Research Article

Blackwater Communal Septic Tank Domestic Waste Treatment into Clean Water with Multilevel Filter Method, Wetland, Lotus Fish Pond, Continued to Aquaponics IPAL in Terms of TSS and TDSA

Lies K. Wulandari, Vega Aditama, Hery Setyobudiarso[3]

Institut Teknologi Nasional Malang, Malang, Indonesia

Corresponding Author: Lies K. Wulandari; email: lieskwulandari@gmail.com

Published 26 May 2023

Publishing services provided by Knowledge E

Abstract.
Blackwater or domestic waste is a type of liquid waste that requires adequate treatment so as not to pollute the environment. The effectiveness of wastewater treatment can be increased by using multilevel filters and aquatic plants as remediation agents. This study aims to improve the quality of communal domestic wastewater (WWTP) by reducing the value of domestic waste quality parameters. This study used an aquatic plant used as a Blackwater remediation agent, namely Roots Wangi (Vetiveria zizanoides). The independent variables in this study were plant distance, residence time, and plant root depth. The parameters observed were TSS (total suspended solid), TDS (total dissolved solid). The stratified filter consists of an arrangement of gravel, charcoal and sand, and the residence time is divided into a maximum of 60 days while waiting for the plants to thrive. The methods used are: Cleaning all WWTP ponds, preparing vetiver and hydroponic plants, preparing 3" PVC and holes, preparing multilevel filter gabions with weir mesh and plates, preparing multilevel filter materials, namely sand, gravel, and coconut shell charcoal. The implementation is: 3 multilevel filter packages, installation of fragrant root wetland plants in the 2nd pond, making fish and lotus ponds, aquaponics in WWTP. The data analysis method used is factor analysis. The results of the analysis show statistical similarities between vetiver plants and wastewater quality parameters, the formula is TSS = 142,395–1,865 * Wetland + e dan TDS = 1007,441–9,839 * Wetland + e. Therefore, it can be concluded that the use of multilevel filters, vetiver ponds, fish lotus ponds, aquaponics will significantly reduce the TSS and TDS parameters.

Keywords: clean water, waste water, wetland, lotus fish pond

1. Introduction

The human need for clean water continues to increase along with the increase in population [1]. In addition to being consumed, water is also used by humans to meet other needs by using the technology they have to support survival [2]. The use of water is highly dependent on the quality of the water itself, regardless of its designation, whether it is for consumption, for cleaning the body or clothes, for fishing, agriculture, industry, and so on [3]. On the other hand, wastewater production also continues to increase and has the potential to pollute clean water sources and the environment in general [4]. Urban residential areas in Indonesia are one of the main contributors to river pollution up to 70% [5]. In fact, domestic wastewater contributes much more to river pollution than industrial waste [6].

Environmental problems arise when waste water disposal is carried out without going through an effective treatment process first [7], [8]. The increasing amount of domestic wastewater which is not matched by an increase in receiving water bodies both in terms of capacity and quality, causes the amount of wastewater entering the water body to exceed its capacity and carrying capacity [7], [9]. Government Regulation of the Republic of Indonesia Number 82 of 2001 describes wastewater as the residue from a business and/or activity (household and industrial) in the form of liquid, both from household and industrial activities. Household wastewater consists of 3 important fractions, namely feces (faeces) which have the potential to contain pathogenic microbes, urine (urine) which generally contains Nitrogen and Phosphorus, and small possibility of micro-organisms, and greywater (sullage) which is used washing water. kitchen, washing machine and bathroom. Domestic waste treatment aims to minimize its negative impact when discharged into the environment, or in accordance with the carrying capacity of the environment [10], [11].

Based on observations in the field, the management of domestic wastewater generated from the rest of the results of household activities does not meet the rules of good waste water management. Blackwater waste is generally stored in septic tanks belonging to each resident [12], where not all residents have the infrastructure, especially in areas with high population density [13]. In other words, it is not uncommon for wastewater to be directly discharged into the waterways around the house without carrying out initial management first. This certainly has a negative impact on health and environmental sustainability. According to Slamet [14], excreta waste (feces and urine) is harmful to the environment and health because it contains pathogenic microorganisms and other toxic substances [15]. Although the largest content in blackwater waste is organic matter, very high levels make it dangerous for the environment [16].

The solution for treating blackwater waste that has been proven so far is through the use of various materials as filters, such as sand [17], [18], charcoal [19], [20], gravel [21], to shredded plastic bottle waste [22]. In addition to filter material, waste treatment can also be carried out by utilizing various plants as remediation agents, namely through the wetland system [23], [24]. Some of these types of plants include Wangi Root (Vetiveria zizanioides) [25], [26] and Lembang (Typha angustifolia) [27], [28]. The application of filtration techniques is proven to be able to effectively filter various suspended solids in water [29]. Not only that, the combined use of charcoal can bind pollutants and help neutralize the pH of the water [30]. Meanwhile, the use of plants as remediation agents has also been shown to drastically improve water quality through the symbiosis found in plant roots [31]. However, these various innovations certainly require development in order to further maximize wastewater treatment technology, especially blackwater.

Based on this background, it is necessary to develop research to improve the quality of waste treatment output from the system that has been implemented so far. Better waste management output is expected not to pollute the environment if disposed of, not to endanger human health, and can be used directly if used in agricultural/plantation irrigation activities. The widespread application of waste treatment innovations will be very beneficial for environmental sustainability.

2. Methods

This study uses 1 type of aquatic plant that will be used as a remediation agent in the treatment of household waste (Blackwater), namely Wangi Root (Vetiveria zizanoides). The independent variables in this study were plant distance, residence time, and root depth, while the dependent variable was discharge. The parameter observed is TSS (Total Suspended Solid). And TDS (Total Dissolved Solid). The stratified filter consisted of gravel, charcoal and sand composition, and the residence time was divided into 28 days, 35 days, 40 days, 43 days, 45 days, 47 days, 52 days, 55 days and 60 days. The following are the locations of waste treatment that will be applied in this research:

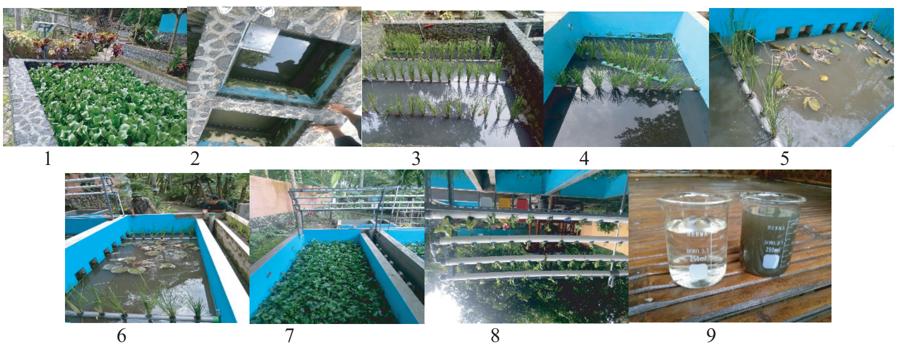

Figure 1: Design of Tlogomas WWTP Blackwater Waste Treatment until it becomes clean water.

1. The initial waste pond after the crushing tank with water hyacinth plants to reduce the processed waste.
2. The second image output from pond 1 shows a row filter or multilevel filter with the following arrangement: the first filter contains gravel, the second filter contains coconut shell charcoal, and the third filter contains cast sand. The filter box is made of weirmesh wire and stainless plate with a size of (30x40x40) cm.
3. Figure 3, the output of the multilevel filter shows the 2nd waste pond with a Wetland plant Root of vetiver (Vetivria Zizanioides) by planting it in a 3” diameter PVC pipe hole.
4. Picture 4 of the output from the 2nd pond, namely the 3rd pond with vetiver plants on a 3’ pvc pipe
5. The 5th output of the 3rd pond shows the Lotus fish pond
6. Figure ?? output from pond 4 shows the Lotus fish pond continued from pond 5 and the water can be pumped up to irrigate the aquaponics standing upright above pond 4,5,6 transversely.
7. The 7th image is the last pond or the 6th pond is the output of aquaponics and the 5th pond.
8. Figure ?? is aguaponics with mustard plants and the water is taken from pond 5 or Figure ?? which will be pumped up.
9. Figure ?? is a picture of the water quality at the beginning in pond 1 and at the final place, namely aquaponics with a residence time of up to 60 days while waiting for the plants to thrive which produces class 2 water quality or clean water assessed from its TSS and TDS.

2.1. Linear Regression Test Results

Linear regression is a test tool to determine the effect of independent variables on the dependent variable, namely the effect of wetlands on water quality parameters TSS, TDS, with the following results.

The equation formed from these results is

TSS = 142,395 – 1,865 * Wetland + e

Table 1: Effect of Wetland on TSS Parameters.

Model	Unstandardized		Standardized Coefficients	t-result	Sig. t
	Coefficients				
	B	Std. Error	Beta		
(Constant)	142.395	14.236		10.003	0
Wetland	-1.865	0.31	-0.676	-6.023	0
R-Square	0.458				
F-hitung	36.276				
Sig. F	0				

The effect of the wetland on the TSS parameter obtained a constant coefficient of 142,395, which means that without the influence of the wetland, the predicted TSS parameter of 142,395 will be obtained. Then the effect of wetland on the TSS parameter obtained a regression coefficient of -1.865 with a t-count value of 6.023 and a significance value of 0.000. These results show a significance value of less than 0.05 (sig < 0.05) which means that there is a significant negative effect, meaning that every 1 day wetland and with the use of multilevel filters, vetiver ponds, fish lotus ponds, aquaponics and will affect the decrease TSS parameter is 1,865 units. The value of the coefficient of determination of 0.458 indicates the magnitude of the influence of the wetland on the TSS parameter is 45.8 percent.

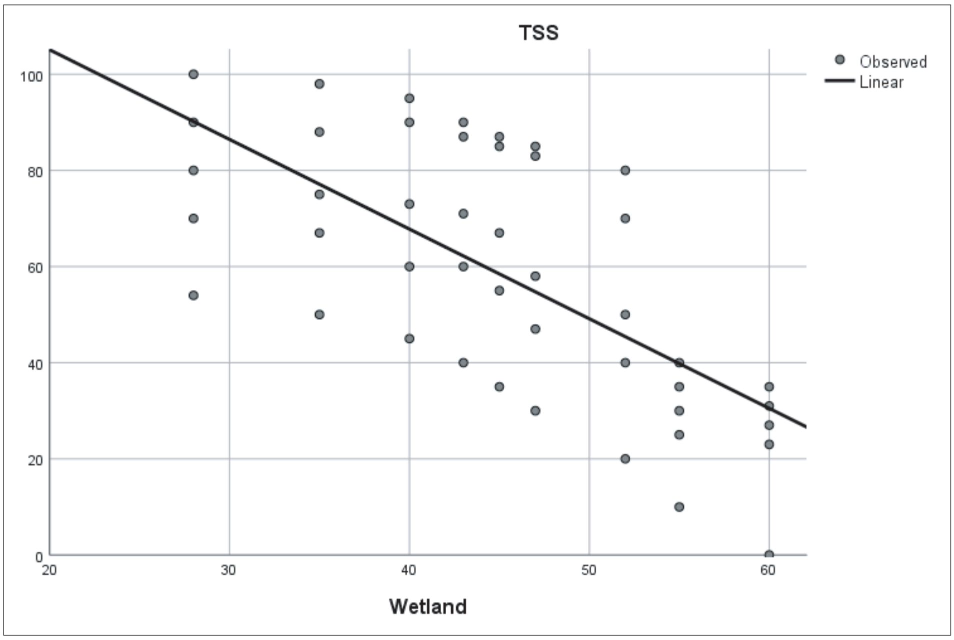

Figure 2: Linear Regression Test Results in TSS Parameter.

The equation formed from these results is :

Table 2: Effect of Wetland on TDS Parameters.

Model	Unstandardized		Standardized Coefficients	t-Result	Sig. t
	Coefficients				
	B	Std. Error	Beta		
(Constant)	1007.441	35.276		28.559	0
Wetland	-9.839	0.767	-0.89	-12.822	0
R-Square	0.793				
F-Result	164.415				
Sig. F	0				

Source: Processed Research Data (2021)

TDS = 1007,441 – 9,839 * Wetland + e

The effect of the wetland on the TDS parameter obtained a constant coefficient of 1007.441, which means that without the influence of the wetland, the predicted TDS parameter of 1007.441 will be obtained. Then the effect of wetland on the TDS parameter obtained a regression coefficient of -9.839 with a t-count value of 12.822 and a significance value of 0.000. These results show a significance value of less than 0.05 (sig < 0.05) which means that there is a significant negative effect, meaning that every 1 day wetland and with the use of multilevel filters, vetiver ponds, fish lotus ponds, aquaponics and will affect the decrease TDS parameter is 9,839 units. The value of the coefficient of determination of 0.793 indicates the magnitude of the influence of the wetland on the TDS parameter is 79.3 percent.

2.2. ANOVA Test Results

Analysis of Variance (ANOVA) is a test tool to determine the difference between several treatments on the dependent variable, namely the difference between blackwater, water in vetiver ponds, water in fish lotus ponds, and water in aquaponics on water quality parameters TSS, TDS, with the results as follows.

Table 3: ANOVA Test Results on TSS Parameters.

	N	Mean	SD	Reduction	F - Result	Sig. F
Black Water	9	860.78	70.539		943.401	0
Fragrant Root Pool	9	76.22	23.889	↓ 91.2%		
Lotus Fish Pond	9	54.56	18.331	↓ 28.6%		
Aquaponic	9	31.56	18.386	↓ 41.9%		

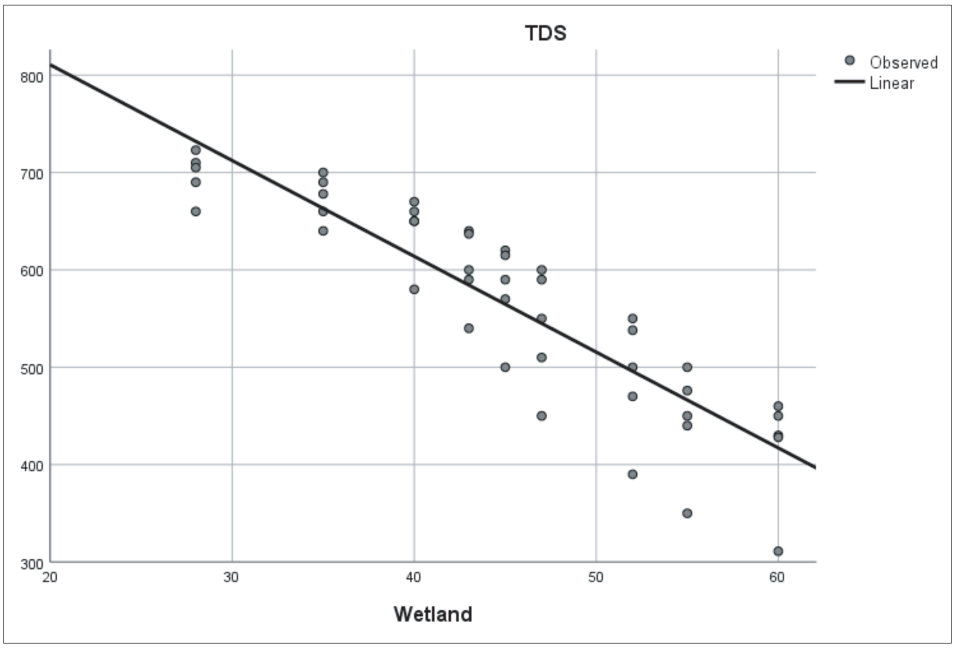

Figure 3: Linear Regression Test Results in TDS Parameter.

Source: Processed Research Data (2021)

The results of the blackwater TSS measurement obtained an average of 860.78 then decreased by 91.2 percent in the vetiver pond to 76.22, then decreased by 28.6 percent in the fish lotus pond to 54.56, and decreased by 41.9 percent in aquaponics to 31.56. The results of the ANOVA test obtained the calculated F value of 943.401 with a significance value of 0.000. These results indicate a significance value of less than 0.05 (sig < 0.05), which means that there is a significant difference between blackwater, water in the vetiver pond, water in the fish lotus pond, and water in aquaponics on the TSS parameters.

The results of the description of the TDS water quality parameters in blackwater on filter 1 to filter 3 obtained a TDS value of 550 to 756, then experienced a large decrease in the filter by 523 to 740, after that it decreased to aquaponic by 311 to 660.

3. Conclusions

Based on the results of theoretical and analytical calculations from the physical model test data, the equation results obtained from the problem formulation are:

1. Total Dissolved Solid (TDS), in the blackwater model against the stratified filter and the wetland, an equation of TDS = 1007,441 – 9,839 * Wetland + e

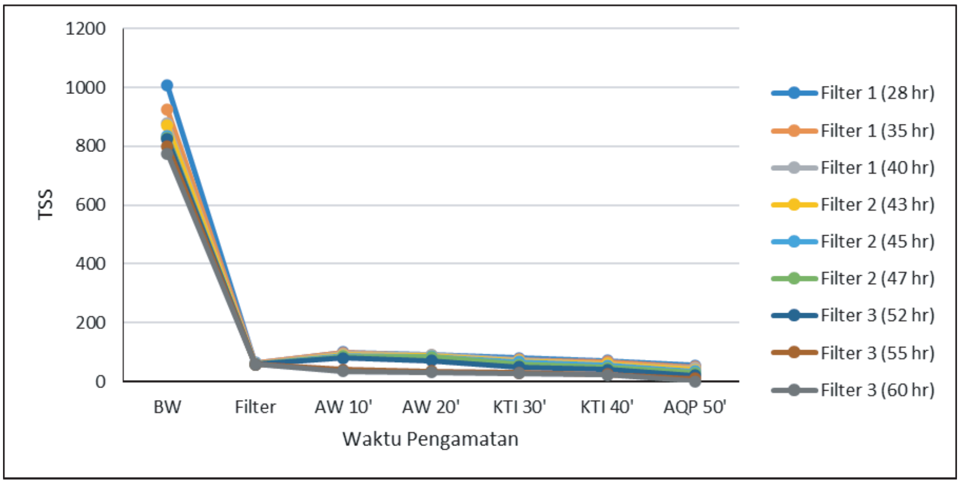

Figure 4: Blackwater TDS measurement results.

2. Total Suspended Solid (TSS), in the blackwater model against the stratified filter and the wetland, an equation of TSS = 142,395 – 1,865 * Wetland + e

Acknowledgments

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