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Structural Conditions and Improvement Possibilities of Dairy and Beef Cattle Barns in Family Farms Established in the Van Region of Turkey

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Abstract: Meat and milk production, which is the main source of human nutrition, can be significantly increased provided that animals are accommodated in barns designed based on the project criteria. Factors such as climate, construction system, construction materials and breeding types should be considered in planning animal barns. In this study, present situation of barns of beef and dairy cattle enterprises in the Van region, where most of people gain their income from animal farming, was determined and the possibilities to improve these barns were investigated. Also appropriate barn design criteria suitable to climatic conditions of the region was determined and was found that long side of the barns should be positioned in the north-south direction for natural aeration, which is one of the most significant environmental factors, of the barns.

Key words: Barn, beef cattle, dairy cattle, environmental controls

INTRODUCTION

Selection of barn type, planning of the barns for determined purposes and their building are the most important issues to minimise the possible effects of environmental factors. However, same type of the buildings is usually established at different climatic conditions.

Since environmental conditions vary at different regions of Turkey, climatic conditions of the region should be considered when planning the barns to control in-barn conditions. Animal species, breeding type, economical structure of the farm and market demanding determine the type of animal farming.

During planning of animal barns and preparing the application projects so many factors should be considered such as, selection of the building area, production system, climate conditions of the region, storage buildings, position of the other buildings established earlier in the same region.

Hellickson *et al.*^[1], Rook and Thomas^[2], Mutaf and Sönmez^[3], Okuroğlu and Yağanoğlu^[4], Moran^[5], Ekmekyapar^[6], Balaban *et al.*^[7] and Mutaf *et al.*^[8] emphasised that animal barns should be built in concerning the climatic conditions of environment

and animal requirements. Barns built without proper planning and project, would not be suitable for animal health and expected production could not be obtained.

When building a barn, wind direction, the angle of sunlight^[9], drain conditions and topographic structure of the selected land^[10], the distance of selected land to market place and urban area, access to main roads, convenience for feed providing^[11] should be considered. Selected land for building farm enterprises should also be unsuitable for crop farming.

Alkan^[12], Tekinel^[13], Balaban and Şen^[14], Demir^[15], Olgun^[10] and Ayık^[16] emphasised that feed stores, utility units such as milking, slaughtering and manure storage units should also be planned when dairy and beef cattle barns were built. Furthermore feed storage units should be planned with the concern of daily feed consumption and storage period whilst daily milk yield is considered as main issue when building milking units. Warehouse of the farm should be located with the concern of mechanization situation of the enterprises. Daily manure yield and storage period of it are important factors when planning manure storage units.

Many researchers^[10,14-19] suggested that clean and sufficient amount of water, curb and feed boxes for water and feed requirements should be located in barn. They

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also suggested that curbs and feed troughs must be far away from resting area of animals and made in suggested size and shape.

This study aimed to improve the tie stall dairy and beef cattle barns in the city of Van with concerns of factors stated above.

MATERIALS AND METHODS

This study was carried out in the city of Van, located in the East Anatolian Region of Turkey in 1998, which has the area of 19.069 km², about 2.5% of total land of Turkey. Main income of local people living at rural area of the region is animal production. Study was carried out in the center and 7 towns of the city, Van.

The average lowest and highest temperatures of the region during the last two decades were recorded as -28.7 and 37.5°C, respectively. The average relative humidity was recorded as 59%, average annual rainfall was 380.6 mm and average snowy days were 80 day/year. Wind roses for winter and summer seasons were given in Fig. 1^[20,21].

Pre-investigations for family farm enterprises were carried out with the suggestions of agricultural council of the city and towns. The 81 enterprises surveyed in this study were selected by aimed sampling methods^[22,23].

Isolation, aeration, production systems, barn capacities, barn equipments, other barn sections and structural characteristics of the enterprises and the problems faced by farmers were determined in this survey.

The conditions of the investigated barns and other structures at the enterprises were evaluated based on the sufficiency of the environmental conditions and planning strategies points using the survey results. Survey results were evaluated by utilizing the ADA program^[24].

Leveling of the temperature and humidity of suggested barns (dairy and beef cattle barns) were planned to make at monthly intervals. For both barn systems in door relative humidity and temperature were accepted as 75% and 10-15°C, respectively, according to reported literature. However, the lower limit of optimum indoor temperature was accepted as 10°C^[6,7,25].

RESULTS AND DISCUSSION

The study showed that all farm barns used for dairy and beef cattle breeding were much below the desired minimal expectations in terms of planning and other building characteristics. It was found that the 89% of the surveyed enterprises at region were built without project and planning and they could not meet the basic requirements of barn.

Only 7.4% of barns were projected and 34% of them were established in North-South position and remaining of them were established in West-East position (Table 1).

The 65% of the studied establishments were built on flat land while the others were located on sloppy lands and all of them had electricity power.

The 81% of the surveyed enterprises were built with own resources of family, whilst 4% of them were built using bank credit and 13% of them were built using agricultural subvention credit.

It was determined that 46% of the farmers were experienced, while 51% of them were fairly experienced and only 3% of them were found inexperienced about dairy cattle farming. The 56% of the farmers were experienced while remaining of them was fairly experienced about beef cattle farming.

Most of the dairy cattle enterprises were established after the year 1985 and it were observed that the number of dairy cattle barns increased in recent years (Table 2).

The number of animal in most of the surveyed enterprises was less than 20, indicating that a cattle

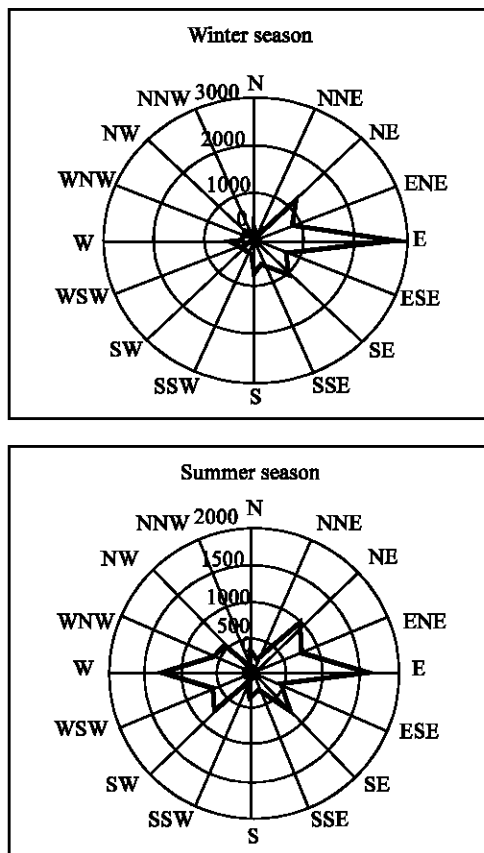


Fig. 1: Wind roses for winter and summer seasons for the city of Van

Table 1: Project resources and barn position

Project resource	North-South	%	West-East	%	Total	%
The planning improved by producer	37	78.7	26	76.4	63	77.8
The planning impressed by other producers	8	17.0	4	11.8	12	14.8
The planning developed by government institutions	2	4.3	4	11.8	6	7.4
Total	47	100.0	34	100.0	81	100.0

Table 2: Type and establishment time of enterprise

Establishment of enterprise	Beef	%	Dairy	%	Beef-Dairy	%	Total	%
<1970	0	0.0	4	7.4	1	10	5	6.2
1970-80	4	23.5	5	9.3	3	30	12	14.8
1981-85	2	11.8	8	14.8	1	10	11	13.6
1986-90	5	29.4	14	25.9	1	10	20	24.7
1991-94	6	35.3	21	38.9	3	30	30	37.0
>1994	0	0.0	2	3.7	1	10	3	3.7
Total	17	100.0	54	100.0	10	100	81	100.0

Table 3: Materials used in wall construction and the number of animals in barns in different towns

Towns	Materials						Number of animal								Total					
	Stone	%	Brick	%	Adobe	%	Total	%	1-10	%	11-20	%	21-30	%	31-40	%	>40	%	Total	%
City center	0	0.0	8	28.6	16	59.3	24	29.7	9	6.5	8	36.5	4	40	1	9.0	2	50	24	29.7
Erciş	6	23.1	11	39.3	0	0.0	17	21.0	5	14.7	3	13.6	4	40	5	45.5	0	0	17	21.0
Gevaş	9	34.6	0	0.0	0	0.0	9	11.1	4	11.8	4	18.2	1	10	0	0.0	0	0	9	11.1
Gürpınar	4	15.4	0	0.0	2	7.4	6	7.4	4	11.8	2	9.1	0	0	0	0.0	0	0	6	7.4
Muradiye	3	11.5	9	32.1	0	0.0	12	14.8	3	8.7	1	4.5	1	10	5	45.5	2	50	12	14.8
Özalp	1	3.9	0	0.0	9	33.3	10	12.3	9	26.5	1	4.5	0	0	0	0.0	0	0	10	12.3
Çaldıran	3	11.5	0	0.0	0	0.0	3	3.7	0	0.0	3	13.6	0	0	0	0.0	0	0	3	3.7
Total	6	100.0	28	100.0	27	100	81	100.0	34	100.0	22	100.0	10	100	11	100.0	4	100	81	100.0

Table 4: Materials used on barn floors

Materials	Number of Barn	%
Concrete on stone	72	88.9
Soil	1	1.2
Concrete on soil	8	9.9
Total	81	100.0

breeding at the region was carried out in small farms (Table 3).

All cattle barns were built as single stair for surveyed enterprises. Most of the barns were built in the village and nearby the house of the owner.

The 88.9% of the floor were made of concrete on stone (stone fill) and only 9.9% of them were made of concrete on naked land without using any steel construction. All barn floors were made sloppy for draining purposes, however, none of them were met satisfactory requirements (Table 4).

Stone, brick and adobe were used as wall material for all barns built in the region. Mainly stone was used as building material in Gevaş (34.6%), however, brick was the main material used for barns located in Erciş and Muradiye (39.3 and 32.1%), while only adobe was used for walls of the barns built in Özalp as shown in Table 3.

The 46% of the surveyed barns had roof and 22% of them were made in single slope and the remaining of them were built in double way slope. Corrugated-galvanized-sheet was used as roof material for all surveyed barns. No isolation was applied at roofs for most of the barns. It

was also observed that only few of them had compressed soil and five of them had satisfactory isolation material. Wood was used at the roof of the barns as ceiling joists. However none of these joists was met the basic standards.

Average width, length and height of the surveyed barns were 5.57, 13.51 and 2.97 m, respectively.

It was determined that barn capacities and base areas of the barns were not established according to project criteria reported in literature (Table 5).

It was recorded that 96.3% of the surveyed barns had 1-7 m² window area each and the ratio of total window area to barn basement was less than 5% for 85% of the surveyed barns (Table 6).

The 76% of the surveyed barns had aeration chimney made at different shape and sizes, however, it was noted that 86% of the barns were not sufficiently aerated.

The average width and height of the doors were recorded as 105 and 178 cm, respectively.

The average values of feedbox for front height, rear height, outer width, inner width and inner depth were 56, 59, 57, 42 and 24 cm, respectively. Feedboxes were located parallel to longer side of the barns.

Special water supplies were located in (13/21) and out (8/21) of the 21 barns. For other barns, with no water supply in barn or paddocks, animals were watered using buckets or plastic bowls and ratio of this type of the barns were calculated as 74%.

Table 5: Barn basement areas and grouping based on animal capacity in enterprises

Capacity	<30	%	31-60	%	61-90	%	91-120	%	121-150	%	>151	%	Total	%
<10	9	100	21	67.7	1	10	2	11.1	0	0	0	0.0	33	40.7
11-20	0	0	10	32.3	6	60	5	27.8	1	16.7	1	14.2	23	28.4
21-30	0	0	0	0.0	2	20	5	27.8	1	16.7	2	28.6	10	12.4
31-40	0	0	0	0.0	1	10	6	33.3	2	33.3	2	28.6	11	13.6
>41	0	0	0	0.0	0	0	0	0.0	2	33.3	2	28.6	4	4.9
Total	9	100	31	100.0	10	100	18	100.0	6	100.0	7	100.0	81	100.0

Table 6: Total window area and ratio of window area to basement area in barns

Window area (m ²)	Enterprise		Window area/ Basement area (%)	Enterprise	
	Number	%		Number	%
<1.0	28	34.6	<1.0	13	16.0
1.1-3.0	42	51.9	1.01-3.0	36	44.5
3.1-5.0	4	4.9	3.01-5.0	19	23.5
5.1-7.0	4	4.9	5.01-7.0	6	7.4
7.1-9.0	1	1.2	7.01-9.0	6	7.4
>9.0	2	2.5	>9.0	1	1.2
Total	81	100.0		81	100.0

Animals were lined up single and double-row in the 60 and 40% of the surveyed barns, respectively. Animals were looking at walls and each other in the 73 and 27% of the barns.

The average width and depth of urine channels were 28 and 15 cm, respectively, there was, however, no urine channel in the 69% of the barns in where urine was discharged with faeces using service area.

Cleaning and feed delivery pathways were also investigated for barns of both dairy and beef cattle. Only 19% of the barns had feed delivery pathways of which widths were ranged Between 55-80 cm. The average width of cleaning and service pathways was 118 cm and none of the barns had mechanic system for cleaning.

There was no silo in surveyed farms and only 2% of had proper storage system for faeces. Faeces were stored outside of the barns without any cover at the remaining farms.

The 90% of the enterprises grow their own feeding material in their farms, 10% of them buy it from market. However all farms buy their required concentrated feed stuff from the market. The 75% of the enterprises had no proper store for feed stuff.

Concerning the meteorological data of Van, which takes place East Anatolia climatical zone, the city is so convenient for dairy and beef cattle breeding.

The barns located in surveyed enterprises had not been established with proper project and planning. This situation decreases the productivity of enterprises.

From the points stated above, farming enterprises built in the region were not located properly. Most of the barns were built in village and nearby or even attached to the farm houses.

Stores and other utility units had not been considered when planning the farm buildings in the region

and this situation obstructs the rationalization of the enterprises. Milking process in all farms is carried out by hand and this procedure takes 50% of the total labour of dairy cattle farms. Manure are stored outdoor and this cause severe environmental and health problems for local people. This had an adverse affects on the financial situation of the farms.

Okuroğlu and Delibaş^[26] and Anonymous^[27] reported that the ratio of total window area to barn base area should be between 3.5 and 10% for a sufficient illumination. However, 84% of the surveyed barns in the region had insufficient window area resulting inadequate aeration and illumination.

Polyethylene foil was used instead of glass for the windows of the barns and this caused that long wave radiation energy was reflected especially during winter, resulting waste of energy. However, extra cost of using glass for windows is negligible comparing to total cost of barns.

Various reports were appeared for aeration in dairy cattle barns in literature, such as 100-125 m³ h⁻¹ for 500 kg live weight^[19], 336 m³ h⁻¹ for 450 kg live weight^[28], 30 m³ h⁻¹^[29], 114-204 m³ h⁻¹ for per 400 kg live weight Balaban ve Şen^[14], 0.2-0.3 m³ h⁻¹ kg⁻¹ live weight^[30]. The 76% of the surveyed barns had chimneys with various shape and sizes.

None of the barns had aeration holes. Concerning all these data, in surveyed dairy and beef cattle barns, it was readily perceived from in-barn conditions that aeration systems of them were not sufficient.

Aeration chimneys were located unevenly on roofs of the barns. No conventional air motion was observed in the barns causing adverse environmental conditions not only for animals but also for animal keepers. Microbial activities were observed on construction components, meaning there was insufficient aeration and unbalanced temperature-humidity in the barns.

Only 26% of the surveyed barns had specially made curb and feed trough, however they were inadequate number and unevenly distributed. 39% of these curbs were established outside of the barns.

But curbs and feed troughs located in surveyed barns were not suit the required criteria which had adverse affect on milk and meet production of enterprises.

SUGGESTIONS AND CONCLUSIONS

The suggestions to improve the current situation of the beef and dairy cattle farms in the Van region are listed here:

For both dairy and beef cattle barns tie stall barn type should be established in the region.

When planning the both beef and dairy cattle barns, climatical conditions of the region should also be taken into account. Construction material should be supplied locally (due to economical reasons) and possible enlargement of the units should be considered taking into account animals such as bulls, heifers and calves etc. Barns should have sufficient chimneys, windows and holes for aeration and light.

When the other buildings are established around the barns, their connection to barns should be considered. Before establishing a farm enterprise, selected land should be large enough for possible annexes leading to enlargement of the farm units.

Drain system should be sufficient for the land selected to build barns. This land should be appropriate for construction of drain system

Manure must be collected in properly isolated storage units and therefore appropriately collected and matured manure could be secondary income for cattle farms. Hence, location of the manure storage unit should be planned well, concerning the decrease for manure-transport-labour. When the planning of size of this unit, the fact that winter season is so long (5 to 7 months) in the city of Van should be considered.

Access systems within farm units and between enterprises and market should be adequate. In particular for dairy cattle farms transport system and rapid access to the market is vital issue that should be discussed in detail before establishing a farm.

Results of this study indicated that temperature raised during summer season had no adverse effect on animals. Therefore, to obtain maximum benefit from winter sunlight and wind stream during summer period, barns in the region should be built at North-South direction for long axis. Main wind streams during winter season should also be taken into account and analysed in detail when barns are established and essential precatory measures should be considered.

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