

Economic Valuation of Water Quality Condition Ogan River against the Clean Water in the District of Ogan Komering Ulu

Valuasi Ekonomi Kondisi Kualitas Air Sungai Ogan terhadap Air Bersih di Kabupaten Ogan Komering Ulu

Enda Kartika Sari^{1*)}, Lucyana Lucyana¹

¹Lecturer Civil Engineering Program, Faculty of Engineering, Baturaja University, Ogan Komering Ulu, South Sumatra 32115

^{*)}Corresponding author: endaunbara@gmail.com

(Received: 18 March 2020, Accepted: 14 September 2020)

Citation: Sari EK, Lucyana L. 2020. Economic valuation of water quality condition ogan river against the clean water in the district of Ogan Komering Ulu. *Jurnal Lahan Suboptimal : Journal of Suboptimal Lands* 9(2): 139-148.

ABSTRAK

Keberadaan Sungai Ogan saat ini telah mengalami penurunan kualitas air, hal ini akibat aktivitas yang keliru dari masyarakat seperti membuang sampah rumah tangga dan membuang limbah industri ke sungai. Kenyataan ini menyebabkan perlunya melindungi kualitas air sungai Ogan dengan cara penggunaan Perusahaan Daerah Air Minum (PDAM) dan sumur dangkal untuk memenuhi kebutuhan air bersih bagi masyarakat. Penggunaan sumur dangkal dan PDAM ini menimbulkan kerugian secara ekonomi bagi masyarakat. Hal ini menimbulkan extra cost atau biaya pengganti yang harus dibayarkan masyarakat. Tujuan penelitian ini adalah untuk mengetahui persepsi masyarakat terhadap dampak kualitas air sungai dan mengetahui besar biaya pengganti yang harus dikeluarkan masyarakat di sekitar Daerah Aliran Sungai Kabupaten Ogan Komering Ulu. Metode yang digunakan adalah analisis deskriptif dengan menggunakan pendekatan biaya pengganti (replacement cost) selama setahun. Jumlah populasi seluruhnya adalah 3.329 kepala keluarga (KK). Sampel dalam penelitian ini berjumlah 149 KK. Terkait dengan valuasi ekonomi terhadap aspek air bersih diperoleh 71,8 persen masyarakat menggunakan PDAM, 25,5 persen menggunakan air sumur dan 2,7 persen memanfaatkan air sungai sebagai sumber air bersih. Hasil estimasi biaya pengganti atau replacement cost yang dikeluarkan selama satu tahun adalah sebesar Rp 102.510.000 dan kebutuhan air bersih sebesar 20.502 m³/tahun. Total biaya yang dikeluarkan masyarakat adalah sebesar Rp 357.852.500.

Kata kunci: persepsi masyarakat, air bersih, replacement cost

ABSTRACT

The existence of the Ogan River has experienced a reduction in water quality, this is caused activities from the community such as disposing household waste and dumping industrial waste into the river. This fact causes the need of protecting the quality of Ogan river water by using Perusahaan Daerah Air Minum (PDAM) and shallow wells to fulfill the needs of clean water for the community. The use of shallow wells and PDAM caused economic losses to the community. They raise extra costs or replacement costs that must be

paid by the community. The purpose of this study was to determine the community's perception of the impact of river water quality and to determine the cost of replacement by using the replacement cost method that must be spent by the community around the Ogan River Basin Ogan Komering Ulu Regency. The method used descriptive analysis, and a replacement cost approach for a year. The total population of 3,329 is family head (KK). The samples in this study amounted to 149 KK. The perception of people who want to improve the quality of the river Ogan by 90.6 percent and of 88.6 percent of the public said it would remain in the vicinity of the Ogan River despite the condition change or increasingly bad. . In this study was take the reason people remain 51 percent is due to an economic factor. Regarding the economic valuation of clean water aspects, 71.8 percent of the people use PDAM, 25.5 percent use well water and 2.7 percent use river water as a source of clean water. The estimated cost of replacement costs incurred for one year is Rp102,510,000 and the need for clean water is 20,502 m³/year. The total costs incurred by the community amounted to Rp 357,852,500.

Keywords: public perception, clean water, replacement cost

INTRODUCTION

Indonesia is one of the countries that have a lot of source freshwater, but in the World Water Forum II, one of the topic issues discuss is that in 2025 there will be a water crisis in many countries including Indonesia. This water-scarce issue becomes crucial because water is a major need for the community and can threaten global security (Martha, 2017). This problem is due to errors in the management of water and not conducive to environmental conditions so as to accelerate water scarcity (Pertiwi *et al.*, 2015). The development of the population in an area that has increased and the need for water has increased (FAO, 2015) so that the demand for the waters will increase from year to year (Zakiyyatul, 2019). In addition, the conversion of land by humans from natural land turns into an industry area causing natural damage and degrades environmental quality (Heryawan *et al.*, 2014). Industrial expansion so rapidly adversely impacts the hydrological and ecological conditions that cause environmental problems.

The river as a provider of water contributes to welfare for humans especially for drinking water, irrigation, and other purposes. The river ecosystem services involve the quantity of water resources and water use benefit assessments (Momb Blanch *et al.*, 2017) and

environmental support defined by environmental services produced by natural ecosystems (Mulawarman *et al.*, 2020). Losses begin to arise from community activities in the utilization of rivers for example by removing waste and waste from the household and industrial to the river causing the quality of the river to decrease (Maharini *et al.*, 2017). The water quality of the river will affect the clean water that the community uses for its daily needs. Water pollution can cause a lot of loss, namely damage to the water that has been suspecting water supply, disruption of human health, loss of recreational functions, fisheries, biodiversity, and many other indirect losses. All of these losses are the cost of compensation or estimated economic losses that need to be accounted for magnitude (Yao *et al.*, 2016). Poor water quality strongly affects the willingness of the public to pay for the water condition (Jalilov, 2018). The phenomenon of river water pollution as a raw source of drinking water will impact clean water treatment and the risk of access to clean water received by the public (Pradana *et al.*, 2019). Agricultural intensification (Boerema *et al.*, 2014), the exploitation of natural resources from upstream to downstream causes the river basin area uncontrolled (Sukwika *et al.*, 2018) and greatly affects the water quality. So, the drinking Water supply system (SPAM) will be assigned a drinking

water service zone to address the problems and provide clean water service for the community (Azmeri, 2016). River water pollution becomes a problem in obtaining clean water resources needed by the community. The condition of the polluted river will cause disease for the people who consume the water (Hampson *et al.*, 2017). The qualifications of raw water to be suitable drinking water must be odorless, colorless and tasteless (Peraturan Menteri Kesehatan, 2017).

Environmental support is determined by the number of environmental services produced by natural ecosystems (Mulawarman *et al.*, 2020) Its determination with the approach and availability of water needs (Ramdhan *et al.*, 2019) and the ability of the supporting power is the availability of water needs and Food (Admadhani *et al.*, 2014) where the competition for water use as a natural resource becomes a serious problem with water limitations (Wulandari, Ilyas, 2019). Economic and social aspects and population will also affect them (Ketjulan *et al.*, 2019). The existence of Ogan River is very important for the OKU community, which is the source of water for the intake of Ogan Komering Ulu District. The economic value of this river provides the benefits and significance of both economic and ecological resources for both the society and the Government (Suryawati *et al.*, 2019). The water quality assessment by using the contamination index method in the water quality category of the Ogan River is lightly polluted with a value of 1.3 – 2.3 (Sari and Wijaya, 2019) while using the National Sanitation Foundation-Water Quality method. The Index (NSF-WQI) quality of the Ogan River is a medium with a value of 56-57 (Yulistia *et al.*, 2018). This raises extra cost as an effort to protect the quality of the Ogan River by means of the use of shallow wells and business entities or organizations engaged in clean water management i.e. Perusahaan Daerah Air Minum (PDAM) (Utami *et al.*, 2019) to fulfill the needs of the community in the

aspect water supply in the Ogan River basin of Ogan Komering Ulu regency. PDAM has a very important role in regional development, especially in the fulfillment of clean water needs (Putro *et al.*, 2018). Another alternative for people to clean water needs is the manufacture of digging wells (Sari and Huljana, 2019). As a means of sanitary water supply needs to get attention, because the wells are easily exposed to pollution and doping from the outside (Heluth, 2013). Water pollution causes poor water quality, resulting in the safety and health of the community to be threatened (Wulan, T.S., 2016). The greater the need for clean water needed by the community, the greater the economic value. The use of shallow wells and the PDAM raises economic harm to society (Rosminiati *et al.*, 2019). Related to this, there is a substitute fee using the replacement cost method that must be paid to the public. The purpose of this research was to know the public perception of the quality impact of Ogan River water and to know the cost of substitute by using the method of replacement cost of the community around the Ogan River flow area Regency of Ogan Komering Ulu.

MATERIALS AND METHODS

This study was chosen as the population is a community living a round the Ogan River that has intake of PDAM namely Tanjung Agung, Sukajadi and Tanjung Baru Village. The total population of 3,329 is family head (KK). The samples in this study amounted to 149 KK. In this study was taken using the Krejcie and Morgan formula as follows:

$$n = \frac{x^2 \cdot N \cdot P (1 - P)}{(N - 1) \cdot d^2 + x^2 \cdot P (1 - P)}$$

$$n = \frac{3,841 \cdot 3.329 \cdot (0,5 \cdot 0,5)}{(3.329 - 1) \cdot 0,05^2 + 3,841^2 (0,5 \cdot 0,5)}$$

n = 149 sampel

The Determination of the sample is done deliberately (purposive sampling) base on the special objectives of the study. The data needed in this research are primary and secondary. Primary data were obtained using interviews with respondents using questionnaires and direct observation in the field, and secondary data were obtained from relevant agencies, literature studies, and other literature. In analyzing the community's perception of the water quality of the Ogan River, Ogan Komering Ulu Regency is using descriptive analysis. In analyzing the public's perception of the water quality of the Ogan Komering Ulu Regency with a descriptive analysis. Descriptive analysis in this study using tables and graphs. To see how big the economic valuation of the river water quality to clean water in this study using replacement cost for a year (Kementerian Negara Lingkungan Hidup Republik Indonesia, 2010). The cost of replacement of the population can be calculated as follows:

$$BP = P \times QD$$

where:

BP = Replacement fee (Rp/year)

P = Clean Water Unit Price (Rp/m³; Rp/Container)

QD = amount of net water requirement (m³/year; container/year)

RESULTS

Public perceptions of the Ogan river water quality are shown in Figures 1-5 which are described descriptively. 49.66 percent of the people who live around the river say that the ogan river is of good quality (Figure 1). However, 90.6 percent of the people really want an improvement in the Ogan River ecosystem (Figure 2) and 88.6 percent of the people want to stay around the Ogan River even though the condition of the Ogan River is changing or getting worse (Figure 3). Economic reasons related to people's livelihoods that cannot be separated from the Ogan River water source causes 51 percent of the community to remain living around the Ogan River (Figure 4). An illustration of the source clean water utilized by the community can be seen in (Figure 5), which is 71.8 percent of the community uses PDAM as a source of clean water. and the biggest need for clean water is the community of Sukajadi village, which is 48.81 percent (Figure 6). This replacement cost is derived from the cost of the respondent from the installation and purchase of well water and the purchase of refill water (Table 1). Estimation of the economic value of losses water quality impacts on clean water are calculated using the Replacement cost for a year is 2019 (Table 2).

Table 1. Replacement cost

Village	Clean Water Demand (m ³ /tahun)	Percentage (%)	Replacement Cost (Rp/m ³ /tahun)
Tanjung Baru	4.374	21,33	21.870.000
Tanjung Agung	6.120	29,85	30.600.000
Sukajadi	10.008	48,81	50.040.000
Jumlah	20.502	100,00	102.510.000

Table 2. Replacement cost of clean water

Village	Total Cost of Installation of PDAM (Rp/th)	Total Well Production Cost (Rp/th)	Total Cost of Purchase of Clean Water (Rp/th)	Total Replacement Cost (Rp/th)
Tanjung Baru	71.900.000	1.400.000	73.300.000	146.600.000
Tanjung Agung	35.450.000	5.250.000	40.700.000	81.400.000
Sukajadi	35.200.000	35.200.000	59.452.500	129.852.500
Jumlah	142.550.000	41.850.000	173.452.500	357.852.500

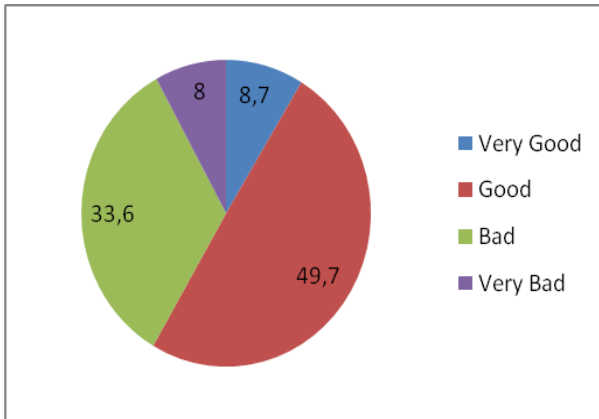


Figure 1. Public perception of the Ogan river

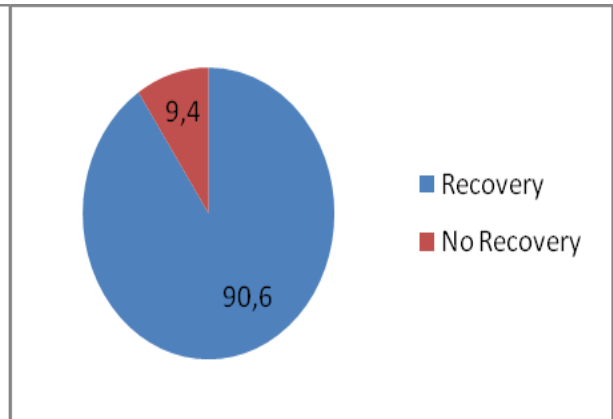


Figure 2. Community perception of Ogan River quality

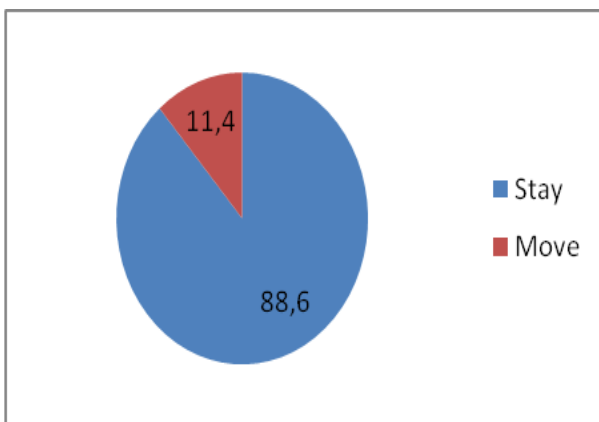


Figure 3. Community perception is changing the quality of Ogan River

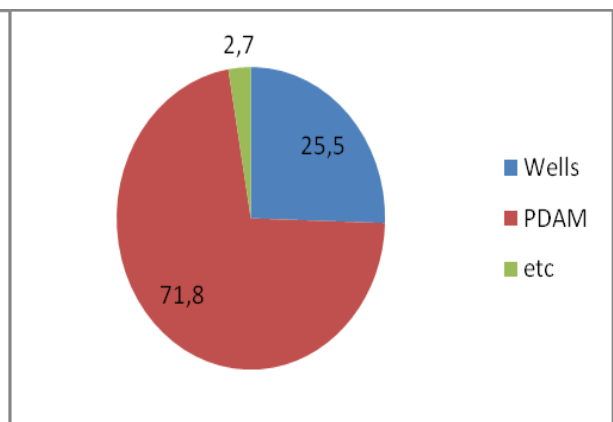


Figure 4. Society reasons to stay in the condition vicinity of the Ogan River

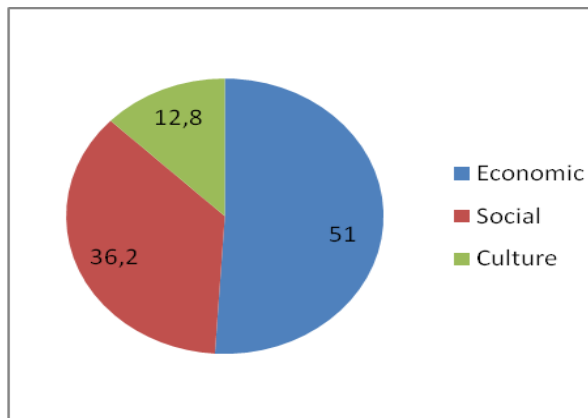


Figure 5. Community clean water resources

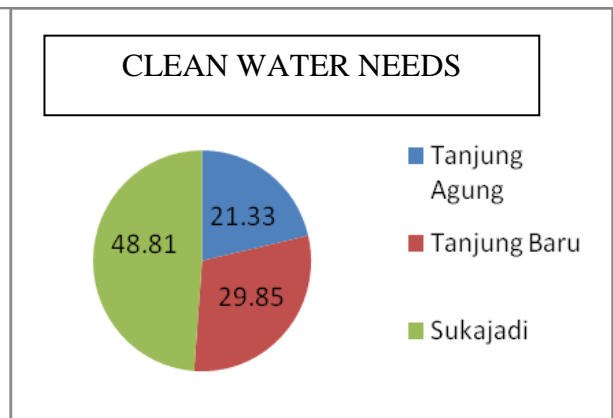


Figure 6. Percentage of clean water needs at research sit

DISCUSSION

The territory of Ogan Watershed, the upstream area is in the district of Ulu Ogan, Muarajaya, and Pengandonan. The territory of Ogan Watershed the middle area is in the district of Semidang Aji, Sosoh Buay Rayap, Baturaja Barat and Baturaja Timur. The territory of Ogan Watershed in the downstream is in the territory of the Lubuk Raja, Lubuk Batang, Peninjauan and Sinar Peninjauan (BPS OKU, 2019). Ogan River water pollution is the majority of the result of the negative behavior of the people who utilize the water of the Ogan River for daily living purposes as well as the consequences of household waste along the Ogan River. Based on the research (E.K.Sari and O.E.Wijaya, 2019) according to KepMenLH No 115 the year 2003 about the guidelines on determining the quality of water status based on the pollution index seen that in Tanjung Agung, Kebun Jeruk, Kemalaraja, Air Gading and Sukajadi village has a quality status of mildly polluted water, with the highest value of pollution index found on the location of the village Air Gading and Sukajadi is 2.3. This location is a populated residential location that has the possibility of river water experiencing mild pollution. People who live along Ogan watershed generally rely on the water of the Ogan River for their daily life needs. People are still doing their daily activities such as bathing, washing clothes and washing dishes. The height of population growth in the surrounding areas of the river that generally evolved into growth centers impact the increasing domestic waste disposal without processing, disposal of waste and industrial waste that add The pollution burden to the Ogan River.

The erosion issues in Ogan watershed majority occurred at the upstream. The main cause of the erosion disaster is due to reduced function of protected areas (forest and non-forest) into settlements and the mining of mines C around the river. Problem over land function is a problem

that many occur in sub-watershed of upstream to downstream. The function of land is rather than land function of agricultural land into settlements due to the development of settlements without good planning. The type of land function that contributes to forest damage which of course resulted in damage to the hydrological forest is the logging of trees (forest tree) in protected forests and the expansion of agricultural land and plantation land. On protected forest areas. Rather, the land function caused the destruction of the forest to become more widespread and would have a considerable impact on environmental damage and natural disasters. If forest damage is not prevented, the disaster will emerge quite a lot, such as flood, avalanche, drought and including ecosystem damage. Local wisdom is synonymous with the local cultures of the community in a region that is usually done hereditary. Many things related to local wisdom that is potentially in the management of watershed has not been managed and optimally excavated. For example, cleaning the river from garbage and waste together is a form of local culture that if managed properly will be able to help the management of watershed with no cost.

Public perception of the Ogan River quality of 49.66 percent said well (Figure 1). According to the public condition of the Ogan River can still be utilized for drinking water and fulfillment of community needs. However certain conditions such as when the high rainfall causes the volume of the river to rise, the upstream of the river carries a lot of garbage and sludge so that the state of the Ogan River becomes very cloudy and bad. Based on the study of the river Ogan seen from the pollution index was lightly contaminated with the value of pollution index 1.3 – 2.3 (Sari and Wijaya, 2019). The pollution index is one of the methods used to determine the quality status of water. The water quality Status represents the level of the source water quality by comparing the predefined quality

standards. People who lived around the Ogan River 90.6 percent strongly wanted an improvement on the ecosystem of the Ogan River (Figure 2). The condition and quality of the Ogan River is increasingly worrying and causing public discomfort.

According to the quality Society of Ogan River has undergone change or decline. People want the condition of the river Ogan as it used to be the one that can still be used to drink water directly. The public also wanted the government's participation in enforcing regulations governing not to dispose of household waste and industrial waste to the Ogan River. In addition, the community wants the hydrological functions of the river basin area Ogan River watershed remains awake by avoiding the sediment or the sedimentation which becomes one of the causes of flooding, when the river rainy season is not able to Water, so that water is overflowing and floods occur. But when the dry season arrives the water discharge becomes small and the water supply of PDAM is interrupted.

Changes that occurred to the water quality of the river Ogan cause the people living around the Ogan River to take a stance of 88.6 percent of the community said it will remain in the vicinity of the Ogan River although the condition of the Ogan River experienced Change or getting worse (Figure 3). The declining quality change of Ogan River does not affect people to stay around the river. The reasons for society to stay because of economic, social and cultural factors. A total of 56 percent of the people decided to stay around the Ogan River for economic reasons. Economic reasons related to the search of the society that can not be separated from the water source of the Ogan River, causing most people to remain in the vicinity of the Ogan River (Figure 4).

Related to economic valuation in Ogan River, Ogan Komering Ulu Regency, especially in the access to clean water, then obtained community data in the use of clean water resources of 71.8 percent of people

use PDAM as a source of clean water. A picture of the source of clean water utilized by the public (Figure 5).

According to the regulation of the Governor of South Sumatera No. 16/2005 that the quality of water in the Ogan River is the class I, namely water that can be used for raw water drinking water and or other requirements that require the same water quality as the same. Based on the Governor of South Sumatera Regulation number 16/2005 of the state of the Ogan River based on 10 parameters measurements of physical, chemical and biological parameters are obtained that the turbidity, PH, temperature, nitrate, and fecal coli still meet The required quality standards, while the DO and BOD parameters have exceeded the standard quality of the water, the phospat parameter has exceeded the standard quality standards of water, the MBAS parameter has exceeded the standard of water quality standards (E.K.Sari and O.E.Wijaya, 2019). Water quality in the lower Ogan River certainly raises extra cost as an effort so that the quality on the Ogan River is not decreasing. Efforts undertaken to protect the quality of the Ogan River is by means of the use of shallow and PDAM wells to fulfill the needs of the community in the clean water aspect of Ogan River watershed. In the use of shallow wells or PDAM, it certainly raises economic losses related to the cost of replacement or replacement cost incurred by the community.

The replacement cost of this replacement cost is derived from the cost of the respondent from the installation and purchase of well water and the purchase of refill water can be seen in Table 1. The cost of replacing clean water supply at the largest research site was issued by the people of Tanjung Baru village for Rp 146.6 million per year. Estimation of economic value of losses Water quality impacts on clean water are calculated using the Replacement cost for a year is 2019, can be seen in Table 2. The need of clean water at research site is 20,502 m³ per year with a

large replacement cost of Rp 102,510,000 per year. Replacement Cost of Sukajadi village is very large Rp 50.040.00 per year and the need for clean water of 10,008 m³/year or 48.81 percent (Figure 6). The cost of replacing clean water is large enough. This cost is related to the protection of the quality of the river Ogan, which is declining, so that the ecosystem around the Ogan River is not disturbed.

CONCLUSION

The perception of people who want to improve the quality of the river Ogan by 90.6 percent and of 88.6 percent of the public said it would remain in the vicinity of the Ogan River despite the condition change or increasingly bad. In this study was take the reason people remain 51 percent is due to an economic factor. Related to economic valuation in the Ogan River, Ogan Komering Ulu is specialized in clean water access, then obtained as much as 71.8 percent of people using PDAM as a source of clean water, 25.5 percent use well water as a source of clean water and 2.7 percent utilize river water as a source of clean water. The economic value of the water quality of the Ogan River as an effort to preserve the water quality of the Ogan River for the community around the Ogan River basin is the result of an estimated replacement cost or replacement cost for one year is Rp 102,510,000 and the need for clean water at 20,502 m³/year. The Total cost of the respondent from the installation of PDAM, the manufacture of wells and the purchase of water refill that was issued by the community at the research site is Rp 357,852,500.

ACKNOWLEDGEMENT

Thank you for the team of research institutions and community service to the Universitas Baturaja especially to the Ministry of Research and Technology/national Research and Innovation agency through the funding of

Simlibtamas grants for beginner lecturer research program in budget year 2020.

REFERENCES

- Admadhani DN, Hajil AHS, Susanawati LD. 2014. Analysis of water supply and water demand for Carrying Capacity Assesment (Case Study of Malang). *Jurnal Sumber Daya Alam dan Lingkungan* 1(3): 13-20. Azmeri A. 2016. 'Kajian prioritas zona layanan sistem penyediaan air minum (SPAM) regional kabupaten Aceh Utara dan Kota Lhokseumawe' dalam *Pertemuan Ilmiah Tahunan PIT XXXIII & Kongres XII HATI*.
- BPS OKU. Badan Pusat Statistik. 2019. Ogan Komering Ulu dalam Angka.
- Putro B, Furqon MT, Wijoyo SH. 2018. "Prediksi Jumlah kebutuhan pemakaian air menggunakan metode exponential smoothing (Studi Kasus : PDAM Kota Malang)," *J. Pengemb. Teknol. Inf. dan Ilmu Komput. Univ. Brawijaya*.
- Boerema A, Schoelynck J, Bal K, Vreboos D, Jacobs S, Staes J, Meire P. 2014. 'Economic valuation of ecosystem services, a case study for aquatic vegetation removal in the Nete catchment (Belgium)', *Ecosystem Services*. 7 (March): 46-56. doi: 10.1016/j.ecoser.2013.08.001.
- FAO. 2015. Available online: <http://www.fao.org/ag/agp/greencities/en/whyuph/>. [Diakses tanggal 15 Juli 2019]
- Hampson DI et al. 2017. 'River water quality: who cares, how much and why?', *Water (Switzerland)*. doi: 10.3390/w9080621.
- Heluth OM. 2013. Kualitas air sumur gali masyarakat desa Tifu Kecamatan Waeapo Kabupaten Buru Propinsi Maluku. *Jurnal MKMI*, 9(2):67-73.
- Heryawan A, Fauzi A, Hidayat A. 2014. 'Analisis pengelolaan air bersih berkelanjutan di Kota Bogor (Studi Kasus: PDAM Tirta Pakuan)', *Jurnal Ekonomi Pertanian, Sumberdaya dan*

- Lingkungan* 2: 1–12.
- Jalilov SM. 2018. 'Value of clean water resources: Estimating the water quality improvement in Metro Manila, Philippines', *Resources*. doi: 10.3390/resources7010001.
- Ketjulan R *et al.* 2019. 'Daya dukung lahan untuk pemukiman penduduk dan implikasinya terhadap kualitas perairan di pulau-pulau kecil (Kasus Pulau-pulau Kecil Selat Tiworo Kabupaten Muna Barat)', *Jurnal Ilmu dan Teknologi Kelautan Tropis*. 11(3): 569-582 <https://doi.org/10.29244/jitkt.v11i3.25731>.
- Kementerian Negara Lingkungan Hidup Republik Indonesia. 2010. Panduan Valuasi Ekonomi Sumberdaya Alam dan Lingkungan. Kementrian Negara Lingkungan Hidup Republik Indonesia. Jakarta.
- Maharini L, Nugraha WD, Hadiwidodo M. 2017. 'Valuasi ekonomi lingkungan kondisi kualitas air sungai gelis terhadap aspek air bersih (studi kasus: daerah aliran sungai gelis, Kecamatan Jati, Kabupaten Kudus)', *Jurnal Teknik Lingkungan*.
- Martha J. 2017. 'Isu Kelangkaan air dan ancamannya terhadap keamanan global', *Jurnal Ilmu Politik dan Komunikasi*.
- Momblanch A, Paredes-Arquiola J, Andreu J. 2017. 'Improved modelling of the freshwater provisioning ecosystem service in water scarce river basins', *Environmental Modelling and Software*. doi: 10.1016/j.envsoft.2017.03.033.
- Mulawarman A *et al.* 2020. 'Daya dukung ketersediaan air dan pangan di Kecamatan Sukamaju', *Jurnal Linears*. 2(2): doi: 10.26618/j-linears.v2i2.3126.
- Pertiwi IG, Agung IM. 2015. 'Analisis nilai satuan biaya jasa pengelolaan sumber daya air', *Jurnal Matrix: Jurnal Manajemen Teknologi dan Informatika*.
- Peraturan Menteri Kesehatan Nomor 32 tahun 2017. tentang Standar Baku Mutu Kesehatan Lingkungan dan Persyaratan Kesehatan Air untuk Keperluan Higiene Sanitasi.
- Pradana HA. *et al.* 2019. 'Identifikasi kualitas air dan beban pencemaran sungai bedadung di intake instalasi pengolahan air PDAM Kabupaten Jember', *Jurnal Kesehatan Lingkungan Indonesia*. 18(2): 135-143.
- Ramadhan M. *et al.* 2019. 'Simulasi daya dukung lingkungan di pulau Gili Ketapang Probolinggo dengan mengandalkan curah hujan pemenuhan kebutuhan air', *Jurnal Kelautan Nasional*. doi: 10.15578/jkn.v14i1.6861.
- Wulandari RSA, Ilyas A. 2019. Pengelolaan sumberdaya air di Indonesia: Tata pengurusan air dalam bingkai otonomi daerah. *Jurnal Gema Keadilan*. 6(3): Oktober 2019.
- Rosminiati R, Syahnur S, Hamzah A. 2019. 'Faktor-faktor permintaan dan kesediaan membayar wisatawan terhadap objek wisata berdasarkan travel cost method', *Jurnal Ekonomi dan Kebijakan Publik Indonesia*. 6(1): doi: 10.24815/ekapi.v6i1.14258.
- Sari EK, Wijaya OE. 2019. 'Penentuan status mutu air dengan metode indeks pencemaran dan strategi pengendalian pencemaran sungai ogan kabupaten Ogan Komering Ulu', *Jurnal Ilmu Lingkungan* 17(3):486.
- Sari M, Huljana M. 2019. 'Analisis bau, warna, TDS, pH, dan salinitas air sumur gali di tempat pembuangan akhir', *ALKIMIA: Jurnal Ilmu Kimia dan Terapan*. 3(1):1-5.
- Sukwika T. *et al.* 2018. 'Skenario kebijakan pengelolaan hutan rakyat berkelanjutan di kabupaten Bogor', *Jurnal Pengelolaan Sumberdaya Alam dan Lingkungan (Journal of Natural Resources and Environmental Management)*. 8(2):207-215.
- Suryawati SH. *et al.* 2019. 'Valuasi ekonomi sumberdaya terumbu karang dan mangrove di kawasan taman wisata perairan (TWP) Gili Matra, Lombok Utara, Nusa Tenggara Barat', *Jurnal Kebijakan Sosial Ekonomi Kelautan dan Perikanan*. 8(2):151-161.
- Utami AK, *et al.* 2019. Optimasi

- pendistribusian air menggunakan *improved zero point method* (Studi Kasus di PDAM Tirta Kepri). *UNP Journal Mathematic*. 2(1).
- Wulan TS. 2016. Analisis Kualitas air sumur masyarakat kelurahan lalolara Kecamatan Kambu. Skripsi. Universitas Haluoleo
- Yao H, You Z, Liu B. 2016. 'Economic estimation of the losses caused by surface water pollution accidents in China from the perspective of water bodies' functions', *International Journal of Environmental Research and Public Health*. doi: 10.3390/ijerph13020154.
- Yulistia E, Fauziyah S, Hermansyah H. 2018. 'Assessment of Ogan River water quality kabupaten OKU SUMSEL by NSFQI Method', *Indonesian Journal of Fundamental and Applied Chemistry*. 3(2): 54-58.
- Zakiyyatul MM. 2019. Analisis ketersediaan air meteorologis untuk memenuhi kebutuhan air domestik penduduk di Kabupaten Malang. *JPIG (Jurnal Pendidikan dan Ilmu Geografi)* 4 (2):1-9.