Soil Water Journal
topraksu dergisi

Water Quality and Two-Way Effects in Terms of Animal Production

Mesut Yıldırır*

*Soil, Fertilizer and Water Resources Central Research Institute, Ankara

*Sorumlu yazar e-mail (Corresponding author e-mail): mesutyildirir@hotmail.com

Geliş tarihi (Received) : 04.08.2020
Kabul tarihi (Accepted): 01.09.2020
DOI: 10.21657/ topraksu.780468

Abstract

The use of safe, quality water sources as drinking water in livestock production is essential. Effects of livestock production on water sources by potential runoff and contamination is an environmental concern. A total of 628 water quality analyzes, carried out in Ankara province during three years (2017-2019), were evaluated in terms of animal production. In addition, the potential effects of animal production and manure management practices on water resources were evaluated. Water physico-chemical properties of; total dissolved solids (TDS), pH, calcium, sodium, magnesium, sulfate and boron were evaluated. Based on the results obtained in the water analyze reports, the possible effects of water quality properties on animal production were discussed. In terms of salinity, the mean concentration of TDS was 1003,07±75,54 mg/l. TDS values above 3.000 mg/l were observed in 36 samples (5,7%) in total above the upper limit recommended for various livestock species.

According to livestock requirements water samples of; 4,9% above upper limit of 1.000 mg/l for sulfate; 1,0% was above 9,0 pH, and 7,5% exceed upper limit for boron. It was found that TDS hazards are low, hence the water of the study area is suitable for livestock usage. Excessive boron levels might restrict the usage of the study area for livestock. Ankara province represent around the mean value of livestock unit (LU) in Turkey as 0,25 LU/ha and 560.838 LU in a total of 16,02 million LU in Turkey. Livestock density ranged from 0,08 LU/ha to 0,75 LU/ha between districts. Especially in the high density areas, manure depots should be monitored, planned, necessary precautions should be taken in a way to minimize the effects on water resources and to prevent water contamination.

Keywords: Animal density, livestock unit, water quality, water pollution

Hayvansal Üretim Açısından Su Kalitesi ve İki Yönlü Etkileri

Öz

Hayvansal üretim için güvenilir ve iyi kalitede içme suyu kullanımı temel gereksinimdir. Hayvansal üretimin çevresel etkileri açısından yüzey akışı ve su kaynaklarını kirletmesi önemlidir. Ankara ilinde üç yıl sürede gerçekleştirilen (2017-2019) toplam 628 adet su analizi hayvansal üretim açısından değerlendirilmiştir. Ayrıca bölgede hayvansal üretim ve gübre yönetimi su kaynaklarına potansiyel etkileri bakımından değerlendirilmiştir. Fiziko-kimyasal özellikleri bakımından sularda; toplam çözünmüş katı madde (TDS), pH, kalsiyum, sodyum, magnezyum, sülfat ve bor değerleri incelenmiştir. Genel TDS ortalaması 1003,07±75,54 mg/l bulunmuştur. TDS değerlerinde riskli olarak bildirilen 3.000 mg/l üzerinde 36 örnek (5.7%) belirlenmiştir. Hayvancılık açısından riskli olacak oranlar; sülfat için %4,9 (>1.000 mg/l); pH için %1,0 (>9,0) ve bor için %7,5 olarak belirlenmiştir. TDS risk grubu açısından oranlar düşük bulunmuştur.

Dr. Mesut Yıldırır: 0000-0003-3710-2038

Bor oranlarında üst limiti geçen değerler ise yüksektir. Ankara ili için ortalama hayvancılık birimi (LU) Türkiye ortalamasına yakın 0,25 LU/ha ve toplamda Türkiye'nin toplam 16,02 milyon LU birimi içerisinde 560.838 LU olarak belirlenmiştir. Hayvancılık yoğunluğu ilçeler arasında 0,08 LU/ha ile 0,75 LU/ha arasında değişiklik göstermiştir. Özellikle yüksek yoğunluklu alanlarda gübre depoları gözlenmeli, planlama yapılmalı ve su kaynakları üzerinde etkilerinin azaltılması için mecburi önlemler alınmalıdır.

Anahtar kelimeler: Hayvansal yoğunluk, hayvancılık birimi, su kalitesi, su kirliliği

INTRODUCTION

Water quality is important for avoiding production losses in livestock production because excessive contents may potentially harmfull effects on livestock. Features of water quality in terms of the effects of water resources used in animal production to animal husbandry; organoleptic, physical-chemical, excess substances, toxic content, and microorganisms (main bacteria) are grouped under five headings (Beede, 1993; Waldner and Looper, 2020). Possible water quality issues may include high concentrations of minerals or salt, high nitrogen, contamination with fertilizers or other chemicals, bacterial contamination, or algae growth (Parish, 2020). The amount of water lost from the body of cattle is influenced by the activity of animal, air temperature, humidity, respiratory rate, water intake, feed consumption, milk production and other factors (Waldner and Looper, 2020).

The daily water requirements and intake by livestock varies considerably according to class of stock, production status, age and condition of the animal, dry matter intake, quality and nature of the feed, climatic conditions, and the quality of the water. The water requirements of ruminant livestock are provided essentially from three sources of drinking water, water present in feed, and metabolic water, which is formed by the oxidation of nutrients and body tissues (Olkowski, 2009). Water is necessary for maintaining body fluids and proper ion balance; for digesting, absorbing, and metabolizing nutrients; for eliminating waste material and excess heat from the body; for providing a fluid environment for the fetus; and for transporting nutrients to and from body tissues (Waldner and Looper, 2020). Water intake may vary drastically with the source of feed moisture and environmental temperature therefore this factors must be carefully considered and included in the overall evaluation of potential impact of water quality (Olkowski, 2009).

Livestock unit (LU) denotes the feed requirement of a standard animal of a certain live weight. Then various animals' species converted to LU according to production characteristics (FAO, 2011; Dida, 2017; Eurostat, 2020). The livestock density index is an indicator for the pressure of livestock farming on the environment in certain area (Eurostat 2020). The mean livestock density (in the Netherlands, Belgium, Denmark, and Ireland) is between 1,5 and 4,0 LU/ha, and the average amounts of N in animal manure range from 100 to 300 kg/ha of agricultural land (Oenema, 2005). Practices including manure or slurry applications at times when their beneficial effects cannot be fully realized also have detrimental implications for the wider environment, including water quality (Hooda et al., 2000). Environmental pollution arising from livestock activities has increased mainly as a result of the intensification. Intensification is occurring in many countries, particularly in the vicinity of urban conurbations (FAO, 2011). Changing livestock production systems towards greater specialization together with high livestock limited area can have adverse effects on the environment. The livestock wastes contain valuable quantities of N, P, K and other micronutrients. Livestock, through manure production, contributes to greenhouse gas emissions and nutrient leaching into water and air. Surface runoff and or through leaching causes farm effluents (e.g. silage, slurry), and principally N and P accumulation. However, in livestock farming areas, excessive loss of nutrients are the principal causes of degradation in surface and ground water quality (Hooda et al., 2000). Trends should be assessed and the likely impacts on land degradation, atmospheric and other pollution, nutrient recycling, water supplies and biodiversity (FAO, 2011). Therefore, water analyse results on the water supply quality for livestock production, and livestock population intensitiy and the potential effects of animal production on water resources in Ankara were disscussed.

MATERIAL AND METHOD

Ankara province and its 25 districts were chosen as the research area (Figure 1). Animal population of cattle, water buffalo, sheep, goat and poultry species were assumed main animal production unit and included in the model.

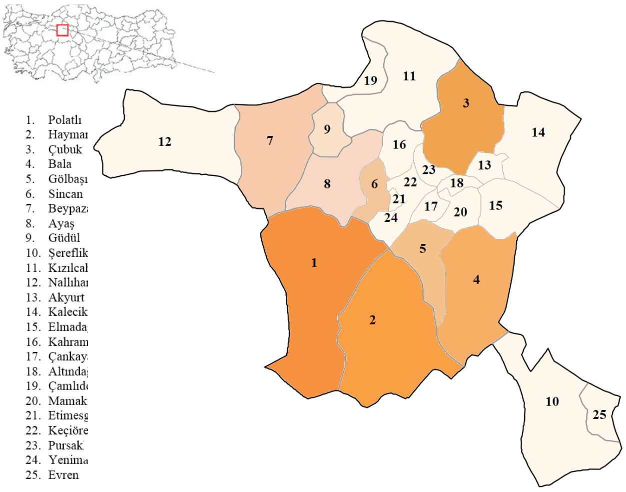

Figure 1. Research area and the density of the 'Livestock Unit' according to district land area

Şekil 1. *Araştırma alanı ve hayvan populasyonunun ilçe alanına göre yoğunluğu*

Density of Livestock Unit

To determine water quality concerns from livestock population intensity and the potential effects of animal production on water resources in the district area (Anonymous, 2020a) and livestock population data (TUIK, 2020) were collected from official records. Livestock numbers are converted into livestock units using specific coefficients. A livestock unit (LU) is a reference unit which facilitates the aggregation of livestock from various species (FAO, 2011; Eurostat 2020). LU was taken for cattle, water buffalo, sheep, goat and chicken as 0,6; 0,7; 0,1; 0,1 and 0,01 respectively.

Water Samples and Analyses

Water samples that collected by mostly agricultural producer around mainly district of the Ankara. A small amount of the samples came from provinces near Ankara. Vast majority of the samples has been from well water. Total of 628 water quality analyzes in the laboratories of the Soil, Fertilizer and Water Resources Central Research Institute (SFWCRI) were evaluated around Ankara province carried out from 2017 to 2019. All analyses performed for physicochemical parameters according to procedures outlined in the standard methods by; EC, pH; potentiometric, Sodium, Potassium; flame photometric, Calcium, Magnesium; titrimetric, Boron; spectrophotometric.

Statistical Analyses

The data were analyzed using Statistical Package for Social Sciences (SPSS, version 17.0) computer software. It involved descriptive statistics such as mean, percentile and standard error for the different variables. Statistical significance was accepted at $p < 0.05$ level.

RESULTS AND DISCUSSION

Water quality characteristics for livestock consumption

The mean concentration of TDS was 1003,07±75,54 mg/l. According to the analysis results, the water quality of 592 (94,3%) samples was found to be at a level that would not cause a problem in terms of TDS for livestock consumption (Table 1). But, TDS values above 3.000 mg/l were observed in 36 samples (5.7%) in total. This ratio is above the upper limit recommended for various animal species, age and physiological period. The ideal TDS value in farm animals is 0-1.000 mg/l and it is considered as bad quality over 3.000 mg/l (Beede, 1993; Parish, 2020). The tolerance of animals to salt can vary according to species, age, water requirement, season and physiological status (Bagley et al., 1997). Water containing more than 7.000 mg of soluble salts per liter can be tolerated by cattle and sheep under low stress conditions but between 5.000 to 7.000 mg/l may

Table 1. Total Dissolved Solid (TDS) values of water samples around Ankara

Çizelge 1. *Ankara ili çevresinde su örnekleride toplam çözünmüş katı madde oranları*

EC categories	Sample number	Percentage, %
<1000	501	79,8
1.000-2.999	91	14,5
3.000-4.999	18	2,9
5.000-6.999	7	1,1
7.000-10.000	4	0,6
>10.000	7	1,1
Total	628	100

present a health risk for pregnant, lactating, or stressed animals (Carson, 2000). Water containing high levels, 4.000 mg/l or more, of TDS such as salt can lower beef cattle feed intake and daily gains (Parish, 2020).

Little is known about the specific pH's effect on water intake, animal health and production, or the microbial environment in the rumen (Olkowski, 2009). The preferred pH of drinking water for dairy animals is 6,0 to 9,0 (Beede, 2006). If the pH drops below 5,1, it can cause problems with acidosis (Adams and Sharpe, 1995). In the analysis, total of 83 sample (13,2%) among 8,0-9,0 pH values and 6 samples (1,0%) were above 9,0 pH alkali class, which can be considered as risky (Table 2). Total of 539 sample (85,9%) were found in the preferred pH range for dairy animals (6,0-8,0 pH). Excessively alkaline water can cause digestive upset in cattle and increase the laxative effect of high sulfate consumption (Parish, 2020).

Table 2. pH value rates of water samples around Ankara
Çizelge 2. *Ankara ili çevresinde su örneklerinde pH değer oranları*

pH categories	Samples number	Percentage, %
6,0-7,0	64	10,2
7,0-8,0	475	75,6
8,0-9,0	83	13,2
>9,0	6	1,0
Total	628	100

Calcium is an essential element for livestock nutrition. The overall mean calcium values was 66,48±3,08 mg/l, which was lower than limit for livestock (Table 3). Livestock should tolerate concentrations of calcium in water up to 1000 mg/L, if calcium is the dominant cation and dietary phosphorus levels are adequate (ANZECC, 2000). Minerals in drinking water can contribute to the mineral needs of the animal (Göncü-Karakök et al., 2008), as well as high calcium content may also increase the incidence of milk fever in dairy cattle (Anonymous, 2014). Higher amount of calcium in water should be considered as a part of the total mineral intake. Many mineral salts are relatively insoluble and pass through the body without being absorbed (Lardy et al., 2008). Extremely high concentrations of calcium or magnesium above 500 mg/l should be included in ration formulation (TUIK, 2020). Maximum acceptable calcium level is 500 mg/l for poultry (Fairchild and Ritz, 2020). Under the majority of practical situations, livestock should tolerate concentrations of calcium in water up to 1000 mg/L, if calcium is the dominant cation and dietary phosphorus levels are adequate (Olkowski, 2009).

The overall mean magnesium values was 126,75±40,76 mg/l, which was lower than limit of 250 to 500 mg/l for livestock. Fairchild and Ritz, (2020) reported average magnesium level 14 mg/l and maximum acceptable level 125 mg/l for poultry. Magnesium is an essential element for livestock diet. In high doses magnesium can cause scouring and diarrhea, lethargy, lameness, decreased feed intake and decreased performance (ANZECC, 2000). Drinking water containing magnesium at concentrations up to 2000 mg/l has been found to have no adverse effects on cattle (ANZECC, 2000). Manganese is often considered along with iron when addressing water quality (Beede, 2008). However, they are rarely present in concentrations considered toxic to beef cattle (Wright, 2007). Specific information of the effects of manganese on dairy cattle is limited (Beede, 2008).

Most animals can tolerate relatively large amounts of sodium, and responses are variable (Olkowski, 2009). The maximum allowable concentration of sodium for livestock is 250 mg/l for poultry (Fairchild and Ritz, 2020). Excessive level of Sodium (Na) have a diuretic effect (German et al., 2008). The mean concentration of sodium was 188,83± 21,01 mg/l, and 28 (4,45%) samples was higher then 1.000 mg/l of upper limit for

Table 3. Some mineral element values and rates of the water samples around Ankara province
Çizelge 3. *Ankara ili çevresinde su örneklerinde bazı mineral element değerleri ve oranları*

Element	Normal limit		Excessive limit	
	value, mg/l	Sample, number (%)	value, mg/l	Sample, number (%)
Calcium	2,40 – 760	627/629 (99,7)	> 1.000	2/ 629 (0,3)
Magnesium	1,22 – 258	607/629 (96,5)	> 300	22/629 (3,5)
Sodium	1,61 – 782	601/629 (95,5)	> 1.000	28/629 (4,5)
Sulphate	0,961 – 1.000	589/629 (95,1)	> 1.000	31/629 (4,9)
Boron	0,00 – 1,55	582/629 (92,5)	> 5,0	47/629 (7,5)

livestock (Table 3). At concentrations above 200 mg/L, sodium may reduce water palatability, which may result in lowered water intake, water containing 6726 - 6826 mg Na/l resulted in a loss of condition, scouring and death in 15/220 cattle (Olkowski, 2009). Cattle ingesting water containing 975 mg Na/l for 28 days showed increased water intake, decreased milk production and diarrhea (Olkowski, 2009).

The mean concentration of sulfate was 265,05±46,21 mg/l, and total 31 samples (4,9%) were above upper limit of 1.000 mg/l (Table 3). Adverse effects may occur at sulfate concentrations between 1000 and 2000 mg/l, especially in young or lactating animals or in dry, hot weather when water intake is high (ANZECC, 2000). Levels of sulfate greater than 2000 mg/l may cause chronic or acute health problems in stock (ANZECC, 2000). Maximum acceptable sulfate level is 250 mg/l for poultry (Fairchild and Ritz, 2020). Over periods of greater than one week, high-sulfate water results in reduced feed consumption, lowered weight gains, scours, and suboptimal production (Parish, 2020). Water intake starts to fall at sulfate concentrations of 2.500 to 3.000 mg/l of sulfate and continues to drop as sulfate concentrations increase beyond these levels (Parish, 2020). High sulphate waters can cause health problems (especially polioencephalomalacia; sPEM) in growth and yield (Cammack et al., 2012).

Recommendations for levels of Boron in drinking water for livestock maximum 5 mg/l (ANZECC, 2000). Here, mean concentration of Boron was was 2,12±0,31 mg/l, 582 samples (92,5%) lower maximum level (5 mg/l), and 47 samples (7,5%) exceed upper limit. Sangodoyin and Ogedengbe (1991) were reported about 45% of the samples tested had boron levels exceeding the stipulated limit of 5 mg/1 for livestock usage.

Since some other important factors of water quality in animal production are not included in the current analysis, this view is not discussed in this paper. A main shortcoming in establishing water quality factor for livestock is the lack of toxicological data (Valente-Campos, 2019). Therefore, the main objective of this work was to reduce the number and the type of studies required, but without compromising the guideline quality Lead, arsenic, cyanide, and mercury are all examples of toxic compounds found in water (Beede, 2008). Bacteria, viruses, and parasites are regularly found in ponds and other surface water supplies that collect runoff from a manure source or that allow direct cattle access (Parish, 2020). Some situation coliform bacteria level as high as (75-600 kob/100 ml) harmful level (Kocaman et al., 2015). Maximum acceptable Total Bacteria and Coliform Bacteria level is 100 CFU/100ml and 50 CFU/100ml respectively for poultry (Fairchild and Ritz, 2020). While most microorganisms in cattle water supplies are quite harmless, there are some organisms that can contribute to reduced cattle health and performance (Parish, 2020). The coliform group of bacteria has traditionally been the indicator used to assess the degree of water pollution (Carson, 2000). For example, the amount of faecal residue in the water exceeding the level of 0,25% significantly reduces the amount of water consumed by cattle (Braul ve Kirychuk, 2001). Compared with swine and other monogastric animals, ruminants are generally more susceptible to nitrate toxicosis because the bacteria in the rumen readily reduce the nitrate to nitrite (Carson, 2000). Nitrate and nitrite are oxidized forms of nitrogen. These compounds occur naturally in waters, although nitrate generally predominates. Nitrate is usually present in unpolluted streams at very low, usually less then 1 mg/L, levels. The recommended levels of nitrates and nitrites in water for livestock, according to present Canadian guidelines for livestock drinking water, are 100 mg/L nitrate (Olkowski, 2009).

Water quality issues related to animal production

A total of 16,02 million LU was found in Turkey, according to official statistics (TUIK, 2020); about cattle, poultry, sheep, goat and water buffalo constitute of 52,7%, 20,8%, 19,3%, 6,5% and 0,6 % respectively. Sakarya has the highest total LU (0,68 LU/ha) per hectare followed İzmir (0,53 LU/ha) while Ankara represent around the mean value of Turkey (0,25 LU/ha). Livestock density ranged from 0,07 LU/ha in to 0,74 LU/ha (Table 4). A total of 131 million LU in the EU-28; about one half (49,0 %) were cattle, one quarter (25,2 %) were pigs and close to one sixth (15,8 %) were poultry (Eurostat, 2020). France has the highest number of total livestock units (22,1 million LU), followed by Germany (18,2 million LSU), Spain (14,4 million LSU) and the United Kingdom (13,3 million LSU) (Eurostat, 2020). Average livestock density in the EU reached 0,8 livestock units per hectare of agricultural area, ranging from 0,2 in Bulgaria to 3,8 in the Netherlands (Eurostat, 2020).

Table 4. Livestock Unit (LU) according to livestock population and density as per hectare of districts in Ankara
Çizelge 4. *Ankara ilçelerinde hayvan sayıları ve ilçe alanına göre hayvan birimi (LU) yoğunluğu*

District	cattle	water buffalo	sheep	goat	poultry	LU*	ha	LU/ha
Polatlı	61.255	0	179.680	13.225	2.567.670	81.720	361.800	0,23
Çubuk	55.492	569	29.865	4.830	2.200.000	59.163	119.800	0,49
Haymana	31.500	4	179.530	5.755	241.000	39.841	216.400	0,18
Beypazarı	13.866	0	89.495	46.404	1.746.000	39.370	169.700	0,23
Ayaş	20.227	2	68.128	16.995	1.393.882	34.589	104.100	0,33
Bala	27.182	103	131.908	8.783	382.449	34.275	185.100	0,19
Gölbaşı	27.678	172	119.370	5.950	377.340	33.033	136.400	0,24
Kalecik	21.207	214	17.184	4.312	1.635.786	31.381	54.700	0,57
Sincan	28.254	53	78.146	3.242	182.700	26.955	88.000	0,31
Kahramankazan	16.849	117	25.605	3.117	1.147.688	24.540	111.000	0,22
Güdül	11.922	0	45.575	64.021	474.456	22.857	54.000	0,42
Nallıhan	9.333	18	51.108	35.904	583.787	20.151	207.900	0,10
Akyurt	27.729	27	8.639	1.047	5.383	17.679	36.900	0,48
Kızılcahamam	20.279	491	21.288	12.864	121.500	17.141	162.300	0,11
Şereflikoçhisar	14.551	159	61.260	10.625	5.600	16.086	215.500	0,07
Elmadağ	15.946	24	33.886	6.785	240.000	16.052	64.700	0,25
Çankaya	8.627	0	44.277	3.546	1.600	9.975	48.300	0,21
Altındağ	14.750	15	2.640	254	950	9.159	12.300	0,74
Mamak	10.947	61	9.271	1.131	6.250	7.714	32.100	0,24
Çamlıdere	11.065	37	8.550	1.570	2.000	7.697	78.200	0,10
Keçiören	3.481	5	4.202	1.752	2.041	2.708	15.900	0,17
Etimesgut	2.206	19	11.610	957	2.150	2.615	27.300	0,10
Pursaklar	3.590	10	3.438	222	2.800	2.555	16.900	0,15
Evren	2.181	7	4.400	302	1.519	1.799	22.200	0,08
Yenimahalle	2.133	51	4.061	500	1.101	1.783	21.900	0,08
Total/average	462.250	2.158	1.233.116	254.093	13.325.652	560.838	2.563.400	0,25

*; LU: Livestock Unit; cattle = 0,6/water buffalo = 0,7/sheep = 0,1/goat=0,1/and poultry= 0,01. **Livestock species (cattle, water buffalo, sheep, goat and poultry population heads.

A higher livestock density means that a higher amount of manure is available per ha of utilized agricultural area, which increases the risk of nutrient leaching (Eurostat 2020). The environmental impact of livestock production is not only depending on the amount of livestock, but also depends on farming practices. An increase in the livestock index, therefore does not necessarily needs to lead to environmental degradation (Eurostat 2020). But, an increase in the intensity of land use implies that use of other resource inputs and levels of product output per hectare have increased (FAO, 2011). The intensified farming practices where large numbers of animals are reared on relatively small areas, with the waste production (e.g. farmyard manure, slurry, dirty water, silage effluents and poultry litter) from these farms being large, and its disposal locally being aggravated by the limited land area available (Hooda et al., 2000). In some cases, it was evaluated that almost none of the cattle farms had manure pits and harmed the environment (Çayır et al., 2012). Quantities of farmyard manure and slurry may excess of crop requirements and untimely apply to soils. Practices including manure slurry applications at times when their beneficial effects cannot be fully realised also have detrimental implications for the wider environment, including water quality (Hooda et al., 2000). Regarding livestock production problems relating to nutrient loss are either short-term direct losses or long-term, related to accumulated nutrient surpluses Hooda et al. (2000). Agricultural activities are main contributors to nitrogen pollution in the environment. Runoff from agricultural farms is a major source of N entering rivers, lakes and coastal waters (Carpenter et al., 1998). For agricultural production, livestock manures and chemical fertilizers are essential. Nitrates from manure or fertilizers can mix with water supplies and generate water quality problems for livestock. Water supplies from shallow wells in agricultural areas and surface water sources prone to fertilizer runoff are more likely to contain problematic nitrate levels than other water supplies (Parish, 2020). Water contamination with nitrates becomes an even more serious concern when feed or forage supplies contain high levels of nitrates and when water levels in surface ponds recede during drought and concentrate nitrate levels (Parish, 2020).

As a result of the accumulation of animal wastes on the soil in cattle breeding enterprises, groundwater and soil cause increased nitrate and ammonium density, and uncontrolled cattle breeding enterprises may cause harm to the environment in the near future (Can and Alagöz, 2014). Much livestock holdings are closer to the settlements than the acceptable distance (Kocaman et al., 2015), animal manures uses in agricultural lands without taking necessary measures for the maturation (Öztürk and Ünal, 2011). Manure storage and weather considerations often determining the timing and rates of application, rather than agronomic interests (Hooda et al., 2000). If the area where the animals are located is easily permeable, underground waters are affected if the animal litter or the floor is made close to the surface (Harris et al., 1996). Manure storages should be at least 30 m away from wells and similar places in the business and its surroundings, and at least 15 m from milking units (Karaman, 2006). Chicken manure (a valuable fertilizer in plant nutrition) contains nitrogen and phosphorus and caused groundwater and groundwater pollution (Demirulus and Aydın, 1996). Wastes generated in livestock enterprises can pollute the water resources and precautions should be taken. The capacity of manure storage facilities should be such as to prevent water contamination by direct discharge or surface runoff and soil interference. If a limit of 250 kg total N/year/ha is recommended from livestock manures, 4 LU can produce this value (Smith and Frost, 2000). EU rule, the amount of N applied via livestock manure shall not exceed 170 kg ha^{-1} yr^{-1} (Oenema, 2005). Reasonable farming practices and manure utilization can help to reduce the environmental pollution problems arising from livestock production. The methods of using manures requires rationalization in order to complement the benefits derived from fertilizers. For livestock keepers the process is reflected in increased stocking rates, a switch to more intensive types of livestock and/ or increased variable input use per animal (FAO, 2011). Possible indicators: Increase in livestock numbers, increase in production per head, increase in carcase weights, switch from ruminants to intensive poultry production (FAO, 2011).

CONCLUSION

Water quality, although do not directly cause health problems, they are in the infrastructure of different problems. Recommended water sample analysis should include tests for total coliform bacteria, pH, total dissolved solids, total soluble salt, salinity, nitrates, sulfate, and other factors as appropriate such as toxicity problems with specific minerals, pesticides, or blue-green algae growth (Parish, 2020). Analyses show that limited water samples have excessive TDS, sulfate, sodium, magnesium and boron for the animal needs. Therefore, make sure drinking water supplies are safe for livestock consumption. The geographic concentration of livestock operations can overwhelm the ability of a watershed to assimilate the nutrients contained in the waste and maintain water quality.

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