Original Research

Farmstead Planning of Commercial Dairy Farms in Urban and Peri Urban Areas of South Gujarat

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Abstract

An investigation was carried to study the ways of farmstead planning by commercial dairy farmers in and around Navsari city of South Gujarat. For this purpose 20 each dairy farms in urban and peri urban area were selected randomly. The required information was collected through personal interview, observation and assessments methods. Data were analyzed by suitable statistical techniques revealed that few farmers (12.5%) had open area and feeding alley in their animal shed. About 30 per cent farms had more scientific water bowl system in animal shed. Almost all the respondents had pucca manger in animal shed. Housing dimensions of the farms under study revealed that majority of farms had constructed their livestock shed by keeping the standard in their mind. Average length, width and height of shed were 21.01, 8.55 and 3.17 meter, respectively. Average space provided was 4.73 m2 per adult unit which was near to the standard space requirement per adult animal. Most of farms had adopted the manger height and width as per BIS recommendation; however, very shallow mangers were provided by farmers. Majority of respondents kept the dimensions of water trough nearer to BIS standard. Majority of the (75%) respondents had even surface in their animal shed, 70 per cent had grooved surface, 52.5 per cent had well sloped and 60 per cent uniform without crack. The planning of farmstead in both regions was non-significant in most aspects.

Key words: Animal Housing dimensions, Commercial dairy farms, Manger, Shed dimension, Water trough

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Introduction

An efficient dairy farm management is incomplete without a well-planned and adequate farmstead. Improper farmstead planning or arrangement of buildings may result in reduced labour efficiency and poor animal welfare. During erection of shelter for dairy farm, care should be taken to provide maximum comfort

for each animal. Proper planned farmstead renders lifelong benefits to farm owners by continuously facilitating easy and efficient execution of routine operations. Various management practices such as feeding, breeding, disease control and labour inputs were constant depend on the type of housing (Djorhjani and Ibrahim, 1993). Proper house with well ventilation, lighting and proper flooring provides comfortable atmosphere to livestock, thus, have major effect on dairy animal production. Good farmstead planning is necessary for dairy farm mechanization and proper efficient management. Housing is very important for effective management of livestock especially to reduce the incidence of the probable complications arising out of metabolic disturbances (Reddy *et al.*, 2016). 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. Selection of proper location of shed prevents stagnation of water; provision of drainage channel averts the development of mosquitoes, flies, ticks, mites etc., which cause the dreadful diseases thus affecting the production performance of the animal. Good farmstead planning require sufficient knowledge of animal welfare needs, availability of resources and much more. There are certain standards developed by scientists for construction of livestock shed in various countries. India has their own 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. However, the idea about extent of adoption of housing standard in planning of farmstead in urban and peri-urban commercial dairy farms was not well documented. Therefore, an effort was made to study detail aspects of dimensions used in livestock sheds of urban and peri-urban areas of Navsari, Gujarat.

Materials and Methods

Study was conducted in Navsari district of south Gujarat. The area fall in 8 km radius to Navsari city was consider as urban area whereas, the areas falls in 16 km radius minus urban area was considered as peri-urban area. A list of all the commercial dairy farms having herd strength more than 20 adult units of cattle, buffalo or both was prepared. Twenty dairy farms each from urban and peri urban area were selected randomly. 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 BSI housing standards (Anon. 2005). The required information was collected from dairy farm owners by questionnaire. The data were

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scrutinized and tabulated into frequency, percentages, arithmetic mean, standard error and analysis of variance following the methods suggested by Snedecor and Cochran (1994).

Results and Discussion

Adoption of Various Housing Components in Commercial Dairy Farms

Provision of open area, feeding alley, drinking water systems, manger types are important housing structure components associated with livestock comfort and health. It was studied by observation method in selected urban and peri urban dairy farms and reported in Table 1 and discussed below.

Table 1: Adoption pattern in various housing components in commercial dairy farms

S. No.	Housing components	Urban (n=20)		Peri urban (n=20)		Over all (n=40)		Chi square	
		n	%	n	%	n	%	Value	p
1	Open area							2.06	0.15
	Yes	01	05	04	20	05	12.5		
	No	19	95	16	80	35	87.5		
2	Feeding alley							2.06	0.15
	Yes	01	05	04	20	05	12.5		
	No	19	95	16	80	35	87.5		
3	Drinking water system							0.48	0.49
	Water bowl system	07	35	05	25	12	30.0		
	Water trough & other	13	65	15	75	28	70.0		
4	Material of manger							1.03	0.31
	Pucca	20	100	19	95	39	97.5		
	Wooden &*Kutcha*	00	00	01	05	01	02.5		
5	Manger Shape							1.79	0.41
	"U" Shaped	17	85	14	70	31	77.5		
	Flat bed	03	15	05	25	08	20.0		
	Kutcha	00	00	01	05	01	02.5		

Data in Table 1 showed that few (12.5%) respondents had open area with their livestock shed. As now, a day's farmers cannot afford it due to high cost of land. However, open area has its own importance for livestock welfare concern. Farmers might not aware about the benefit of exercise to their livestock, which is extremely important for better health and production. They are also believing that animal can be kept cleaner and disease free only in tied stall condition. It was evident from the Table 1 that only 12.5% dairy farms had feeding alley. It might be to avoid much investment toward housings and also due to high cost of land. It is avidest from Table that 30% farms are using new generation water bowl system, which tells, that dairy farmers are quite innovative in nature. This finding was higher than reported by Costa *et al.* (2013). It indicated that all the respondents knew the importance of free choice wholesome water for their livestock. Further, majority of the respondents (97.5%) had *pucca* manger while remainders had wooden

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manger. Previous many studies revealed that dairy farmers across India are mostly (60-75%) feeding their animals using mangers (Waykar *et al.*, 2012, Sabapara *et al.*, 2015, Patbandha *et al.*, 2018, Viswkarma *et al.*, 2018 and Mishra *et al.*, 2018). However, adoption level and construction material are varying from place to place and livestock holding (Suratani *et al.*, 2017). Waykar *et al.* (2012) found that 70.72 % respondents were using wooden plank manger and only 29.38 % provided *pucca* manger. Above said all studies were mostly focused on small dairy farmers at rural regions while this study on commercial dairy farms of urban and peri urban region hence, the difference was observed. It was found that majority of the respondents (77.5%) possessed book written "U" shape manger followed by flatbed (20%). It was consistent in both regions indicating that farmers were aware about the effect of 'U' shape manger to prevent feed wastage.

Extent of Adoption in Housing Dimensions

To study extent of adoption in housing dimensions, the dimensions like length, width, height etc. were measured and shed area and area per adult unit were derived which is depicted in Table 2. Mean length of shed was 20.68 ± 1.89 and 21.34 ± 3.25 m in urban and peri urban commercial dairy farms, respectively. 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. Mean width was 6.98±0.96 and 10.13 ±2.76 m in urban and peri urban region, respectively. As per the standard width requirement is 1 to 1.2 m per animal. Das *et al.* (2016) observed 2.49 m length and 1.42 m width in livestock shed at farmer's level, so, it is quite less than present finding. Most of the livestock shelter was gable type with two mangers at centre and standing area on both sides. Some farms were also tying calves behind their dams in same shed, hence, more shed width was observed than previous results. Average height of the shed from middle was 3.19±0.10 m. The BIS standard height of roof is 1.75 m in high rainfall area. In study area, it was found higher than standard height. Means farmers have kept more shed height then recommendations. Hence, extent of adoption in shed height was 182.55±5.54% of BIS recommendation. To construct houses with more height is costly but it facilitates ventilation and thus, reduce heat load in summer, hence, it is always desirable. According to Djorhjani and Ibrahim (1993) farmers had provided 1.8 to 2.3 m length and 0.9 to 1.9 m width to the animal at Indonesia. The different in the result because of this study was taken on small dairy farmers whereas; present study was on commercial dairy farms. They also observed that height of the roof was 2-3 m in the studied area. The present result is slightly higher than Djorhjani and Ibrahim (1993). Average length and width of feeding alley was 20.80±2.63 and 0.96±0.1 m, respectively. Length of feeding alley was depend on the length of the shed. Majority of the respondents did not providing feeding alley. The chi square value suggests the

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significance difference between two regions, dairy farm at urban area have kept more width. As per BIS width of central passage is 1.8 m but farmers adopted less width in feeding alley which might be due to the lack of space and to save construction cost.

Table 2: Extent of adoption in housing dimensions (Mean±S.E.) by dairy farmers of urban and peri urban area

S. No.	Shed dimension	Urban (n=20)	Peri urban (n=20)	Overall (n=40)	F value	p value
1	Length of shed (m)	20.68± 1.89	21.34± 3.25	21.01± 1.86	0.03	0.86
2	Width of shed (m)	6.98±0.96	10.13±2.76	8.55±1.46	1.16	0.28
3	Shed height from middle	3.22±0.16	3.17±0.11	3.19±0.10	0.08	0.77
4	Adoption of standard (%)	184.20±9.41	180.90±6.11	182.55±5.54	0.08	0.77
	Feeding alley	**n=1**	**n=4**	**n=5**		
5	Length of feeding alley (m)	18.50 ±0.00	21.38±3.32	20.80±2.63	0.15	0.72
6	Width of feeding alley (m)	1.50 ±0.00	0.83±0.04	0.96±0.14	48.60	0.01

Extent of Adoption in Manger Dimensions

Table 3 depict that mean manger height was 0.57± 0.0 m. It was statistically similar in both regions. The manger height employed by dairy farms were scientific as the BIS standard height of manger is 0.50 m. Compare to standard farmers are providing little more manger height (extent of adoption 113.30 ± 2.73%). More manger height was attributed with breed and class of livestock possessed by them as they were keeping large sized Mehsana and Banni buffalo and crossbred cattle breeds, which are having more height. Mean width of manger was 0.59 ± 0.02 m nearly similar in both regions.

Table 3: Extent of adoption in manger dimensions (Mean±S.E.) by dairy farmers of urban and peri urban area

S. No.	Manger measurement	BIS Standard (m)	Urban (n=20)	Peri urban (n=20)	Total (n=40)	F value	p value
1	Manger height (m)	0.5	0.59± 0.02	0.54± 0.02	0.57± 0.01	2.98	0.09
2	Adoption of standard (%)		117.90± 3.69	108.70± 3.84	113.30± 2.73	2.98	0.09
3	Manger Width(m)	0.60	0.60± 0.03	0.58± 0.04	0.59± 0.02	0.23	0.63
4	Adoption of standard (%)		100.00± 4.56	96.55± 5.14	98.28± 3.41	0.25	0.62
5	Manger Depth (cm)	40	11.95± 0.59	11.40± 1.19	11.68± ± 0.65	0.17	0.68
6	Adoption of standard (%)		29.951.48	28.65± 2.98	29.30± 1.64	0.15	0.70

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Further, it is near to BIS standard manger width (0.60 m). Mean depth of manger was 11.68 ± 0.65 cm. It was 11.95± 0.59 in urban and 11.40± 1.19 in peri urban. Standard for the manger depth was 40 cm. It indicated that only 29.30± 1.64 % extent of adoption was found in depth of manger. It shows that farmers adopted very shallow manger depth. Rioja-Lang *et al.* (2015) have observed 0.30 to 0.75 m feeding space per animal in their experiment.

Extent of Adoption in Water Trough Dimensions

Mean dimensions of water trough in urban and peri urban area is depicted in Table 4. The table revealed that length of water trough in urban area was 2.87±0.26 m and in peri urban area it was 4.63 ±0.78 m. Length of water trough is significant more in peri urban region. It might be due the less availability of land in urban region. The extent of adoption in length of water trough was 86.97±11.92% considered as nearer to BIS standard. Mean width of water trough was 1.16±0.09 m. It was 1.22± 0.15 and 1.09±0.10 m in urban and per urban area, respectively. Compare to standard water trough width (0.60 m) extent of adoption was 98.28± 3.41per cent.

Table 4: Extent of adoption in dimensions of water trough (Mean ±S.E) by dairy farmers

Sr. no.	Water trough measurement	BIS Standard (m)	Urban (n=16)	Peri urban (n=15)	Total (n=31)	F value	p value
1	Length of water trough (m)	6 Rcm/ Animal	2.87±0.26	4.63 ±0.78	3.73±0.42	4.80	0.04
2	Adoption of standard (%)		101.56 ±17.50	71.40± 15.66	86.97± 11.92	1.63	0.21
3	Water trough width	0.60	1.22± 0.146	1.09±0.097	1.16±0.09	0.54	0.47
4	Adoption of standard (%)		203.33± 5.55	181.66± 6.26	193.33± 4.12	0.30	0.59
5	Water trough height (m)	0.5	0.66± 0.03	0.60±0.040	0.63±0.02	1.28	0.27
6	Adoption of standard (%)		132± 4.11	120±5.49	126±3.45	1.88	0.18
7	Water trough depth (m)	0.40	0.72±0.057	0.69±0.1	0.71±0.03	0.41	0.53
8	Adoption of standard (%)		180±2.97	172.5±0.97	177.5±1.62	0.00	0.99
9	Water tank capacity (liter)	--	4025.00± 257.71	4184.21± 545.06	4102.56± 292.84	0.07	0.79

During course of research it was observed that water troughs were mostly constructed in such a way that their one long wall remain jointly with shed. So, animal can drink water from one side of water trough only, so, the widths they have kept were enough. Mean height of water trough was 0.63±0.02, nearly similar in both regions and also near to BIS standard (0.50 m). Regarding depth of water trough, it was found 0.71±0.03 m. In urban it was 0.72±0.06 m and in peri urban it was 0.69±0.1 m. It was statistically similar between two regions; however, it was having 77% more depth than BIS standard. It may be associated with

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farmer's planning to secure water as much as possible to cope of situations of temporary water crisis in conditions like power failure, damage to pumps etc. Further, storage capacity of water tank was 4102.56±292.84. All the respondents were storing water for animals and various farm activities. Majority of the farmers had water trough in their farms although they were not adopted water trough all dimension as per standard which might be due the lack of knowledge about the standard and lack of space for the construction.

Extent of Adoption in Provision of Spacing by Dairy Farmers

Data in Table 5 showed that in urban area, mean of total floor area of shed including open area was 160.74±18.90 m^2 and in peri urban area it was 210.20±70.36 m^2. Overall, it was 185.47±36.17 m^2. Average number of adult unit housed was 38.71±3.84. The table revealed that average space provided per adult unit was 4.73±0.39 m^2. Statistically it was similar between two regions but urban farms they are provided less space might be due to high cost and less availability of land. As per the BIS standards, space per adult unit should be 5.78 m^2. Sastri and Thomas (2005) have suggested floor space requirement 3.5 m^2 for cattle and 4 m^2 for buffalo under covered area. It means that all respondents have not provided sufficient space (extent of adoption was 81.80±6.80%) to animal as per BIS, however, they have provided enough space to their livestock as per recommendations of Sastri and Thomas (2005). Suratani *et al.* (2017) revealed that about 80% farmers of Andhra Pradesh were provided proper spacing to their animals. Inadequate stocking densities for feeding, drinking, loafing or lying down will all impact on positive health and performance. This may cause increase stress to animal and which leads to decrease in production. The farmers did not provided sufficient space due to the lack availability of space and high cost of construction. Generally, price of land is high in urban area than rural, therefore, urban dairy farmers were not able to provide sufficient space to their animals (Duguma *et al.*, 2011)

Table 5: Space (Mean ±S.E) provided by dairy farmers in comparison with standards

S. No.	Dimension of shed	BIS Std	Urban (n=20)	Peri urban (n=20)	Total (n=40)	F value	p value
1	Total area of farm (m^2)	5.78 m^2	160.74±18.90	210.20±70.36	185.47±36.17	0.46	0.50
2	Total number of animal		57.85±7.42	46.30±7.36	52.08±5.24	1.22	0.28
3	No of adult unit		42.94±5.62	34.48±5.21	38.71±3.84	1.22	0.28
4	Provided space per adult unit (m^2)		4.00±0.30	5.45±0.70	4.73±0.39	3.62	0.07
5	Space provided compare to BIS (%)		69.25±5.32	94.35±12.04	81.80±6.80	3.64	0.06

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Adoption of Quality Standard in CC Floor in Livestock Shed

Mostly cement concrete (CC) is common and very popular flooring in livestock shed. CC flooring is good as far as shed hygiene concern. However, it is hard and may be slippery if not grooved properly or don't have proper slope. Therefore, the quality aspects of CC were studied and collected data were analyzed and presented in Table 6. Majority (75%) of the respondents had even surface in their shed while 25 percent had uneven surface (Table 6). It was evident from the table that 70 percent respondents had grooved surface and 30 percent had not grooved. Data in table indicated that 52.50 and 42.5% respondents had well and bad slope, respectively. Further 5% farms have not kept slope in their shed might be to prevent animals from slips. As far as quality in term of integrity in CC concern sixty percent respondents had good quality uniform CC without any visible cracks. Remainders had broken CC with cracks and crevices in them. This result is more or less in agreement with Sabapara *et al.* (2015) and Patbandha *et al.* (2018). Rao *et al.* (2015) reported that about 85% livestock shed in coastal region were having good quality CC.

Table 6: Distribution of the dairy farm owners according to adoption of quality CC floor

S. No.	Particulars	Urban (n=20)		Peri urban (n=20)		Over all (n=40)		Chi square	
		n	%	n	%	n	%	Value	p
1	Surface evenness of CC floor								
	Even	16	80	14	70	30	75	0.53	0.47
	Uneven	4	20	4	30	10	25		
2	Surface smoothness of CC								
	Grooved	14	70	14	70	28	70	0.00	1.00
	Not grooved	6	30	6	30	12	30		
3	Slope in CC								
	No slope	0	0	2	10	2	5	2.49	0.29
	Bad slope	8	40	9	45	17	42.5		
	Well slope	12	60	9	45	19	52.5		
4	Integrity of floor CC								
	Broken	6	30	10	50	16	40	1.67	0.20
	Uniform without crack	14	70	10	50	24	60		

Extent of Adoption of Dimensions in Shed Components

The frequency distribution of respondents based on adopted or not adopted the BIS standard is presented in Table 7. It revealed that all the respondents (100%) have adopted roof height as per BIS standard. It indicated that farmers have aware about the required height of the animal shed. It is good source of light and ventilation. It helps to decrease the moisture in animal shed. Data in table indicated that majority (90%) respondents have adopted standard height of manager, whereas, 30% have adopted proper width of manger. All the respondents did not adopt depth of manger. Manger plays crucial role in animal feeding. In the study area farmers have knowledge about providing manger in animal shed but they have not adopted manager

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dimensions properly. Hence, it is required to train them about manager standards for animal wellbeing and benefits. Data in Table 7 indicated that more than half of the (72.5%) of the respondents did not adopt water trough length, further, 22.5 percent did not have water trough. Only few (5%) respondents adopted water trough width. Only 20% respondents have constructed water trough with proper height. Seventy five per cent of the respondents did not adopt water trough depth. Majority of the respondents possessed water trough in their animal shed and some famers also provided water bowl system for animals. The farmers did not adopt the dimension of water trough according to standard. They constructed the water trough on the basis of space availability. The adoption frequency of shed area was 27.5 percent. It revealed that farmers did not have the required space for animals in their shed. They kept their animal in congested condition. The reason behind is lack of space for construction of shed and cost of construction is also high. This result is not in agreement with Kishore *et al.* (2013) and Vranda *et al.* (2017) who said 71.12 per cent of the farmers had adequate floor space in their animal shed.

Table 7: Distribution of the dairy farm owners according to adoption of proper dimensions as per standard

S. No.	Name of component of shed	Urban (n=20)		Peri urban (n=20)		Over all (n=40)		Chi square	
		n	%	n	%	n	%	Value	P
1	Height of shed	20	100	20	100	40	100	0.00	1.00
2	Manger height	18	90	18	90	36	90	0.00	1.00
3	Manger width	5	25	7	35	12	30	0.48	0.49
4	Manger depth	0	0	0	0	0	0	0.00	1.00
5	Length of water trough	7	35	4	20	11	27.5	1.13	0.57
6	Width of water trough	1	5	1	5	2	5	0.01	0.99
7	Height of water trough	3	15	5	25	7	20	2.37	0.31
8	Depth of water trough	0	0	0	0	0	0	0.00	1.00
9	Total area adoption	3	15	8	40	11	27.5	3.14	0.07

Conclusion

From the present study it can be concluded that few farms had open area and feeding alley in their shed. Majority of the farmers (70%) were providing water by water trough and bowl system. The average manger height and width was near to the standard. Average manger depth was found shallow than standard. Majority (97.5%) of the farmers were *pucca* "U" shaped manger. The average shed height was 182.55±5.54% of recommended roof height. Majority of the farmers had even and smooth surface of CC floor. About 52.5 percent CC floor was well sloped and 60 percent of them were uniforms without crack. Manger height was adopted by 90 percent farmer. Only 27.5 percent farmers adopted water trough length, 5 percent adopted width, 20 percent adopted height and no one adopted depth of water trough. Only 27.5 percent adopted total area of farm.

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