



MANAGEMENT OF MANURE FROM LIVESTOCK HOUSING AND ITS ENVIRONMENTAL POTENTIAL IMPACT ON WATER RESOURCES

Atilgan Atilgan, Ali Coskan, Hasan Oz

Suleyman Demirel University Isparta

Summary

Nowadays the increasing number of animal enterprising depending on the needs of human population growth and nutrition need that was occurred during the production of animal breeding have revealed the manure issue. Manure from animal barn, when not stored properly, causes environmental problems including odour and visual pollution, and could create environmental pollution problems. On the other hand, random storage of manure on the land outside animal barn as a result of climate parameters such as rainfall results in leakage of manure and can cause contamination of water resources. In Turkey, animal manure obtained from animal barns is almost not utilized and is accumulated outside. Manure which is produced in animal barn to be used for agricultural purposes must be stored in the areas which prevent the spread of in the environment. Thus, the loss of minerals in the soil plant available forms are contained in manure, will be prevented. In addition, due to the nutrients and microorganisms, surface and underground water resources can be a factor in polluting and may create a risk to animal health and environmental pollution.

The study has been carried out by determining the 4950 cattle breeding enterprises around the Eğirdir, Beyşehir Burdur and Salda lakes in the Lakes Region. About 50000 cattle are bred in the 4950 cattle breeding enterprises in the study area. However, of these animals 43502 are bred for commercial purposes. When the values in literature are taken into account, the daily manure amount that would be put forth has been calculated as 1500 tons. It has been concluded that animal manure which is the output of animal breeding enterprises will result in environmental pollution, water resource pollution as well as posing a threat to life in general by mixing with water resources such as underground water, lakes etc. when deposited haphazardly in stacks that are not well managed. As a result, we believe that our producers should be well informed regarding manure management prior to experiencing such problems.

Key words: water resources, animal manure, manure management, environmental pollution

INTRODUCTION

Animal manure is composed of fertilizer that is spread underneath the animals after being excreted either as solid or liquid following the digestion of consumed fodder that meets their nutrient demands to enable the continuation of their development [Bayindir et al., 2004]. When manure that is produced in animal breeding facilities is stored without taking into account manure methods or storage conditions, the nutrient elements and microorganisms inside the manure can cause surface or underground water pollution. The storage of manure allows the producers to use the best food source for crop production. However, if manure is not stored properly at animal breeding enterprises, it can create risks for human and animal health as well as constitute an environmental risk. Therefore, manure (solid or liquid) that is formed at such enterprises should be stored properly, so as not to create environmental or water pollution until is applied to the cultivated areas for crop production [Harris et al., 2001]. Animal manure is by nature an organic material. When we consider that organic materials decompose over time, manure will also decompose thereby lose its structure and properties. That is why random storage and uncontrolled usage of organic manure should be stopped. The usage of manure in cultivated areas or the stages of storage for use in other operations should be carried out consciously and under conditions that will prevent pollution [Jacobson et al., 1999].

It is estimated that farm animals produce an annual solid manure of 1.7 billion tons [Sheffield, 2012]. Two problems arise about this issue. First is the mixing of contaminants that are formed due to the wastes in the animal shelters to surface waters via surface flow and to underground waters via percolation; the second is the transfer of wastes from the shelters to another area [Lunin, 1971; Ozek, 1994; Karaman, 2006]. The effects of animal breeding enterprises on environmental pollution have recently become an important issue along with the ways in which manure will be used or eliminated at these enterprises. Hence, manure management has become an important topic for animal breeding enterprises. This has shown that the collection, transfer and storage of manure should be considered together with health protection and pollution control programs [Erensayin, 1992; Karaman, 2006].

Current industrial facilities, residential areas along with insensible agricultural applications cause significant water and land contamination in our country. Animal manure from enterprises can be shown as one of the contaminants in agricultural areas. In our country, manure processing and usage is carried out insensibly. In addition to the insufficiency of manure consumption, another problem that arises is the imbalance in its usage. In many areas where extensive agriculture is carried out manure usage is below average whereas in certain regions the excessive use of manure causes serious environmental problems [Ergin and Eyicil, 2008].

Even though Turkey has freshwater reserves of lakes and rivers, it is not a water rich country. On the contrary, it will be a country facing severe water shortage problem unless required precautions are taken [Akuzumet al., 2003]. It is possible to estimate the possible pressures on water resources due to factors such as the current growth rate, change of water consumption habits etc. In addition, these estimations will be valid for the case that the current resources will be transferred to 25 years in the future without any further damage. Therefore, the current resources should be preserved and consumed in a much more sensible manner for us to be able to leave enough healthy water to posterity [Cakmaket al., 2005a].

Even though the average water consumption amount per person in Turkey is $1730 \text{ m}^3 \cdot \text{year}^{-1}$, this same value is 2000 m^3 in Iraq and 5000 m^3 in Western Europe. In 2030 the population of Turkey is estimated to be 80 million and accordingly it is estimated that the annual water consumption per person will be 1100 m^3 . This value is currently the value for countries that face water shortage problems [Cakmaket al., 2005b]. Today, the global climate changes (drought) along with human activities (population increase, industry, tourism and agricultural activities) pose a pressure and threat to the sustainable use of water resources. Manure that is formed due to animal breeding in agricultural activities is an important contaminant for water resources quality. The sustainability of the quality of water resources can be ensured by minimizing or eliminating contaminants.

The fertility of the soil should be increased or the current fertility potential should be preserved and the plant nutrients that are removed from the soil should be bedspreads via environmentally friendly methods in order to ensure that plants continue their developments in the soil and plant system. Fertilization is one of the foremost precautions that should be taken in order to ensure this. It is only through fertilization that the nutrients removed from the soil can be recycled back. If animal manure is properly managed and responsibly applied, it can be a good source of nutrient elements [Harris et al., 2001; Cayleyet al., 2004]. Dairy cattle with an average weight of about 550 kg produces an annual manure of total 32 tons, 11% of which is liquid including washing water. This manure provides 28 kg N, 11.2 kg P_2O_5 and 13.4 kg K_2O plant nutrients when applied on 1 decare of land [Weeks, 1994; Demirkiran, 2004].

Soil and water resources are among the most important natural riches of countries. The development and reasonable use of these resources is very important for the socio-economic developments of societies. Water is an indispensable resource for all living things; crop production is greatly limited in its deficiency [Kanberet al., 2008]. The objective of our study is to attract attention to the possible effects of animal manure in animal breeding enterprises around water sources on water quality. Hence, information has been given regarding the

preservation of water sources along with the precautions that can be taken in order to prevent the possible environmental pollution.

MATERIAL AND METHODS

The lakes region in our country covers a total area of 36.672 km² encompassing Antalya, Isparta and Burdur to the west of the Mediterranean Region. 20.591 km² of this region belongs to Antalya, 7152km² to Burdur and 8933 km² to Isparta. 36.672km². Beysehir, Egirdir, Acıgol, Burdur, Ilgin (Cavuscu), Aksehir, Eber, Sugla and Kovada are the major lakes of the region [Anonymous, 2013]. A great majority of the study material consists of cattle breeding enterprises located on the coast of Egirdir, Beysehir, Burdur and Salda lakes in the Isparta, Burdur and Beysehir region. According to the data regarding cattle breeding activities in the study region obtained from the Provincial Directorate of Agriculture, there are a total of 4950 animal breeding enterprises with 43502 commercially bred animals. The number of cattle in the study area has been given in Table 1.

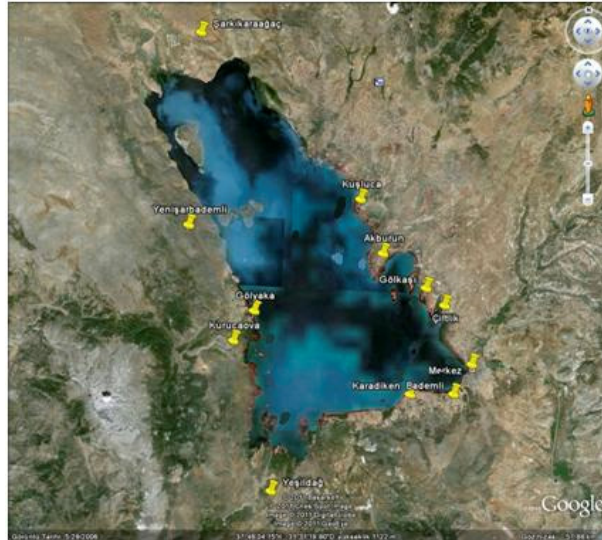
Table 1. The proportional distribution of the animals in the cities and districts of the region

City/Town	Animal Numbers (Unit)	Percentage
Beysehir	6859	16
Burdur	23850	54
Egirdir	3563	8
Gelendost	2050	5
Keciborlu	5043	12
Yesilova	2137	5
Total	43502	100

Animal breeding enterprises active around the study area of Egirdir, Beysehir, Burdur and Salda lakes have been shown in satellite maps.

RESULTS AND DISCUSSION

Animal manure production is also carried out at animal breeding enterprises throughout the regular production. Manure that is not properly managed and is stored in open stacks outside causes odour pollution, visual pollution and water pollution. Manure should be either stored under proper conditions or should be properly managed in order to prevent such problems.



Source: www.maps.google.com/

Figure 1. The coastal view of cattle breeding enterprises around the Beyşehir Lake



Source: www.maps.google.com/

Figure 2. The coastal view of cattle breeding enterprises around the Eğirdir Lake

It is a fact that the Lakes Region is in need of a proper manure management due to the animal manure problem that will arise in line with significant agricultural activity. A total of about 50000 cattle are bred in the 4950 cattle breeding enterprises located around the water resources coastal area. However, 43502 of these animals are bred for commercial reasons. According to studies that have been carried out, 10,000 cattle produce a total of about 300 tons manure daily [Anonymous, 1992; Bayindir et al., 2004]. When the daily manure amount is calculated by taking into account the values in Table 2, it is observed that this value is 5 times more (1500 tons·day⁻¹) [Bengtsson and Whitaker, 1986].

Table 2. Manure production by cattle

Weight of animal (kg)	Faeces (kg·day ⁻¹)	Urine (kg·day ⁻¹)	Total Manure (kg·day ⁻¹)
Dairy cattle			
50	2.7	1.2	3.9
100	5.2	2.3	7.5
250	14	6	20
400	23	10	33
600	35	15	50
Beef cattle			
350	15	6	21
450	19	8	27
550	24	10	34

Based on the satellite images of the study region, it is understood that some of the animal breeding enterprises are close to water resources and that the animal manure will have to be managed properly. Because if the animal manure that will be produced in these enterprises is randomly stockpiled in open air, it will cause environmental pollution, visual pollution and odour pollution thereby creating a potential contamination source for water resources. These estimations are based on the observation and survey studies carried out by Cayret al. [2012] in the study region. The studies carried out in our country about this issue indicate that manure especially from animal breeding enterprises is collected randomly and is stockpiled without taking the environment and water resources into any kind of consideration [Mutlu 1999; Erkan, 2005; Atilgan et al., 2006; Cayır, 2010]. The nutrients of the manure collected as such percolate into the underground waters or water resources and the most efficient part of farm manure cannot be used. Water resources and underground waters close to animal breeding facilities where manure is not properly stored face contamination due to rain water and seepage effect.

Unless the processing, storage and protection with regard to water resources of manure from animal breeding facilities is handed over to local producers or unless the required precautions are taken; animal manure will be a potential contamination factor. Nutrients in the manure can be lost and animal manure can become a potential contaminant. Kanber and Unlu [2008] state, that the provision and development of new water resources is very expensive and indeed impossible. Therefore, it is a fact that we should pass on the awareness of protecting our current resources to the people and future generations. It is especially indispensable that we pass this awareness onto our producers first. Because if we lose our current resources while continuing to produce, it will be both very expensive and very difficult to win these resources back. However, such faulty applications continue even today. Indeed, in a recent study carried out in this region on Burdur lake it was determined that animal manure was not managed and stored under proper conditions and that it was piled up with no precautions regarding water resources [Cayiret al., 2012]. This indicates that producers either do not have sufficient knowledge or education regarding this issue.

In order to reach these goals, various criteria have been determined regarding the management and storage of animal manure and its location with reference to water resources:

- the minimum distance of animal manure that is randomly piled up in the outside in case of a drainage for drinking water should be 75 m [Anonymous, 2002a],
- concrete and synthetic manure storage should be 50 m from all kinds of surface waters and water well [Anonymous, 2002b],
- at least 100 m from water resources such as lakes, rivers and streams for solid manure and at least 50 m for liquid or semi-solid manure storage areas, all manure storage structures must be a minimum of 15 m from all field drainage tiles or piped municipal drains [Ward and Johnson, 2009],
- minimum 100 m from irrigation and drainage channels,
- minimum 30 m for liquids manure from sanitation systems that provide water [Liang and Van Devander, 2010],
- animal manure kept in the open should be at least 30 m away from permanent flowing streams and 15 m from intermittent flowing streams [Fulhage, 2000],
- it is also stated that stockpiles manure or storages should be at least 150 m away from neighbouring enterprises for small companies whereas this value should be at least 402 m for large companies and especially those with capacities of 600 pieces of stock or 430 pieces of dairy cattle [Liang and Van Devander, 2010].

CONCLUSIONS

Animal manure which in our country is known as organic fertilizers should be stored, in other words it should be allowed to mature before being used. However, this is generally carried out in the open air and without taking any precautions. The objective of our study is to ensure the proper and planned management of our current resources while preserving them in line with the socio-economic development of societies. Part of the recent scientific studies carried out in the world and in our country on animal breeding is about the determination of the best method for manure management. When it is taken into account that under today's conditions environmental pollution has reached alarming states threatening the lives of humans along with the effect of manure as a contaminant on the protection of water resources; the increase for the need of such scientific studies can be better understood.

As a result, it will be expected that, when not managed properly, animal manure from cattle breeding enterprises will cause contamination of our water resources and will threaten our lives by leaching into our underground waters [Atilgan et al., 2012]. We believe that in order to solve these problems before they arise, a proper management system for the manure from animal breeding enterprises should be determined and our producers should definitely be informed about this issue.

REFERENCES

- Akuzum, T., Cakmak, B., Gokalp, Z. Dünyada Su ve Yaklaşan Su Krizi. 2. Ulusal Sulama Kongresi. Kuşadası, Aydın, 2003, pp. 145-154 (in Turkish).
- Anonymous, Agro-Chemicals News in Brief, Vol:15 October-December,1992, pp.4-8.
- Anonymous, Natural Resources Conservation Service Conversation Practice. Standard Waste Storage Facility. 2002a, Code 313.
- Anonymous, Factsheet Series on Environmental Guidelines for Livestock, Site Selection, Publication SLM045 September 2002b, pp. 8-13.
- Anonymous, Göller Bölgesi Nerededir (web document) URL:<http://cevaplar.mynet.com/soru-cevap/goller-bolgesi-nerededir/5203968,2013>,(in Turkish).
- Atilgan, A., Erkan, M., Saltuk B., Alagoz T., Akdeniz Bölgesindeki Hayvancılık İşletmelerinde Gübrenin Yarattığı Çevre Kirliliği, Ekoloji Dergisi, İzmir, (15) 58, 2006, pp. 1-7 (in Turkish).
- Atilgan, A., Oz, H., Karaca, C., Can, M.E. Hayvan Barınaklarında Oluşan Gübrenin İşletimive Depolanması İçin Mevcut Yasal Düzenlemeler. II. Ulusal Sulamave Tarımsal Yapılar Sempozyumu. 24-25 Mayıs 2012, İzmir, Cilt II, 2012, pp. 891-898 (in Turkish).
- BayindirS., Sahin, S., Uysal F. Türkiye' de Çiftlik Gübresi Kullanım Potansiyeli, 3. Ulusal Gübre Kongresi 11-13 Ekim 2004 Tokat, pp. 735-741 (in Turkish).
- Bengtsson, L. P., Whitaker, S. H. Farm Structures in Tropical Climates, A textbook for Structural Engineering and Design Animal Housing. Chapter 10, Rome, 1986, pp. 257-330.

- Cakmak, B., Akuzum, T., Ciftci, N., Zaimoglu, Z., Acar, B., Sahin, M., Gokalp, Z. Su Kaynaklarının Geliştirmeve Kullanımı. TMMOB Ziraat Mühendisleri Odası Türkiye Ziraat Mühendisliği VI. Teknik Kongresi 3-7 Ocak 2005a, Cilt:1, pp. 191-211 (in Turkish).
- Cakmak, B., Yurdem, H., Gokalp, Z., Erdogan, F.C., Demir, G.,Kumbaroglu, S.SulamaAraç, Yöntemve Organizasyonları. TMMOB Ziraat Mühendisleri Odası Türkiye Ziraat Mühendisliği VI. Teknik Kongresi 3-7 Ocak 2005b, Ankara, Cilt:2, pp. 911-934 (in Turkish).
- Cayir M.Büyükbaş Hayvan Barnaklarında Oluşan Atıkların Çevre Üzerine Etkileri, Süleyman Demirel Üniversitesi, Fen Bilimleri Enstitüsü, Tarımsal Yapılarve Sulama Anabilim Dalı Yüksek Lisans Tezi, Isparta, 2010, pp.89 (in Turkish).
- Cayir, M., Atilgan, A., Oz, H. Büyükbaş Hayvan Barnaklarında Oluşan Gübreve Su Kaynakları İle İlişkisi, SDÜ, Ziraat Fakültesi Dergisi 7(2), 2012 pp. 1-9 (in Turkish).
- Cayley J., Johson, J., Ward D. Nutrient Management Act-Siting Regulations for Manure Storage Structures. 2004, (webdocument), URL:<http://www.gov.on.ca/OMAFRA/english/engineer/facts/04-11.htm>.
- Demirkiran A.R. Kahramanmaraş Yöresindeki Bazı Organik Gübrelere Fizikselve Kimyasal Özellikleri. 3. Ulusal Gübre Kongresi 11-13 Ekim, 2004 Tokat, pp. 753-759 (in Turkish).
- Erensayin C. Tavukçuluk; Bilimsel-Teknik-Pratik. 72 DTFO Matbaası, Ankara, 1992, pp. 534 (in Turkish).
- Ergin, G., Eyicil, Z. Türkiye Tarımı 2000, (webdocument), 2008, URL:http://www.zmo.org.tr/odamiz/ana_hatlariyla_turkiye_tarimi.php
- Erkan, M. Mersin Yöresindeki Büyükbaş Hayvancılık Tesislerinin Mevcut Durumve Bu Tesislerde Ortaya Çıkan Atıkların Yarattığı Çevre Kirliliği Üzerinde Bir Araştırma, Çukurova Üniversitesi, Fen Bilimleri Enstitüsü, Tarımsal Yapılarve Sulama Anabilim Dalı, Yüksek Lisans Tezi No: 2605, Adana,2005, pp. 90 (in Turkish).
- Fulhage, D.C. Separation Distances for Livestock Manure Management Systems, Environmental Quality, MU Guide, Published by MU Extension, University of Missouri Columbia , 2000, pp. 1-2.
- Harris, B.L., Hoffman, D.W., Mazac, F.J. Reducing Contamination by Improving Livestock Manure Storage and Treatment Facilities. (webdocument), 2001, URL:<http://www.waterhome.brc.tamus.edu/texasyst/livestock.html>
- Jacobson, L.D., Moon, R.,Bicudo J. Generic Environmental Impact Statement on Animal Agriculture. A Summary of the Literature Related to Air Quality and Odor (H). Prepared for the Environmental Quality Board, 1999.
- Karaman, S. Hayvansal Üretimden Kaynaklanan Çevre Sorunlarıve Çözüm Olanakları, KSÜ. Fen veMühendislik Dergisi, 9(2), 2006, pp. 133-139 (in Turkish).
- Kanber, R., Unlu, M.Türkiye’ deSulamave Drenaj Sorunları: Genel Bakış, 5. Dünya Su Forumu Bölgesel Hazırlık Süreci, DSİ Yurtiçi Bölgesel Su Toplantıları Sulama-Drenaj Konferansı Bildiri Kitabı, 10 – 11 Nisan 2008, pp. 1-45 (in Turkish).
- Liang, Y., Van Devender, K. Managing a Livestock Operation to Minimize Odor. University of Arkansas, United States Department of Agriculture, and County Governments Cooperating. Cooperative Extension Service FSA 3007, 2010.
- Lunin, J. Advances in Environmental science and Technology. Agricultural Wastes and environmental Pollution. U.S. Department of Agricultural, Beltsville, Maryland Vol: 2,1971, pp. 215-257.
- Mutlu, A. Adana İli ve Çevresindeki Hayvancılık Tesislerinde Ortaya Çıkan Atıkların Yarattığı Çevre Kirliliği Üzerinde Bir Araştırma. Yüksek Lisans Tezi, Çukurova Üniversitesi, Fen Bilimleri Enstitüsü, Master tezi No:1646, Adana, 1999, pp.91 (in Turkish).
- Ozek, E. Tarımdan Kaynaklanan Çevre Kirlenmesive Simülasyon Çalışmaları. Ankara Üniv. Fen Bilimleri Enstitüsü, Zootečni ABD, Yüksek Lisans Tezi, Ankara, 1994, pp.79 (in Turkish).

- Sheffield, J. Farm Animal Manure is an Important Sustainable Renewable Energy Resource Director for Energy Technology Programs, Oak Ridge National Laboratory, PO Box 2008, Oak Ridge, TN 37831-6248. (web document),2012, URL:http://www.ornl.gov/~webworks/cpr/pres/107931_.pdf.
- Ward, D, Johson, J. Siting Regulations for Manure Storage Facilities, Replaces OMAFRA Factsheet 06-021,Order No. 09-061 Agdex 720/538 November, 2009.
- Weeks, S.A., Dairy Manure Handling for the 90's, Dairy systems for the 21st Century, Proceeding of the 3rd Inc. Dairy Housing Conference, Florida, USA, 1994, pp. 769-774.

Dr. Atilgan Atilgan, Hasan Oz
Agricultural Structures and Irrigation Department
Faculty of Agriculture
University of Suleyman Demirel
32260 Cunur-Isparta, Turkey
E-mail: atilganatilgan01@gmail.com

Dr. Ali Coskan,
Department of Soil Science and Plant Nutrition
Faculty of Agriculture
University of Suleyman Demirel
32260 Cunur-Isparta, Turkey

