Analysis on microplastics in dug wells around Tamangapa Landfills, Makassar City, Indonesia☆

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A B S T R A C T

Objective: This study aims to determine the microplastics abundance of dug wells around Tamangapa Landfills in Makassar area.
Method: The research method used is quantitative research with a descriptive. The number of samples is 8 dug wells with the criteria of 4 dug wells that are <500 m from landfills and 4 dug wells that are 500 m–1 km from landfills.
Results: The most common forms of microplastics were fiber (72%) and fragments (28%). The microplastic sizes found ranged from 0.069 mm to 4.459 mm with the largest size being smaller than 2 mm (86%). The most microplastics color found was blue (53.6%). The lowest amount of microplastics content was 0.25 particles/L and the highest was 0.95 particles/L.
Conclusions: This study found that the eight samples dug wells around Tamangapa landfills area were positive for microplastics and there was no relationship between the landfill distance and the dug wells on their microplastic abundance.

Introduction

Makassar is one of the major cities in Indonesia with a population of 1339 million people. The large population will certainly cause various problems. One of the problems that arise is the increasing amount of waste generated every day.

Garbage in the city of Makassar is collected at the Tamangapa Landfills, Antang. Around Tamangapa landfills, there are many houses. There are even some residents who live in the Tamangapa landfills location. Of course this is very worrying because it can endanger health from various factors. One of them is seepage water from landfills which affects the quality of groundwater.

Water that comes from groundwater, such as dug wells water or borehole water, is very susceptible to pollution. Dug wells water can be contaminated through seepage from various sources of pollution[1] such as septic tanks,[2,3] human waste, animal waste, domestic waste, and so on. Apart from distance from pollutant sources, dug well construction that does not meet the requirements also affects the pollutant content in dug wells water.[1,2,4]

The source of pollutants with high potential to contaminate dug well water is the landfills (TPA).[5,6] Landfills have the potential to produce leachate that contains a lot of pollutants that can contaminate dug well water.[7,8]

Apart from contamination caused by bacteria and heavy metals, clean water sources are now also contaminated by solid waste such as plastic. The use of plastic is one of the materials most widely used by humans. Its application is very wide, both in daily activities and in commercial matters. Humans are very much using plastics in a variety of applications without realizing the long-term impact it causes. Plastic waste produced by humans will eventually return to the environment.[9] The composition of plastic waste dumped into landfills is also quite high, namely 16.66%.[10]

Plastic waste that pollutes the environment can be in the form of microplastics. These microplastics can contaminate clean water sources such as dug wells because they are recycled using hazardous chemicals. In addition, the decomposition process can take hundreds of years.

Method

The research method used is quantitative research with a descriptive approach to determine the quality of clean water in dug wells around Tamangapa landfills. This research was conducted in Manggala District, Makassar City, especially in clean water sources around Tamangapa landfills. The study was conducted from August to September 2020. The sampling technique used was purposive sampling. Sampling is carried out at dug wells that are less than 1 km from the landfills with a total of 8 dug wells sampled.

Results

The water sampling locations are scattered in several points in Manggala District, sampling is carried out at a radius of 0 to 1 km from the landfills. The total wells sampled were 8 dug wells, 4 dug

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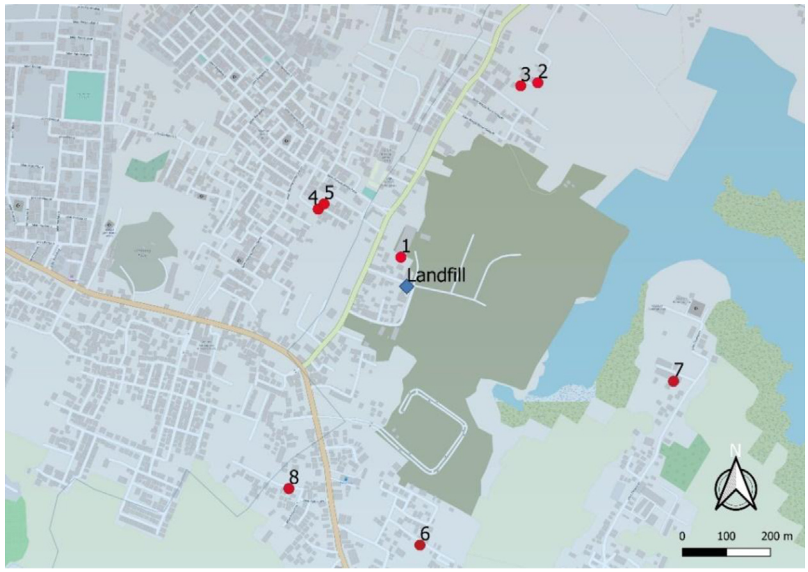

Figure 1. Sampling points.

Table 1
Microplastic abundance in clean water around Tamangapa Landfills, Antang, Makassar City.

Sample	Distance from landfills	Form (N)	Color (N)	Size (mm)	Abundance (particle/L)
Sample 1	<500 m	Fiber (13), Fragment (2)	Blue (6), Green (1), Red (5), Transparent (2), Purple (1)	0.346–4.459	0.75
Sample 2	>500 m	Fiber (10), Fragment (3)	Blue (7), Green (1), Red (4), Purple (1)	0.175–2.844	0.65
Sample 3	>500 m	Fiber (11)	Blue (3), Green (1), Red (6), Purple (1)	0.573–2.36	0.55
Sample 4	<500 m	Fiber (5), Fragment (4)	Blue (6), Transparent (3)	0.131–1.534	0.45
Sample 5	<500 m	Fiber (7), Fragment (4)	Blue (6), Green (1), Red (4)	0.196–2.635	0.55
Sample 6	<500 m	Fiber (5)	Blue (2), Red (2), Purple (1)	0.709–1.631	0.25
Sample 7	>500 m	Fiber (8), Fragment (6)	Blue (11), Red (3)	0.173–2.625	0.7
Sample 8	>500 m	Fiber (11), Fragment (8)	Blue (11), Green (2), Red (4), Transparent (2)	0.173–1.708	0.95

Source: Primary Data, 2020.

wells less than 500 m from the TPA and 4 dug wells more than 500 m from the landfills (Fig. 1).

The results showed that the most common forms of microplastics were fiber (72%) and fragments (28%). The microplastic sizes found ranged from 0.069 mm to 4.459 mm with the largest size being smaller than 2 mm (86%). The most microplastic color found was blue (53.6%). The lowest amount of microplastic content was 0.25 particles/L and the highest was 0.95 particles/L. (Table 1).

Discussion

Based on the results of the observations, it was found that several wells were dug less than 10 meters from pollutant sources, such as garbage dumps and incinerators, septic tanks and sewers. The results of the interviews revealed that the water from the dug wells was used by the local community for bathing and washing purposes, but they did not use it for cooking or as drinking water. One of the 10 samples taken has a cloudy yellow color, but based on the results of interviews in other locations it is known that the well water tastes salty and cloudy and smells during the dry season.

The results of measurements of microplastics levels in the 8 dug wells samples were all positive abundance microplastics. The most common types of microplastics were in the form of fiber by 70 (72%) and fragments by 27 (28%). Several other studies have also found that fiber microplastics are more common in surface water.[11–14] In several other waters, microplastic fragments were found more frequently than fiber types.[15–17] Apart from waters and sediments, fragment-type microplastics are also found in plastic drinking water bottles.[18] Fiber microplastics are more commonly found because they come from community activities around dug wells.

The size of the microplastics found in the eight samples of dug wells around Tamangapa landfills varied from 0.069 mm to 4.459 mm. The most microplastics found were those smaller than 2 mm, which was 86%. Microplastics with sizes smaller than 2 mm are also more common in several locations such as Lake Wuliangshui China.[12]

The most common microplastic colors were blue (53.6%), red (28.9%), transparent (0.7%), green (0.06%), and purple (0.04%). This result is different from the waters in Kupang Bay which mostly get black microplastics, namely 38.02% at high tide and 49.25% at low tide.[14]

The number of microplastic particles in each sample examined is different. The distance between the dug well and the landfills does not affect the microplastics abundance of the well. The lowest microplastic abundance is found in sample 6 which is less than 500 m from the landfill location, namely 0.25 particles/L, while the dug well sample with the highest microplastic abundance is found in sample 8 which is more than 500 m from the landfill, which is 0.95 particles/L. This research is in line with research in Banyuarip waters which obtained yields lower than 1 particle/L.[15] This study is not in line with research that measured microplastic levels in mineral water refill bottles of 188 ± 88 particles/L and 14 ± 14 particles/L single-use bottles.[18]

Microplastics found in clean water sources will be dangerous if consumed by humans. Microplastics that are in the lumen, can interact with blood through the adsorption process and will fill protein, so that it can affect the immune system and intestinal swelling.

Transport to other body tissues and other organs is also possible because the size of microplastics are very smalls.[19]

Microplastics found in waters will also be dangerous for aquatic biota. The very small size of the microplastic also allows it to enter the body of aquatic biota such as fish. The existence of these plastic pollutants in fish can pose a food safety risk that needs to be studied further. Microplastics can also be a pathogenic factor because they have the potential to carry microbial species into the waters and will accumulate in aquatic biota which is dangerous if consumed by humans.[20]

Conclusions

Based on the results of research that has been conducted regarding the analysis of microplastic in dug wells water around the Tamangapa landfills, Antang area, Makassar City. It was found that the eight positive samples contained microplastics with a total of 0.25 particles/L to 0.95 particles with a size of 0.069–4.459 mm. It is recommended to the community around the landfill to keep the dug wells from contaminants so that they do not cause disease.

Conflicts of interest

The authors declare no conflict of interest.

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