BIO Web of Conferences **123**, 01047 (2024) https://doi.org/10.1051/bioconf/202412301047
ISOTOBAT 2024

Management of water sources and liquid waste in dairy farming environments

Ellin Harlia [1*], *M. Ali* Mauludin [2], *Lilis* Nurlina [2], Annisa [3], *Eulis Tanti* Marlina[1]

[1] Department of Animal Products Technology, Faculty of Animal Husbandry, University Padjadjaran.
[2] Department of Socioeconomics, Faculty of Animal Husbandry, Padjadjaran University
[3] Department of Biology, Faculty of Mathematics and Natural Sciences , Padjadjaran University

Abstract . Water resource management in a dairy farming environment is very important. Properly managing dairy farm wastewater and converting it into products that can increase soil fertility is needed to prevent pollution of water sources. Pollution can change the physical, chemical and biological properties of water, resulting in eutrophication. The aim of this research is to find out how livestock activities cause pollution to water sources and whether aerobic fermentation treatment of liquid waste can produce products that are beneficial to the agricultural environment. The water resources management study was carried out in an exploratory manner, water samples were taken from several points, namely household, domestic and river, followed by a liquid waste processing experiment using a completely randomized design, samples were obtained from holding ponds, treated with 4% Molasses, a starter consisting of from silage leachate 4%, and fish meal 1-5% fermentation was carried out aerobically for 3 weeks, with two repetitions. The results of the research obtained a soil conditioner product with an organic carbon content of close to 10, pH according to standard, heavy metal and micronutrient content below standard, biological results did not find *E.coli bacteria.* and *Salmonella bacteria* .

1 Introduction

Management of water sources in dairy farming environments has not been carried out seriously, and is still ignored unless there is a pollution case that is brought up in the mass media. Pangalengan is traversed by several rivers and lakes, which are sources of drinking water for other areas, so that various activities such as agriculture, animal husbandry, households and others are not permitted to dispose of waste into water sources in accordance with applicable regulations. The reality in the field is that water sources become waste disposal sites. To prevent pollution, the government has actually issued the Citarum Harum program, which aims to protect the Citarum river from pollution from various activities. Dairy farming activities require large amounts of water for drinking water for cows, cleaning cows, cleaning pens, and pushing cow manure through gutters, thus producing large amounts of liquid waste [1].

* Corresponding author: ellin.harlia@unpad.ac.id

Untreated water used for cleaning and other livestock activities are often discharged into rivers, ditches, and lagoons without receiving proper sanitation [2]. This practice leads to environmental damage and serves as a means for disease transmission. Furthermore, the close proximity of waste water to drinking water sources may increase the possibility of water source pollution. In fact, the government has set Quality Standards for drinking water, for domestic waste and river surface water, which can be used as indicators for water resource management. Livestock farming is one of the main causes of ecological problems, namely that it can damage water quality. Livestock manure contains large amounts of nutrients, large amounts of organic matter and microorganisms, heavy metals, veterinary drug residues and so on [3]. When cattle are kept concentrated in an area with intensive maintenance due to limited land, waste production will generally exceed the buffer limit of the surrounding biological system, thereby polluting surface and ground water.

Dairy farms are challenged to save water, which requires reducing water consumption and implementing recovery measures by recycling waste water without compromising barn hygiene, quality and safety of dairy products [4]. Dairy farms are also responsible for pollution of surface and ground water . The livestock industry confines thousands of livestock to very limited land, resulting in large amounts of waste and large amounts of water use, without using efficient methods for processing or disposal.

Direct impacts occur when waste flows directly into receiving water bodies due to poor stormwater management or failure of storage facilities. Indirect impacts occur when waste is thrown onto land and flows into water Water from rain runs across the ground, carrying pollutants with it. This water then seeps into the underground water supply, which eventually makes its way into rivers or ditches. Drainage systems can be contaminated by the combination of rainwater and other types of organic waste, such as livestock manure, silage leachate, or dairy waste. Animal feces from cattle commonly contains pollutants such as nutrients, organic materials, pathogens, particulates, pesticides, hormones, antibiotics, trace elements, silt, and heavy metals. The presence of nutrients such as nitrogen, ammonia, and phosphorus can lead to a decrease in oxygen levels, an increase in algae growth, contamination of drinking water, and the death of aquatic organisms. Pathogens, such as parasites, bacteria, and viruses, have the ability to induce illness in people. Antibiotics: Around 70-80% (equivalent to 29 million pounds) of the country's antibiotics are included in livestock feed annually. This is done to prevent and control diseases that arise from overcrowded conditions in animal housing. The widespread use of antibiotics in animals contributes to the emergence of resistant bacteria [5]. Microorganisms from livestock include microbes, such as *Campylobacter spp., Escherichia coli O157:H7, Salmonella spp.* Moreover, *Clostridium botulinum* and protozoan parasites, for example *Giardia lamblia, Cryptosporidium parvum* , and *Microsporidia spp* ., all cause large amounts of contamination each year [6].

Water source pollution in dairy farming environments includes heavy metals, pesticides and veterinary drugs. Heavy metals can come from the use of chemical fertilizers, waste sludge, and liquid fertilizers such as cadmium in phosphorus mineral fertilizers, and copper and zinc in animal feed. Pesticides exist in the environment by contaminating soil, surface water and ground water. Veterinary medicines, such as antibiotics, reach agricultural land, surface water, and groundwater directly from livestock or indirectly through the application of manure. Inadequate management of dairy farm waste poses significant risks to local water sources and rivers. In livestock areas , they generally keep feeding areas on the banks of waterways, so that liquid livestock waste such as urine (rich in supplements) can be channeled directly into the river. Livestock manure is collected to make compost and used as natural fertilizer, which causes water contamination because its use spreads if used in large quantities. In general, fertilizer is not stored in closed areas and, when it rains, fertilizer is carried into the canal and can contribute to a large nutrient load in the water . Implementation of quality standards must be carried out considering the occurrence of pollution of water sources originating from livestock. This is done to reduce the pollution load from dairy farms by processing liquid waste by fermentation into soil conditioner following KEPMENTAN RI NO. 261 of 2019 concerning Minimum Technical Requirements for Organic Fertilizers, Biological Fertilizers and Soil Fortifiers. Considering the importance of data-based water management to optimize the use of limited resources [7]

2 Materials and methods

The research was conducted in the Pangalengan dairy farm environment. Water quality analysis was carried out in two laboratories, namely the Institute of Ecology, Soil Chemistry and Plant Nutrition Laboratory at the Faculty of Agriculture, and the Microbiology and Animal Waste Handling Laboratory at the Faculty of Animal Husbandry, Padjadjaran University. Liquid soil conditioner can be obtained by fermenting liquid waste aerobically for 3 weeks, by adding organic carbon sources such as molasses and leachate silage.
The research used an exploratory method, and the data was analyzed descriptively.
Parameter:

1) Groundwater quality (physical, chemical, biological) is compared with Quality Standards based on Decree of the Minister of Health of the Republic of Indonesia number 907/Menkes/SK/VII/2002 dated 29 July 2002 concerning Requirements and Supervision of Drinking Water Quality. , and Quality Standards Based on Regulation of the Minister of Health of the Republic of Indonesia number 492/Menkes/Per/IV/2010 dated 19 April 2010 concerning Drinking Water Quality Requirements.
2) The quality of domestic wastewater (physical, chemical, biological) is compared with Quality Standards based on the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.68 /Menlhk/Setjen/Kum.1/8/2016 Concerning Domestic Wastewater Quality Attachment to Standards I and Standards Quality based on Regulation of the Minister of Environment of the Republic of Indonesia No. 5 of 2014 concerning Waste Water Quality Standards Appendix XX.
3) River water quality (physical, chemical, biological) is compared with Quality Standards based on Republic of Indonesia Government Regulation No. 82 of 2001 concerning Water Quality Management and Water Pollution Control.
4) Quality of organic Soil Conditioners (physical, chemical, biological) compared with KEPMENTAN RI NO. 261 of 2019 concerning Minimum Technical Requirements for Organic Fertilizers, Biological Fertilizers and Soil Conditioners.

Three sample waste liquid from dairy farms is treated as follows:

1. LW + 2% silage leachate.
2. LW+M2% +Sil2%
3. LW +M4% +Sil4%

3 Results and discussion

3.1 Result

3.1.1 Groundwater Quality

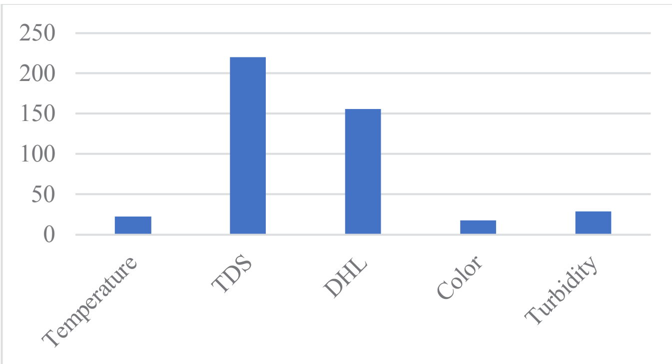

Fig 1. Physical analysis of groundwater

Results of analysis of the quality of residents' water sources. Physical, chemical and biological analysis of water quality in the dairy farming environment can be seen in fig 1.

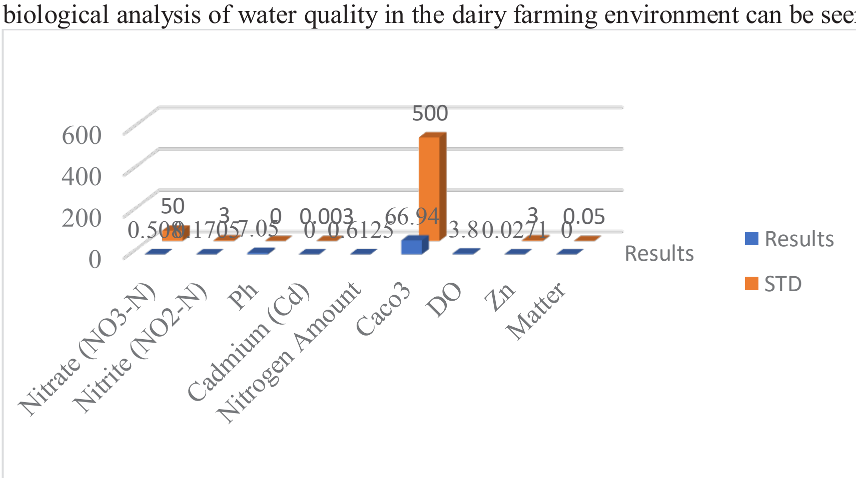

Fig 2. Chemical analysis of groundwater

Fig 1 and Fig 2. presents the findings of an analysis of the quality of groundwater, specifically focusing on its physical and chemical components.

https://doi.org/10.1051/bioconf/202412301047

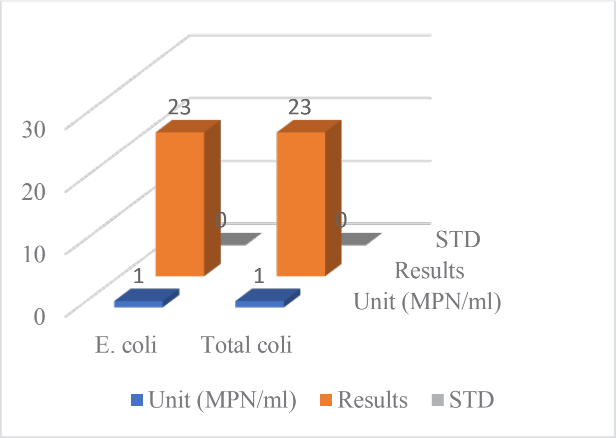

Fig 3. Biological analysis of Groundwater

Fig 3. about biological components, namely *E Coli* bacteria and total Coli with a number of 23 x 10^2 MPN/100ml which were detected in groundwater causing color changes and turbidity.

3.1.2 Domestic water quality

The results of domestic wastewater quality analysis of its physical and chemical components can be seen in Fig 4 and Fig 5.

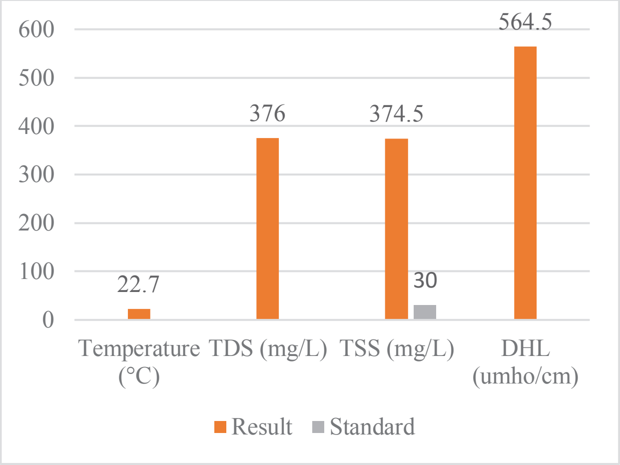

Fig 4. Physical analysis of domestic water quality

 https://doi.org/10.1051/bioconf/202412301047

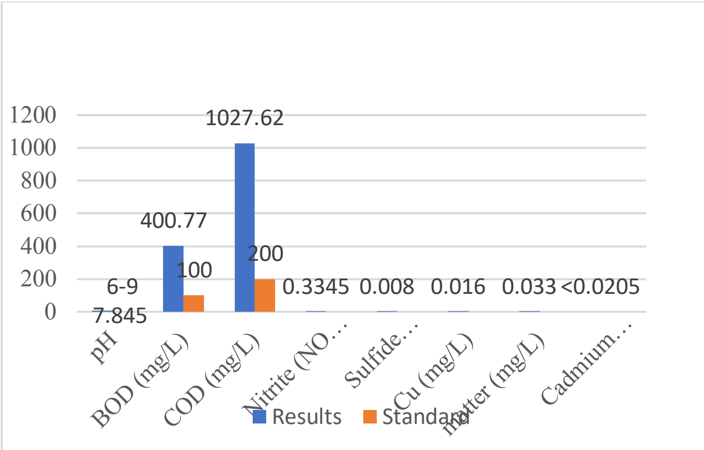

Fig 5. Chemical analysis of domestic water quality

3.1.3 River water quality

The quality of river surface water can be seen in Fig 6 and Fig 7.

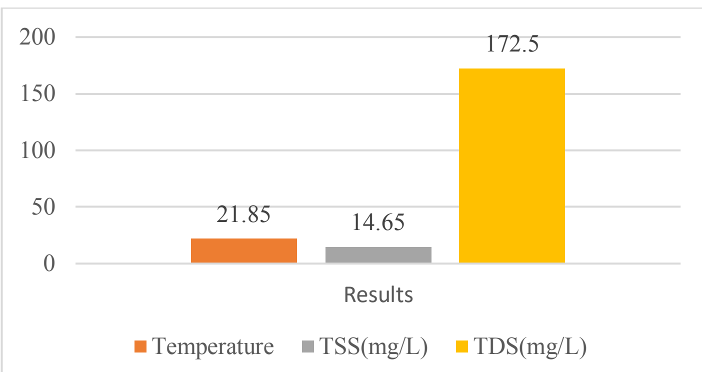

Fig 6. Physical analysis river surface water

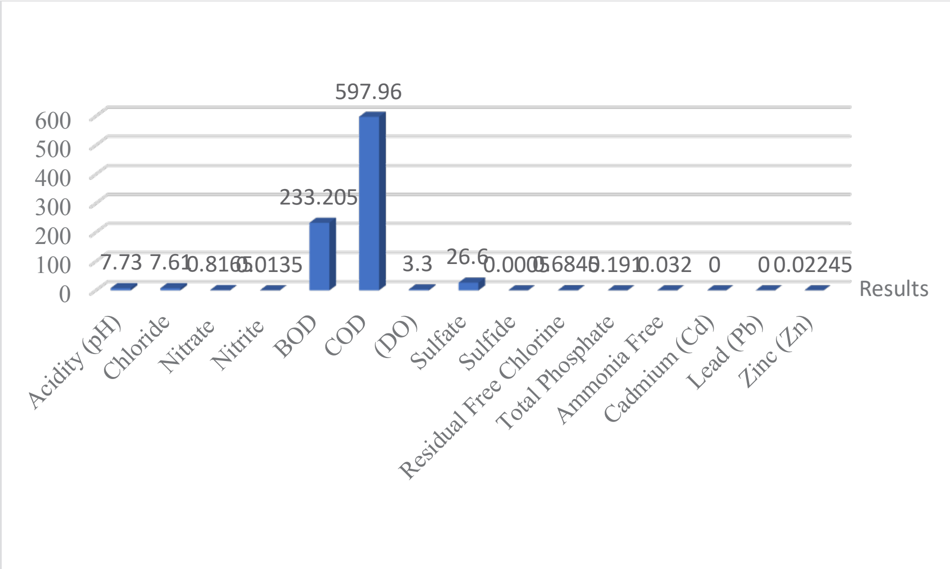

Fig 7. Chemycal analysis river surface water

3.2 Discussion

3.2.1 Groundwater Quality

Results of analysis of the quality of groundwater. Physical, chemical and biological analysis of water quality in the dairy farming environment can be seen in Fig 1, compared with drinking water quality standards. Fig 1 and Fig 2. presents the findings of an analysis of the quality of groundwater, specifically focusing on its physical and chemical components. The results indicate that the groundwater meets the requirements set by the Republic of Indonesia Health Quality Standards, as stated in regulations number 907/Menkes/SK/VII/2002 dated 29 July 2002 and 492/Menkes/Per/IV/2010 dated 19 April 2010. However, it is worth nothing that the physical components, namely color and turbidity, exceed the Quality Standards. According to the findings of [8], many contaminants in groundwater are present in colloidal form of colloids, which cannot be easily separated or settled.

The presence of suspended solids such as clay, organic substances, plankton and other fine substances causes turbidity in the water. Cloudy water is an indication that the water is polluted and contains microorganisms that are dangerous to human health. The coagulation-flocculation process will not be economical if the turbidity is high because it is a habitat for pathogenic bacteria. According to [9.] color in water is attributed to the existence of metal ions like iron and manganese, suspended particles, other colloids, microorganisms residing in water, and the decomposition of humus acid from the breakdown of organic materials.
Fig 3 . about biological components, namely *E Coli* bacteria and total Coli with a number of 23 MPN/ml which were detected in groundwater causing color changes and turbidity. Groundwater generally has lower levels of particulate matter, such as leaves, soil, and insects, and higher concentrations of dissolved compounds, such as chemicals and minerals that dissolve from the soil as water passes over it. [10].

3.2.2 Domestic wastewater quality

The results of domestic wastewater quality analysis of its physical and chemical components can be seen in Fig 4 and Fig 5. Domestic wastewater is wastewater originating from agricultural, livestock and residential activities. This water contains high levels of organic and inorganic compounds and pathogenic microorganisms originating from residential, agricultural and livestock businesses which can pollute the environment, cause disease and cause unpleasant odors [11]. The results of the domestic wastewater quality analysis in Table 2. show that the physical quality meets quality standards except for Total Suspended Solids (TSS). Observations of TSS distribution are often carried out to determine the water quality in a water body. A high TSS value indicates a high level of pollution and inhibits the penetration of light into the water [12.] Sources of pollution that can increase TSS are household wastewater and wastewater from livestock, because some farms still dispose of liquid and solid waste in gardens or public facilities. Organic matter can increase BOD and COD in waters, the higher the BOD level directly reflects the higher the amount of degraded organic matter in water sample [13].

3.2.3 River water quality

The quality of river surface water can be seen in Fig 6 and Fig 7. Farmers' awareness of treating waste water before disposing of the waste into the environment causes a decrease in river water quality [14] [15]. In accordance with the quality standars of Government regulation of the Republic of Indonesia Number 82 of 2001 concerning Water Quality Management and Water Pollution Control the surface water quality of the river examined in this study produces BOD and COD values that exceed class 1, II and III quality standards. Wastewater properties indicate that it the rich source of nutrient that may serve as a catalyst for the of algae result in eutrophication of berby water bodies [16].

Organic materials that affect BOD can come from flora and fauna that live in or near water sources as well as microorganism contamination in water sources [17]. The majority of untreated water sources contain organic matter levels that exceed the threshold. COD stands for Chemical Oxygen Demand, which quantifies the oxygen needed to convert organic water pollutants into inorganic byproducts. It is employed to assess the organic composition of water samples. [18]. The BOD and COD levels of all drinking water samples in this study exceeded National Water Quality Class III Quality Standards, so it is not safe for consumption by livestock.

The biological water quality is assessed based on many characteristics, specifically those related to microbial contaminants, diseases, and toxin production. Microbes frequently become dispersed in water, particularly in shallow groundwater. *E. coli* bacteria are the most dangerous microbes because they come from feces and can cause health problems if used for life purposes. One of the water quality criteria is the degree of acidity (pH). Good water is water that is not polluted. In such conditions, it means that the water is neutral, whereas if there are pollutants in the water, the water's properties can change to acidic or alkaline. pH is a chemical quality criterion. Apart from chemical quality, physical and biological quality are factors that determine water quality.

Water that has a high BOD will generally give off an unpleasant odor, because if the BOD is high it means the DO is low and also means the decomposition of organic waste will take place anaerobically. The anaerobic process is a waste fraction (oxidation) that does not use oxygen so that NH_3 , H_2S, CH_4 compounds are produced which smell unpleasant odor. High BOD and COD and low DO cause aquatic animals and plants to not develop well and even die [19] [5]. The natural composition of groundwater and surface water can be changed by pollution through human activities, which causes the infiltration of contamination such as pesticides, fertilizers, animal waste, and chemicals [20].

River water around dairy farms does not meet good water quality standards, either class one or class three. The small number of microorganisms in river water can have an impact on the high BOD content in it. The number and activity of microorganisms have a significant influence on the BOD value. When the number of microorganisms is small, the biochemical breakdown process does not occur or the intensity of biochemical breakdown is not significant. This effects are always brought about in natural environment by an array of harmfull substances (such as heavy metals) that impair microorganisms ability to produce enzymes [21]

3.2.4 Management of Dairy Farm liquid waste

Managers in the dairy farming setting have the duty of overseeing the management of both solid and liquid waste to uphold the quality of various water sources. The management of liquid waste is crucial due to the prohibition of direct disposal of liquid waste into water or land. Therefore, it is necessary to undertake measures to treat the waste.

The liquid waste fromd dairy cow pen is gathered and processed by introduction starter from leech silage and adding molasses as an energy source, as shown in Table 1. It shows that liquid waste processed with 2% starter silage produces yield soil conditioner of high ggrade according to the specified requirements.

Table 1. Effect of Treatment on Soil Conditioning Quality

NO	Parameter	Unit	Treatment			Ministry of Agriculture Soil Conditioner Standards No. 261 of 2019
			LW + seal 2%	LW+ M4%+Sil 4%	LW+ M2%+Sil2%	
1	C-organic	%	9.89	8.54	9.50	10.00
2	Heavy metal					
	As	matter	0.00	0.00	0.00	max 5
	H.G	matter	0.00	0.00	0.00	max 0.2
	Matter	matter	3.6	3.19	3.71	max 5
	CD	matter	0.01	0.00	0.00	max 1
	No	matter	1.49	1.29	1.58	max 4
	Cr	matter	1.82	2.24	2.23	max 10
3	pH		8.57	6.9	8.19	4.00 - 9.00
4	Microbial contaminants					
	E coli	MPN/ml	Negative	negative	negative	< $1x10^2$
	Salmonella	MPN/ml	Negative	negative	negative	< $1x10^2$
5	Micronutrients					
	fee available	matter	6.19	15.03	8.61	15,000
	Total cost	matter	238.07	483.93	313.84	500
	Zn	matter	6.87	5.57	6.36	5,000

Table 1. displays the microbiological contaminants quality, with all treatments yielding negative findings. This indicates that the treatment is effective in eradicating *E. coli* and *Salmonella* germs. Total coliforms refer to the level of coliform bacteria, which includes fecal and non-fecal sources, in a sample drinking water. The combined coliform count from three treatments was below the detection limit, indicating that it complied with the quality standards for safe usage as soil fertilizer in a dairy farming context. As stated by [22], the existence of competitive bacterial activity in the stomach of ruminant, which are rich in microbes, enables them to withstand many coliform bacteria.

The PTO technical criteria mandate that the heavy metal content in Organic Soil Improvers must meet specified parameters. The Concentrations of heavy metals, including arsenic (As), mercury (Hg), lead (Pb), cadmium (Cd), nickel (Ni), and chromium (Cr), in wastewater fermentation products are all within the limits specified in the technical specifications determined by the Ministry of Agriculture. Therefore, the wastewater fermentation product derived from this study can be confidently used as a PTO (soil conditioner) application without any safety concerns. Several countries have established measures to regulate the total concentration of heavy metals concentration in wastewater and set maximum annual and total loading limits for the releases into the soil. In additionally, regulations have been established to determine the maximum allowable limits for heavy metal concentrations in fertilizers. There is concern that the elevated levels of heavy metals in PTO may contaminate the food chain and pose a risk to human health [23].

The acidity (pH) of waste water fermentation products with various treatments for 4 weeks showed that the acidity level was in the neutral range, namely 6.9 – 8.57 (Table 4). This shows that the waste water fermentation process with the addition of various other organic materials meets the standards of the Ministry of Agriculture. The addition of 2% silage leachate did not affect the acidity level of the fermented product.

Indicators of microbial contaminants in organic soil amendments are listed in Minister of Agriculture Regulation no. 261 of 2019 are *Escherichia coli* and *Salmonella sp*. These two types of microbes are a group of pathogenic bacteria so their status in wastewater treatment products must be negative. It is feared that the presence of pathogenic bacteria in PTO will pollute groundwater which will have a negative impact on the health of humans who consume it. Referring to WHO, drinking water sources must not contain pathogenic bacteria [24].

Soil amendments is materials that can be used to accelerate the recovery/improvement of soil quality. Apart from being able to function as a source of nutrients, organic materials have also been proven proven to function as a soil conditioner [25]. The micro elements content in soil amendment that must be available according to Minister of Agriculture Regulation no. 261 of 2019 is a total of Fe and Zn, namely 500 ppm and 5,000 ppm respectively (Table 4). However, the content of microelements Fe and Zn in wastewater fermentation products with various mixtures of organic materials is still lower than the standards stated in the technical requirements. It is suspected that the process of degradation of organic materials into inorganic materials has not been completed during the three week fermentation process.

4 Conclusion

The article on water resource management in a dairy farming environment explains the impact of livestock activities on the environment because they cause pollution to water sources. The high level of organic matter and nutrients from livestock waste can cause eutrophication, thus requiring management of water sources in the dairy farming environment. Efforts to process liquid and solid waste from dairy farms must be carried out by farmers before they are disposed of into the environment. Management of water sources and processing of liquid waste into soil improvement products in the dairy farming environment can be carried out by farmers to realize sustainable farming.

Reference

1. FAO, Water use in livestock production systems and supply chains. Food and Agriculture Organization of the United Nations, Rome, Italy (2019)
2. Anh NT, Le Duy Can, Nguyen Thi Nhan, Britta Schmalz, Tran Le Luu . Influences of key factors on river water quality in urban and rural areas: A review. Case Studies in Chemical and Environmental Engineering **8**, 100424. (2023)
3. Kumar N, Arvind Kumar, Binny Marry Marwein, Daneshver Kumar Verma, Ilakiya Jayabalan, Agam Kumar, Duraisamy Ramamoorthy. Agricultural activities causing water pollution and its mitigation – a review. International Journal of Modern Agriculture, Volume **10**, No.1, ISSN: 2305-7246 590. (2021)
4. Zablocka- Joanna Boguniewicz & Iwona Klosok - Bazan & Vincenzo Naddeo, Water quality and resource management in the dairy industry. water industry: the water-energy-health nexus. Environ Sci **26**:1208–1216 (2019)
5. Ferro, F., Aguilar, F., Pérez, R., Rodríguez, H., & Miranda, L. A, Water quality and livestock health in northwestern Argentina. Environmental Science and Pollution Research, **29** (3), 2313-2326 (2022)
6. Christou, L. The global burden of bacterial and viral zoonotic infections. Clinical Microbiology and Infection, **17(3):** 326–330. (2011)
7. Banhazi, TM, Seedorf, J., & Halachmi, Effect of dietary fiber on drinking behavior of dairy cows. Animals, **13** (2), 260-268 (2019)
8. Pereira, L.S., Allen, R.G., & Smith, M. Water management and irrigation practices in agriculture: emerging challenges and opportunities. Water Resources Management, **37** (2), 413-428. (2023)
9. Pritchard M., T. Craven, T. Mkandawire, A.S. Edmondson, J.G. O'Neill, A study of the parameters influencing the effectiveness of Moringa oleifera in drinking water purification, *Physics and Chemistry of the Earth* ., **35** , 791-797 (2010)
10. Nishi, L., AM Salcedo Vieira, M. Fernandes Vieira, M. Bongiovani , F. Pereira Camacho, R. Bergamasco ., Hybrid coagulation/flocculation process with Moringa oleifera followed by ultrafiltration to remove Microcystis cells from water supplies, *Procedia Engineering* . , **42** , 865-872 (2012)
11. USGS (Geological Survey), Groundwater pollution. US Department of the Interior US Geological Survey. (2016).
12. Suoth, EA, & Nazir, EN, Characteristics of Household Wastewater in One of the Upper Middle Housing Estates in South Tangerang. Ecolab Journal, **10** (2), 80–88 (2016)
13. Indrayanti, E., Maslukah, L., Astariningrum, M. & Zainuri, M, Impact of Suspended Nutrients and Particulates on Phytoplankton Chlorophyll-a Biomass, in Muara Kendal, Indonesia. *Ecological Engineering and Environmental Technology* , **23** (4):212–218 (2022)
14. Ahuja, S, Advances in water purification techniques: meeting the needs of developed and developing countries. Ahuja Consulting, Cal abash, NC, United States (2019)
15. Ming, TT, Hyun, KT, Joo, LM, Characterization of livestock wastewater at various stages of wastewater treatment plants. Malay. J. Anim. Science. **11** , 23-28 (2007)
16. Jafarinejad , S., Cost estimation and economic evaluation of three activated sludge process configurations for wastewater treatment plants using simulation. Application. Water Science . **16** , 446-448 (2016)

17. Anderson, WB, Huck, PM, Dixon, DG, Mayfield, CI, Inactivation of endotoxins in water using a medium pressure UV lamp. Application. Envi ron. Microbiol . **6,** 3002-3004 (2003)
18. Ian Olmstead. Eco-efficiency for the Milk Processing Industry, Publication by: Dairy Australia (2019)
19. Abdul majeed khan, ataullah, azra shaheen, ijaz ahmad, fazal malik and hafiz abdullah shahid. Correlation of COD and BOD of Domestic Wastewater with the Power Output of Bioreactor. J.Chem.Soc.Pak., Vol. **33**, No. 2, (2011)
20. Sasakova , N., Gregova , G., Takacova , D., Mojzisova , J., Papajova , I., Ven - glovsky , J., Szaboova , T., Kovacova , S., Pollution from surface and ground water sources related to agriculture activity . Front. Su. Food Systems . **2** , 42. (2018)
21. Koda, E., Miszkowska, A., and Sieczka, A, Indicators of Organic Pollution Levels in Ground Water in Old Landfills and Waste Management Sites. *Applied Science* s**,** *7* (6): 1-22 (2017)
22. Sejian , V., Naqvi, SMK, Ezeji, T., Lakritz, J., Lal, R., Environmental stress and improvements in livestock production. Springer Heidelberg, New York, Dordrecht London. (2012)
23. Briffa J, Emmanuel Sinagra , and Renald Blundell . Heavy metal pollution in the environment and its toxicological effects on humans. Heliyon . September; **6**(9): e04691. (2020)
24. Gorchev, HG, & Ozolins , G, guidelines WHO for drinking water quality. *WHO Chronicle*, **38** (3), 104–108 (2011)
25. Rachman, A., A. Dariah , and D. Santoso . Fertilizer Green. Pp 41-58 *In* Fertilizer Organic and Fertilizer Live it . Center for Resources Land Agriculture. Body Research and development Agriculture (2006)