Analysis of water quality and hotel liquid waste in Ubud Region, Gianyar

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Abstract. A research on the analysis of water quality and hotel liquid waste in Ubud sub-district, Gianyar-Bali has been conducted. The analysis of raw water quality was done to discover whether the raw water can be appropriately classified as clean water. The parameters used in analyzing the raw water are its bacteriological and hardness level. Analysis on the quality of liquid waste was done discover whether the hotel liquid waste can still be categorized align with the government standard in the disposal to the surrounding environment. Based on the result of hotel raw water analysis, five samples have aligned with the clean water standard, which is possible to categorized as clean water; while for the analysis of hotel liquid waste, the parameters used are turbidity, pH, BOD, COD and bacteriological test. The analysis shows that four hotels have exceeded the reasonable level of waste, where scheduled surveillance is required in keeping the environment away from waste disposal.

1. Introduction

Control and management of the water quality is an important concern in Indonesia. There were insufficient information data in transferring data to the public. Water quality parameter shows the correlation between turbidity, PH, BOD, COD, and bacteriological test to the raw water. Factor analysis identified three factors that explained 82.8% of the variation in water quality parameters. Discriminant analysis selected phosphate and nitrate as the most sensitive parameters in domestic roof harvested rainwater. Correlation analysis of the resulting roof runoff WQI with the air quality parameters showed that the indicator has significant correlation with most air quality parameters [1]. Considering the megatrends and the objective of sustainable development, environmental governance has become subject of a global policy and local (in particular urban) management. The ongoing shift from a technology-driven to a governance-driven society will define the need and kind of future technological improvements and innovations. Mainly based on the industrial and sanitary revolution, it is illustrated lessons can be drawn from facts and storylines, suitable for decision-making and technological applications. Water technology provides part of the solutions for water-related issues, in the sense techniques from the past may still offer opportunities for future applications [2]. This study aims to analyzing the raw water are its bacteriological and hardness level also this study analyze the factors that effected to the water quality.

Some studies of the government about the water pollution shows chemical material and plastic rubbish that existing in the tourist attraction. Water quality was the important issues in Bali. In 2015,
data shows water in Ayung River and Badung river has been polluted to the chemical material. Due to the Bali Government Regulation number 16 Year 2016 which contain the regulation of the standard use of hazardous chemicals, the government of the Gianyar regency were develop a standard of using the chemical material especially in tourist accommodations. Gianyar is the regency that is trying to develop its region potential on tourism purposes that can attract tourist visit. Tourism in Gianyar regency has developed well, even more so in several tourism places and spots that manages to attract worldwide attention. Ubud region; a home to artists all over Gianyar, has become the reason of tourist visits, where some places in Ubud have also develop various international level accommodation, which turned Ubud into a tourism icon in Gianyar regency [3].

Through sheer number of tourist visit that stayed in Ubud, a lot of local people have utilized this chance to provide temporary accommodation for the tourists while they enjoy their vacation; and some even rented their own place to the tourists to stay. Accommodation business in Ubud is quite diverse, starting from a cottage, budget hotel, up to a star class hotel [3]. The rapid development of tourism has pushed the growth of small tourism accommodation in hotel, home stay, art shop, restaurant, and bistro with its various services and amenities provided. Currently, in Ubud sub-district, there are 35 hotels, 207 home stay, 43 restaurants, 90 stalls, 132 art shops and various other type of amenities. The existence of this tourism services and amenities has successfully increased the community income, whilst also causing the decay of environmental quality. Establishment of hotel and home stay around local people settlement has diminish other possibility on open spaces, since the local will tend to use it fully on the establishment of accommodation and other business such as restaurant, stall, art shop and other various supporting amenities. The negative impact of tourism that has anxiously threatened the environment sustainability of Ubud sub-district is the increase of hotel and restaurant waste volume. The increase of this volume can potentially injure the environment. When hotel liquid waste disposed is not well treated, it will surely bring upon bad impact to the surrounding environment. The damage caused can also inflict damage to the aquatic, land, and air environment. This impact occurs due to the fact that hotel waste has relatively higher concentration of pollutant [4]. Water is an important environment component for surrounding life. The decrease on water quality will also decrease the usefulness, effectiveness, productivity, building and capacity of water resources, which will eventually reduce the wealth of natural resources [5].

Clean water is needed to fulfill human needs in doing most of their activities; so it is imperative to realize the distinction of clean water from quality perspective that can be used in sufficient amount for their daily needs. From the quality perspective, there are several requirements to meet, they are chemical quality consisting pH and hardness as well as biological quality where the water is free from disease inducing microorganism. Hotel liquid waste or water waste is the leftover water that comes from hotel hospitality activities. This water generally contains substances or matters that potentially endangered human health and disrupt natural environment [4]. The increase of water pollution from the source of waste disposal may also tend to reduce the important river water resource that supports irrigation; whether in its quantity or quality. This research was conducting liquid waste analysis that viewed from its physics qualities of hardness, chemical quality of pH, BOD, COD and its bacteriological quality. Based on those concepts, a research to analyze water quality and hotel liquid waste in Ubud sub-district, Gianyar-Bali is necessary to be conducted. This study is a cross sectional surveys and experimental approach. The samples are five non-stars hotel in Ubud regency and entered to the inclusion criteria of the study. The analysis shows that four hotels have exceeded the reasonable level of waste, where scheduled surveillance is required in keeping the environment away from waste disposal.

2. Methods
This research used a cross-sectional survey, descriptive method with an experimental approach. Target population in this research is 303 hotels in Ubud region, Gianyar regency. Accessible population in this research is 5 non star hotels in Ubud region, Gianyar regency that aligned to the criteria of sample extraction. Target population is stated by considering previous researches on liquid waste and hotel criteria from the Government Tourism Office of Gianyar regency. This study was done by Ethic
Committee at Udayana University. Sample extraction method is done by simple random sampling. The sample in this research consists of 5 non star hotels based on the criteria of Tourism Health of Gianyar district. The sample extraction of water from non-star hotel was based on hotel that has water sources originating from a well around the hotel vicinity. The sample extraction of liquid waste from non-star hotel was based upon the end of hotel sewer around the hotel vicinity. These samples were then analyzed in the Health Laboratory of Bali province.

3. Result

Table 1. Analysis result on water.

| No. | Hotel Name | Parameter | Standard   | Lab Analysis Result | Note |
|-----|------------|-----------|------------|---------------------|------|
| 1.  | Sample A  | Hardness  | <500 mg/l  | 175,90              | MS   |
|     |            | Coliform  | 50 MPN     | 2                   | MS   |
| 2.  | Sample B  | Hardness  | <500 mg/l  | 165,43              | MS   |
|     |            | Coliform  | 50 MPN     | 13                  | MS   |
| 3.  | Sample C  | Hardness  | <500 mg/l  | 180,08              | MS   |
|     |            | Coliform  | 50 MPN     | 11                  | MS   |
| 4.  | Sample D  | Hardness  | <500 mg/l  | 186,37              | MS   |
|     |            | Coliform  | 50 MPN     | 17                  | MS   |
| 5.  | Sample E  | Hardness  | <500 mg/l  | 129,78              | MS   |
|     |            | Coliform  | 50 MPN     | 2                   | MS   |

Note, TMS: Not Qualified

Through the chemical parameter of raw water analysis, the hardness analysis on five villas produced a value lower than the standard value; which suggest that this raw water can reasonably categorized as clear water.

Table 2. Analysis result of water waste based on physics parameter.

| No. | Hotel Name | Parameter | Standard   | Lab Analysis Result | Note |
|-----|------------|-----------|------------|---------------------|------|
| 1.  | Sample A  | pH        | 6 – 9,0    | 5,79                | TMS  |
|     |            | BOD₅      | <28 mg/l   | 150,79              | TMS  |
|     |            | COD       | <50 mg/l   | 700                 | TMS  |
| 2.  | Sample B  | pH        | 6 – 9,0    | 5,09                | TMS  |
|     |            | BOD₅      | <28 mg/l   | 750,79              | TMS  |
|     |            | COD       | <50 mg/l   | 1200                | TMS  |
| 3.  | Sample C  | pH        | 6 – 9,0    | 5,26                | TMS  |
|     |            | BOD₅      | <28 mg/l   | 763,79              | TMS  |
|     |            | COD       | <50 mg/l   | 3500                | TMS  |
| 4.  | Sample D  | pH        | 6 – 9,0    | 6,67                | MS   |
|     |            | BOD₅      | <28 mg/l   | 445,79              | TMS  |
|     |            | COD       | <50 mg/l   | 1600                | TMS  |
| 5.  | Sample E  | pH        | 6 – 9,0    | 6,93                | MS   |
|     |            | BOD₅      | <28 mg/l   | 15,28               | MS   |
|     |            | COD       | <50 mg/l   | 29,40               | MS   |

Note, TMS: Not Qualified

From table 2, the analysis of laboratory findings on waste physics parameter of hardness parameter, all samples are above the standard quality, which above >5 NTU. This result showed that high hardness value can obstruct filtering effort and decreasing disinfection effectiveness of water purification process.

Table 3. Analysis result of water waste based on chemical parameter.

| No. | Hotel Name | Parameter | Standard   | Lab Analysis Result | Note |
|-----|------------|-----------|------------|---------------------|------|
| 1.  | Sample A  | pH        | 6 – 9,0    | 5,79                | TMS  |
|     |            | BOD₅      | <28 mg/l   | 150,79              | TMS  |
|     |            | COD       | <50 mg/l   | 700                 | TMS  |
| 2.  | Sample B  | pH        | 6 – 9,0    | 5,09                | TMS  |
|     |            | BOD₅      | <28 mg/l   | 750,79              | TMS  |
|     |            | COD       | <50 mg/l   | 1200                | TMS  |
| 3.  | Sample C  | pH        | 6 – 9,0    | 5,26                | TMS  |
|     |            | BOD₅      | <28 mg/l   | 763,79              | TMS  |
|     |            | COD       | <50 mg/l   | 3500                | TMS  |
| 4.  | Sample D  | pH        | 6 – 9,0    | 6,67                | MS   |
|     |            | BOD₅      | <28 mg/l   | 445,79              | TMS  |
|     |            | COD       | <50 mg/l   | 1600                | TMS  |
| 5.  | Sample E  | pH        | 6 – 9,0    | 6,93                | MS   |
|     |            | BOD₅      | <28 mg/l   | 15,28               | MS   |
|     |            | COD       | <50 mg/l   | 29,40               | MS   |

Note, TMS: Not Qualified
Hydrogen Potential (PH) as indicator to determine the size of the hydrogen ion concentration from the solution. Biological Oxygen Demand (BOD) as empirical analysis to measure biological processes (specifically the activity of microorganisms that take place in water. Also COD as the amount of oxygen needed so that organic waste in the water can be oxidized through chemical reactions. Table 3 presented the result of laboratory test on biological parameter can be seen. It shows that water used by hotel has fulfilled the standard requirements laid by the Bali Government Regulation number 16 Year 2016. From table 3 on the analysis of laboratory findings to chemical parameter of water waste, pH level on laboratory check shows a dissatisfactory result, where three samples of hotel water waste contain below standard level of pH, while the other two samples have neutral level of pH. The water acidity level is measured by pH level. Acidity is measured based on the high-low concentration of ion hydrogen in the water. The pH level can affect biological life in the water. Over low or high level can kill the life of microorganism [6].

Table 4. Analysis result of water waste based on biological parameter

| No. | Hotel Name | Parameter            | Standard  | Lab Analysis Result | Note |
|-----|------------|----------------------|-----------|---------------------|------|
| 1.  | Sample A  | Total coliform-colifekal | < 4000 ml/MPN | 24. 10° ml/MPN | TMS  |
| 2.  | Sample B  | Total coliform-colifekal | < 4000 ml/MPN | 24. 10° ml/MPN | TMS  |
| 3.  | Sample C  | Total coliform-colifekal | < 4000 ml/MPN | 2.8.10° ml/MPN | TMS  |
| 4.  | Sample D  | Total coliform-colifekal | < 4000 ml/MPN | 1.8.10° ml/MPN | TMS  |
| 5.  | Sample E  | Total coliform-colifekal | < 4000 ml/MPN | 0.14.10° ml/MPN | TMS  |

Note, TMS: Not Qualified

Total coliform that an indicator to determine whether a water source has been contaminated by pathogens or not. Table 4 shows the laboratory analysis result of biological parameter water waste, the high level of coliform-colifekal total in biological parameter of the laboratory showed that hotel water waste was still polluted.

4. Discussion

This study identified factors that influenced the quality of water and liquid waste in the sample such as chemical material which are used at the sample. Factors that influenced the water quality of the study are physic, chemical, and also biological. The high level of BOD on water waste laboratory check result, showed that there is still some liquid waste disposal that were not decomposed well and still relatively hard to underwent decomposition and decay process [5]. On this step, the after process liquid waste disposed to the environment did not meet the requirements laid by Bali Government Regulation number 16 Year 2016. Biological Oxygen Demand (BOD) check is needed to state the pollution level. The high level of COD on the laboratory check result showed that pollution aspect of hotel water waste was still polluted.

The high level of COD on the laboratory check result showed that pollution aspect of hotel water waste was still relatively high. This fact would mean that there are still a lot of dangerous substances taken part in the process of hotel waste treatment that will pollute living organism, especially the aquatic ones. Measurement of waste strength through COD is another way of measuring oxygen need in the water waste. Liquid waste that did not treated well can cause pollution on the water sources (ground level) or environment, which turned into the place that pathogen microorganism pullulates; insects that can transmit diseases especially cholera, dysentery, Typhus abdom-inalis [6]. The high level of organic substances that reflected by high value of BOD and COD cause microbes to become active and decompose that organic substances biologically into organic acids compound. Thus, The FA identified the two groups of water quality variables, which explain majority of the experimental data, and resulted organic pollutant as main factor that influenced DKI Jakarta river water quality. Therefore, BOD and COD used as main parameter for water quality further assessment. CA grouped sampling sites into four clusters. Five sampling locations on 4 rivers (Ciliwung, Krukut, Groglol and Pesanggrahan River) need further study which be proposed as additional raw water sources [7].

From table 4 on the laboratory analysis result of biological parameter water waste, the high level of coliform-colifekal total in biological parameter of the laboratory showed that hotel water waste was still polluted. Domestic water waste that came from hospitality activities; especially feces, are sure to contain
a lot of coliform bacteria. The higher contamination of coliform bacteria occurs, the higher the risk of other pathogen bacteria emerge as well; usually pullulate on human and animal feces that can cause water borne disease [8]. There was water quality significant parameter dynamic to mean concentration of each water quality parameters, which are TDS, SO4, EC, TSS, NO3N, COD, BOD5, Grease Oil and NH3N. On the river WQI transformation/standardization, the water quality significant parameter showed the level of Gadjah Wong River pollution, which are EC, DO, BOD5, COD, NH3N, Fecal Coliform, and Total Coliform. These seven parameters are the minimal amount of water quality parameters that has to be consistently measured on predetermined time and location, and also become the indicator of human health and environment health quality. The result of Scilab multivariate analysis was not different with the result from Bi-plot Add in multivariate analysis, in which the results of water quality significant parameter has been verified with bio-monitoring [9].

5. Conclusion

Based on this research, there are two findings to conclude: analysis on villa raw water, from 5 samples, the raw water has aligned with the standard clean water and fit to use as such. Analysis on villa liquid waste, from 5 samples, there is only 1 villa that aligned with the Bali Government Standard Number 16 Year 2016, while the other 4 villas dispose a non-standard liquid waste that went beyond acceptable level.

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