

Manure Management Systems and Development Possibilities in Dairy Cattle Farms in Konya Center Region #

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Abstract: In this study, it is aimed to determine the current manure management systems and research development opportunities in dairy cattle farms in Konya Region in which there is a large number of dairy cattle breeding. The research was performed in selected 32 dairy farms which are in center districts of Konya and the members of Cattle Breeders' Association of Konya, Turkey. The analyzed dairy farms were specially selected by purposive sampling method providing that they are capable of representing the region and convenient for the aim of this study. The characteristics of dairy farms were defined by face to face survey, measurement, observation, and photography studies. As a result of this study, it was determined that 58% of the examined farms were built after the year 2000. Besides, it was observed that 81% of the farms breed animals in semi open loose housing system. It was defined that mechanization were used in 81% of the studied farms to collect the manure. It was determined that manure was stored as a bulk form outside of the barn in 62% of the dairy farms, in paddocks in 19% of the farms and in the pits in 19% of the dairy farms. It was determined that the most of managers of dairy farms have not knowledge of manure management and the negative effect of manure on environment. it is very important for the farms, human health, and environment pollution that dairy farms are designed by considering the future situation of the farm in respect of manure management and that modern manure management systems are built in the farm

Key words: *Barn, Dairy cattle farm, Waste storage, Waste management.*

Introduction

Environmental pollution is defined as negatively disturbance of natural balances in the environments air, water, and soil by the wastes of substances and energy occurring as a result of human activities. For being able to prevent environment pollution that gradually increase, with contributions of many scientists, local and worldwide studies are carried out. These studies deal with environmental pollution in different dimensions and suggest solution ways (Özek, 1994).

When the pollutions occurring from barns are mentioned about, the most important factor in terms of its amount and effects is manure. The manure in barns creates environmental pollution in both internal and external environment. Manure transportation system in barn is directly related to the spread of pollution and badly odour in internal environment. In external environment, wrongly transportation and unsuitable storage of manure are the primary reasons for affecting and increasing environmental pollution (Atılğan et al., 2006; Karaman, 2005; Öztürk, 2009). In addition, in dairy cattle farms, depending on capacity increase, increases in the amount of manure occur and this case leads to environmental pollution (Öztürk, 2009).

The causes such as detrimental wastes occurring outside of barn, not collecting manure in a suitable storage, not burying the dead animals in pits and not dropping lime on them before burying, and lack of slaughterhouse designed in sufficient capacity in the farm create environmental pollution including the badly odour and visual pollution, resulted from these negative conditions. For this aim, for the wastes occurring in breeding farms not to create negative environmental conditions, it is necessary to examine the legal and technical actions that should be taken and storing and designing criteria (Mutlu, 1999, Anonymous, 1996).

The orientation to renewable energy resources in the world has made obligatory Turkey to effectively evaluate its existing potential (Öztürk, 2009). In our country, the studies on waste management are very below the desired levels (Polat, 2007). The major aims targeted in manure

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management required in dairy cattle farming are protecting animal health by forming healthy environments; lowering water and air pollution to minimum; reducing badly odour and pollution; taking under control proliferation of pests; and balancing, the fixed investment, operational expenditure, and use of labour force and nutrition by implementing the existing regulations (MWPS, 1989 and 1987; Field and Embleton, 2007).

In breeding farms, since storage of solid wastes is an important factor in preventing negative environmental conditions, the distances of manure storages to settlement areas, neighbouring farms, and houses are important. Today, the increase of interest toward environmental protection makes it obligatory producers to make arrangements considering these factors and use the necessary technical information. In all farms making cattle breeding, it was suggested that the main principles that were necessary to be considered in the selection of barn location were not complied with; that in selection of location and barn positioning, some faults were made; and the buildings in farms were not placed according to a certain order. It was identified that a large part of the barns in this kind of farms were in the court of farm and integrated into houses. It was emphasized that the places, where solid and liquid wastes are stored, were generally positioned adjacent to the barns; that these manure piles were near the neighbouring farms; and that they led to environmental problems (Karaman, 2005).

Animal wastes contains nutrition of nitrogen, phosphorus, and potassium, important to vegetables, as well as organic solid matter, insoluble heavy metals, salts, bacteria, viruses, sediments, and other microorganisms at the measure to be able to create environmental pollution. When this type of wastes mixes with water resources, making some chemical reactions, they reduce the amount of dissolved oxygen in water. These events both reduce water quality and endanger the life of aquatic living (Mielke, 1992).

The milk production in Turkey, according to the data of 2012, is totally 12,977,838 ton. The milk production in the province Konya, with 772,784.72 ton, consists of 4.8% of the production in Turkey. In the province Konya, there are 144,505 agricultural enterprises. 41,911(29%) of these enterprises makes only vegetable production; 4,646 (3%), only animal production, and 97,868 (68%), animal and vegetable production together (Anonymous, 2013). This case clearly reveals breeding potential in the study area and the requirement of carrying out studies to scientifically evaluate this potential and make orientations.

This study was carried out to examine the dairy cattle farms that are located in the province Konya, in which dairy cattle breeding is intensively performed, and manure management systems applied; identify their problems; and develop solution suggestions. Thus, the environmental pollution occurring with dairy cattle breeding and its causes will be identified and solutions toward preventing harm to environment were attempted to be developed.

Materials and Method

The cattle asset of Turkey in the year 2011 is 12,366,337 (Anonymous, 2013), The cattle asset in the province Konya is 471,534 (Anonymous, 2012). There are 44,243 dairy cattle farms in the province Konya. For Meram, Karatay, Selçuklu, the central districts of Konya, a total numbers of farms are 3025, 2924, and 577, respectively. A total number of farms in the central districts of Konya (6526 pieces) consists of 15% of total number of farms in the province Konya. The number of dairy farms which are the members of Cattle Breeders' Association of Konya (having cattle capacity 5 heads and more), is 593, 644 and 71 for the districts Meram, Karatay, and Selçuklu respectively. This consists of 13% of the number of dairy cattle farms, which are the members of association in the province Konya (Table 1). In the study, 32 dairy cattle farms being in active in the province Konya were selected as material. For the study to be carried out homogeneously, both high capacity farms and low capacity family farms were given place. The field works of the studies were carried out in the years 2012 and 2013.

In identification of dairy cattle farms being in active in the province, decision sampling method was used. For this aim, interviewing with public and private corporations, an inventory of dairy farms in the province Konya was taken. In identification of the dairy farms in the central districts of Konya (Karatay, Meram, Selçuklu), where dairy cattle breeding is widely carried, the opinions of technical staff in Provincial Directorate of Agriculture of Konya, and Dairy Cattle Breeders Association of Konya were received. In the study, the inventory (determination of number of farm, its capacity, and breeding system) of the dairy farms being in active in the study area was taken by means of the data

obtained from Provincial Directorate of Agriculture of Konya, and Dairy Cattle Breeders Association of Konya. In the study, the farms that perform breeding in the barns, which are in quality to be able to represent the structure of the region, have different manure management application; are in different features in terms of building type, production style and capacity; and predominantly have freestall were selected as material.

Table 1. Total number of farms in the central districts of Konya and examined farms (Anonymous 2012)

	Dairy farms having dairy cattle capacity 5 heads and more			Total		
	Total number of farms	The number of examined farms	Percentages (%)	Total number of farms	The number of examined farms	Percentages (%)
Meram	593	14	2,3	3025	14	0,5
Karatay	644	12	1,9	2924	12	0,4
Selçuklu	71	6	8,5	577	6	1,0
Konya City	10393	32	100	44243	32	100

In the farms examined in the study, for identifying the existing state, survey study was carried out. Survey study was carried out by making face to face interviews with the farm managers. The general characteristics of dairy farms such as the case of infrastructure in farm; land asset, capacity, foundation year of farm; and educational study of farm manager were studied. The data about manure management systems, applied in the farms, such as the building date of barns in the farm, planning system, and the collection, storage, and evaluation of mature were obtained by means of survey, measurement, observation, and taking photos. Taking the layout plans and plans of building in farm, the structural characteristics of farm were determined. Receiving information from farm managers about manure management applications performed in farms, it was attempted to be determined the positive and negative aspects of the system.

In grouping of dairy farms examined in the scope of the study according to the size of farm, total asset of animal they have was assessed in terms of animal unit (AU). While the numbers of animals are converted to AU, Yüksek et al (2003)., drawing on Armağan et al. (2004), used the coefficient of 1 for cow, 0.6 for calf and heifer, and 1.2 for bull.

The data obtained as a result of the study were evaluated, considering results of the other studies, relevant standards TSE, 1987 and TSE, 1988) and legal arrangements (Ministry of Environment, 1986 and Ministry of Environment and Forestry, 2006).

Results and Discussion

General Characteristics of Dairy Cattle Farms

In the scope of study, dairy cattle breeding is widely carried out in the district Meram according to the number of farm and in the district Karatay according to the number of animal. Therefore, a large part of the barns to be examined from the districts of Meram and Karatay. 43.75% of the farms, in which the study is carried out, take place in the district Meram; 37.50%, in the district Selçuklu, and 18.75%, in the district Karatay.

The Educational Status of the Farm Managers

It was identified that 50.00% of the managers of the farms, in which the study is carried out, graduated from primary school; 18.75%, from secondary school; 12.50%, from high school. 12.50% of them had undergraduate degree and 6.25% postgraduate degree. In the study, that 31% of farm managers have an educational status of high school and over show that breeding are carried out more consciously every passing day. In the study, it was identified that there was no illiterate farm owner. Öztürk (2009), in his study, for the farms in the district Tire of İzmir, reported that 96% of farm managers graduated from primary and secondary schools (primary school, 87%; secondary school, 9%), while 4% graduated from high school and university. Han and Bakır (2010), in the study they carried out in Diyarbakır, they reported that 19.8% of farm managers were illiterate; 7.2% of them were only literate; 58.1% graduated from primary school; 7.2% graduated from secondary school; and

7.8%, from high school and equivalent. Boz (2013), in the study, he carried out, in West Mediterranean Region (Kahramanmaraş, Adana, Hatay, İskenderun, Osmaniye), stated that 7% of farm managers were illiterate; 61% of them graduated from primary school, and 32% received education over primary school. In a similar study, carried out Soyak *et al.* in Tekirdağ and its vicinity, it was reported that 1% of farm manager performing dairy cattle breeding was illiterate; that 85% graduated from primary school and secondary school; and 11%, from university. Kayar (2011), in the study he carried out in vicinity of Denizli, expressed that 18.2% of farm managers graduated from primary school; 6.1%, from secondary school; 18.2%, from high school; and 57.6%, from university. According to the results of the present study, it was identified that the educational levels of farm managers performing dairy cattle breeding in the central districts of Konya were higher than İzmir Tire, Diyarbakır, East Mediterranean Region and vicinities of Tekirdağ, and lower than vicinity of Denizli.

The Foundation Years of the Farms

While the farms examined in the study are evaluated according to their foundation years, a grouping was made. The farms, whose foundation years are before 1990 were assigned as 1st Group; 2nd group for the period 1990-1995; 3rd Group for the period 1996-2000; 4th Group for the period 2001-2005; 5th Group for the period 2006-2010, and 6th group for the date after 2010. It was identified that 60% of the farms examined in the study was founded after 2000. It was identified that the foundation year of 15.63% of the farms were before 1990 (Table 2). It is seen that about 50% of the farms examined in the study were founded in the last 20 years. In addition, in the scope of the study, it is seen that the farms built in the last 20 years, due to the fact that the aids given by the government and breeding returns were high, are high capacity farms, and are organized in a modern structure. According to the study, the number of small family farms increasingly decreases every passing day.

Table 2. Distribution of farms according to their foundation years

The foundation years of farms	The number of farms	Percentage %'si
1 st Grup (<1990)	5	15,63
2 nd Grup (1990-1995)	2	6,25
3 rd Grup (1996-2000)	6	18,75
4 th Grup (2001-2005)	8	25,00
5 th Grup (2006-2010)	10	31,25
6 th Grup (2010<)	1	3,13
Total	32	100.00

The Capacity of Farms According to Animal Unit

When the farms examined in the study are evaluated in terms of animal unit (AU) according to animal capacities, it was identified that 15.63 % of the farms had capacity of 20-40 AU; 18.75%, 41-60 AU, 15.63%, 31-80 AU; 15.63%,81-100; and 34.38%, 101 AU and over capacity (Table 3). 65.64% of the farms examined in the study are over 60 AU of capacity.

Table 3. Distribution of the dairy cattle farms according to animal unit (AU)

Animal Unit (AU)	The number of farm	Percentage (%)
20-40	5	15,63
41-60	6	18,75
61-80	5	15,63
81-100	5	15,63
100<	11	34,38
Total	32	100.00

The origin of applied barn projects in farm

It was identified that in 56.25% of the farms, examined in the scope of study, the farm managers built the barns, being inspired from their own thoughts and their circles and that 43.25% of them received support from the private farms. In receiving in technical support, it was identified that they had milking unit built and that standard projects the firms had them prepared were used. Kayar

(2011), in the study he carried out in the vicinity of Denizli, stated that 42.4% of farm managers made examinations in the sample farms in the environment before beginning to build barn, and had information from the farm managers; that 33.3% built the barns and facilities with their own experiences; that 6.1% visited the sample businesses and utilized their own experiences; that 3% utilized Projects Provincial Directorate of Agriculture; and that 3% built barns and facilities, receiving consultancy services from the technical staff.

Housing System of the Farms

It was identified that 81.25% of the farms, in which the study is carried out, were planned as semi open loose housing system; 15.63%, as freestall system; and 3.13% (only one barn was examined so that it can be example) as tie-stall system. Öztürk (2009), in the study he carried out in the vicinity of Tire (İzmir), reported that 92% of barn system used in the farms was loose housing system; and 8%, free stall system. Uğurlu and Uzal (2004), for reducing stress effect on animals, emphasized that loose housing system was suitable so that animals could be sheltered in the environments near their natural environments and utilized more the clean air and sunshine

Distances of Farms to Konya City Center

In the study, when regarded to the distances of the farms to the centrum, it was identified that 37.50% were 8-10 km; 37.50%, 11-20 km; 12.50%,12-30 km; 9.38%, 31-40 km; and 3.13% , 41 km and over (Table 4). Uzal (2004) stated that that the farms are near to the centurms and highways was an important advantage in the direction of utilizing the marketing opportunities at the desired level and that the farms are outside the sentiment place was important in direction of the badly odors that form do not disturb the settlement units. As a result of the study carried out, since the significant part of the farm is near to the centrum (75% < 20 km), they were positioned in the vicinity of settlement place that are advantageous in terms of marketing.

Table 4. Distribution of the dairy cattle farms according to distances of farm to Konya city center

Distances of farm to Konya city centre (km)	The number of farm	Percentage (%)
0-10	12	37,50
11-20	12	37,50
21-30	4	12,50
31-40	3	9,38
41<	1	3,12
Total	32	100.00

Manure Management Practices in the Research Area

Applications of manure management applications of the farms, examined in the scope of the study, are examined as three separate titles as manure collecting, manure storage, and manure valuing. In the studies carried out, associated with the applications of waste management, the dimensions of manure storage places and distances of storage place to the farms and houses were measured. In case that manure is stored within dairy farm, the distance between manure pile and houses was found as average 63 m. In case that manure is stored outside the farm, it was in the distance of average 500 m to the farm. This situation is in accordance with the principles that are necessary to be complied with the facilities like henhouse and barn in Air Pollution Control Regulations in Industrial Plants of Ministry of Environment and Forestry.

Applications of Manure Collecting

It was identified that 59.38% of the dairy cattle farms in the study area used wheelbarrow and trowel; 15.63%, Tractor front scraper and Scraper; 9.38%, Tractor front scraper, 9.38%, automatic scrapers and 6.25%, tractor front scraper-wheelbarrow (Table 5).

In the study, in 40.62% of the farms, it was identified that mechanization was utilized. In addition, in the study, it was determined that large farms are more suitable for mechanization, while in the small farms, more labor force was utilized.

Öztürk (2009), in the study he carried out in the vicinity of Tire, in 69% of the farms, he reported that manure was collected by Tractor front scraper, in 5%, by leveling scraper; and in 26% by wheelbarrow; in addition, that open typed barns having loose housing systems were designed in such that it will enable the mechanization applications. Karabacak (2000), in the study he carried out in the vicinity of Ereğli, expressed that in 90% of farms, the manures were manually, while in 10% of them, they were collected by means of tractor.

In the recent years, dairy cattle farms are built as modern plants in such a way that they will more utilize mechanization. As a result of the study, it was identified that manure collecting method in small family farms exhibited similarity with the study results presented above, however, that manure collecting method in large farms was the automated systems suitable for mechanization.

Table 5. Distribution of the dairy cattle farms according to manure collecting methods

The manure collecting method	The number of dairy cattle farms	Percentage (%)
Wheelbarrow –Trowel	19	59,38
Tractor front scraper - Scraper	5	15,63
Tractor front scraper	3	9,38
Automatic scrapers	3	9,38
Tractor front scraper- Wheelbarrow	2	6,25
Total	32	100.00

Manure Storage Practices

In 18.75% of farms in the scope of study, manure is stored in paddocks; in 18.75% of them in manure pits (pit storage); and in 62.50% of them in solid (bulk form) (Table 6). It was identified that the farms storing manure in bulk form generally used wheelbarrow-trowel and trowel as manure collecting method. It was observed that the farms using wheelbarrow-trowel collected borrow at least for one time. It was identified that the farms using levelling trowel collected manure between three-six months and that the material characteristic of the place they store manure was land. In the study area, it was identified that 70% of farms storing in bulk form built the farms according to their own preferences and that they did not receive specialist view. It was observed that these farms had semi-open loose housing system barns founded before 2010. In addition, in the farms, it was identified that the manures were transported to the distance average 50-100 m and the area average 500 m² by means of barrows and trailers, and base slope of the area was 2%.

It was identified that the farm managers storing manure in paddocks generally graduated from the primary school; that they kept manure in paddocks until harvest season; that they transported it in trailers of 5-6 tons; and that base material of storing place was generally land. It was detected that the farms storing the manure in manure pits were generally large farms; that educational status of their farm managers were generally high school and over; that automatic scraper were used in the farms to collect manure; and that operation of manure collecting was performed at least one time a day. It was identified that the manures accumulated in manure pits were stored in an empty part of the farm away from the farm by means of pump and sprinkler pipe.

Öztürk (2009), in a study he carried out in the vicinity of Tire, reported that 78% of the farm stored the manure in bulk form. Erkan (2005), in the study he carried out in the vicinity of Mersin, in 84.2% of the farms, reported that the manure was accumulated in open land in the bulk form. Karaman (2005), in the study he carried out in the vicinity of Tokat, reported that in 35% of the farms, there was no place for storing manure, and that in these vicinities, manure was accumulated by dropping into empty land, in open land, and in the bulk farm. In addition, he stated that, just as untidy storage of manure affects animal and human health in the negative direction, due to the fact that mechanization could not be passed in manure cleaning, it increased the need for labor force

According to the results of study, in dairy cattle breeding carried out in the vicinity of Konya, the method of storing manure shows similarity with the farms of the other vicinities. It is seen that the manure pit, whose three parts are closed, and top part is opened, is more compared to the other vicinities.

Table 6. Distribution of the dairy cattle farms according to manure storage methods

Manure Storage Methods	Number of dairy cattle farms	Percentage (%)
Solid (bulk form) storage	20	62,50
Pit storage	6	18,75
Storage in paddocks	6	18,75
Total	32	100.00

The manure treatment methods

It was identified that 68.75 % of the farms in the study area valued their manure by administering them in their own lands; 15.63%, in the form of selling to others; and 15.63% both by administrating to their own lands and in the form of selling to others (Table 7). Öztürk (2009), in the study he carried out, stated that 98% of the farms used the manure in their own lands to increase the organic matter content of land; however, for it to become useful for agricultural land, that they could not realize the necessary applications; and that 2% valued some part of the manure as fuel (cow dung cake). Kayar (2011) in the study in the vicinity of Tokat, stated that 66.6% of the farms valued the manure in their own lands; 15.2%, in their own lands and by selling to others; and 24.2% by selling to others. Erkan (2015), in the study in the vicinity of Mersin, reported that 61.4% of the farms valued the manure by administrating it to their own lands; 10.5%, giving the neighbouring farms; and 28.1%, by selling it to others and, in addition, that they administered it to the land; that since the strange hayseeds the animals eat remain in the manure, manure directly administered to the land caused to the problems with weed, and burns in some sensitive plants.

Manure valuing system, applied in the study area, shows similarity with valuing system of the other vicinities. It is seen that two farms examined valued the manure as compost and that some farms consciously administered the manure by means of solid manure distribution machine to land without maturing it and this engendered negative results in the land and environment.

It was identified that 62.5% of the farms stored the manure in the bulk form near the farm and houses; that 68.75% of the farms administered these manures to their own farm fields. The reason for that the farms cannot value as biogas, etc. is that the foundation cost of such a plant is high and that a sample farm has not been founded yet on the years, when the study was carried out. In face to face survey interviews carried out with the farms managers, it is understood that the common problem of the great majority of farms is the badly odour resulted from manure and harm flies do to them and environment. It was observed that the farms did not take necessary actions about this subject. In the farms examined in the study, it was identified that there was no enough information about manure storage and that there was no structure to store manure. In the interviews made with the farm managers, it was detected that the reason for this case is that they do not have enough information about manure storage and that there was not enough area for the structure of manure storage.

Table 7. Distribution of the dairy cattle farms according to manure treatment methods

Manure treatment methods	Number of dairy cattle farms	Percentage (%)
Fertilizer for their own farm field	22	68,75
Fertilizer for their own farm field – Selling to others	5	15,63
Selling to others	5	15,63
Total	32	100.00

Conclusion

In dairy cattle farms, for the works carried out according to a plan, to draw productivity at optimum level from the farm, and to reduce its adverse environmental effects to minimum level, it is necessary to plan manure management in a good way. In terms of environmental air quality, animals that are present in the farm, and health of workers giving daily care to the animals, manure management has a vital importance. For negative environmental conditions that will affect the productivity of farms and unhealthy life conditions, standards related to manure management and legal arrangements should be taken into consideration. Depending on this, in order to raise the productivity of the existent and potential farms and provide a more successful manure management, while the farms are founded, the structures related to manure management should be planned, considering the development case of the farms in the future. About maturing time of manure, what should be done

during maturation, and how to apply it to the land, it is necessary for the farm manager to be informed. Giving importance the use of mechanization in farms will increase the success in manure management. For being protected from insects like fly resulted from manure, it is necessary to frequently collect the manure and, storing them to the suitable places remote from farm. Thus, harmful effects of manure on the human, animal, and environmental health should be eliminated. While planning the structures of manure storage, the direction of wind must be well identified and badly odor resulted from manure should be prevented reaching the farm and houses. Especially, the pass of large farms to the modern manure management system (biogas, compost, etc.) should be supported, giving training by the relevant institution.

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