Water Testing Report

PROJECT CLEAN ULUWATU DECEMBER, 2017

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Resume

Some water testing were conducted in Suluban Beach during June to November 2017 to provide condition of beach in related to health risk and hygiene. It was also some water testing in Seminyak Beach for slight comparison. Fecal coliform, *E. coli*, Enterococci and some physical-chemical factors were included as indicators. The samples were taken during low tide, which was twice a month with some exception on a couple months. On several samples, fecal coliform were found in a large number, surpassed the acceptance level stated by local government. Physical and chemical factors said that there were an excessive number of nitrate, ammonia and phosphate on Suluban Beach. It could be said that there was a quite a lot waste input to the beach. Unless it is well managed, this may impact to increasing health risk for whom do activities in the beach, decrease the aesthetic value of the beach due to bad smell below the cave and some dirt on some point on the beach and corrupting biodiversity around Suluban beach. Some recommendations for solving this problem were provide.

Background

Sea water testing is crucial to tell people about the water condition if it is good and save to do various activities along the beach or not. Moreover, sometimes water testing could be very helpful to understand the process and issues regarding to ambient environment as beach is actually the end point of water flows from land. If it be conducted regularly, water testing could provide us a lot of precious data and information which can help to decide the best practices regulation for maintaining the beach ecosystem and surrounding environment.

Various parameter and indicator can be used to water test such as water clarity, odor, total suspended solid (physical), salinity, pH, any chemical matter (chemical), fecal coliform, enterococci, staphylococcus (microbiology) and also the present of oils and fats. Those three group parameter (physical, chemical and microbiology) are commonly and recently have been used to assess sea water quality and its impact to marine ecosystem (El Farrah, et al., 2016). However, sometimes there is only one or two parameter that is taking into account for water testing especially for specific objective. For instance, the level of ammonia, nitrate and phosphate are usually used to understand the effect of urban agriculture to the beach as by Lomoljo et al (2009), the present of lead (Pb) can be used to detect pollution by fuel, and fecal coliform and other several group or species of bacteria can indicate the level of risk for human health for whom do activity on the beach.

In regard to health risk associated with some recreational activity and an environmental issues due to waste water management in Suluban Beach, fecal coliform and enterococci were used as an indicators for this water testing. The test using these organisms usually be easily detectible by simple laboratory test. Otherwise, they are generally not present in unpolluted waters and appear in concentrations that can be correlated with the extent of the contamination.

A fecal coliform bacteria generally originate in the intestines of warm-blooded animals. Coliform bacteria include genera that originate in feces (e.g. *Escherichia*) as well as genera not of fecal origin (e.g. *Enterobacter*, *Klebsiella*, *Citrobacter*). The assay of fecal coliform is intended to be an indicator of fecal contamination, more specifically of *E. coli* which is an indicator microorganism for other pathogens that may be present in feces. In general, increased levels of fecal coliforms provide a warning of failure in water treatment, a break in the integrity of the distribution system, possible contamination with pathogens. When levels are high there may be an elevated risk of waterborne gastroenteritis. Main problem resulting from fecal coliform contamination in water is increasing risk of pathogens being present in the water such as ear infections, dysentery, typhoid fever, viral and bacterial gastroenteritis, and hepatitis A

In contrast to fecal coliforms that own short survival times in marine waters, Enterococci survive for longer periods in seawater and are thus good indicators of the presence of aged fecal contamination (Beachwatch Partnership Program, 2004). Important clinical infections caused by *Enterococcus* include urinary tract infections, bacteremia, bacterial endocarditis, diverticulitis, and meningitis (Fisher & Phillip, 2009). Where fecal coliform and *E. coli* still use as bioindicator for sea water contamination in Indonesia (Menteri Negara Lingkungan Hidup, 2004), Enterecocci has took the place of them as new USA standard for water quality at public saltwater beaches (US EPA, 2012). Therefore, enterococci then was took into this water testing as well as fecal coliform and *E. coli*.

In summary, the objectives of this study are:

1. To understand Suluban Beach condition using microbiology and physical and chemical indicators.
2. To observe the water quality around Suluban Beach if there is waste water input to the beach.

Protocols

Sampling location

Water sampling were taken at mostly at Suluban Beach. Some water sampling were also taken at Seminyak Beach for comparison. Regardless that the Suluban Beach is the main focus-site of whole projects of PCU, Suluban and Seminyak Beach were selected because both of them were favorite beach for surfing and were probably having different experience on pollutant exposure from tourism industry near them so that they are ideally to compare.

Suluban Beach is located in Pecatu village, in South Kuta. Suluban Beach is also called Blue Point Beach as there is Bluepoint Villa stand on the top of the edge of the beach. The beach is typically a rocky beach with breaking wives presence a little further away from the beach. The beach substrate are mostly rocks, roughly and complex so that many tide pool naturally occur. In the

other hand, Seminyak Beach is situated at Seminyak village, in Central Kuta. The beach are very famous tourism destination as there are a plenty restaurant, café and beach club presence along the beach. The beach is typically sandy beach and the wave are relatively strong every day.

Sampling time and situation

The samples were taken when it was low tides during May to November 2017. Sampling when low tide is always giving advantage as it's safer and the water condition is more stable in term of their existence near the beach rather than while at high tide and frequently exposure of waves which may not represented the water near the beach.

5 sampling points were taken on each location as sampling repetition horizontally along the beach. The sampling points were located near the people do their water activities the most.

Field sampling technique

Before sampling, we have checked the tidal level to ensure the presence of water and it is safe for sampling.

Care should be used all the time to avoid contamination of the inside of the bottle and the cap. Bottle sample was submerged up to the middle of water body (approximately at 30 cm depth). Then, bottle's cap was opened in the water and let the water come in to the bottle fully or up to shoulder level. Finally, the bottle was closed in the water and then stored in the sample box carefully.

Several samples were taken for each sample point, one is for microbiology analysis and the others are for physicochemical analysis (only one time out of all samplings). In regard to physicochemical analysis, the sample were taken and divide into several bottles as the lab process required for several variant analysis. All the sample were transferred to the lab within 24 hours to be preserved and then be analyzed.

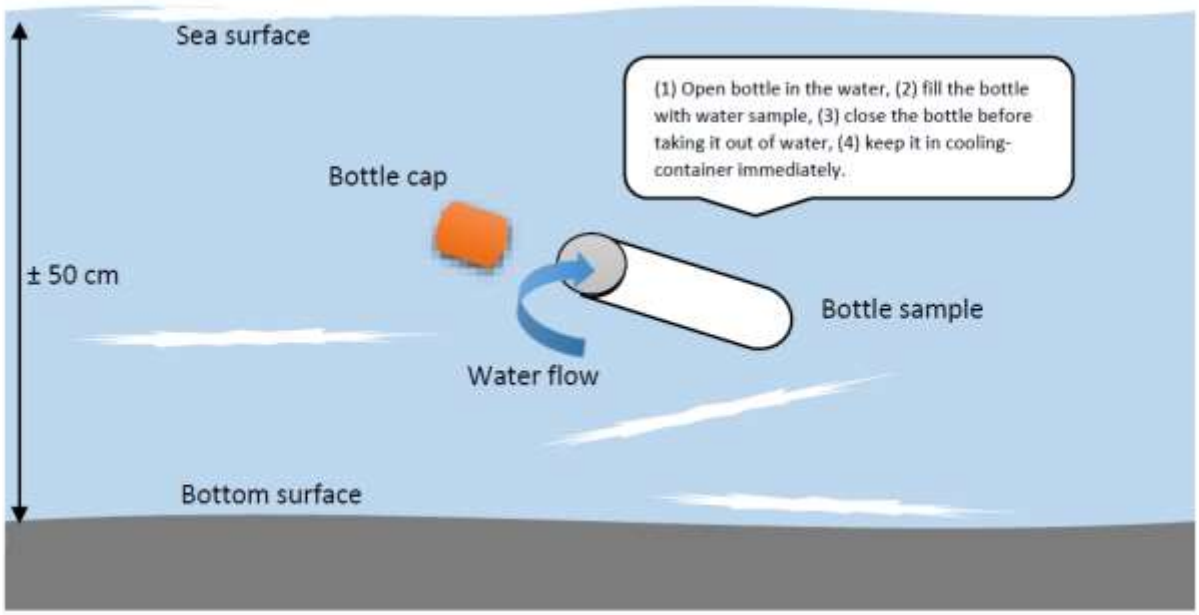


Figure 1. Sampling procedure

Figure 2. Water testing locations, A. Suluban Beach, B. Seminyak beach, red dot (●) represents for sampling point

Laboratory analysis

All samples were analyzed for Fecal coliform, *E. coli*, and Enterococci which was conducted in Microbiology Laboratory of Biology Department Udayana University. The physic-chemical factors were included Total Nitrogen, Total Phosphorus, Ammonia, Fat/Oil, Total Suspended Solid (TSS) and Biological Oxygen Demand (BOD) conducted in Analytical Laboratory of Udayana University.

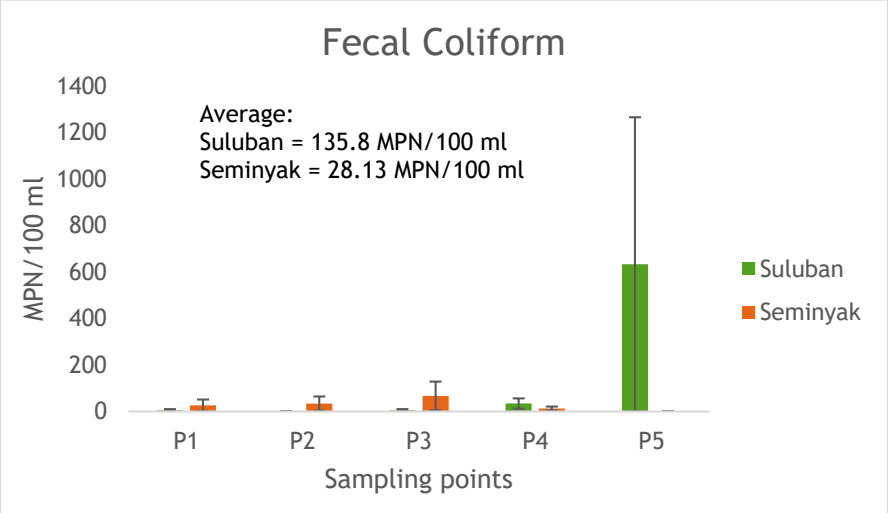
Reporting and presenting

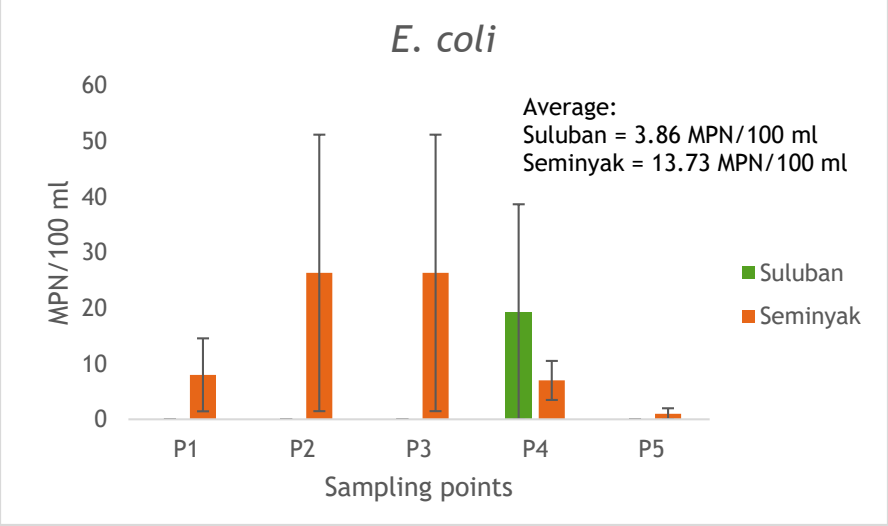
The data result were displayed with time series graph in weekly or monthly basis. The qualitative information will also be provided. Recreational Water Quality Criteria by EPA (US EPA, 2012) and Keputusan Menteri Negara Lingkungan Hidup No 51 Tahun 2004 Tentang Baku Mutu Air Laut (Menteri Negara Lingkungan Hidup, 2004) will be used as standard of the water quality.

Results

Bacteria

Comparison of fecal coliform, *E. coli* and Enterococci between Suluban and Seminyak Beach were shown on the graphs below.





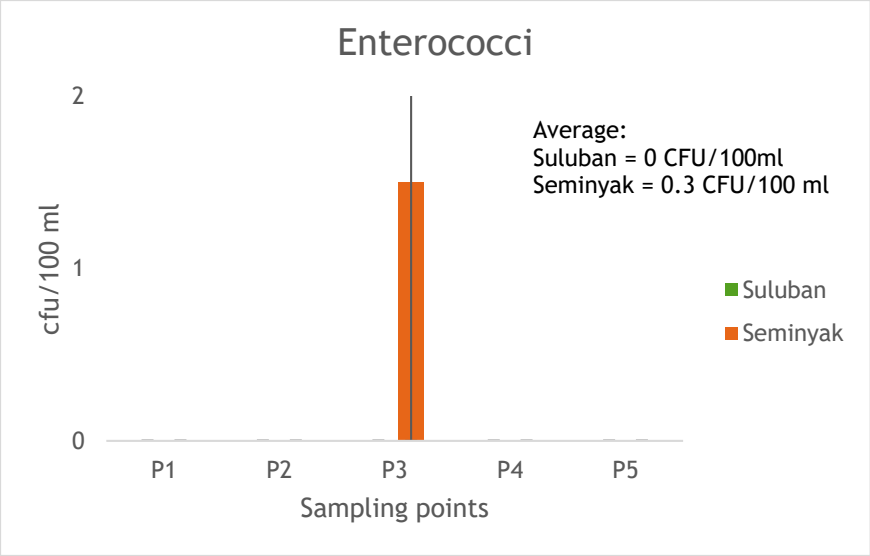


Figure 3. The graph of comparison number of fecal coliform (top), *E. coli* (mid) and Enterococci (down) between Suluban and Seminyak Beach

These data were taken on the first three sampling in order to compare the Suluban beach with other location that is considered to have an extreme gray water input. The grey water input on Seminyak Beach come from the estuary river stream in front of point 3 (P 3) which is continue to send grey water to the beach. In the other hand, there is no direct river ends to Suluban Beach unless it was hard rain caused flood on the top hill. Surprisingly, the average number of fecal coliform and *E. coli* of Suluban Beach were higher than Seminyak Beach. This is probably caused by the extreme value of fecal coliform on point 5 (P5) and *E. coli* on point 4 (P4) of Suluban Beach where in the other hand, the average value of fecal coliform and *E. coli* along all points (P1 to P5) on Seminyak Beach were more even than Suluban Beach. However, the Enterococci of Seminyak Beach were absolutely higher than Suluban Beach. It was believed as the result of continues exposed by the water from river in front of point 3 (P3).

To be focused on Suluban Beach, some fecal coliform and *E. coli* were observed on the sampling points where no Enterococci found on every samples. The fecal coliform and *E. coli* number were fluctuated between sampling efforts. Additionally, some of the result shown over the maximum acceptance level state by local government. The detail of laboratory result can be seen on the table below.

The standard of maximum value accepted for Fecal coliform, *E. coli* and Enterococci are 1000 MPN/100 ml, 200 MPN/100 ml (Menteri Negara Lingkungan Hidup, 2004), and 35 MPN/100 ml (US EPA, 2012) respectively. No enterococci value for the first (SE 1) and second (SE 2) sampling due to late consideration of enterococci as a proper variable for sea water.

The point 3 (SP 3) and point 5 (SP 5) were considered as the highest fecal coliform contamination during the study, while the point 4 (SP 4) was the highest of *E. coli* (Figure 4). Vertical line on the bar was the standard error representative. Longer line shown the higher standard error value. For example, the standard error of SP 4 for *E. coli* were very high because it was found a great number of *E. coli* in one sampling (see Table 2, SE 2) where the other only found the small amount.

Table 1. Laboratory analysis result of fecal coliform (MPN/100ml)

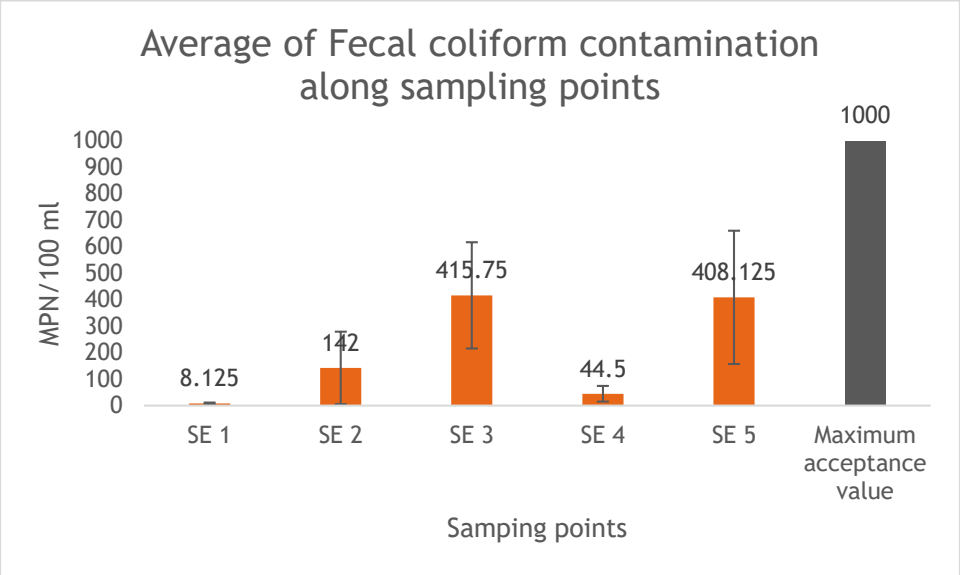
SP	SE 1	SE 2	SE 3	SE 4	SE 5	SE 6	SE 7	SE 8
1	15	0	0	23	4	20	0	3
2	3	0	0	23	0	7	1100	3
3	15	0	0	1100	0	11	1100	1100
4	28	75	0	240	3	7	0	3
5	3	1898	0	240	0	21	1100	3

Table 2. Laboratory analysis result of *E. coli* (MPN/100ml)

SP	SE 1	SE 2	SE 3	SE 4	SE 5	SE 6	SE 7	SE 8
1	0	0	0	4	4	0	0	3
2	0	0	0	4	0	1	4	0
3	0	0	0	4	0	2	1	1
4	0	58	0	0	4	1	0	1
5	0	0	0	0	0	0	3	3

Table 3. Laboratory analysis result of Enterococci (MPN/100ml)

SP	SE 1	SE 2	SE 3	SE 4	SE 5	SE 6	SE 7	SE 8
1			0	0	0	0	0	0
2			0	0	0	0	0	0
3			0	0	0	0	0	0
4			0	0	0	0	0	0
5			0	0	0	0	0	0



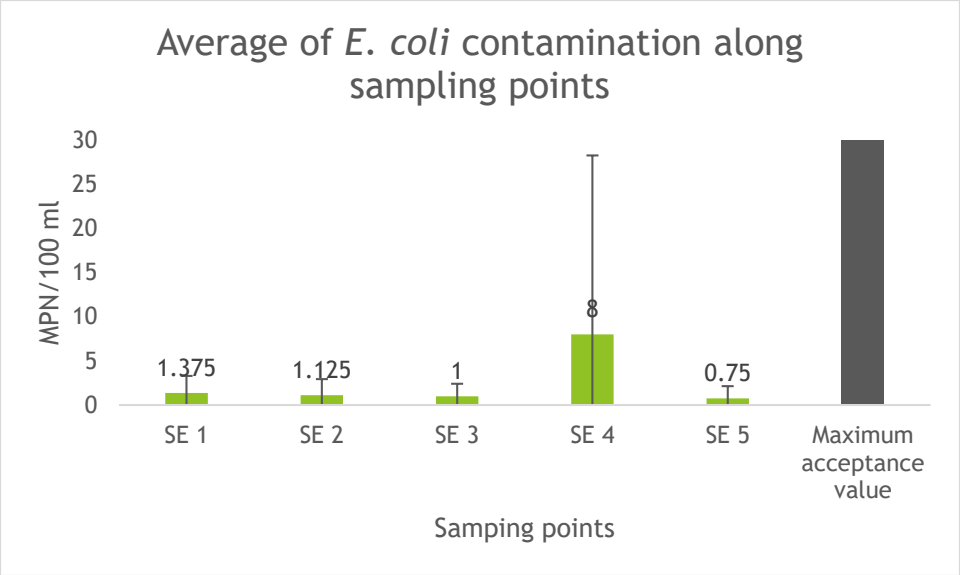


Figure 4. The average of fecal coliform and *E. coli* within sampling points - Suluban only

PHYSICO-CHEMICAL CONDITION

At the beginning, physic-chemical factors were also taken on both locations for comparison study and understanding the basic character of the sea water of both sites. The result can be seen on the table below.

Table 4. Physico-chemical analysis result for Seminyak Beach. The acceptance level are referring to Indonesian government

Parameter	SP1	SP2	SP3	SP4	SP5	Maximum acceptance
BOD (mg/L)	7.39	5.824	6.427	5.021	7.431	10
Nitrate (NO_3) (mg/L)	0.639	0.902	0.646	0.878	0.747	0.008
Ammonia (NH_3) (mg/L)	n/a	n/a	n/a	0.231	n/a	n/a
TSS (mg/L)	n/a	n/a	n/a	4.198	n/a	20
P Total(mg/L)	n/a	n/a	0.289	n/a	n/a	n/a
Oil and Fat (mg/L)	0.066	0.075	0.086	0.087	0.086	1

Table 5. Physico-chemical analysis result for Suluban Beach. The acceptance level are referring to Indonesian government

Parameter	SP1	SP2	SP3	SP4	SP5	Maximum acceptance
BOD (mg/L)	4.042	4.82	5.623	8.033	5.618	10
Nitrate (NO_3) (mg/L)	0.475	0.72	0.63	0.589	0.948	0.008
Ammonia (NH_3) (mg/L)	n/a	n/a	n/a	n/a	1.17	n/a
TSS (mg/L)	n/a	n/a	0.546	n/a	n/a	20
P Total (mg/L)	n/a	n/a	n/a	n/a	0.306	n/a
Oil and Fat (mg/L)	0.045	0.043	0.048	0.05	0.055	1

Refer to both Table 4 and Table 5, it could be clearly seen that the nitrate value were extremely surpass the maximum acceptance level stated by Indonesian Government while the others parameters value were below of the acceptance level. Some parameters also shown beyond the maximum acceptance level such as Ammonia (P4) and P total (P3) at Seminyak Beach and Ammonia (P5) and P total (P5) at Suluban Beach. In general, there was not a lot different between Suluban and Seminyak beach in consideration of physic-chemical analysis.

Implications

This study was aimed to understand the sea water condition as impact of human activities along the coastline. We took Suluban Beach as it is basically our project-site focus and also Seminyak Beach for comparison, which is considered to have clear impact of human sewage. Regarding to the number of activities in both location, it can be easily said that Seminyak Beach has more daily visitors and more building around the beach rather than Suluban Beach. The beach with numerous people and buildings often suffer high contamination. However, data and information obtained from this water testing was slightly surprising and beyond expectation. Suluban Beach was not truly cleaner than Seminyak Beach even though Suluban Beach is not as crowded as Seminyak Beach in term of facilities and building surrounding the beach.

The most important factors to take into account is that, in most communities, the principal risk to human health derives from fecal contamination which in this case are fecal coliform, *E. coli* and Enterococci. Fecal coliforms are strongly associated with fecal waste, and therefore are excellent indicators of recent fecal contamination (Beachwatch Partnership Program, 2004). This water testing clearly showed that the number of those bacteria were very high and surpassed the maximum acceptance level for healthy environment. Nevertheless, one thing we literally know if some water testing showed the high level of bacteria is caused by fecal input from human or animal source either it is directly from human or indirectly through waste water channel. Additionally, during low tide, the water will stuck longer in the tide pool, increasing a risk of pathogen for everyone whom swimming in it.

To be focused at Suluban Beach, the water quality were vary along the sample point. The lab result said that water condition in Suluban Beach around point 3 (SP3), point 4 (SP4) and point 5 (SP5) were possessed higher level of bacteria than other points. Moreover, the physical and chemical indicators also showed the unusual value around point 4 (SP4) and point 5 (SP5) which were higher than the maximum acceptance level stated. It could be said that there were certainly a lot pollutant or waste water input on specific points along the beach.

Finally, nothing can be blame except some local warungs or buildings (beach club) regarding to the input of waste water around the Suluban Beach. During the day, everyone on the beach could clearly see the awful management of waste water which some of them seep the waste water into the ground which end up below the cave resulting bad smell all the day and the other disposed their waste water directly to the beach. Therefore, in order to keep the beach clean, it is strongly necessary to stop the waste resource to the beach and give practical solution to manage the waste water from those communities and beach-club buildings.

Recommendation

This recommendations are provided to solve the problem of managing the waste water around Suluban Beach. Some actions to take include:

1. Start communicating with suspected warung and beach club who unmanaged their waste water to the beach. They could connected their waste water pipe to our waste water garden system. Otherwise, we can help to build new system of waste water treatment especially for bigger beach club which is considered to have larger amount of daily waste water than all the warungs.
2. Bring this water testing information to the local government (Kantor Desa) or any interest party (such as environmental agency) would be useful. This effort could open their mind about what's happened in Suluban Beach and understand them about how to conserve the hygiene, aesthetic and beach's biodiversity. Finally, the Desa may help us to communicate and push the local to understand the important of waste management. Also, an authority party will take a further action to response this issue.
3. Publish this report to local scientific journal or community magazines. This is good for us to tell to everybody what we have done for keeping the beach. It can also be published to social media. By this, it is hoping to increase the awareness of local people and guests and raise more supports and ideas for cleaning the beach.
4. Keep water testing continue. Next water testing could acted as monitoring effort to sea water condition after some changed of surrounding waste water system already happened. Other thing we can do in the future is to observe the local intertidal marine biodiversity (invertebrates and algae) which is usually used as a bio-indicators of healthy ecosystem.

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