Waste Management System of Badung River in Bali Based on Community Behaviour

IGAI Mas Pertiwi¹, W S Kristinayanti¹, W Sudiasa¹ and K W Andayani¹

¹Civil Engineering Departement, Bali State Polytechnic, South Kuta, Badung Regency, Bali 80361

Email: mspertiwi72@yahoo.co.id

Abstract. The identification of garbage at several points along the Badung river shows a low level of public awareness of the environment. The origin of the contents of the garbage in the Badung river comes from various human activities such as industry, household and nature. Although there is a trash rack, but it is not optimal in reducing plastic waste carried on the river. There are several reasons that cause people to throw garbage into the river. Among other things, disposing of garbage into the river is considered more practical and freer, the lack of garbage disposal facilities around the river and has become a culture. Therefore, research was conducted on community behaviour in disposing of garbage along the Badung river. The results showed trigger factors variable with a very influential factor, namely the existence of a disease of 79%. And as many as 5% of the people feel that the availability of Temporary Disposal Site facilities has no effect. The waste management system will be managed directly by the Waste Self-Management Group in each village, as an effort to build an integrated system. It also educates the public how to sort, manage and utilize waste. With the proper governance, of course, it can reduce the volume of waste to landfill.

1. Introduction

1.1. Background

The arrangement of Badung river has begun, but public awareness of the importance of waste management has not been fully realized with the visible piles of garbage in several places along the Badung river flow. Garbage is a sight that is still found along the river that crosses Denpasar City. Residents outside the watershed also contribute to the dirty Badung river. Need education in the community so as not to throw garbage into the river. A few years back the Badung river had experienced siltation, so when the rainy season arrived, the river often overflowed [1]. Previous study provides evidence that household and community groups' waste disposal practice is careless with the environment. Such waste disposal practice with disregard for the possible environmental consequences is possibly influenced by specific socioeconomic status (sex, education attainment, and household income) and geographic risk factors (residential area and residents' distance to municipal permitted dumpsite). It demonstrated that the respondents not only have poor knowledge of the adverse health effect with regard to improper waste handling but also have unsafe behaviour towards safety practices [2]. To examine the influences of internal and external factors on people’s waste disposal behaviours in Phnom Penh, the results showed that personal and social norms, such as perception of social pressure from friends and family and from the government, had significant influences on intention, whereas the influences of external factors was much smaller [3]. Lack of public awareness and
coordination between agencies involved and other bad natural phenomena that might occur certainly can have a big influence on the environment, natural scenery, conservation of coastal waters, water availability can even cause more severe ecosystem damage along Badung river. The integration of the handling program needs to be prepared and matured and applied well in order to create a clean, safe, sustainable and beautiful ecosystem. Identification of community behaviour in disposing of garbage is very necessary in order to develop a waste management model and this arrangement becomes more important to do besides because Denpasar is the provincial capital also because the Badung river is planned as one of the city's tourist attractions.

1.2. Objectives
The objectives of this study are:
1. Identify the dominant factors that cause community behaviour in disposing of garbage in the area along the Badung river catchment area.
2. Designing the right waste management system to overcome the problem of waste in the Badung catchment area.

2. Research methods

2.1. Research sites
The object of this research was carried out along the Badung river catchment area, namely by analysing 8 survey location points, where 8 points of this location were the river arm which empties into the main river of Badung river namely, Badung river, Langan river, Medih river, Jurang river, Guming river, Ketapian river, Kelandis river and Sudetan Teba river.

2.2. Identification of community behaviour in dispose of trash
The method of observing and retrieving data on the behaviour of people disposing of garbage along the Badung river watershed is by asking a number of questions to respondents who will be answered according to the questions in the questionnaire. The scale used in this study is the Guttman scale [4]. The assessment category is very influential, not influential and not very influential.

3. Result and discussion

3.1. The socio-economic condition of Denpasar City
Denpasar, administratively, has 4 sub-districts and 43 villages. South Denpasar District consists of 10 villages. East Denpasar 11 Villages / Villages. West Denpasar 11 Villages / Villages. Denpasar Utara 11 Village. The total area of Denpasar City is 12,778 hectares or 2.18% of the total area of Bali Province.[5]

3.2. Demographics
The population increase of Denpasar City as the provincial capital is not only influenced by the natural growth of the population but also the high flow of migration. This situation is reflected in the high population density of Denpasar. Based on the results of population projections, the total population of Denpasar City in 2015 was 659,623 people. With such a large population, the population density in Denpasar City in 2015 reached 6,891 people per km². If seen by age group, the population of Denpasar in 2015 is dominated by productive age population (ages 15-64 years).[5] From the data issued by almost 42.19% of Denpasar residents live around the Badung river, so that if not done a good management it will have a significant problem.

3.3. Education
In 2018, Denpasar City has 226 primary schools. at the junior secondary level there are 63 schools, and at the high school/vocational level, there are 65 schools. From the data it can be seen that every year the level of education of the citizens of the city is increasing, where the percentage of citizens who have high school education or who are equal is
85.94%. With a good level of education, it should be easier for the government to sensitize Denpasar residents about the importance of the river, so that what needs to be improved is the ease of the community in carrying out garbage disposal.

3.4. Areas identified as trash along Badung River
This research focuses on the waste problem, where in the field searches that have been carried out along Badung river, identified at several points along the Badung river there are garbage, seen on figure 1 below:

![Figure 1. Areas identified as trash along Badung River](image)

3.5. Community behaviour survey
The river as a cultural centre of society in the past has now lost its function, the river as a centre of community activity can no longer be found at this time, a river by some people is used as a backyard that lacks attention. At present the river is considered a less useful place so that people are accustomed to and assume that it is permissible to dispose of garbage in their backyard (river). The community makes the river a landfill. There are several reasons that cause people to throw garbage into the river. Among other things, throwing garbage into the river is considered more practical and freer, the lack of garbage disposal facilities around the river and has become a culture.[6]

3.6. Population and samples
In this study the population is households in residential areas within the area along the object of the research, namely the Badung River Catchment area, based on a preliminary survey that identified waste. The population of the survey area is 51478 households. Samples to be taken from the
population must be truly representative or representative. In determining the sample, researchers used a withdrawal technique with the Simple Random Sampling method. This method can be done if members of the population are considered homogeneous.

3.7. Data collection
Data collection was done by distributing questionnaires by 5 surveyors in each sub-district by dividing the number of samples according to the results of the above calculations, namely the districts of North Denpasar and West Denpasar as many as 30 samples and South Denpasar sub-districts as many as 40 samples. Questions in the questionnaire consisted of 4 variables, namely background, belief and mental readiness, facilities and trigger factors. Each variable has 2-3 factors that are expected to influence people's behaviour in disposing of garbage. Questionnaires were made with scale 3 questions to find out whether these factors were very influential, not influences and were not very influential on people's behaviour in disposing of garbage. The variables and their factors are as follows:[7]

Table 1. Variable of Community Behaviour and Its Factors

| X1 = background          | X2 = mental trust and readiness | X3 = facilities                        | X4 = trigger factor |
|--------------------------|---------------------------------|----------------------------------------|---------------------|
| X11 = education, occupation, salary | X21 = the advantage of keeping the river clean | X31 = temporary disposal site | X41 = disease |
| X22 = loss of using dirty water | X32 = kitchen site | X42 = fine |
| X12 = culture            | X23 = garbage and self-cleaning activities shouldn’t be thrown into the river | X33 = self-cleaning activities site | X43 = counseling |

3.8. Data analysis
Data analysis using tabulation method using Microsoft Excel software by giving a score of 1 to the choice of respondents. The results of the analysis of community behaviour in disposing of waste are then labelled based on the choice of answers on a scale of 3, which is very influential, not influential and not very influential. The results of the analysis of community behaviour can be seen in the following graphs:

Figure 2. Graph of Very Influence Variable
Figure 3. Graph of Non-Influence Variable

Based on figure 2, it can be seen that the variables that greatly influence the behaviour of people in disposing of garbage are trigger factors variables with very influential factors, namely the existence of a disease of 79% variable followed by X1, namely background with very influential factors are education, employment and income of 75% and counselling of 69%. This shows that education and employment greatly affect the community to dispose of garbage in its place but have little influence on the belief not to dispose of garbage and self-cleaning activities into the river.

Based on figure 3, it can be seen that the variables of trust and mental readiness which have a percentage do not affect the trust of losses using dirty river water by 43% followed by the variables of the means of Temporary Disposal Site and kitchen location of 37% and 36%. This shows that the existence of a disease does not affect the community in disposing of garbage but with a very small percentage, while 43% of the community feels that the loss of using dirty river water does not affect people's behaviour in disposing of garbage.

Figure 4. Graph of Very Non-Influence Variable

And based on figure 4, it can be seen that the variables of trust and mental readiness, namely the public's belief that garbage and Self-Clean Activities may be disposed of into the river, do not affect the community to dispose of garbage into the river by 45%. This shows that still some people still adhere to the belief that it is very not influential to dispose of garbage and self-cleaning activities into the river, while the availability of Temporary Disposal Site facilities does not really affect the community to dispose of garbage in its place.
3.9. Waste management system model plan

The management of municipal solid waste management is getting more severe due to various reasons such as poor land use and infrastructure, weak technical and financial capacity, lack of enforcement of regulations, poor coordination between authorities, deficient policies and absence of political priorities. Municipal solid waste management starts with understanding public concerns, preferences, knowledge and behaviour. The most cost-effective way of reducing municipal solid waste include public education and citizen encouragement to share in the design of recycling processes. Moreover, public participation strongly affects the success of recycling processes [8].

The maximum sorting and recycling activities are carried out from the garbage collection to the final waste disposal. Operational techniques for urban waste management consisting of storage activities up to the final disposal of waste must be integrated by sorting from the source.

First of all, most people consider recycling to be a low priority task and tasks with lower priority have a tendency to not be performed if the task is perceived as inconvenient. Therefore, it is important to design recycling facilities as close to the recycler as possible and facilities should be equipped to work in a given situation, for example, with lower access points. Secondly, it is important to have knowledge about how and where to recyclers or non-recyclers tend to have less or obsolete information that prevents them from recycling. Even if motivation and understanding are in place, without knowledge of how to recycle, it still does not work. Finally, a contributing step is to establish a deeper understanding of the environment and the impact of recycling to gain or maintain a general level of motivation, which might further increase recycling [9]. Based on the results of the research above, the analysis of community behaviour in disposing of garbage results in education and employment greatly influencing the community to dispose of garbage in its place but has little influence on the belief not to dispose of garbage and self-cleaning activities into the river and some people still believe that it does not affect the disposal of garbage and self-cleaning activities into the river, while the availability of Temporary Disposal Site facilities does not significantly affect the community to dispose of garbage in its place. And based on the type of garbage observed visually, the dominant organic waste is obtained from vegetables and wet fruits from kitchen waste. Whereas the dominant an organic waste is food packaging and plastic bags. From these results and based on Denpasar City Governor No. 11 of 2016 [10], the procedures for managing and disposing of waste in Denpasar City are supposed to be carried out by waste management groups coordinated by the village as shown in figure 5. So that the handling of waste starting from upstream can provide education to the community about the sorting, management and utilization of waste. With proper governance, it can certainly reduce the volume of waste to landfill, and inorganic waste can be sorted and saved in a Waste Bank, while organic waste can be used for compost.

![Figure 5. Waste Management System Model Plan](image)

4. Conclusion

Based on the results of the research above, the analysis of community behaviour in disposing of garbage results in education and employment greatly influencing the community to dispose of garbage in its place but has little influence on the belief not to dispose of garbage and self-cleaning activities
into the river and some people still believe that it does not affect the disposal of garbage and self-cleaning activities into the river, while the availability of Temporary Disposal Site facilities does not significantly affect the community to dispose of garbage in its place. From these results and based on Denpasar City Governor No. 11 of 2016, the procedures for managing and disposing of waste in Denpasar City are supposed to be carried out by waste management groups coordinated by the village. So that the handling of waste starting from upstream can provide education to the community about the sorting, management and utilization of waste. With proper governance, it can certainly reduce the volume of waste to landfill, and inorganic waste can be sorted and saved in a Waste Bank, while organic waste can be used for compost.

5. References
[1] https://www.cendananews.com/2018/06/700-kg-sampah-diangkut-setiap-hari-dari-sungai-tukad-badung-denpasar.html. Bali Post
[2] Keita Mamady, 2016. Factors Influencing Attitude, Safety Behavior, and Knowledge regarding Household Waste Management in Guinea: A Cross-Sectional Study. Journal of Environmental Public Health. 2016; 2016: 9305768. Published online 2016 Mar 22. doi: 10.1155/2016/9305768
[3] Pagnarith Srun, Kiyo Kurisu, 2019. Internal and External Influential Factors on Waste Disposal Behaviour in Public Open Spaces in Phnom Penh, Cambodia. www.mdpi.com/journal/sustainability,11,1518; doi: 10.3390/su11061518.
[4] Sugiyono, 2010. Quantitative, Qualitative and R&D Research Methods, CV. Alfabeta, Bandung.
[5] BPS-Statistics of Denpasar Municipality, 2018, Denpasar Municipality in Figures, BPS-Statistics of Denpasar City.
[6] Setiawan, 2009, Martapura River is The Source of Life. http://sebuah blog.blogspot.com/2009/02/sungai-martapura-sumber-kehidupan.html.
[7] Liana Penny, 2012, A Study of People’s Behaviour to Dispose of garbage on The Banks of The Martapura River on The Aquatic Environment. EnviroScientiae 8 (2012) 117-126. ISSN 1978-8096.
[8] Gamze Turan, 2016. The Importance of Environmental Education on Attitudes and Behaviours for Household Waste Management in Black Sea Region, Turkey. The Eurasia Proceedings of Education & Social Sciences (EPESS) ISSN: 2587-1730. Volume 5, Pages 227-231.
[9] K.Johansson, 2016. Understanding Recycling Behaviour: A Study of Motivational Factors Behind Waste Recycling. Proceeding of International Conference on Waste Management and Environment (WM 2016). www.witconferences.com
[10] Perwali Kota Denpasar No. 11 Tahun 2016, Procedures for Management and Disposal of Garbage in The City of Denpasar. Denpasar.