



## Restoration of Water Quality in the Estuary Area of Petitenget Beach with the Use of Hydromakrofita Plants

Ida Bagus Suryabrata<sup>1</sup>, Yudha Akbar Prasetyawan<sup>2</sup>, Agus Putu Abiyasa<sup>3</sup>.

<sup>1,3</sup> Civil Engineering Study Program, Faculty of Engineering and Informatics, National University of Education Denpasar.

<sup>2</sup> Water Resources Management Study Program, Udayana University.

E-mail: [srbrata42@gmail.com](mailto:srbrata42@gmail.com), [baglugking@gmail.com](mailto:baglugking@gmail.com), [abiyasa@undiknas.ac.id](mailto:abiyasa@undiknas.ac.id).

---

### Article History:

Received: 2021-03-13

Revised:

Accepted:

**Keywords:** Akar wangi,  
Phytoremediation, Waste  
water, Hydromakrophytes,  
Restoration.

**Abstract:** Currently, tourist activities around the beach are growing rapidly, especially in the Petitenget Coastal area. Waste management by tourists around the region causes polluted estuary Petitenget Beach. Polluted estuary has an impact on the existing tourism sector, where this results in reduced image of Petitenget beach in the eyes of tourists where tourist activities in the Petitenget area is the main source of income from the Petitenget community. To overcome this problem, it is necessary to restore estuary water, one way is to utilize the potential of The Fragrant Root plant as a fitness agent. From the results of the devotion carried out it is known that the Fragrant Root plant is an effective plant in lowering some polluting parameters, one of which is Ammonia which is the main content of wastewater. The results of this community service will be discussed with the Kerobokan Badung Village and the Badung District Environment and Hygiene Office.

---

## Introduction

Petitenget Beach is located in Kerobokan Kelod Village, North Kuta Subdistrict, Badung Bali Regency. Like the beach in general, Petitenget Beach has an estuary sourced from 4 loloan or small rivers. The loloan has an upstream located in kerobokan village. As we know, the beach is very closely related to the flow of the river that empties into the beach. Therefore, the beach and estuary are inseparable because it is a unity of the river flow system. River estuary is a suburban or coastal area that has a very important role both economically and ecologically. Currently, there are many problems with the development of external resources that are done unmantapped which causes adverse effects both in the short and long term. These impacts can be economic, ecological and even health losses.<sup>1</sup>

---

<sup>1</sup> Dina Isti'anah, Moch. Faizul Huda, and Ainun Nikmati Laily, "Synedrasp. Sebagai Mikroalga Yang



Currently tourist and household activities that occur around the upstream of the mouth of Petitenget Beach are very developed quickly, but it causes a bad impact on the environment, especially on the waterways. Improper sewage treatment from the community and tourists causes rivers or waterways to be their choice in disposing of liquid waste. The character of the waste is known to come from restaurants, public toilets, and laundry. The waste is so polluting river water that the quality of the water becomes decreased. In plain sight the river springs become dredged and cause an unpleasant smell, it gives a bad impression to this river. This problem will gradually raise the threat of pollution, ecological and health problems for the community<sup>2</sup>.



*Figure 1. Petitenget Beach estuary conditions (Left) and Fishermen who are fishing at the estuary of petitenget beach (right)*

Because of the polluted river, it will cause problems in the estuary. This condition has a bad impact on the estuary on Petitenget Beach. Turbid estuary water and bad smell cause bad environmental aesthetics so that it can also have a bad impact on tourist activities in the petitenget beach area. This is also due to the location of the buara adjacent to the place where tourists do activities at petitenget beach. In addition, many people who ignore the polluted estuary so that they remain active around the estuary such as playing water, swimming, even fishing, this is feared will cause health problems for the community.

According to guidelines for technical instructions on river water quality restoration published by the Ministry of Environment and Forestry of the Republic of Indonesia in 2017, to overcome these problems it is necessary to restore river water, one way is by improving river water quality on an ecological-engineering basis. Where this ecological-engineering method improves the quality of river water with the potential of flora or fauna applied to the territorial waters and is able to have a positive impact on the water area. There are many ways that can be done to improve water quality with this

---

Ditemukan Di Sungai Besuki Porong Sidoarjo, Jawa Timur," *BIOEDUKASI* 8, no. 1 (2015): 57–59.

<sup>2</sup> Budiarsa Suyasa W et al., "KUALITAS AIR SUNGAI DI KAWASAN WISATA PANTAI PETITENGET, KEROBOKAN KABUPATEN BADUNG BAL," *ECOTROPHIC* 12, no. 2 (2018): 225–238.



ecological-engineering method, one way is to use the potential of hydromakrofita plants that serve as phytoremediation agents to improve water quality<sup>3</sup>. Phytoremediation or can be called phytoremediation is the potential utilization of a plant to reduce the harmful content in water, both organic and organic<sup>4</sup>.

Hydromakrophytes are the right plants to be used as phytoremediation agents because hydromakrofita vegetation is able to degrade waste materials that are a source of pollutants<sup>5</sup>. There are many types of hydromakrophytes that have potential as phytoremediation agents, including *Vetiveria Zizanodes* L., *Equisetum Ramosissium*, *Sesbania Grandiflora*, and *Scirpus Grossus*. According to the study<sup>6</sup>, when the plant was planted on the edge of a 125m-long rice field irrigation canal for 50 days, the plant was able to reduce the total level of Disolved Solid (TDS) by 10%,  $KMnO_4$  levels by 62.5%, and Orthophosphate by 18% compared to water conditions before passing through the riverbank planted by hydromakrofita plants. The decrease in pollutant levels occurs due to the taking of contaminants from hydromakrophyte and is processed Biologically through various complex stages.



Figure 2. Akar Wangi (*V. Zizanodies* L.).

<sup>3</sup> Retno Dewi Khinanty and Catur Retnaningdyah, "Potensi Beberapa Hidromakrofita Lokal Untuk Meningkatkan Kualitas Air Lindi Tempat Pemrosesan Akhir Sampah Talangagung, Kecamatan Kepanjen, Kabupaten Malang," *Jurnal Biotropika* 1, no. 1 (2017): 1-7.

<sup>4</sup> Muhammad Ainul Yaqin et al., *STUDI KEMAMPUAN TANAMAN HIDROMAKROFITA DALAM FITOREMEDIASI KUALITAS LIMBAH CAIR KAYU LAPIS* Study of Hydromacrophita Plant Capability in Phytoremediation Quality of Plywood Liquid Waste, *Jurnal Sylva Scienteae*, vol. 02, 2019.

<sup>5</sup> Catur Retnaningdyah and Endang Arisoesilaningih, "Efektivitas Proses Fitoremediasi Air Irigasi Tercemar Bahan Organik Melalui Sistem Batch Culture Menggunakan Hidromakrofita Lokal (The Effectiveness of Phytoremediation Process on Irrigation Water Contaminated by Organic Matter through Batch Culture Syste," *Jurnal Biologi Indonesia* 14, no. 1 (2018): 33-41.

<sup>6</sup> Retno Dewi Khinanty and Catur Retnaningdyah, "Potensi Beberapa Hidromakrofita Lokal Untuk Meningkatkan Kualitas Air Lindi Tempat Pemrosesan Akhir Sampah Talangagung, Kecamatan Kepanjen, Kabupaten Malang."



This community service aims to overcome the tourist problems caused by the pollution of petitenget beach estuary water with the use of hydromakrofita as a phytoremediation agent of polluted estuary water. The type of hydromakrofita plant that will be used in this study is a type of local hydromakrofita, namely Akar Wangi (*Vetiveria Zizanodes*) because the plant is quite a lot in the rice fields around Kerobokan Village so that this research will also be able to develop the potential of local plants. It is expected that from this devotion, the problem of petitenget estuary water pollution can be overcome and improve the aesthetic aspects of Petitenget Beach so as to increase the potential of tourism and the existing economy.

## Method

The method used in this study is to use the ex-situ method which is located at the author's residence and fisheries laboratory of the Faculty of Marine affairs and Fisheries Udayana University. The object of the research that will be studied is the estuary water of Petitenget Beach located in Kerobokan Village, Badung Regency, Bali Province. This research will utilize fragrant root plants (*Vetiveria Zizanodies* L.) as a phytoremediation agent sampled the estuary water of Petitenget Beach which will be tested for 30 days using an artificial wetland system.

The first stage is preliminary study, where this preliminary study is the initial stage in conducting a study. At this stage, the author observed the problems on petitenget beach and collected references and data from various sources related to the restoration of estuary water with the utilization of Akar Wangi (*V. Zizanodies* L.).

The second stage is data collection, where the data used by the author in this study is data in the form of sampling and sampling research. Sampling is done to take part of the research object that will be studied in the form of petitenget beach estuary water taken as much as 2 liters at each of the 3 different points that exist along the mouth of Petitenget Beach. After the sample has been taken, then the next is to conduct sample research conducted to find out the level of pollution from the estuary water sample in the Petitenget Beach area. Determination of water quality that has been taken from several points previously determined the value of the pollution index (IP) of the value of physical, chemical and Biological pollution parameters in the Fisheries Laboratory of the Faculty of Marine and Fisheries Udayana University which will later be compared to The Class III Water Quality Standard based on Bali Regulation No. 16 of 2016. The test parameters of this study are divided into physical parameters, Chemistry and biology. Physical parameters are research parameters that include TDS (Total Dissolved Solid), TSS (Total Suspend Solid) and temperature, Chemical Parameters include BOD (Biological Oxygen Demand, COD (Chemical Oxygen Demand), ammonia and pH while microBiological





parameters include coliform and fecal. Samole research will be conducted before and after artificial wetland testing. The third stage is testing the reaction of water to hydromacrophytic plants. The test was carried out by creating an artificial wetland system

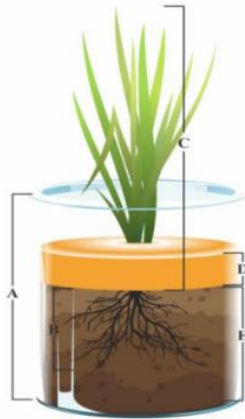


Figure 4.  
*Built Wetlands Design*

Information:

A = 9.5 Liter Bucket

B = Plant roots

C = Akar Wangi Plant As many as 12 sticks

D = 1 liter of wastewater from every 3 water samples.

E = Soil of 14 Kg

This testing process was carried out on February 9, 2021 after the sampling before testing. This activity is carried out at the author's residence for 1 month and after that will be carried out final sample research. After the test, there will be a second stage of sample research to find out the results of the fragrant root plant reaction test on the sample of petitenget beach estuary water. After these results will be obtained, the results will be analyzed to determine and conclude the results of previously artificial wetland system testing based on criteria that have been attached to Bali Regulation No. 16 of 2016.

After the research process, the results will be discussed with the Village Head of Kerobokan Office and badung District Environment and Hygiene Office to get approval and funding from this community service plan. The establishment of relations with the community and the community will also be done to help support the course of community service activities to be in accordance with the expected results later. The role of the community and this community will later play a role to hold socialization to tourists and the community will be important to maintain drainage channels so as not to have problems that spread in the tourism sector because this problem will be able to have an impact also on economic activities in Kerobokan Village. The community and community that is planned to be included are from Sekaa Teruna Teruni (Youth Organization) Kerobokan Village and Malu Dong Bali Community. It is expected that the establishment of cooperation between governments, communities and communities can realize the main goal of the sustainability of this community service program plan.



## Result

From the initial planning of this community service, namely the observation of the problem is known that the estuary on Petitenget Beach is a sewer of 4 loloan or small rivers that were originally a rainwater disposal drainage site but are now misused to be a waste draining site from various activities on the outskirts of loloan. The dense development activities, tourism activities and households around the loloan have a bad impact on the water quality in the loloan which will later pollute the estuary of Petitenget Beach. This pollution will have a bad impact on the existing tourism sector, where pollution that occurs in the estuary of petitenget beach causes reduced aesthetics of the beach itself which is feared will later add to the bad image of Petitenget Beach in the eyes of tourists, of course this also has an impact on the economic sector as well where tourist activities are the main source of income from the residents around Petitenget Beach. To ensure this, it is necessary to find out how quality of the estuary water petitenget beach.

To find out the quality of the estuary water of Petitenget Beach, it is necessary to conduct initial sample testing. This initial sample test was conducted based on the Water Quality Standard from PerGub Bali No.16 of 2016. From the PerGub it is known that the Water Quality Standard has a class that refers to PP No. 82 of 2001, which is a water quality class in divide into 4 classes. with each class showing the level of feasibility of the water to be used for certain things, the following division of the class:

*Table. 1 Division of water quality class based on PP No. 82 Tahun 2001*

Class	Allotment
I	Raw water drinking water
II	Infrastructure / facilities of water recreation, cultivation of freshwater fish, livestock, water, to irrigate the land.
III	Cultivation of freshwater fish, livestock, water to irrigate the Land.
IV	Irrigating the ground.

Known water quality class that is most in accordance with the allocation of the estuary of Petitenget Beach is Class III, which is water intended for freshwater cultivation, livestock and water to irrigate the land. Therefore, it is used by Baku Air Quality III PerGub Bali No. 16 of 2016 as a comparison of the water quality of the Petitenget Beach estuary. Here are the parameters of Water Quality III PerGub Bali No.16 of 2016:



Table. 2 Raw Water Quality/Baku Mutu (BM) class III PerGub Bali No. 16. 2016

Parameter	Unit	BM III	Information
<b>Physics</b>			
Temperature	°C	Deviasi 3	Temperature deviation from its natural state
TDS	mg/L	2000	dissolved residue
TSS	mg/L	400	suspended residue
<b>Chemical</b>			
PH	°C	6-9	water base acid
BOD	mg/L	6	
COD	mg/L	100	
Total Fosfat	mg/L	5	
NH <sub>3</sub> – N	mg/L	-	
<b>Biology</b>			
Fecal	°C	2000	
Coliform	mg/L	10000	

This are the results of a sample of petitenget beach estuary water:

Table 3. Results of petitenget beach estuary water research in February 2021

Parameter	Unit	S1	S2	S3	Average	BM III
<b>Physics</b>						
Temperature	°C	28.3	28.5	28.4	28.4	28.5
TDS	mg/L	2171.5	2168.7	2163.2	2167.8	1000
TSS	mg/L	9.3	10.2	8.9	9.466667	400
<b>Chemical</b>						
PH	-	5.3	4.2	4.8	4.766667	6-9
BOD	mg/L	22.4	23.3	22.7	22.8	6
COD	mg/L	60.5	61.4	59.8	60.56667	50
Total Fosfat	mg/L	0.4	0.3	0.3	0.333333	1
NH <sub>3</sub> – N	mg/L	0.1	0.1	0.1	0.1	0
<b>Biology</b>						
Fecal	Jml/100ml	53370	53362	53595	53442.33	2000
Coliform	Jml/100ml	11432.2	11425.6	116052	11487.6	10000

Information:



S1, S2, S3 = is a sample of the estuary water of Petitenget Beach in February 2021

BM III = Standard water quality group III PerGub Bali No. 16 of 2016



= Green ( $\leq$  BM III), yellow (close to BM III), red ( $>$  BM III)

In table 3 it can be seen that polluted parameters that exceed the Class III water quality standard required in Regulation No. 16 of 2016 are quite dominant. Polluting parameters that exceed the quality standard one of them is Total Dissolved Solid (TDS) which is a parameter that indicates there are dissolved solids (such as calcium, magnesium, potassium, sodium, bicarbonate, chloride and sulfate) in large quantities. The high concentration of TDS in loloan water samples downstream can be caused by the disposal of domestic and industrial wastewater into rivers. Chemicals are one of the largest contributors to TDS concentrations. Other parameters that have the potential to cause problems are BOD, COD, Fecal and Coliform which indicate the high number of organic substances dissolved in estuary water, the high organic substances in loloan water can be a serious problem because the higher the organic substance, microorganisms that multiply more and more because the organic substance is used as a food source by microorganisms. Fecal and coliform parameters are the number of bacteria identified in estuary water. Fecal is a parameter of the number of pathogenic bacteria that can cause disease. and coliform is a parameter of the number of bakteri that has the potential to bring a disease. Because the parameters of microbiology that exceed the limit, the estuary water of Petitenget Beach is very dangerous for the community or tourists if they are active in this estuary. Problems that can be caused by fecal and coliform levels can be diarrhea and skin irritation.

In the final quality research was conducted for 1 month after testing using an artificial wetland system conducted at the author's residence, namely Kerobokan Kelod Village, Badung Regency, Bali. This stage of quality research was carried out at the Perikanan Laboratory of the Faculty of Marine affairs and Fisheries, Udayana University. From the results of the study, the results of testing on the 3 samples are as follows:





*Table. 4 Quality profile of water sample testing of artificial wetland systems*

<i>Parameter</i>	<i>Unit</i>	<i>SP</i>	<i>BM III</i>
<b>Physics</b>			
<i>Temperature</i>	°C	28.2	28.5
<i>TDS</i>	mg/L	2136.2	1000
<i>TSS</i>	mg/L	12.88	400
<b>Chemical</b>			
<i>pH</i>	-	5.1216	6-9
<i>BOD</i>	mg/L	11.6678	6
<i>COD</i>	mg/L	50.5908	50
<i>TOTAL FOSFAT</i>	mg/L	0.30375	1
<i>NH<sub>3</sub>-N</i>	mg/L	0.1052	0
<b>Biology</b>			
<i>Fecal</i>	Jml/100ml	5858.37	2000
<i>Coliform</i>	Jml/100ml	12586.783	10000

Information:



SP = is a water sample from artificial wetland testing in March 2021

BM III = Standard water quality group III PerGub Bali No. 16 of 2016

= Green (<=BM III), yellow (close to BM III), red (>BM III)

From the table above, it was found that some parameters experienced a significant decrease in this test, including TSS or Total Solid Suspend levels which resulted in a decrease of (44%) far below the BM III threshold, pH resulted in an increase of (67%) which was close to the threshold value, Biological Oxygen Demand (BOD) Phosphate resulted in a decrease of (51.40%) but this value was still above the VALUE OF BM III, And the decrease in Chemical Oxygen Demand (COD) levels by (14.4%) is quite close to BM III. But on biology parameters, coliform levels resulted in an increase (8.46%) and fecal resulted in an increase (9.4%).

From these results it is known that hydromakrofita park is very effective in lowering some parameters that are the main source of pollution in the estuary of Petitenget Beach. Based on these results, there will be a discussion process on the part of the government, namely the Head of Kerobokan Village and the Environment and Hygiene Office to carry out the sustainability of this community service program. And the results of community service will later become the material of socialization that will be done with The Kerobokan Village Cadet Reef and Malu Dong Community to open the



minds of the kerobokan village community to the importance of maintaining and avoiding the kerobokan village river / loloan from river pollution. This result will also be an evaluation material of the Badung Regency Environment and Hygiene Office in carrying out river maintenance in the Badung Regency area so that in the future Badung Regency, Bali can avoid the existing pollution hazards.

## Discussion

This community service program has a sustainability plan that realizes the author's goal to restore the estuary water of Petitenget Beach by planting fragrant roots along the edge of the Petitenget Beach estuary. This is done because the results shown in the research that the authors did previously found that fragrant roots are very effective to lower ammonia and microbial levels, plus this plant is a local plant Kerobokan Village that is easy and cheap to obtain. That's why it's the right thing to realize.

The process of realizing this program of course has costs that cannot be borne by the author alone, therefore the author plans to cooperate with the Kerobokan Kelod Village Community, The Head of Kerobokan Kelod Village, Petitenget Tourism Beach Manager, and Badung District Environment and Health Office to participate in this community empowerment program. To realize this is done first discussion related to the concept and results of this community service program, the results will be discussed with the Village Head of Kerobokan Office and Badung District Environment and Hygiene Office to get approval and funding from this community service plan, strengthening cooperation with the government is carried out to facilitate the activities of this community service program on any shortcomings that are exist. By looking at the large number of slum watersheds, it is appropriate for the District Government to pay more attention to the existence of it. The government is required to make breakthroughs that are able to improve and create good conditions for the community<sup>7</sup>.

The establishment of relations with the community and the community will also be done to help support the course of community service activities to be in accordance with the expected results later. Environmental problems that exist today exist in a wide area, this problem is often caused by the activities of humans or communities. One of these things is garbage, garbage is currently a heavy homework not only from the government, but local and village governments. To overcome this, good human resources are needed to reduce the impact of this waste<sup>8</sup>. To realize human resources that care

---

<sup>7</sup> Ike Andini, "Perilaku Dan Peran Pemerintah Kota Surabaya Terhadap Perbaikan Daerah Kumuh Di Kelurahan Tanah Kalikedinding Kota Surabaya," *Kebijakan dan Manajemen Publik* 1, no. 1 (2013): 36–47, [http://www.journal.unair.ac.id/filerPDF/6\\_IKE A. KMP V1 N1 Jan-April 2013.pdf](http://www.journal.unair.ac.id/filerPDF/6_IKE A. KMP V1 N1 Jan-April 2013.pdf).

<sup>8</sup> Muh. Aniar Hari Swasono et al., "Perkembangan Pola Pikir Masyarakat Terhadap Pengelolaan



about the environment, the thought of the people of Kerobokan Village must be more opened, one way is by socialization<sup>9</sup>. The role of the community and this community will later play a role to hold socialization to tourists and the community will be important to maintain drainage channels so as not to have problems that spread in the tourism sector because this problem will be able to have an impact also on economic activities in Kerobokan Village. Later there will also be fragrant root plant planting activities with the community, government, and community together so that communication between stakeholders can run well.

The community and community that is planned to be included are from Sekaa Teruna Teruni (Youth Organization) Kerobokan Village and Malu Dong Bali Community. It is expected that the establishment of cooperation between governments, communities and communities can realize the main goal of the sustainability of this community service program plan. It is also expected that later this program can increase the tourism potential of Petitenget Beach and can be applied to other places that have similar problems with the condition of the Petitenget Beach estuary.

## Conclusion

From the community service article obtained the results of how effective from fragrant root plants in overcoming the levels of Chemical pollutants contained in the estuary water of Petitenget Beach. But it is less effective in lowering the levels of microBiology contained in water. Therefore, the restoration of the estuary water of Petitenget Beach is highly recommended to use hydromakrofita plants, especially Fragrant Roots as a Fitroremediation agent to reduce the levels of Chemical contained in the estuary water of Petitenget Beach so that it is expected that later this can increase the aesthetic value of petitenget beach area. But even so, later the community is still not recommended to do activities on the estuary waters of Petitenget Beach because it still has levels of microorganisms that cannot be mediated by the Fragrant Root plant. To cover the shortcomings of the estuary water remediation process, as a sustainability step of this program will be continued also with socialization carried out by Karang Taruna Kerobokan Village, Environmental Care Community and the Government to open the minds of kerobokan village community to the importance of maintaining loloan / river in

---

Sampah Di Desa Karangrejo Kecamatan Purwosari, Kabupaten Pasuruan," *Community Development Journal : Jurnal Pengabdian Masyarakat* 1, no. 3 (2020): 190–204, <https://journal.universitaspahlawan.ac.id/index.php/cdj/article/view/914/pdf>.

<sup>9</sup> Yunik'ati Yunik'ati et al., "Sadar Pilah Sampah Dengan Konsep 4R (Reduce, Reuse, Recycle, Replace) Di Desa Gedongarum, Kanor, Bojonegoro," *JIPEMAS: Jurnal Inovasi Hasil Pengabdian Masyarakat* 2, no. 2 (2019): 81.



their village. This community service program is very important to be one of the breakthroughs of the Badung Regency Government in managing the environment for the better, it is expected that this empowerment program can be realized well for the sake of the environment that we should take care of.

## Acknowledgements

With the completion of a community service journal article entitled " Restoration of water quality in the estuary area of Petitenget Beach with the use of Hydromakrofit plants " the author expressed his gratitude to the LP2M National University of Education as the organizer of Student Study Service, Lecture of the National Education University odd period 2020/2021, Ir. Agus Putu Abiyasa, B.Eng., Ph.D., IPM. as a guidance lecturer and other parties who participate in helping this activity.

## References

- Andini, Ike. "Perilaku Dan Peran Pemerintah Kotaa Surabaya Terhadap Perbaikan Daerah Kumuh Di Kelurahan Tanah Kalikeding Kota Surabaya." *Kebijakan dan Manajemen Publik* 1, no. 1 (2013): 36-47. <http://www.journal.unair.ac.id/filerPDF/6. IKE A. KMP V1 N1 Jan-April 2013.pdf>.
- Budiarsa Suyasa W, Sri Kunti Pancadewi G. A, Iryanti E. Suprihatin, and Dwi Adi Suastuti G. A. "KUALITAS AIR SUNGAI DI KAWASAN WISATA PANTAI PETITENGET, KEROBOKAN KABUPATEN BADUNG BAL." *ECOTROPHIC* 12, no. 2 (2018): 225-238.
- Dina Isti'anah, Moch. Faizul Huda, and Ainun Nikmati Laily. "Synedrasp. Sebagai Mikroalga Yang Ditemukan Di Sungai Besuki Porong Sidoarjo, Jawa Timur." *BIOEDUKASI* 8, no. 1 (2015): 57-59.
- Retnaningdyah, Catur, and Endang Arisoesilaningasih. "Efektivitas Proses Fitoremediasi Air Irigasi Tercemar Bahan Organik Melalui Sistem Batch Culture Menggunakan Hidromakrofit Lokal (The Effectiveness of Phytoremediation Process on Irrigation Water Contaminated by Organic Matter through Batch Culture Syste." *Jurnal Biology Indonesia* 14, no. 1 (2018): 33-41.
- Retno Dewi Khinanty, and Catur Retnaningdyah. "Potensi Beberapa Hidromakrofit Lokal Untuk Meningkatkan Kualitas Air Lindi Tempat Pemrosesan Akhir Sampah Talangagung, Kecamatan Kepanjen, Kabupaten Malang." *Jurnal Biotropika* 1, no. 1 (2017): 1-7.
- Swasono, Muh. Aniar Hari, Fatimatuz Zahroh, Ria Mutiara, Imroatun Nabila, and Tian Zahril Mufidah. "Perkembangan Pola Pikir Masyarakat Terhadap Pengelolaan Sampah Di Desa Karangrejo Kecamatan Purwosari, Kabupaten Pasuruan." *Community Development Journal : Jurnal Pengabdian Masyarakat* 1, no. 3 (2020):



190–204.

<https://journal.universitaspahlawan.ac.id/index.php/cdj/article/view/914/pdf>.

Yaqin, Muhammad Ainul, Dan Eko, Rini Indrayatie, and Jurusan Kehutanan. *STUDI KEMAMPUAN TANAMAN HIDROMAKROFITA DALAM FITOREMEDIASI KUALITAS LIMBAH CAIR KAYU LAPIS Study of Hydromacrophita Plant Capability in Phytoremediation Quality of Plywood Liquid Waste. Jurnal Sylva Scientiae*. Vol. 02, 2019.

Yunik'ati, Yunik'ati, Rio Miftakhul Imam, Febri Hariyadi, and Ismi Choirotin. "Sadar Pilah Sampah Dengan Konsep 4R (Reduce, Reuse, Recycle, Replace) Di Desa Gedongarum, Kanor, Bojonegoro." *JIPEMAS: Jurnal Inovasi Hasil Pengabdian Masyarakat* 2, no. 2 (2019): 81.

Andini, Ike. "Perilaku Dan Peran Pemerintah Kota Surabaya Terhadap Perbaikan Daerah Kumuh Di Kelurahan Tanah Kalikedinding Kota Surabaya." *Kebijakan dan Manajemen Publik* 1, no. 1 (2013): 36–47. <http://www.journal.unair.ac.id/filerPDF/6.IKE A. KMP V1 N1 Jan-April 2013.pdf>.