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HELMINTH EGGS PARAMETER OF WATER SPINACH AGRICULTURE FIELD IN BANDUNG

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ABSTRACT

The high prevalence of helminth infection in Indonesia had encouraged the government to issue the Regulation of the Minister of Health concerning the Prevention of Soil-transmitted Helminths in 2017. Researches on the presence of helminth eggs in the environment, in soil and water as a media for transmitting the disease, are very few. **Aim: The aim** was conducted to investigate the potential presence of helminth eggs causing STH infections in two urban agricultural areas in northern and southern part of Bandung City. **Methodology and results:** Samples of water from the inlet and plantation area, as well as soil and water spinach produced by both regions, were collected and analyzed for the presence of helminth eggs using modified Bailinger methods. The number of helminth eggs of 1–119 eggs/L in water, soil, and vegetable samples. **Conclusion, significance, and impact study:** The results confirmed that the irrigation water used in both areas has been contaminated by feces. The average number of fecal coli exceeds the allowable value for the irrigation water source based on the Grade 4 of water quality criteria in Indonesia. Variations in the number of helminth eggs found in the samples can be caused by environmental conditions such as temperature, humidity, and soil types. The presence of helminth eggs in irrigation water and land samples exceeds the value recommended by WHO (2006) in the guidelines for the safe use of wastewater for agriculture. It can lead to an increased risk of helminth infection to consumers, agricultural workers, as well as residents around the farmland.

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1. INTRODUCTION

Soil-transmitted Helminths (STH) is a type of worm disease which is one of the most common infectious diseases in the world. WHO (2017) estimates that more than 24% of the world's population is infected with STH, both in tropical and sub-tropical areas. Based on stool tests conducted in 8 provinces in 2008, the prevalence rate of helminth infection in West Java is 6.7% (Directorate General of Disease Control and Environmental Health, 2008). The survey conducted by Bandung District Health Office in 2003 (Andaruni et al., 2012) in 23 puskesmas (community health centers) stated that the prevalence of helminth infection in Jayagiri Puskesmas was 100%, while the total prevalence in Rancaekek and Bojongsoang reached 78.57%. According to Andaruni *et al.* (2012), the results of a study in the village of Pasir Langu, Cisarua, found that the high prevalence of helminth infection is mainly due to personal hygiene problems and poor environmental sanitation, especially related to food sanitation.

Although there are studies on the prevalence of helminth infections, research on the presence of helminth eggs in the environment-which is thought to be a source of distribution in Indonesia-is very limited. This study was conducted to get a preliminary view of the presence of helminth eggs on some media that may be contaminated due to poor sanitation. The study was carried out in urban and semi-urban areas of Bandung Raya, adjacent to residential areas, with irrigation water sources coming from the same channel as drainage and domestic sewerage.

2. RESEARCH METHODOLOGY

Samples of water, soil, and water spinach were collected from two areas, namely Cangkuang Wetan Village in Dayeuhkolot District and Sariwangi Village in Parongpong District. Soil samples were taken from a depth of 10 cm. Both water and soil samples were obtained from the inlet and inside the plantation area of each region.

To detect the presence of helminth eggs in the sample, water samples were allowed to settle overnight. For vegetable samples, 100 grams of water spinach were washed with mixing in 1 liter of 0.95% saline solution (Adanir and Tasci, 2013). For soil samples, 1 liter of distilled water was added in 100 grams of soil. After removing all the dirt-either large or floating, water and saline solution were then allowed to settle overnight. The yielded precipitates were prepared afterward for quantitative analysis.

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Modified technique of Bailinger method (Ayres and Mara, 1996) was applied in the examination of helminth eggs. The observation and counting of the number of eggs were carried out using McMaster slides. In addition to the quantitative analysis of helminth eggs; TSS, Total Coliform, and Fecal Coliform parameters in the water samples were also evaluated. All analyses of water and helminth eggs were done in the ITB Water Laboratory. Simultaneously, to analyse the type of soil at sampling location, soil samples were examined in the ITB Soil Mechanics Laboratory.

3. RESULTS AND DISCUSSION

The first agricultural location to be analyzed is in Cangkuang Wetan Village, Dayeuhkolot District, Bandung Regency. This area is located approximately 10 km from downtown Bandung. Based on laboratory examinations, the soil texture in Cangkuang Wetan area can be classified as clay. While the second location, Sariwangi Village, Parongpong District, West Bandung Regency is in the northern part of Bandung. Its soil texture can be classified as clay loam. The type of vegetables grown in both locations is ranging from Chinese okra, water spinach, bok choy, and lettuce.

Table 1 TSS, Total Coliform, and Fecal Coliform parameters

Parameter			TSS	Total *Coliform*	*Fecal Coliform*
Unit			(mg/L)	(cell/ 100ml)	(cell/ 100ml)
PP 82/2001	2nd grade		50	400	400
	3rd grade		400	10,000	10,000
	4th grade		400	2,000	2,000
Cangkuang Wetan	Inlet	S1	6.5	11,000	11,000
		S2	54.6	2,400	1,100
	Field	S1	73.2	4,600	4,600
		S2	48.8	4,600	1,500
Sariwangi	Inlet	S1	81.5	2,400,000	460,000
		S2	115	460,000	110,000

Note : S1 = 1st sampling, S2 = 2nd sampling

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The quantities of Total Coliform and Fecal Coliform parameters in the water samples used for irrigation water (inlet) indicate that the water is contaminated with fecal coli, exceeding the fourth-grade water quality criteria (PP 82/2001) which address water used for crops irrigation and/or other designations that require the same water quality for such uses. An exception was found in the second sampling in Cangkuang Wetan in August 2017, where the weather conditions were the end of the dry season. It was estimated that the water flow from the residential drainage was somewhat hampered and not all of them streamed down into the Cangkuang Wetan agricultural area. The high value of fecal coliform in the water used to irrigate the vegetable crops in the Sariwangi area indicates a fecal contamination from human feces or warm-blooded animals. Field observations signify that the water ponds used by farmers to water their vegetable crops—adjacent to vegetable gardens—are domestic wastewater disposal pools that serve residents in the eastern part of the pond.

The quantification of eggs was conducted on soil samples and irrigation water of the field, either on the inlet (irrigation water source), soil, or water in the field. In conjunction with results of fecal coli tests, the high level of helminth eggs in Sariwangi inlet water of up to 119.44 eggs/L indicates that the water source used has been contaminated with feces as it is proved to be domestic wastewater from housing areas. The high average number of helminth eggs in the second sampling of Sariwangi, particularly in water spinach plants, is probably due to the end of the dry season where no rainfall leads to no dilution of the water source. This condition turns the residential wastewater pool into the only water source for irrigating the soil/plants, which is done manually.

Figure 1 depicts that almost all samples of water, soil, and vegetable show positive results on the presence of helminth eggs of more than 1 egg/L, failing to comply with the recommended standard for the safe use of wastewater in agricultural activities (WHO, 2006). The allowable amount of eggs is applicable for unrestricted irrigation (watering crops that are commonly eaten raw), restricted irrigation (watering crops that eaten cooked by humans), as well as localized irrigation (a technology that applies water directly to plants such as drip or bubbler irrigation that prevent human contacts with the irrigation water).

The type of helminths found in all samples of water, soil, and vegetable is predominantly *Ascaris lumbricoides*, one of the major species that infect many humans. In Indonesia, the incidence rate of Ascariasis infection is quite high compared with developed countries. From a number of studies on the prevalence of helminths in several regions of Indonesia, such as Palu,

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Donggala, Bali, Malang, Cisarua, and DKI Jakarta, the most common infecting species found in correspondent feces are *A. lumbricoides* (Andaruni et al., 2012; Chadijah and Veridiana, 1996; Chadijah et al., 2013; Mardiana and Djarismawati, 2008; Rahayu, 2006; Widjana and Sutisna, 2000). The high incidence rate of Ascariasis is mainly caused by the number of eggs produced along with the durability of helminth larvae on soils with conducive conditions. According to Sutanto *et al.* (2009), *Ascaris lumbricoides* eggs can thrive on clay with a high humidity at 25°–30° C. It also corresponds to the soil type of both research sites in the form of clay and clay loam. The presence of *Ascaris lumbricoides* in water spinach samples is also in line with the dominance of this helminth type in vegetables sold in the market of Tanjung Sari Sumedang and Jatinangor, located about 20–30 km from Cangkuang Wetan, Bandung (Loganathan *et al.*, 2016).

Although soil types provide the optimum humidity and temperature for *Ascaris lumbricoides* eggs and other types of helminths to grow, the variation in the number of eggs from several observations shows that environmental conditions also affect the rate of egg recovery (the ability of eggs to remain observable in the media). A considerable variation occurs most often on clay-containing soils probably because the eggs bind very strongly to small soil particles, resulting in an uneven distribution (Oge and Oge, 2000).

According to WHO (2006), the use of wastewater for irrigation will provide an increased health risk. With the number of helminth eggs exceeding the recommended value, it will pose risks to 3 groups. The first group is the consumer of the product—the risk of infection both in adults and children due to the use of wastewater without any prior treatment. The second group concerns the plantation workers themselves—the infections resulting from contacts with wastewater, especially when workers or their families (e.g. children) work or come into contact with water and soil without footwear. Lastly, the third group is the neighbors who live around the field. The transmission of helminth infections may be possible through the type of irrigation that might cause contacts. For the case in Bandung, the location of the field adjacent to the housing allows the surrounding population, particularly children, to be exposed to soil or water containing helminth eggs.

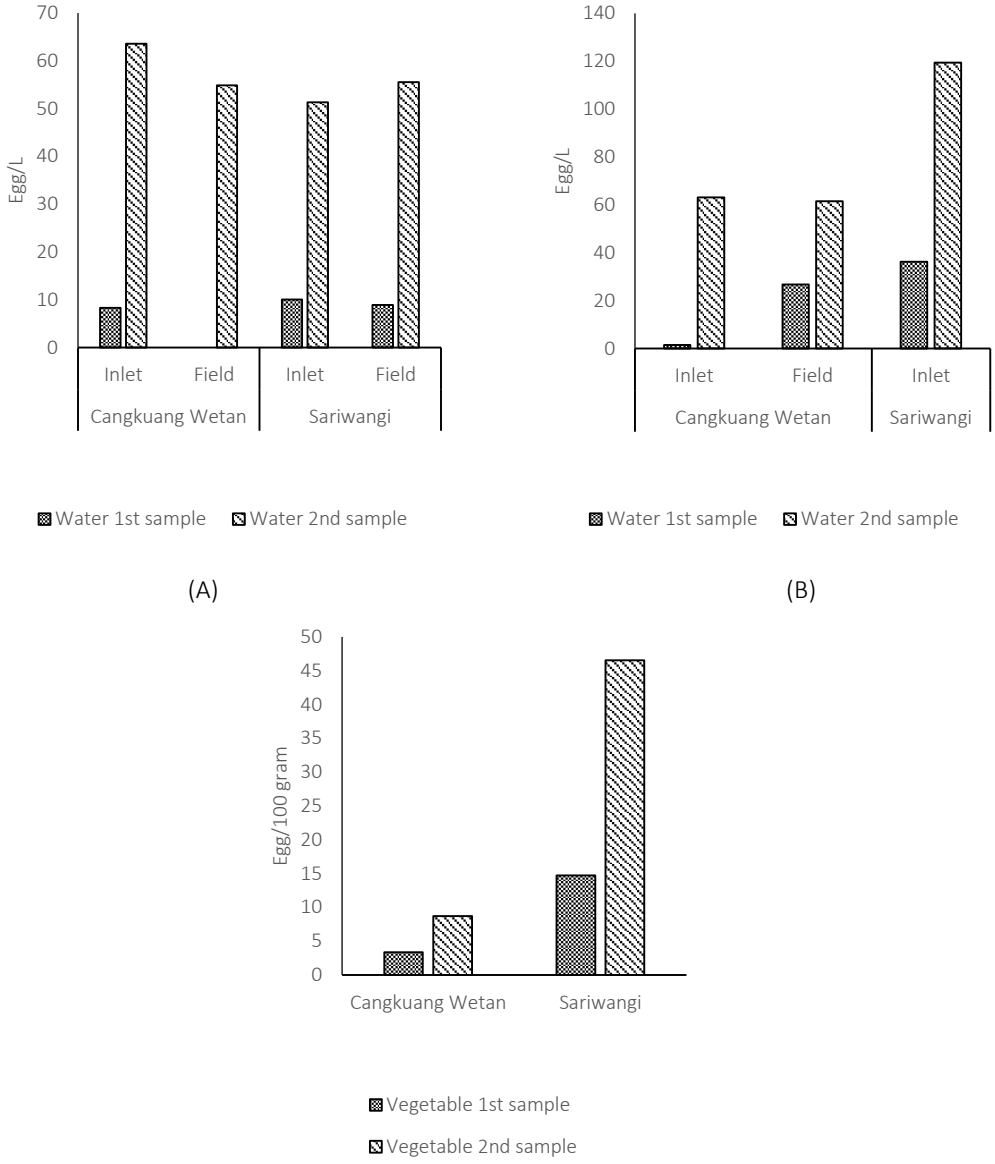

Figure 1 Helminth eggs on (A) soil, (B) water, and (C) vegetable samples in Cangkuang Wetan and Sariwangi

4. CONCLUSION

The agriculture sites chosen as the study area have been contaminated with feces, based on fecal coli and helminth eggs measurements. Sariwangi field holds a higher contamination level than the agriculture field in Cangkuang Wetan. The helminth eggs can be found in all media of soil, water, and vegetable with a number of ≤1 egg/L, exceeding the recommended standard by WHO.

The presence of helminth eggs might pose serious health risks to consumers, agricultural workers, and local people.

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