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*Original Article*

# Spatial Distribution of Livestock Wastewater Pollution and its Treatment in Saddang Watershed

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***Abstract*** - *The Saddang River is the principal river in the Saddang Watershed (DAS) with degraded water quality. Sources of pollution include residential neighbourhoods, industries, and commercial districts. In addition to being a site for exchanging basic necessities, the livestock market is also a specialised area for dealing with animals, particularly buffalo and pigs. Due to improper waste management, the enormous quantity of animals harms the ecosystem. Animal waste runs directly into natural and manmade channels leading to the Saddang river, which is just 64 metres from the livestock market. Therefore, actions must be taken to improve waste treatment technology and lessen the pollution burden. This research consists of determining the spatial distribution of waste pollution or waste distribution patterns using a Geographic Information System (GIS) application, beginning with initial sampling at five stations on the Saddang River and one at the outlet. The sample is tested in the laboratory and the results are validated by determining water quality standards based on the Pollution Index according to Decree No. 11 of the Minister of the Environment. Using organisms to break down livestock waste with Gambas, Zeolite, Bio-ball, Jap mat, and water bamboo plants as buffer media, a reactor with a biofilter and phytoremediation system is used for waste treatment. The results demonstrated that waste treatment with biofilter and Phytoremediation systems effectively reduced waste for physical parameters, namely Dissolved Residue (TDS) of 78.64 percent, Suspended Solids (TSS) of 97.93 percent, Turbidity of 96.90 percent, for parameters Chemical COD of 97.69 percent, DO of 98 percent, Nitrate of 29.29 percent, Ammonia of 66.35*

***Keywords*** - *Biofilter, Effectiveness, Phytoremediation, Water quality, Livestock waste.*

## 1. Introduction

Changes in land use reflect the influence of human activities on the environment, which determines the quantity of accessible land. Water is becoming more scarce, and pollution affects the quantity of water required by the population. The Saddang River in North Toraja Regency was affected by this event. The Saddang River is interprovincial (South Sulawesi and West Sulawesi Provinces). The Regional Drinking Water Company (PDAM) utilises Saddang river water as a supply of raw water for various purposes [1]. As a result of pollution from residential and non-domestic trash, the water quality of a river degrades. The cattle trade center, which is one of the main traditional marketplaces in Indonesia, is one of the causes of pollution [2]. Buffaloes and pigs are the most often sold animals since they are strongly associated with the local community's traditional festivities, and this livestock market is also a tourist attraction due to its distinctiveness, such that it has become one of the symbols of northern Toraja [3]. Tourists come directly to see many varieties of buffalo and pigs. However, the vast quantity of animals generates environmental issues due to improper waste management [4]. This study aims to analyse the water quality in the Saddang watershed using the Pollution Index method, determine the spatial distribution of livestock wastewater pollution, and treat livestock waste by using a waste treatment unit with a specialised treatment process.

## 2. Literature Study

A watershed is a geographical region defined by natural separators in the form of mountain ridges that collects and drains precipitation, sediment, and nutrients to the ocean through the main river. Beneficiaries of the area's cohesive ecology include both natural and human resources. In general, the watershed ecosystem is separated into upstream, middle, and downstream regions that are connected biophysically via the hydrological cycle, with the upstream region serving to safeguard the other regions. Rivers are natural bodies of water through which precipitation and wastewater flow to the ocean, constituting biotic and abiotic environments. Government Regulation No. 35/1991 defines a river as a site, a container, and a network for the flow of water from springs to sound, confined to the right and left and so long as the flow is by a boundary line. In other words, changes in land use reflect the influence of human activities on the environment, which increases the quantity of water that is accessible. The longer it continues to deplete and become polluted, the greater the effect on the community's water supply. The Saddang River in North Toraja Regency was affected by this event. The Saddang River is interprovincial (South Sulawesi and West Sulawesi Province). In the National Spatial Plan (RTRWN), North Toraja is designated as a protected forest region in South Sulawesi. Geographically, it is one of the districts with hilly terrain and forest-dominated land use. This causes the water supply potential to be sufficient for meeting water requirements. As a result of pollution from residential and non-domestic trash, the water quality of a river degrades. Sources of pollution include residential neighbourhoods, industries, and commercial districts. In addition to a site for exchanging basic necessities, the livestock market is also a specialised area for dealing with animals, particularly buffalo and pigs. In addition to being a source of the regional revenue, this cattle market is also a tourist attraction due to its distinctiveness, which benefits the government and community of North Toraja Regency significantly. Due to improper waste management, the enormous quantity of animals harms the ecosystem. Waste from livestock is dumped directly into natural and artificial channels leading to the Saddang River, which is 64 metres from the livestock market; therefore, it is necessary to take steps to develop processing technology and conserve water resources by determining the distribution of pollutants caused by livestock waste and determining management methods so that conservation Water Resources in the form of protection of river restoration sections and their watersheds, so that the river can be restored so that the livestock market can continue to operate.

The following steps provide the foundation for assessing the geographical distribution of livestock wastewater contamination and its treatment in the Saddang Watershed (DAS)[1]:

- Analyze water quality based on pollution-related criteria.
- Calculating the river's pollutant load using the Pollution Index (IP) technique.
- Determine the distribution or distribution pattern of pollution caused by livestock market waste.
- Construct a treatment facility for livestock waste.

### 2.1. River Water Quality in terms of Pollution Parameters

Based on Government Decree No. 82 of 2001 of the Republic of Indonesia of Water Quality Management and Water Pollution Control and its application Water that satisfies the standards, mainly those of Physics, Chemistry, and Biology, where the physical requirements are Temperature, TDS, TSS [5]; chemical requirements are pH, BOD, COD, DO, NO3, NH4-N, Nitrite; and biological terms are Fecal Coliform, Total Coliform. The criteria for river water quality consist of [6]:

- Class I: Water whose categorization may be used for drinking water, raw water, or similar uses.
- Class II: Water whose classification is utilised for water recreation infrastructure/facilities, freshwater fish culture, animal husbandry, plant irrigation, or other designations requiring the same water quality as those uses.
- Class III: water designated for freshwater fish culture, animal husbandry, water for irrigating crops, or similar applications.
- Class IV: water that may be used for irrigating crops and other uses that need the same water quality [7].

### 2.2. River Water Quality in terms of Pollution Parameters

Management of water quality based on the Pollution Index (IP) may provide feedback to decision-makers for evaluating the quality of water bodies for a designation and taking action to improve quality if quality declines due to the presence of pollutant compounds [8]. Evaluation of the value of the Pollution Index:

- $0 \leq IP \leq 1{,}0$ = *good*,
- $1{,}0 < IP \leq 5{,}0$ = *slightly polluted*,
- $5{,}0 < IP \leq 10$ = *fairly polluted*,
- $IP > 10{,}0$ = *heavily polluted* [9]

Pollution Index Equation:

$$PI_j = \sqrt{\frac{(C_i/L_{ij})_M^2 + C_i/L_{ij})_R^2}{2}} \qquad \ldots\ldots(1)$$

Where :

Lij = concentration of water quality parameters listed in the Quality Standard of a Water Designation (j),

Ci = concentration of water quality parameters (i) obtained from the analysis of water samples at a sampling location from a river channel, measurement results

PIj = Pollution Index for allotment (j) which is a function of Ci/Lij [10].

River pollution load is the concentration of a polluting element in river water or water pollution, which is the introduction or integration of organisms, chemicals, energy, or other components into the water as a consequence of human activity [11], resulting in a decrease in water quality that renders the water unusable. based on its designation [12]. This wastewater contains excrement, urine, and washing water obtained from living creatures, such as manure from cattle.

Based on Minister of the Environment of the Republic of Indonesia Regulation No. 5 of 2014 [13].

*2.2.1. Buffalo Liquid Animal Waste*

According to the Central Statistics Agency of South Sulawesi in 2013, there were at least 90,642 buffalo. This necessitates discussion of the buffalo cow industry since the processing of buffalo cattle creates waste that may contribute to environmental damage. The chief sources of pollution generated by buffalo livestock waste are liquid waste in the form of animal-washing water, storage-cage-cleaning water, and urine. While solid waste consists of uneaten feed and faeces, liquid waste comprises urine and other bodily fluids [14].

*2.2.2. Pig Livestock Liquid Waste*

According to data compiled by the Central Statistics Agency of South Sulawesi in 2014, there were at least 60,860 pigs. The organic content of pig farm wastewater is due to the properties of pig farm waste. The wastewater consists of urine, faeces, food leftovers, and water used for cleaning cages [15].

### *2.3. Determine the Pattern of Pollutant Dispersion Caused by Cattle Market Waste*

The Geographic Information System (GIS) application is used to identify the distribution pattern or geographical distribution of animal market waste contamination [16]. GIS is a computer-based technology and methodology for the collection, administration, analysis, and display of geographic data. After collecting data using the Pollution Index Scoring method [Equation 1], this application depicts the waste distribution pattern in the Saddang River. The location of the proposed waste treatment facility close to the cattle market is determined by the findings of the GIS programme.

### *2.4. Animal Waste Treatment Building to Reduce River Water Quality Degradation*

*2.4.1. Model for Wastewater Treatment*

The Wastewater Treatment Building Model Comprises [17]:

- The purpose of an equalisation tank is to limit and regulate variations in the flow of liquid waste, in terms of both quantity and quality, as well as to homogenise the concentration of liquid waste [18].
- Body for Preliminary Settlement: At this step, the wastewater is processed into a settling basin to minimise the waste's suspended particles [19].
- Biofilter Tub: A biofilter is a tank for treating wastewater using microorganisms. During the biofilter process, wastewater is drained into a biological reactor or tub containing a buffered media for the growth of microorganisms.
- Final Settlement, water from the biofilter is precipitated for four hours prior to Phytoremediation and Plant-free treatment [20].
- Phytoremediation tubs and non-Phytoremediation tubs are tubs containing plants and tubs containing merely wastewater from the final sedimentation tank.

*2.4.2. Wastewater Treatment*

The purpose of liquid waste treatment is to remove or isolate contaminants. There are three kinds of liquid waste treatment: physical, chemical, and biological [21]. Physical Treatment: The objective of physical treatment is to remove unwanted chemicals from water without employing chemical or biological reactions [28]; only physical procedures are used. Biological treatment is a wastewater treatment procedure that leverages the growing activity of microorganisms that come into touch with wastewater so that they may use existing polluting organic bacteria as food components and disintegrate or stabilise them under certain environmental circumstances [23]. In this research, wastewater is treated using a combination of physical and biological treatment [24] by filtering the waste treatment building, beginning with the equalisation building and ending with the initial deposition building. Biological wastewater treatment with a biofilter and phytoremediation technology. The Biofilter houses the expansion of degrading microorganisms by using organic and inorganic materials as a buffer medium for the proliferation of microorganisms, namely Jap-mat, Gambas, Zeolite Sand, and Bio-ball. The flow system is conducted in a downward direction (from top to bottom) to facilitate gravity filtering and the formation of biofilm sludge by microorganisms [25, 26], and the Phytoremediation Method, a system in which certain plants collaborate with microorganisms in the water to convert contaminants into less or harmless substances [27].

## 3. Materials and Methods

### *3.1. Type of Research*

The sort of research used is field research and laboratory sample testing. To obtain research data, the data source is primary data obtained directly from the field by sampling at 6 points in the Saddang river, where 3 sample points are upstream, 2 sample points are downstream, and one sample point is at the river's outlet; and waste sampling livestock from the simulation results of physical models in the field before and after being processed and then tested by the Makassar Plantation Product Industry Laboratory (BBIHP), animal wastewater discharge dilution. The DEMNAS 2013-22v1.0 will be used in the process of identifying the distribution of animal waste and RBI maps in SHP format, coordinates for samples in rivers, photographs of research areas, and the quantity of buffalo and pigs on the market.

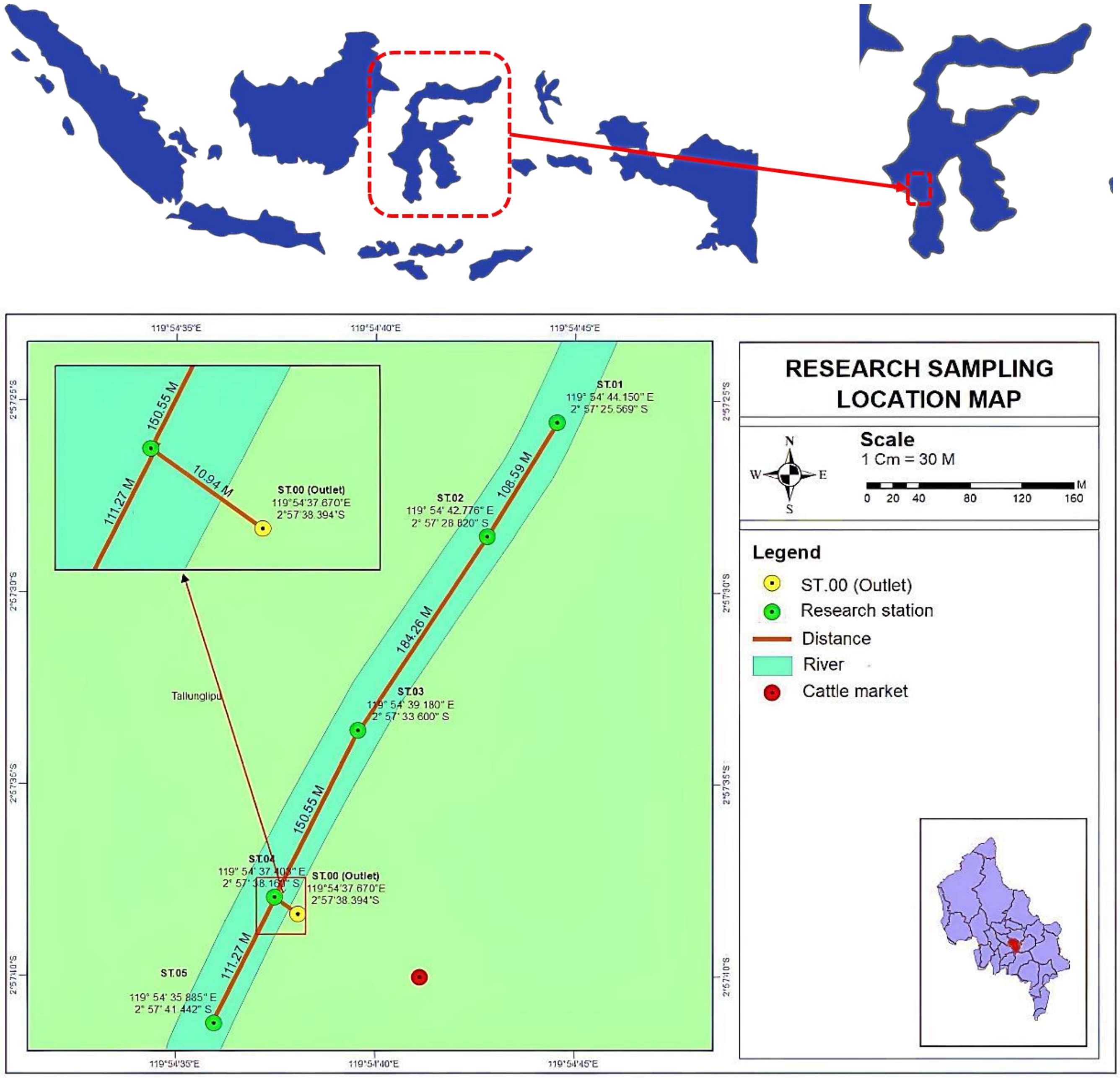


**Fig. 1 Sampling Location Map**

### *3.2. Research Parameter*

This study used Biofilter as a buffer medium, using jap mat material of 50 by 50 centimetres, gambas measuring 20 to 30 centimetres, Zeolite Sand measuring 4.75 millimetres, Bio Ball measuring 3 centimetres in diameter, and water bamboo plants for phytoremediation. The utilised equipment and materials are reactor units built of stone masonry, and the arrangement of the tubs starts with an equalisation tank measuring 80 cm by 153 cm by 60 cm, followed by an initial depositing basin measuring 90 cm by 153 cm by 60 cm. The biofilter tub I am split into 2 rooms with dimensions of 100 cm by 140 cm by 60 cm, each containing gambas buffer media for the first room and Jap-mediated buffer media for the second room. To collect data, the initial sample (inlet) and the last sample (exit) of animal waste processed in the waste treatment plant are collected. 14 days after going through a method starting with the eculization tank and concluding with the final deposition basin by calculating the residence time in the Phytoremediation tank with a 7-day dwelling period, the sample was tested in the laboratory.

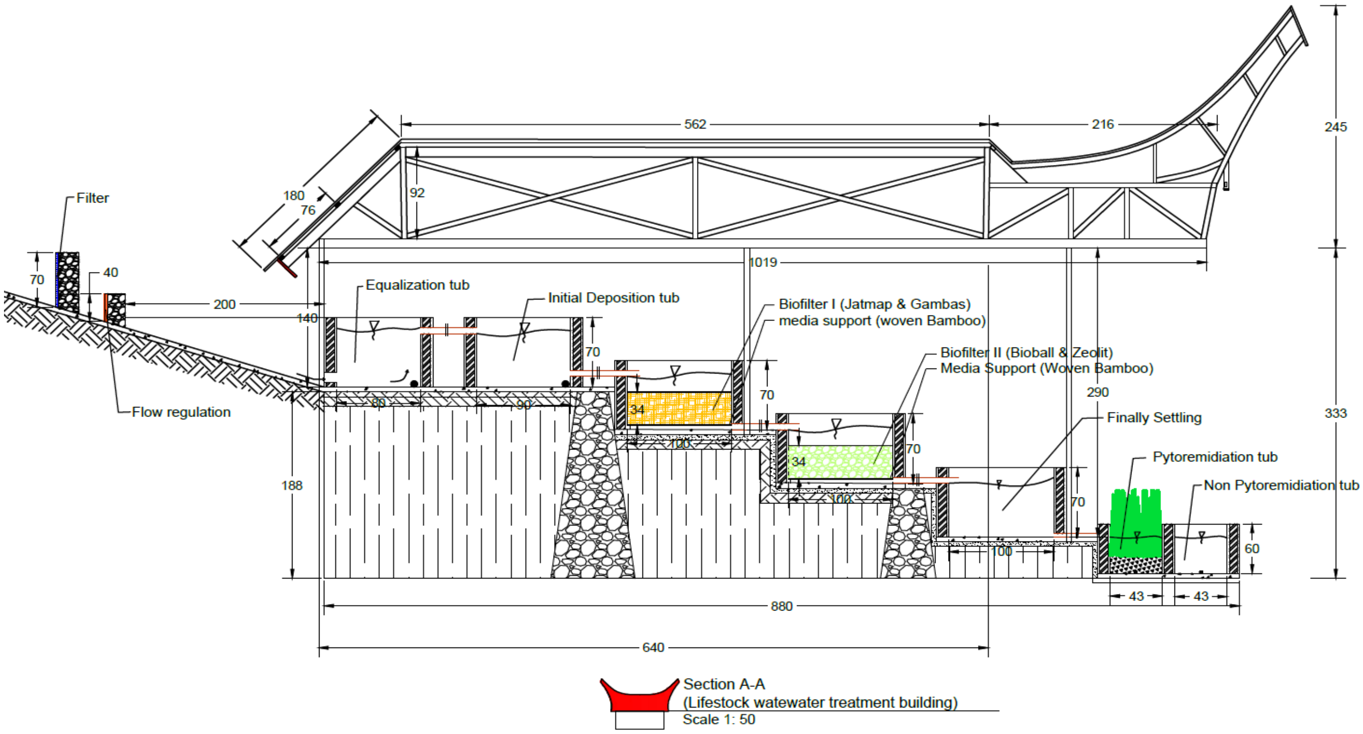


**Fig. 2 Waste treatment building**

The collection of data included many processes, including the assessment of the liquid waste's fundamental characteristics, the collection of samples of Saddang river water, and laboratory testing. Then, determine the water quality condition using the Pollution Index method and input the data from the analysis of the pollution index into the GIS application to determine the distribution pattern or distribution of wastewater pollution in the Saddang River. The variables analysed are the liquid waste intake and output of a sewage treatment plant equipped with biofilters and phytoremediation.

## 4. Results and Discussion

The factors determining the spatial distribution of livestock waste pollution and its treatment in the Saddang watershed are the decrease in the quality of Saddang river water due to the burden of livestock waste pollution; the pattern of waste distribution that indicates the river is heavily polluted; the residence time in the livestock waste treatment building; and the effectiveness of the media buffering gambas, jap-mat, zeolite, bio-ball, and water bamboo plants.

### *4.1. Water Quality Status Determination Analysis*

Laboratory parameters included temperature, TDS, DO, dissolved residue (TDS), suspended solids (TSS), turbidity, chemical parameters (pH, BOD, COD, DO, nitrate (NO3), ammonia (NH4-N), nitrite (NO2)), and biological parameters (Fecal Coliform, Total Coliform). Based on Table 1, which displays the laboratory-tested river water sample, the water quality status is assessed using the Pollution Index (IP) approach by comparing each parameter's value to its respective quality criteria. The example calculation for the pollution index based on equation 1 is ST.01.

The outcomes of identifying the status of water quality at ST.0 (inlet) are shown in Table 2, which is followed by the Recapture of the Status of Water Quality in the Saddang River Using the IP Method. According to Table 3, the water quality along the Saddang River is heavily polluted upstream at station ST.01; moderately polluted upstream at station ST.02; moderately polluted upstream at station ST.03; heavily polluted downstream at stations ST.04 and ST.05; and heavily polluted at station ST.01, which is located at the river's outlet.

### *4.2. Waste Distribution Pattern*

Using a Geographic Information System (GIS) application, determining the distribution pattern or spatial distribution of liquid waste in the Saddang River by digitising the Indonesian Earth Map (RBI) in Tallunglipu District using DEM Data (Digital Elevation Model) DEMNAS 2013-22v1.0, scoring for each water quality parameter data from field research that has been analysed by the laboratory, and the results of determining the status of water quality with a pollution indicator Plotting the coordinates of the research station's location to create a map of the distribution of each water quality parameter so that a map of the distribution zone of livestock waste pollution can be created by entering the Pollution Index method score results.

**Table 1. Test results for each station**

| No | PARAMETER | UNIT | Sample Code | | | | | | Water quality Standard PP No.82 Thn 2001 |
|---|---|---|---|---|---|---|---|---|---|
| | | | ST.00 | ST.01 | ST.02 | ST.03 | ST.04 | ST.05 | |
| **I. PHYSICS** | | | | | | | | | |
| 1 | Temperature | C | 25,9 | 27,2 | 28 | 27,7 | 27,7 | 27,7 | Temperature ± 3 |
| 2 | Total Dispended Solids (TDS) | Ppm | 11,1 | 3,45 | 0,1 | 0,84 | 9,95 | 1,59 | 1000 |
| **II. CHEMICALS** | | | | | | | | | |
| 3 | Potential Hydrogen (pH) | - | 7,12 | 6,93 | 7 | 6,98 | 7,02 | 6,67 | 6—9 |
| 4 | Dissolved Oxigen (DO) | Ppm | 3,21 | 3,04 | 2,9 | 1,9 | 0,48 | 0,36 | 6 |
| 5 | Biochemical Oxygen Dermand (BOD) | Ppm | 2278,3 | 2298 | 131 | 0,65 | 0,98 | 3,92 | 2 |
| 6 | Chemical Oxygen Demand (COD) | Ppm | 5695,7 | 1,63 | 2,5 | 9,79 | 5745 | 326 | 10 |
| 7 | Nitrate (NO1) | Ppm | 0,951 | Tt | 0 | Tt | 1,38 | 0,03 | 10 |
| 8 | Nitrite (NO2) | Ppm | 1,158 | 0,01 | 0 | 0,01 | 1,3 | 0,06 | 0,06 |
| **III. MICROBIOLOGY** | | | | | | | | | |
| 9 | Total Coliform | colony/100ml | >1100 | >1100 | >1100 | >1100 | >1100 | 36 | 1000 |
| 10 | *E.coli* | colony/100ml | 160 | 3500 | 17 | 3500 | 43 | | 100 |

**Table 2. Results of Saddang River Water Quality Status at the first Station (ST.01) with Pollution Index**

| NO | PARAMETER | Unit | Lij | Ci | Ci/Lij | Ci/Lij new |
|---|---|---|---|---|---|---|
| 1 | Temperature | ºC | Normal ± 3 | 25,9 | 8,63 | 5,68 |
| 2 | Total Dispended Solids (TDS) | Ppm | 1000 | 11,1 | 0,01 | 0,01 |
| 3 | Derajat keasaman (pH) | - | 06-Sep | 7,12 | -0,25 | -0,25 |
| 4 | Dissolved Oxigen (DO) | Ppm | 6 | 3,21 | 2,64 | 3,11 |
| 5 | Biochemical Oxygen Dermand (BOD) | Ppm | 2 | 2278,3 | 1139,15 | 16,28 |
| 6 | Chemical Oxygen Demand (COD) | Ppm | 10 | 5695,68 | 569,57 | 14,78 |
| 7 | Nitrate (NO1) | Ppm | 10 | 0,951 | 0,10 | 0,10 |
| 8 | Nitrite (NO2) | Ppm | 0,06 | 5695,68 | 94928,00 | 25,89 |
| 9 | Total Coliform | colony/100ml | 1000 | >1100 | 1,10 | 1,21 |
| 10 | *E.coli* | colony/100ml | 100 | 160 | 1,60 | 2,02 |
| | | | | | **Amount** | 68,82 |
| | | | | | **Average** | 6,88 |
| | | | | | **Max** | 25,89 |
| | | | | | **IP** | 18,94 |
| **Water quality Status** | | Heavy polluted | | | | |

**Table 3. Recap of Saddang River Water Quality Status with IP**

| Point | Upstream Distance (m) | IP Score | Quality Status |
|---|---|---|---|
| ST.01 | 0 | 11.79 | Heavy Polluted |
| ST.02 | 108.59 | 7.28 | Moderately Polluted |
| ST.03 | 292.85 | 6.34 | Moderately Polluted |
| ST.04 | 443.4 | 10.74 | Heavy Polluted |
| ST.05 | 554.67 | 12.17 | Heavy Polluted |

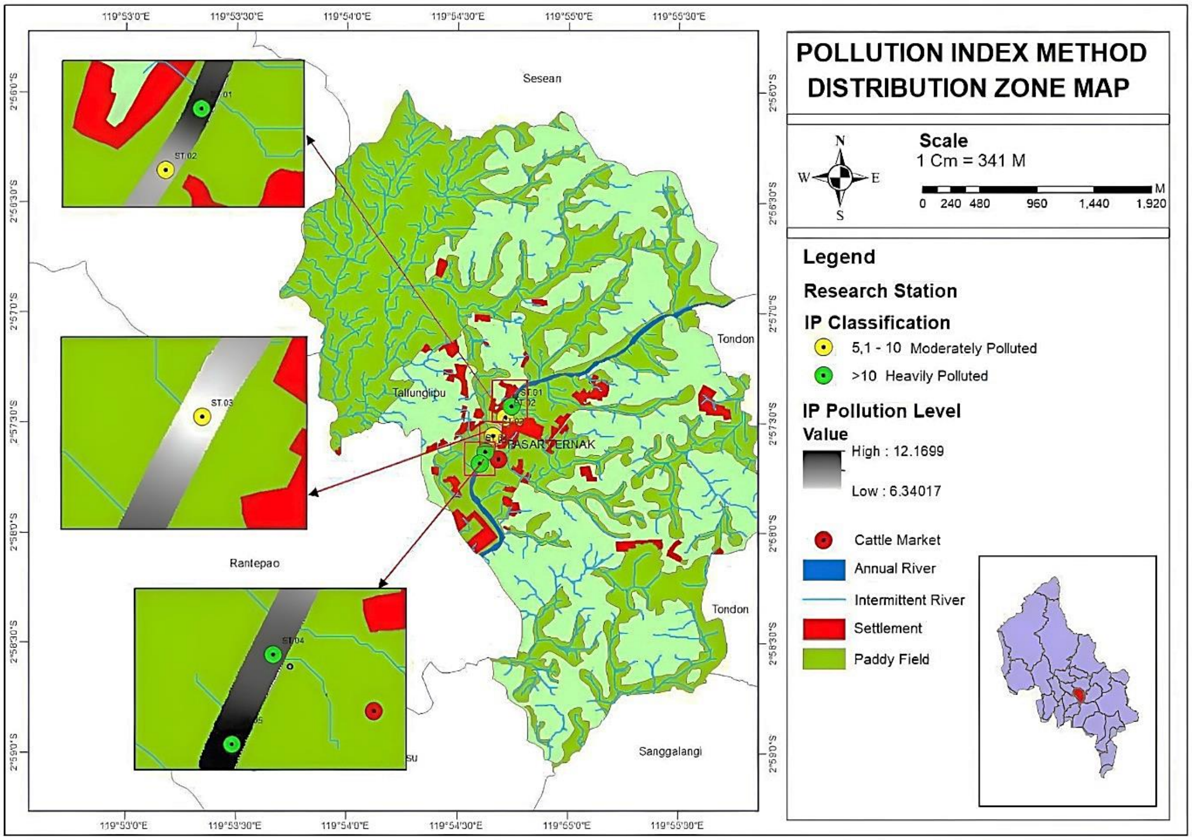


**Fig. 3 Distribution Zone Map**

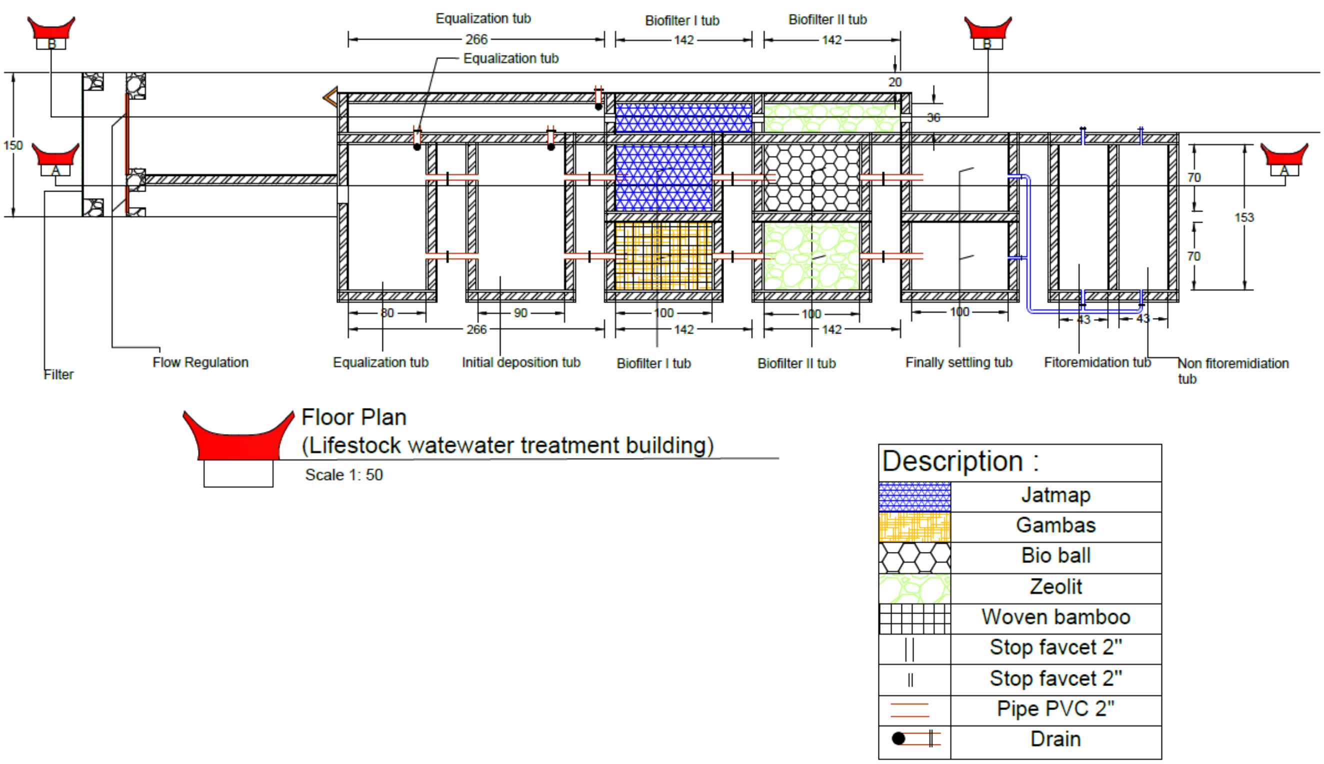


**Fig. 4 Waste Treatment Building**

### 4.3. Waste Treatment Building

Based on the distribution zone map of livestock waste, it is important to construct a treatment facility and waste processing technology to decrease the pollution load by first estimating the discharge of livestock and pig wastewater. The average discharge over three days is 498.53 m3/day. The size of the processing building may be established using the original discharge data. The equalisation tank, the initial deposition tank, the biofilter tank I, the biofilter tank II, the final sedimentation tank, and the phytoremediation tank are all split into two rooms. Then for the biofilter tank II, the zeolite media is absorbent because zeolite has extremely big pores that can collect tiny particles, and Bio-Baal serves as a medium for microorganisms or bacteria to live.

Microorganisms in this context are helpful bacteria that break down trash. To ease biofilter tub processing, each biofilter tub is equipped with bamboo media as a support for the buffer media. The purpose of the phytoremediation tank is to remove or decrease toxins using the following process: Before the wastewater enters the treatment tank, the solid waste is kept using an iron filter, and samples of the wastewater are obtained for further study of chemical, physical, and biological parameters in the laboratory.

Figure 4 depicts the treatment procedure, namely the equalisation tank with a 4-hour residence duration. To steady the flow, the wastewater is pumped into the tank until it is full. When the equalisation tank is full, the wastewater is sent to the first settling basin by opening the equalisation tank's faucet until the wastewater is full. It is deposited in the first sedimentation tank for a specified residence period of 5 hours before being flowed into the biofilter tank, which is separated into two rooms, each of which has been filled with Gambas and Jap-mat media for a predetermined residence time of 5 hours. The water from the biofilter tub I is then pumped to the next treatment, the biofilter tub II, which is separated into two chambers and loaded with Zeolite and Bio-ball media with a 5-hour residence period. The final deposition is the following treatment phase. The water is dumped in the final settling basin for 5 hours after passing through the biofilter II. Following the deposition procedure, the sample is sent to the laboratory for examination. After passing through the last sedimentation tank, the treated water flows into the phytoremediation tank, which is likewise separated into two tanks: tub 1 with water bamboo plants and tub 2 without plants. The sample is obtained for subsequent examination in the laboratory, and it is then kept for another 7 days, for a total of 14 days for testing in the laboratory.

### 4.4. Effectiveness of Waste Treatment on Initial Sample (Inlet) and Final Sample (Outlet)

According to the table, the efficacy of lowering the chemical properties of the first sample (inlet) to the end sample (outlet) is as follows: The phytoremediation concentration stayed neutral for 14 days, lowered BOD by 97.07 percent, COD by 97.69 percent, DO by 98 percent, nitrate by 29.29 percent, ammonia by 66.35 percent, and nitrite by 97.18 percent. For 14 days, the non-phytoremediation concentration remained steady, dropped BOD by 79.24 percent, decreased COD by 76.78 percent, did not decrease DO, decreased nitrate by 14.90 percent, ammonia by 50.80 percent, and nitrite by 89.95 percent.

**Table 4. The effectiveness of reducing inlet to outlet chemical parameters**

| No. | Parameter | Initial Concentration (Inlet) | Phytoremediation concentration 14 days (Outlet) | Non-Phytoremediation Concentration 14 days (Outlet) | % Decrease in Phytoremediation Concentration 14 days (Outlet) | % Decrease in Non-Phytoremediation Concentration 14 days (Outlet) |
|---|---|---|---|---|---|---|
| 1 | pH | 7,56 | 7,80 | 7,60 | - | - |
| 2 | BOD | 416,266 | 121,770 | 864,342 | 97,07 | 79,24 |
| 3 | COD | 1413,98 | 326,504 | 328,304 | 97,69 | 76,78 |
| 4 | DO | 0,0798 | 39,914 | 0,1597 | 98,00 | - |
| 5 | Nitrat ($NO_3$) | 12,924 | 91,390 | 109,980 | 29,29 | 14,90 |
| 6 | Ammonia ($NH_3$-N) | 0,326 | 0,1097 | 0,1604 | 66,35 | 50.8 |
| 7 | Nitrite ($NO_2$) | 1,065 | 0,0300 | 0,1070 | 97,18 | 89,95 |

**Table 5. The effectiveness of decreasing the physical parameters of the inlet to the outlet**

| No. | Parameter | Initial Concentration (Inlet) | Phytoremediation concentration 14 days (Outlet) | Non-Phytoremediation Concentration 14 days (Outlets) | % Decrease in Phytoremediation Concentration 14 days (Outlet) | % Decrease in Non-Phytoremediation Concentration 14 days (Outlet) |
|---|---|---|---|---|---|---|
| 1 | Temperature | 28,7 | 26,4 | 28,9 | - | - |
| 2 | Dissolved Residue (TDS) | 885 | 189 | 244 | 78,64 | 72,43 |
| 3 | Suspended Solids (TSS) | 2170 | 45 | 88 | 97,93 | 95,94 |
| 4 | Turbidity | 523 | 8,69 | 16,20 | 98,34 | 96,90 |

**Table 6. The effectiveness of reducing inlet to outlet biological parameters**

| No. | Parameter | Initial Concentration (Inlet) | Phytoremediation concentration 14 days (Outlet) | Non-Phytoremediation Concentration 14 days (Outlet) | % Decrease in Phytoremediation Concentration 14 days (Outlet) | % Decrease in Non-Phytoremediation Concentration 14 days (Outlet) |
|---|---|---|---|---|---|---|
| 1 | Fecal Coliform | 2 | 1,8 | 1,8 | 10,00 | 10,00 |
| 2 | Total Coliform | 40 | 3,5 | 17 | 91,25 | 57,50 |

The efficiency of reducing the physical characteristics of the starting concentration (inlet) to the final concentration (outlet) is shown in the table as follows: Phytoremediation samples remained stable for 14 days at temperature concentrations, with TDS 76.64 percent lower than the initial concentration, TSS 97.93 percent lower, and turbidity 98.34 percent lower, while non-phytoremediated concentrations remained stable for 14 days at temperature concentrations, with TDS 72.43 percent lower than the initial concentration, TSS 95.94 percent lower, and turbidity 96.90 percent lower.

Based on the table of the efficiency of reducing the initial concentration of biological parameters (inlet) to the end concentration (outlet): The phytoremediation concentration lowered Fecal Coliform by 10% from the starting concentration after 14 days. Total coliform decreased by 91.25 percent from the original concentration in the 14-day phytoremediation sample.

According to the results of wastewater treatment shown in tables 4, 5, and 6, the effectiveness of reducing the concentration of waste has met the water quality standards, though the results obtained have not been maximised where TSS is reduced due to the process of absorption and decomposition of contaminants (waste) in water by microbial activity in the biofilter building and aquatic plant roots.

Microorganisms flourish in neutral pH environments, minimizing waste. Plants may grow successfully with a neutral pH, minimizing waste since the nutrients required are phosphate and nitrogen. The presence of microorganisms that settle in the biofilter and plant roots reduces BOD by allowing the breakdown of organic materials, lowering the concentration of pollutants. COD reduction achieves regenerative efficiency (reduction) by the ability of biofilters and plant roots to break down COD levels, allowing microorganisms to break down COD levels. The reduction in TSS, COD and BOD parameters increases the availability of dissolved oxygen (DO), allowing plants to develop healthily. This implies that stem and root plants can adequately photosynthesize, allowing phytoremediation to occur. The capacity of the roots to absorb water increases, resulting in a reduction in turbidity.

Ammonia levels dropped owing to the capacity of the biofilter and water bamboo roots to penetrate deeply, increasing the contact area with the waste and so providing more possibilities to absorb nitrogen. Smaller amounts of enfluent were found with residency lengths of 7 and 14 days, resulting in a decrease in waste levels.

## 5. Conclusion

According to the study's findings, the spatial distribution of livestock waste in the Saddang watershed experienced waste distribution that did not meet water quality standards, with the level of pollution in ST01, ST.04, ST.05, and ST0 (outlet) being so high that it was treated with a biofilter and phytoremediation system. The results of the effectiveness of waste reduction for physical parameters are Dissolved Residue (TDS) of 78.64 percent, Suspended Solids (TSS) of 97.93 percent, Turbidity of 96.90 percent, COD of 97.69 percent, DO of 98 percent, Nitrate of 29.29 percent, Ammonia 66.35 percent, Nitrite 97.18 percent, and for biological parameters, Fecal Coliform by 10%, Total This leads to the conclusion that treatment using a combination system of biofilter and phytoremediation may eliminate pollutants in livestock effluent, hence reducing the deterioration of river water quality.

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