Seashore Community Engagement Program for A Clean Seawater at Banyu Biru Village

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Abstract. This paper presents the community engagement program conducted at Banyu Biru Village in Banten, Indonesia related to seacoast waste and water quality. Banyu Biru Village has a potency to increase its economic gain from tourism. The aim of our community engagement program is to collect the water and seacoast waste database. These data can be used as a benchmark for evaluating the environment based on BlueMetric indicators created by Universitas Indonesia. The results of socialization and outreach activities revealed that majority of respondents aged 26-35 years old (30%), female (100%), having elementary education background (86.7%), and unemployed (70%). Other measurement results show that most respondents have fair knowledge about seawater pollution (56.7%), fair attitude (56.7%), and implemented the organic waste management (53.3%). The types of waste that have been processed by some residents of Banyu Biru Village are organic waste by burning. To increasing the knowledge, attitudes, and behaviours are needed so the goal of protecting the environment from the danger of water pollution can be achieved. It is hoped that the BlueMetric program can be carried out sustainably and can also be applied in other regions in Indonesia.

1. Introduction

Water is the most important component of human life. Clean water and seacoast area benefit the sustainability of the nature and living creature in the area. However, it could not functioned well if the quality of life in the area degraded because of pollution. Nowadays, fresh water is only 2.5% from all the planet’s water, two-thirds of it is still locked in ice at the polar region. The rest are groundwater and only 0.3% are surface water such as rivers, lake, and reservoir [1].

Based on the Government Regulation of the Republic of Indonesia Number 19 of 1999 concerning the Control of Marine Pollution and/or Destruction, marine pollution is the entry or inclusion of organisms, substances, energy and/or other components into the marine environment due to human activities so that the quality drops to a certain level, which causes the marine environment is no longer compatible with the standards and/or its functions.

The existence of waste, both organic waste and inorganic waste, may profane the water. Heavy metal is a pollutant from inorganic waste which is hazardous to the marine and coastal ecosystem, including biota in it. Some heavy metals are used for various purposes and produced from industrial
activities. Based on previous research, heavy metals such as mercury (Hg), lead (Pb), cadmium (Cd), zinc (Zn), and chrome (Cr) can be found in water and sediment [2]. The use of these heavy metals directly or indirectly has polluted the environment.

1.1. Sea coast resident and their lifestyle impact to water quality

According to the Law of Republic of Indonesia Number 27 of 2007 concerning Management of Coastal Areas and Small Islands, coastal areas are transitional areas between land and sea ecosystems that are affected by changes in land and sea. Coastal areas are locations that are rich in resources to support the lives of people living in those coastal areas. These resources include food, energy, building materials, recreation, employment, and other necessities of life [3].

The availability of resources in the coastal environment is one of the main driving factors in the economic and social development of coastal communities. In terms of macroeconomics, the development that occurs in coastal areas will also have an impact on the growth of Gross Regional Domestic Product (GRDP) [4]. However, the potential of rich natural resources, if not accompanied by positive behaviour of local people in protecting the environment, it will affect the natural conditions and the lives of the surrounding communities.

Banyu Biru is a village in the Labuan Sub district, Banten. The village is located on the coast, with a height of 15 meters above sea level, and basically consists of rice fields and agriculture. The majority of the people of Banyu Biru Village depend on their lives on agriculture, plantations, and freshwater inland fisheries. This makes the Banyu Biru Village known as a tourism village. Banyu Biru Village has the potential to be affected by water pollution. This water pollution will also have an impact on people who live around the area for short and/or long term if it is not handled seriously.

1.2. Seawater quality

According to the Ministry of Environment Decree Number 51 of 2004 concerning Seawater Quality Standards, the seawater quality standards are measures of limits or levels of living things, substances, energy or components that exist or must exist and/or pollutants which are tolerated by their presence in seawater [5]. The determination of seawater quality standard includes the standard for port waters, marine tourism and marine biota. This regulation also stipulated that regions can set seawater quality standards with a value that is equal to or more stringent than the seawater quality standards specified in the decision.

The decrease of quality standards will affect the biota that live in it. Water quality can be known by measuring the physical, chemical, biology and heavy metals. Physical parameters include brightness, turbidity, temperature and current velocity. Chemical parameters are salinity, pH, dissolved oxygen, nitrate, phosphate, Biochemical Oxygen Demand (BOD), and Total Suspended Solids (TSS). Biological parameters, such as total coliform. The parameters of heavy metals are lead and copper [5].

UI BlueMetric indicator serves as a tool for Regency to deal with the sustainability of water challenges our world is facing. Regency can work together to reduce negative environmental impacts on the coastal areas. UI BlueMetric is an evaluation with procedure and standards. Therefore, all of the regency in Indonesia that have a coastal area can participate for free. We have evaluated the village based on UI BlueMetric and conducted community empowerment program. The purpose of our community empowerment program is to increase people’s knowledge and awareness to protect the aquatic environment in Banyu Biru Village. The result of these activities are expected to be useful for the general public and government, particularly on water quality so that it can be an input to the management of aquatic ecosystems in that particular coastal areas.

The rest of the paper can be organized as follows. The second part of this paper illustrates the methods that have been taken by the team to implement the BlueMetric program in Banyu Biru Village. The third part will show the result and discuss the UI BlueMetric implementation. The last part concludes this paper.
2. Methods

2.1. Study sites
This community engagement program is the result of collaboration between the Directorate of Research and Community Engagement of Universitas Indonesia (DRPM UI) and Faculty of Engineering UI with community in Banyu Biru Village, Labuan Sub district, Banten. The program was conducted from July to October 2019.

2.2. Respondents
The respondents for this community engagement were community that concerned for environmental issue in Banyu Biru Village, Banten. The total respondents were 30 people.

2.3. The stages of activity
On early May 2019, our team has conducted a Focus Group Discussion (FGD) by inviting marine and environmental experts. The team and FGD members discussed and reviewed the BlueMetric indicators i.e. biodiversity-natural ecosystem, water quality, waste, and human activity. The weight for each indicator is shown in table 1.

| Table 1. Criteria and weighting of BlueMetric. |
|-----------------------------------------------|
| Criteria                                      | Score |
| Biodiversity - Natural ecosystem              | 2000  |
| Water quality                                 | 5700  |
| Waste                                         | 2000  |
| Human activity                                | 300   |

The specific indicators and their points awarded are shown in table 2. Each indicator has been uniquely identified by a category code and number (e.g. 1.5).

| Table 2. Indicators weighting of BlueMetric. |
|---------------------------------------------|
| No.  | Criteria                                  | Score |
| 1.   | Biodiversity-Natural ecosystem             | 2000  |
| 1.1  | Fish                                       | 400   |
| 1.2  | Total area of coral reefs                  | 300   |
| 1.3  | Coral reef condition                       | 300   |
| 1.4  | Mangrove density                           | 300   |
| 1.5  | Seagrass                                   | 300   |
| 1.6  | Macerozoobenthos                           | 400   |
| 2.   | Water Quality                              | 5700  |
| 2.1  | Turbidity                                  | 300   |
| 2.2  | Total Suspended Solids (TSS)               | 300   |
| 2.3  | pH                                         | 300   |
| 2.4  | Salinity                                   | 300   |
| 2.5  | Dissolved Oxygen (DO)                      | 300   |
| 2.6  | Biochemical Oxygen Demand (BOD5)           | 300   |
| 2.7  | Free ammonia (NH3-N)                       | 300   |
| 2.8  | Total phosphat (T-PO4)                     | 300   |
| 2.9  | Nitrate (NO3-N)                            | 400   |
| 2.10 | Mercury (Hg)                               | 400   |
| 2.11 | Sulphide (H2S)                             | 300   |
| 2.12 | Surfactants (MBAS)                         | 300   |
| 2.13 | Oil and grease                             | 300   |
| 2.14 | Cadmium (Cd)                               | 300   |
No. | Criteria | Score  
--- | --- | ---  
2.15. | Copper (Cu) | 300  
2.16. | Lead (Pb) | 300  
2.17. | E-coliform (fecal) | 400  
2.18. | Coliform (total) | 300  
3. | Waste | 2000  
3.1. | Total number of waste types | 400  
3.2. | Type of waste | 400  
3.3. | Total amount of waste | 400  
3.4. | Spreading of waste | 400  
3.5. | Trash can provision program | 400  
3.6. | Existence of garbage patch | 400  
4. | Human Activity | 300  
4.1. | Number of industry types |  
4.2. | Type of industries |  
4.3. | Community's organization |  
4.4. | Community's organization in the field of environment and sanitation |  
4.5. | Number of ships |  
4.6. | Types of ships |  
4.7. | Community's organization information (such as UKM, cooperatives) |  
4.8. | Education program for fisherman | 300  
4.9. | Total area of fishpond |  
4.10. | Total number of fisherman |  
4.11. | Total number of educated fisherman |  
4.12. | Marine tourism |  
4.13. | Type of marine tourism |  
4.14. | The existence of community monitoring group so called Pokmaswas |  
4.15. | Number of tourist per month |  
**Total** | **10000**  

Scoring for each item is in numeric so that data can be processed statistically. Scores is in a simple counts of things or responses on a scale of some sort. Each criteria will be categorized in a general class of information and when the results are processed, the raw scores will be weighted to give a final calculation.

The next phase was the training program to community. The UI BlueMetric team trained the community in Banyu Biru Village to do self-evaluation by filling out the UI BlueMetric questionnaire. The total of participant were 30 person.

The sample of seawater was analyzed in the analytical services laboratories. The types of seawater physical and chemical parameters were tested in this study and the method of analysis were provided in table 3. The assessment was carried out descriptively so that the result of laboratory analysis will be compared with the seawater quality standard for marine biota. The seawater quality standard used in this assessment is the decision of the environment minister number 51 of Year 2004 concerning the seawater quality standards which includes seawater quality standards for the life of marine biota.

**Table 3. Parameters and method of water analysis.**

| No. | Parameters | Units | Limit of Reporting | Technique |
|-----|------------|-------|--------------------|-----------|
| 1.  | Turbidity  | NTU   | 0.5000             | Turbidimetric |
| 2.  | Total Suspended Solids (TSS) | mg/L | 1.0000             | Gravimetric |
| 3.  | pH         | -     | 0.1000             | Probe     |
| 4.  | Salinity   | g/l   | 0.1000             | Salonometer |
| 5.  | Dissolved Oxygen (DO) | mg/L | 2.0000             | Probe     |
No. | Parameters | Units | Limit of Reporting | Technique
--- | --- | --- | --- | ---
6. | Biochemical Oxygen Demand (BOD5) | mg/L | 2.0000 | Incubation-Probe
7. | Free ammonia (NH3-N) | mg/L | 0.0200 | Ion Selective Electrode
8. | Total phosphat (T-PO4) | mg/L | 0.0050 | Colorimetric
9. | Nitrate (NO3-N) | mg/L | 0.0050 | Colorimetric
10. | Sulphide (H2S) | mg/L | 0.5000 | Ion Selective Electrode
11. | Surfactants (MBAS) | mg/L | 0.0100 | Colorimetric
12. | Oil and grease | mg/L | 1.0000 | Gravimetric
13. | Cadmium (Cd) | mg/L | 0.0001 | ICP-MS
14. | Copper (Cu) | mg/L | 0.0010 | ICP-MS
15. | Lead (Pb) | mg/L | 0.0010 | ICP-MS
16. | E-Coliform (fecal) | MPN/ml | 200/100 | 
17. | Coliform (total) | ml | 1000/100 | 

2.4. Data analysis
Descriptive statistical analysis were used to evaluate the respondents, including cadres and household characteristics in tables. Subsequently the difference between the understood values among respondents before and after the treatment was obtained by testing.

3. Result and discussion

3.1. Advocacy and initial sampling
An initial survey was carried out on 9 May 2019 at Carita beach located in Sukarame Village. Sukarame is a village at Carita Beach, Banten, Indonesia. The sampling site was randomly selected around the coastal in the point 6°17'41.4"S 105°50'15.8"E. The sample was analyzed at the analytical services laboratories of PT. Intertek Utama Service, Jakarta.

Table 4. Result of water quality assessment.

| No. | Criteria | Score |
|-----|----------|-------|
| 1.  | Biodiversity-Natural Ecosystem | 1300 |
| 1.1 | Fish | 400 |
| 1.2 | Total area of coral reefs | - |
| 1.3 | Coral reef condition | 225 |
| 1.4 | Mangrove density | 75 |
| 1.5 | Seagrass | 300 |
| 1.6 | Macrozoobenthos | 300 |
| 2.  | Water Quality | 2850 |
| 2.1 | Turbidity | 150 |
| 2.2 | Total Suspended Solids (TSS) | 150 |
| 2.3 | pH | 150 |
| 2.4 | Salinity | 150 |
| 2.5 | Dissolved Oxygen (DO) | 150 |
| 2.6 | Biochemical Oxygen Demand (BOD5) | 150 |
| 2.7 | Free ammonia (NH3-N) | 150 |
| 2.8 | Total phosphat (T-PO4) | 150 |
| 2.9 | Nitrate (NO3-N) | 200 |
| 2.10 | Mercury (Hg) | 200 |
| 2.11 | Sulphide (H2S) | 150 |
| 2.12 | Surfactants (MBAS) | 150 |
| 2.13 | Oil and grease | 150 |
The evaluation was carried out to determine the improvement of the community’s knowledge about water quality measurement, what kind of efforts that should be done, and to elaborate the efforts to prevent and overcome environmental problems.

3.2. BlueMetric questionnaire counseling on community
The counseling activity for UI BlueMetric questionnaire was held on July, 26 2019 at Communal Waste Water Treatment Plant (WWTP) Banyu Biru Village. After counseling and discussion, the participants filled out the questionnaire. The questionnaire is to know the rate of knowledge, attitudes and behavior of the Banyu Biru Village community regarding water pollution issues. The result of questionnaire showed in table 5.

**Table 5.** The characteristics of respondents.

| No. | Variables                        | Frequency | Percentage |
|-----|----------------------------------|-----------|------------|
|     | Age group                        |           |            |
|     | 17 - 25                          | 3         | 10.0       |
|     | 26 - 35                          | 9         | 30.0       |
|     | 36 - 45                          | 7         | 23.3       |
|     | 46 - 55                          | 3         | 10.0       |
|     | 56 - 65                          | 8         | 26.7       |
|     | Sex                              |           |            |
|     | Female                           | 30        | 100.0      |
|     | Educational background           |           |            |
|     | Elementary school                | 26        | 86.7       |
|     | Middle school                    | 4         | 13.3       |
The average age group of respondents for our community engagement was 26-35 years old. All of the respondent were female (100%), elementary school educated (86.7%), and unemployed/housewife (70%) jobs. All of the participants have trained to fill out the BlueMetric questionnaire. Total of participants were 30 people (see table 5).

Table 6. Level of environmental knowledge, attitude, and behaviour.

| No. | Variables                              | Frequency | Percentage |
|-----|----------------------------------------|-----------|------------|
| 1.  | Knowledge                              |           |            |
|     | Good                                   | 13        | 43.3       |
|     | Fair                                   | 17        | 56.7       |
| 2.  | Attitude                               |           |            |
|     | Good                                   | 13        | 43.3       |
|     | Fair                                   | 17        | 56.7       |
| 3.  | Behavior                               |           |            |
|     | Managing the organic waste             | 16        | 53.3       |
|     | Not managing the waste                 | 14        | 46.7       |

The results of this initial study showed that most respondents have fair of knowledge about seawater pollution (56.7%), fair attitude (56.7%), and implemented the organic waste management (53.3%). The types of waste that have been processed by the residents of Banyu Biru Village are organic waste by burning it in the open area.

Based on the results, the community of Banyu Biru Village need to improving their knowledge, attitude, and their behaviour so the environment quality. On this community engagement activity, it was found that the community will be involved in this program if they find the benefits of the waste management program for environmental sustainability and improved quality of life. Cooperation with the government also should be maintained for developing the waste management facilities, and to cooperate with non-profit organization if it's necessary.

4. Conclusion

This paper presented an initial study of community engagement program in Banyu Biru Village. Increasing the knowledge, attitudes, and behaviors are needed so that the goal of protecting the environment from the danger of water pollution can be achieved. Future research can explore the system of waste management and enhancing the community awareness about environmental issues. It also hoped that the BlueMetric program can be carried out sustainably and can be applied in other regions in Indonesia, with collaboration of community and stakeholders.

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