MANAGEMENT OF MANURE FROM LIVESTOCK HOUSING IN TIGRIS BASIN AND ITS ENVIRONMENTAL POTENTIAL IMPACT

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Abstract. The study was carried out in the Tigris basin and covered four cities (Diyarbakır, Mardin, Batman, Siirt and Sirnak). The potential pollution impacts of the cattle breeding enterprises in the research area on the Batman, Botan, Garzan and Tigris Rivers were examined. In this context, the borders of the research provinces and current water resources were drawn with ARCMAP 10.0 software by making geographical adjustments. In order to enable each province's questioning to be done independently from other provinces and water resources, all borders were divided into separate layers on the basis of provinces, districts, and villages. Furthermore, in accordance with the purpose of this study in the database the number of cattle at the cattle breeding enterprises close to water resources (minimum 150 meters-maximum 5 kilometers) was entered into the Geographical Information System (CIS) database and interpreted taking into account the average waste to be created by the cattle. In this study, the potential risk areas to be created for the environment and water resources were tried to be determined when the manure generated in the cattle breeding enterprises operating in the research area is not stored and utilized appropriately. It was found that the water resources, particularly in the villages of Batman and Diyarbakır provinces, faced a higher risk of contamination. A high level of contamination risk was determined in the section of the Tigris River passing through Ergani, Hani, and Bismil districts of Diyarbakır Province and in the upper section of the Botan River passing through Kozluk district of Batman Province and its villages. Furthermore, attention was drawn to the issue of environmental pollution caused by animal manure, and the measures to be taken not to experience these and similar situations were mentioned.

Keywords: cattle, livestock, manure, Tigris basin.

Introduction

Although nowadays animal foods obtained from animal husbandry enterprises are useful for the human, the manure and waste generated in these enterprises are harmful to the health, environment, and water resources if they are not stored properly. A random release of the waste into the environment, which is seen as an important economic benefit for enterprises, creates a potential risk of pollution, particularly for water resources. It is undoubted that the pollution problem caused by manure is important. How to make use of the manure and eliminate it in animal husbandry enterprises is an important issue. Therefore, manure management is an important part of animal husbandry enterprises. This situation showed that collection, transportation, storage and usage of the manure should be considered together with health protection and pollution control programs [1].

The Turkey's number of cattle is approximately 15 million [2]. In our country, the number of cattle is increasing with each passing day, and this causes an increase in the amount of cattle waste every day. Especially in the areas where cattle breeding is performed, these wastes create important problems and pose a threat to the people living in that region. Therefore, removal of cattle waste from the environment is gaining importance every day, and solutions to this problem are being investigated [3].

When compared in terms of the nature of pollution they reveal that pollution generated by animal husbandry enterprises is different from industrial and urban pollution. Pollution generated by animal husbandry enterprises is not a point source of pollution; it spreads to wider areas and makes it difficult to know the extent of water pollution caused by these sources. Indeed, the products such as manure and other animal waste, which are described as diffuse sources of pollution, get mixed with surface waters or underground waters and degrade the quality of water resources and make them unusable [4]

The uncontrolled transformation of agricultural areas into residential and commercial activity areas leads to the contamination of natural resources such as water resources, soil, and air, in particular and, as a result, non-reversible environmental problems. Turkey, like other candidate countries, in parallel with the European Union harmonization process, continues its studies on water pollution caused by agricultural activities by giving even more importance to them in recent years [5].

This study was carried out in 5 provinces (Diyarbakir, Mardin, Batman, Siirt and Sirnak) in the Tigris Basin in the Southeastern Anatolia Region of Turkey, where intensive agricultural and animal

husbandry activities take place. In this context, the potential pollution impact of cattle breeding enterprises operating close to water resources (Batman, Botan, Garzan and Tigris) in the basin was tried to be determined using Geographical Information Systems. It is believed that the results of this study will help to improve the manure assessment practices of the enterprises in the study area and to realize the potential pollution of water resources.

Materials and methods

This study was carried out in the Southeastern Anatolia Region of Turkey and covered Diyarbakır, Mardin, Batman, Siirt and Sirnak provinces and the Batman, Botan, Garzan and Tigris rivers in the Tigris basin. The information in literature and the present number of the cattle for the year 2015 in 5 provinces and their districts which was obtained from the Veterinary Information System (VETBIS) of the Republic of Turkey Ministry of Food, Agriculture and Livestock were used in order to determine the environmental criteria in the Tigris Basin, which was the subject of this research.

The Tigris River, which passes through the borders of 5 provinces in the study area and the most important tributaries of which are the Garzan, Botan, Habur, Upper Zab and Lower Zab, rises in Turkey, has many tributaries, passes to the Iraqi territory, combines with the Euphrates in Iraq and flows into the Persian Gulf at the Shatt al-Arab. The river takes its main sources from the Eastern Anatolian Mountains and from Lake Hazar (Golcuk) in the surroundings of Elazig through leaking from the bottom. The main materials of this study are the villages, which are at a distance of minimum 150 meters and maximum 5 kilometers to the water resources and the number of cattle in the enterprises operating in these villages. Based on this, the presence of a total of 56768 cattle in 444 villages was considered as a potential pollutant factor. 444 villages were distributed among the provinces as follows: 12 villages in Sirnak province, 58 villages in Siirt province, 68 villages in Mardin province, 239 villages in Diyarbakır province, and 67 villages in Batman province.

The places, which were the subject of this study, were digitized as polygons in the GIS environment primarily based on the provincial borders and then district borders. ArcMAP 10.0 software was used for this purpose. The topographic base map within the said software was used. Since the software works on a layer basis, each characteristic obtained was evaluated as one layer. First of all, the boundaries of the study area were digitized by making geographic adjustments. In order to enable each province's questioning to be done independently from other provinces, all borders were divided on the basis of provinces as a separate layer. Similarly, the districts of each province were divided in the form of district boundaries as a separate layer. The current base materials were evaluated, and the water resources of the area were identified and then digitized as a separate layer. The attribute data were created by entering the number of cattle obtained from the VETBIS system into all these layers prepared. Erdas Imagine 9.3 and ArcMAP 10.0 software were used in this study. The present number of cattle for the year 2015 that was obtained from the VETBIS system was evaluated as 5 layers (1-9 cattle (●), 10-22 cattle (●), 23-41 cattle (●), 42-82 cattle (●) and 83-maximum cattle (●)), colored with different colors and shown on the maps drawn on the basin.

Results and discussion

It was observed that the waste and manure particularly generated by the cattle breeding enterprises close to the water resources directly flowed into the streams with surface water due to the rugged and sloping topography of the Southeastern Region. When the provinces in the basin were compared, it was found that cattle breeding was intensively performed particularly in the villages that were close to water resources in Diyarbakır and Batman provinces, whereas fewer cattle breeding activities were carried out in the villages that were close to water resources in Sirnak and Siirt provinces. When the reason for this was investigated, it was found that both the number of villages and the number of the cattle in these villages were less due to the topography and climatic conditions in the region.

Agricultural and animal husbandry activities were observed to be carried out around the Batman, Botan, Garzan and Tigris rivers. In the research area, it was observed that the operating enterprises concentrated around the streams and those enterprises stored the manure directly on the top of the exposed soil without taking any measures. Animal waste can pollute surface and underground water resources as a result of the uncontrolled waste management. This is caused by the animals' easy

accession to a water resource and the surface waters passing through manure piles, animal shelters and open feeding areas, leakages from the manure storage buildings, inundation of the storage areas, surface waters passing through the areas to which manure is applied and surface waters passing through pastures [6].

When the provinces in the basin in question were compared, it was observed that Diyarbakır province had an important place within the research area in terms of territory and the presence of animals. Cattle breeding in Diyarbakır province and its villages and particularly in the villages close to the water resources was observed to be an important activity. It was observed that the enterprises in the region did not have an objective of storing their manure and waste, they did not give importance to the storage buildings, and they were not sensitive to the environment. Especially the enterprises which are close to the Tigris River but away from the center keep the manure obtained by spreading it on the surrounding ground. Manure and waste piles created in these areas are spread to the surrounding areas by rainfalls and cause bad smell and disease agents directly or indirectly, particularly in summer months. In the study carried out by Erkan and Vural [7] in order to determine the hygienic quality of the water resource in the part of the Tigris River passing through Diyarbakır province, it was found that the contamination of the used water directly or indirectly poses a risk to public health. Therefore, it was emphasized that the environment should be treated more carefully in the studies carried out on public health in the region, and particularly the water resources must be protected from this and similar polluting environments.

The number of cattle raised in 239 villages that might have a direct impact on the water resources in Diyarbakir region was determined to be 38784. According to Bengtsson and Whitaker [8], 38784 ton/month of animal manure will be generated in these villages. Therefore, the water resources in this province are expected to be exposed to higher levels of pollution than in other provinces (Fig. 1).

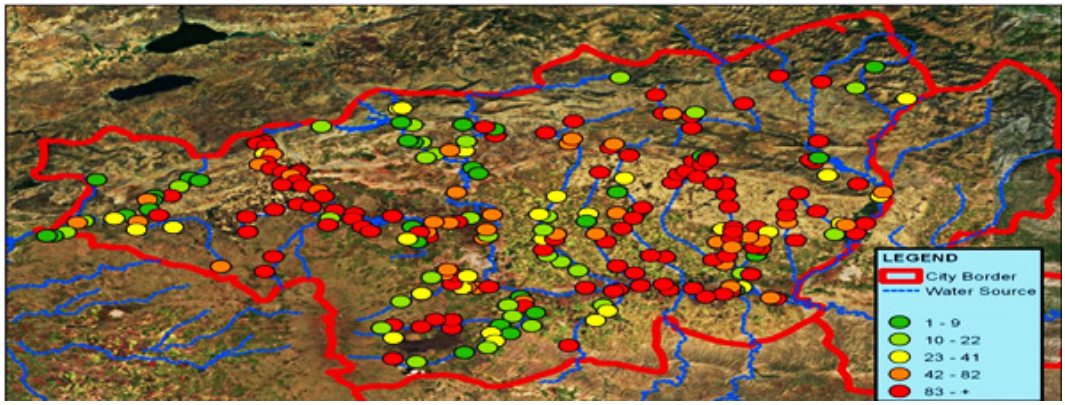

Fig. 1. **Number of cattle in Diyarbakır province**

239 of 902 villages in Diyarbakir province in which the presence of animals was detected were determined to be close to water resources and included in the evaluation. 59 % of the enterprises located in these villages close to water resources were determined to have more than 42 animals. Considering the closeness to water resources and the number of animals, 37 villages of Bismil district, 28 villages of Ergani district and 27 villages of Cinar district are determined as the places where the enterprises are concentrated. 19 % of the total number of cattle in Diyarbakir province are bred in the villages of these three districts. When the number of cattle was considered, it was observed that 105 villages had 83-83+ heads, 36 villages had 42-82 heads of cattle, and the number of cattle increased particularly in the enterprises close to water resources. Furthermore, it was found that the breeders had no information about environmental pollution and the utilization of manure and the manure generated was stored on the part of the territory to be used in the future. It was concluded that the solid and liquid waste, particularly in the enterprises close to water resources, could directly mix into surface waters and this could lead to the environmental pollution effect and economic loss.

Manure also has a certain amount of nutrients in its content that are not used by the digestive system. If the average amount of manure per animal is high, it is an indicator of improper feeding and, at the same time, means feed wastage. In addition to this, the excessive manure released into the

environment causes environmental pollution. In particular, a significant level of valuable resources such as nitrogen and phosphorus is excreted with manure [9].

Batman province was found to be the second within the basin in terms of its territory and the number of animals. 67 of 275 villages in Batman region in which the presence of animals was detected were determined to be close to water resources and included in the evaluation. 11870 heads of cattle are bred in this area, and 28 % of the total numbers of cattle in the region are bred in the villages close to water resources. According to this, the first three districts, which have the most villages close to water resources, are Sason with 17 villages, Kozluk with 16 villages and Besiri with 13 villages, respectively. The number of cattle in 27 villages in the region was determined to be 83-83+ heads. Therefore, it is considered that the cattle breeding activities in the region can have a high potential pollution effect on water resources (Fig. 2).

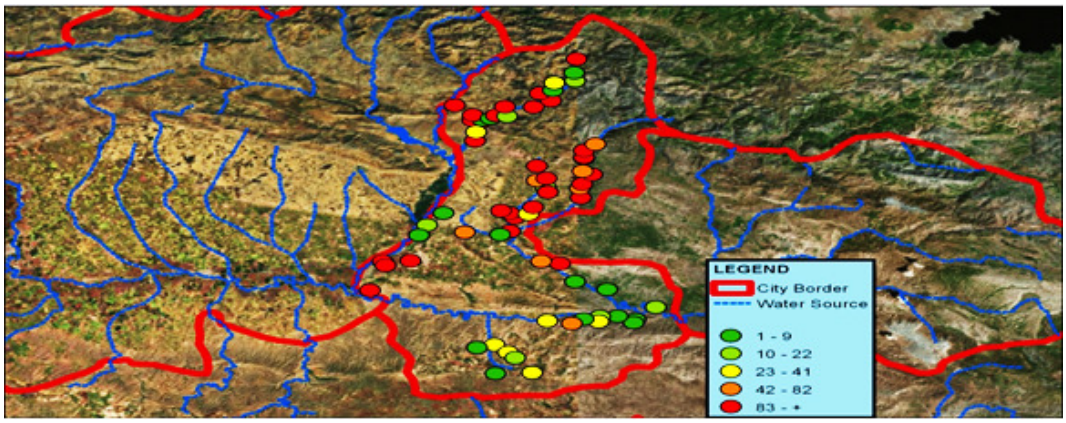

Fig 2. **Number of cattle in Batman province**

68 of 443 villages with the presence of animals in Mardin province and its rural areas, which was determined to be at the third rank in the Tigris basin in terms of both the number of animals and closeness to water resources, were determined to be close to water resources and included in the evaluation. 3442 heads of cattle are bred in this area, and the first three districts with the highest number of villages close to water resources are Artuklu with 21 villages, Nusaybin with 17 villages and Midyat with 13 villages, respectively. When the water resources in Mardin province are considered, there are the Beyazsu and Karasu rivers in the surroundings of Midyat starting from Nusaybin district. Particularly cattle breeding activities were determined to be performed around these water resources, and the number of cattle was determined to be 83-83+ in 10 villages, 42-82 in 16 villages, 23-41 in 7 villages, 10-22 in 12 villages, and 1-9 in 23 villages. The potential pollution effect of the cattle breeding enterprises in Mardin region on water resources was considered to be partial (Fig. 3).

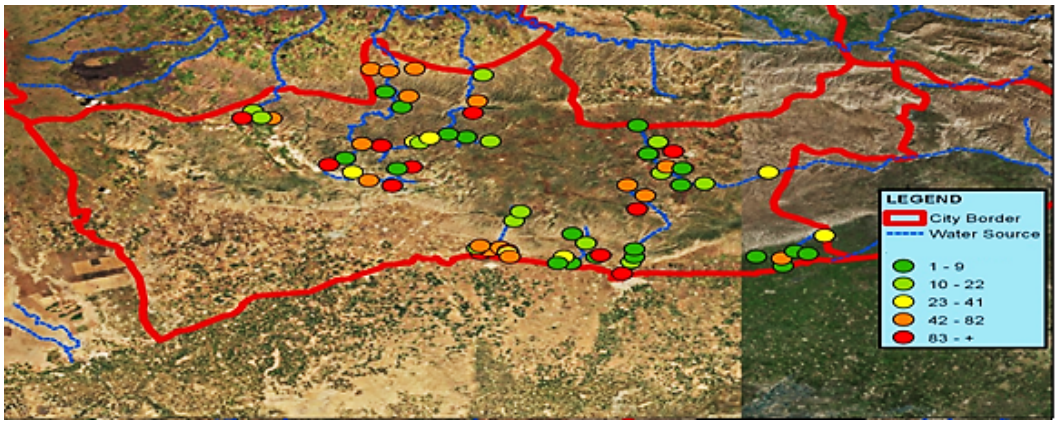

Fig 3. **Number of cattle in Mardin province**

When the number of cattle and closeness to water resources were considered in Siirt region, it was found that cattle breeding activities were carried out in 210 villages, and 58 of these villages were close to water resources. Within the whole territory of the province, Sirvan, Baykan and central

districts and their villages are leading in terms of the number of cattle, and the total number of cattle is 1897 heads. The enterprises are small and family businesses decrease the potential pollution, and the presence of fruit orchards in the region provides an opportunity for the use of the manure generated. For these reasons, no intensive pollution is expected in the part of the Botan and Garzan rivers passing through Siirt region. The water contamination caused by the cattle breeding enterprises in the region can be said to be less compared to other provinces. However, considering the waste generated from the cattle breeding enterprises, it was concluded that potential pollution could occur on the basis of the basin since all tributaries of the river are directly or indirectly in contact with each other (Fig. 4).

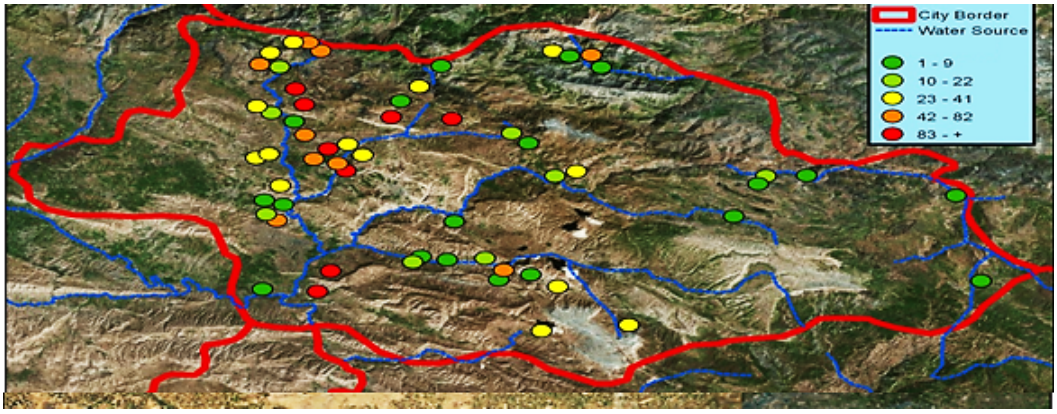

Fig 4. **Number of cattle in Siirt province**

The number of villages, where cattle breeding is performed, is 136, and 12 of these villages are carrying out production activities close to water resources in Sirnak province and its districts. The number of cattle that are bred in the enterprises close to water resources is 369 heads. Cattle breeding activities are carried out in the villages of Idil district at the most. Cattle breeding activities in the region were observed to remain limited due to the topography and the lack of workforce in the region. Therefore, it was concluded that the effect of the cattle presence in the region on water resources could be limited (Fig. 5).

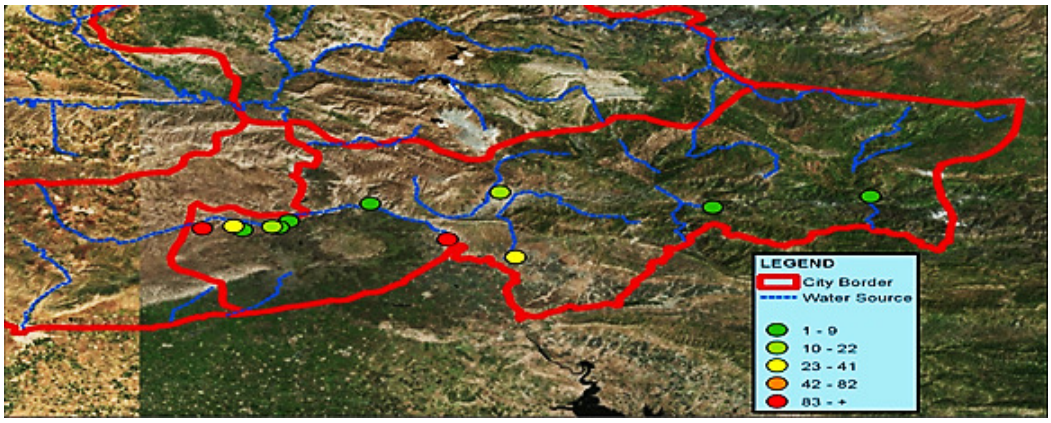

Fig 5. **Number of cattle in Sirnak province**

In this study, in which the closeness to water resources and the waste generated by cattle breeding enterprises were evaluated, the number of animals in the areas close to the Batman, Tigris, Botan and Garzan Rivers and other water resources in the region was observed to be high particularly in Diyarbakir, Batman and Mardin regions. The amount of animal waste in these parts of water resources is predicted to be higher. It is thought that the Tigris River will be affected by these wastes when they reach its main tributary. However, the number of cattle in Siirt and Sirnak provinces and their villages was also observed to be quite low. The contamination is predicted to be less at the points where these tributaries flow into the Tigris River.

Conclusions

It was found that the number of cattle per village in the provinces (Diyarbakır and Batman) with the enterprises established along the Tigris River and continuing production exceeded 3000, and this number remained under 150 per village in the provinces located along the Botan, Garzan and Batman rivers (Mardin, Siirt, and Sirnak). It was found that the water resources in the villages of especially Diyarbakır and Batman provinces were under a higher pollution risk. It was concluded that the contamination would be higher in the part of the Tigris River passing through Ergani, Hani and Bismil districts of Diyarbakır province and in the upper part of the Botan River passing through Kozluk district of Batman province and its villages. It was thought that the results of this study would contribute to the improvement of the manure utilization applications of the current enterprises in the research area and to the realization of the potential contamination risks to the water resources, and some recommendations were made. According to this.

1. First of all, the manufacturers should be informed and directed on this issue in order to build manure storage buildings in the enterprises.
2. When the distances of the manure to be stored in the enterprises to settlement units, lakes, and similar water resources are calculated, the values recommended in the literature should be taken into consideration.
3. If there is a manure storage building in the enterprise, its floor should often be controlled and cracks and leakages, if any, should be removed in order to prevent the ground water from being contaminated.
4. Manure storages must be built in accordance with the construction techniques. Manure storage areas should be projected providing a proper slope to the base of compacted soil and manure storage.
5. The manure storages can be transformed into lagoon storages so that the animal manure can be used in the agricultural activities. Thus, commercial revenue can be provided for the enterprises.
6. Both the Dicle University and the provincial directorates of the Ministry of Food, Agriculture and Livestock should carry out studies and make agricultural publications on prevention of potential pollution considering the waste and environmental pollution in the villages located around the part of the Tigris river passing through Diyarbakir province, which are maximum at 5 km distance to water resources, where particularly cattle breeding activities are intensively carried out.

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