n	**NG farms**	**n**	**SG farms**	**n**	**Overall**	
Manger	Height (m)	0.50	7	0.72±0.02	8	0.65±0.04	15	0.68±0.02	NS
	Width (m)	0.60	7	0.59±0.02	8	0.58±0.03	15	0.58±0.01	NS
	Depth (cm)	40	7	31.50±0.84	8	30.14±0.93	15	30.87±0.61	NS
	Height inner wall (cm)	50	7	41.87±0.91	8	40.28±0.28	15	41.13±0.53	NS
Feed table / Feed bunk	Height (cm)	10	2	22.50±2.50	3	20.66±0.66	5	21.40±0.97	NS
	Width (cm)	70	2	52.50±2.50	3	63.33±6.66	5	59.00±4.58	NS
	Width of alley (m)	5.5	2	3.25±0.25	3	3.16±0.16	5	3.20±0.12	NS

Provision of space

Data in Table 4 showed that in NG farms mean space provided under roof and open area per adult unit was 5.18±0.10 and 10.49±0.44 square meter (SM), respectively. While in SG farms it was 4.24±0.24 and 10.90±0.91 SM, respectively. Overall it was 4.71±0.32 and 10.64±0.42 m^2. Average number of adult unit was 85.64±6.88. As per recommendations of BIS, space required under closed and open area per adult unit is 5.78 and 9.5 SM, respectively. It means that all respondents have provided little less space under roof. However, all respondents were provided sufficient open space to animal. Rathva *et al.* (2019) [9] also revealed that commercial farms in south Gujarat also provided less space to animals under roof. Inadequate stocking densities for feeding, drinking, loafing or lying down will all impact on positive health and performance. This may cause increases stress in animal and which leads to decrease in production. The farmers did not provided sufficient closed space due to the lack availability of space and high cost of construction. It was statistically similar in both the region. Generally price of land is high; therefore, dairy farms were not able to provide sufficient space to their animals (Duguma *et al.* 2011) [3]. Mean length of shed, width of standing area, width of alley and roof height were 44.56±3.31, 8.67±0.37, 1.41±0.05 and 4.49±0.12, respectively and all were nonsignificant between two regions. The length of shed requirement depends on number of animals to be housed. According to BIS standard one adult cow required vary from 1.5 to 1.7 m length. However, there are no standards of maximum or minimum length and one can keep the shed as long as possible just to reduce construction cost per unit of livestock. As per the standard width requirement is 1 to 1.2 m per animal as it is common practice to tie calves behind adult females, hence, width of standing area is more in present study. Means farmers have kept more shed height then recommendations which are desirable feature and it is accordance with Rathva *et al.* (2019) [9].

Table 4: Adoption of spacing (meter) compared to housing standard at specialized dairy farms

Region	BIS SM	n	NG farms	n	SG farms	n	Overall	Sig (Man Whitney)
Length of shed (meter)		10	43.11±6.2	10	46±2.69	20	44.56±3.31	NS
Width of standing place (meter)		10	8.47±0.6	10	8.87±0.47	20	8.67±0.37	NS
Feeding alley width (meter)		10	1.44±0.06	10	1.38±0.08	20	1.41±0.05	NS
Average roof height (meter)		10	4.59±0.2	10	4.38±0.13	20	4.49±0.12	NS
Area under roof (Sq. Meter)		10	339.34±26.96	10	409.61±32.43	20	374.48±22.05	*
No of AU tied		10	73.33±10.1	10	97.96±8.03	20	85.64±6.89	NS
Space provided/AU Sq. meter	5.78	10	5.18±0.57	10	4.24±0.24	20	4.71±0.32	NS
Area of open paddock (Sq. Meter)		10	766.07±108.66	6	1123.37±143.57	16	900.06±94.87	NS
Space provided in open paddock/AU Sq. Meter	9.50	10	10.49±0.44	6	10.9±0.91	16	10.64±0.42	NS

* Significant ($p< 0.05$)

Conclusion

All the dairy farms of both regions were having livestock shed with proper dimensions suggested by BIS. One farm in north region and two farms at south zone have most advanced feed bunk system. Many farms across both regions were using gravity based water bowl system to ensure drinking water available round the clock.

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