Global Scientific JOURNALS

GSJ: Volume 7, Issue 3, March 2019, Online: ISSN 2320-9186
www.globalscientificjournal.com

ANALYSIS OF THE CONDITION OF JATIGEDE RESERVOIR WATER REVIEWED FROM NITRATE CONCENTRATION, PHOSPHATE AND CHLOROPHYLL-A

Farras Faishal[1], Zahidah Hasan[2], Iis Rostini[2], Heti Herawati[2]

[1]Student at Faculty of Fisheries and Marine Scicence, Padjadjaran University, Bandung – Sumedang KM 21 Jatinangor 45363, Indonesia
E-mail adress: farraspanjul@gmail.com
[2]Lecturer at Faculty of Fisheries and Marine Science, Padjadjaran University, Bandung – Sumedang KM 21 Jatinangor45363, Indonesia
Email adress: h.herawati@unpad.ac.id

KeyWords
Chlorophyll-a, Jatigede Reservoir, nitrate, phosphate, reservoir management, trophic status.

ABSTRACT

Jatigede Reservoir is a reservoir located in Sumedang Regency, West Java Province. This reservoir is classified as a new puddle so it is necessary to do research on the condition of its waters. For this reason, this study was conducted with the aim of knowing the condition of water quality by looking at the content of nitrate, phosphate and chlorophyll-a as one of the indicators of the quality of water in the waters of the Jatigede Reservoir. The implementation of this study began from June 2018 to September 2018. Data collection was carried out at four stations with data collection six times. The sampling method used was purposive sampling. Collection of observation data using survey method sampling technique. The parameters of chlorophyll-a, nitrate and phosphate were analyzed in the laboratory using spectrophotometric methods. Other physical and chemical parameters such as temperature, DO, and pH are measured in situ. The parameters of the quality of water in the Jatigede Reservoir are chlorophyll-a concentrations ranging from 2.06 - 25.79 mg / m3. Nitrate concentrations ranged from 0.148 - 0.657 mg / l and phosphate concentrations were 0.160 - 0.188 mg / l. Temperatures ranging from 24.8 - 28.7 oC and DO are 2.3 - 7.3 mg / l and pH ranges from 6.7 - 8.4. Based on the concentration of chlorophyll-a, the Jatigede Reservoir is in mesotrophic-eutrophic conditions.

INTRODUCTION

Jatigede Reservoir is a reservoir located in Sumedang Regency, West Java Province. The reservoir was inaugurated in 2015 and began full operation in 2017. The Cimanuk River in the Jatigede District Area, Sumedang Regency is dammed to make this reservoir with a capacity of 979.5 million m^3 of water. One of the functions of this reservoir is as a source of irrigation for 90,000 hectares of paddy fields in Indramayu, Majalengka, and Cirebon [15]. The management of the Jatigede Reservoir will continue the target of empowering the function of the Jatigede Reservoir as raw water and electricity generation. At first the function of this reservoir was calculated to last for 50 years. So that all activities and forms of utilization carried out in the reservoir require permission and study first. One form of utilization of reservoirs that is often in the spotlight is regarding floating net karamba (KJA). In the Jatigede Reservoir there are several KJA found, most of which are erected around the reservoir inlet. The development of the Jatigede Reservoir is regulated in the Regional Regulation of Sumedang Regency Number 2 of 2012 concerning the spatial plan for the Sumedang area. Article 52 paragraph 4 letter b provides confirmation of the prohibition of aquaculture aquaculture activities with floating nets.

Jatigede Reservoir has just been flooded so it is necessary to do research on the condition of its waters. Aquatic fertility is often the main topic in researching reservoirs. Aquatic fertility is usually associated with nutrient concentrations in aquatic bodies. The higher intensity or density of anthropogenic activities allows the region to experience excessive trophic status increases [2]. Through several biological and chemical characteristics such as the availability of NO^3, PO^4, and chlorophyll-a nutrients, it can determine the fertility level of a waters [3]. In the Jatigede Reservoir there is still little information about the condition of the waters seen from several water quality parameters. Based on this, it is necessary to do research on the condition of water quality by looking at the content of nitrate, phosphate and chlorophyll-a as one indicator of the quality of water in the waters of the Jatigede Reservoir.

METHODS

The research was conducted in June 2018 - September 2018 with four data collection points (stations). Samples were taken and measured every 14 days six times. The sampling method used was purposive sampling. Collecting observational data using survey method sampling technique, which is data collection by recording a small portion of the population but the results obtained are expected to describe the nature of the population that is the object of research observed [19].

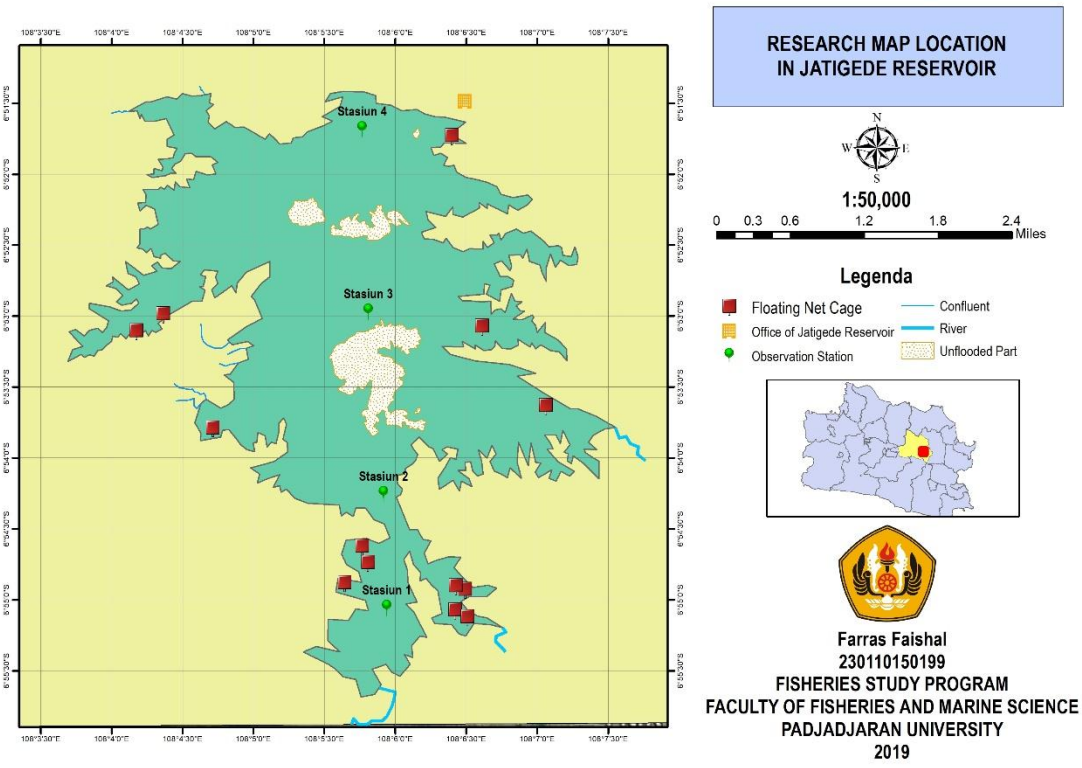

Fig. 1. Map of Research Location

One station studied represents the location of the inlet of the waters, two stations represent the location of the middle body of the water, and one station represents the location of the outlet of the Jatigede Reservoir waters. The predetermined sampling point is used as a reference in random sampling which is still around the point with a radius of 0-200 meters which is sufficient to represent the specified area or station.

The measured physical chemical parameters of the waters include temperature, pH and DO (Dissolved Oxygen) in situ and nitrate, phosphate and chlorophyll-a exsitu. Temperature is measured directly using a thermometer. Acidity (pH) measurement uses the electrometric method with a pH device. Determination of DO value is done by titration and dilution method using the following equation [2]:

$$DO = \frac{8000 \times \text{Na-tiosulfat} \times \text{N Na-tiosulfat}}{50 \times \frac{(\text{Vo (volume winkler)-2})}{\text{Vo (volume winkler)}}}$$

Determination of nitrate and phosphate concentration using the equation below [2]:

$$NO_3 / PO_4 = \frac{1000}{25} \times \frac{\text{sample absorption}}{\text{standard absorption}} \times 5 \text{ Microgram}$$

Calculation of chlorophyll-a content in this research uses the trichromatic method. Based on Vollenweider (1974) the value of chlorophyll-a concentration can be calculated using the following formula [1]:

$$\text{Klorofil-a } (mg/m^3) = Ca \frac{\{(11.6 \times D665)-(1.31 \times D645)-(0.14 \times D630)\} \times v}{V \times L}$$

Information :
v = Acetone volume used
V = Volume of filtered water to be extracted (L)
D665 = Optical density at a wavelength of 665 nm
D645 = Optical density at a wavelength of 645 nm
D630 = Optical density at a wavelength of 630 nm

Trophic status of reservoirs can be determined based on chlorophyll-a concentration with the classification scheme as follows:

Table 1. Assessment of trophic status of reservoirs based on chlorophyll-a concentration

Classification Scheme		Category Description			
Lake Trophic Status	**Annual Max. Chlorophyll**	**Algal Growth**	**Deoxygenation In Hypollimnon**	**Level of Pollution**	**Impairment of Use of Lake**
Oligotrophic (O)	<8	Low	Low	Very low	Probably none
Mesotrophic (M)	8-25	Moderate	Moderate	Low	Very Little
Eut. Moderatly (m-E)	25-35	Substansial	May be high	Significant	Appreciable
Eut. Strongly (m-E)	35-55	High	High	Strong	Appreciable
Eut. Highly (h-E)	55-75	Very High	Probably total	High	High
Hypertrophic (H)	<75	Very High	Probably total	Very high	Very high

RESULTS AND DISCUSSION

The temperature in the Jatigede Reservoir waters shows no significant differences and tends to be stable. The average temperature ranges from 26.2 - 26.7 ^{o}C. According to [2], higher than 15˚C temperatures favored the development of microorganisms and activated chemical reactions. Based on Indonesian Government Regulation No. 82 of 2001 because the quality standard for Class Two (II) Temperature is deviation 3, which means that if the normal temperature of water is 25 °C, then Class II criteria limit water T to 22 °C - 28 °C [3]. This shows that the water temperature in the waters of the Jatigede Reservoir is still within the range that can be tolerated by aquatic organisms.

Table 2. Temperature of the Jatigede Reservoir

Station	Unit	Observation Time					
		1	2	3	4	5	6
1	°C	26.9	24.8	26.2	25.6	26.6	27.2
2	°C	26.8	26.7	26.6	25.9	27.7	26.5
3	°C	26.5	25	26.7	25.4	28.7	26.7
4	°C	27.1	26	26.4	25	28.7	26.8

Table 3. pH value of Jatigede Reservoir

Station	Observation Time					
	1	2	3	4	5	6
1	6.72	6.67	7.19	7.47	7.54	7.25
2	6.84	6.98	8.12	7.78	8.04	7.35
3	6.94	7.38	7.94	7.62	8.11	7.77
4	6.78	7.49	8.09	7.6	8.4	8.21

The pH value obtained is the pH value of the Jatigede Reservoir with a distribution of 6.7-8.4 (Table 3). To support the growth and breeding of aquatic organisms, a pH condition between 6 - 9 [4] is needed. When pH is below 4, it creates an acid pollution resulting in the most of the vertebrates and microorganisms [5]. The pH value of the Jatigede Reservoir waters is still good to support the life of the organism in it.

Table 4. Dissolved oxygen of Jatigede reservoir

Station	Unit	Observation Time					
		1	2	3	4	5	6
1	mg/l	3.4	3.4	3.6	4.3	2.3	4.4
2	mg/l	5.4	4.2	5.6	6.7	3	5.4
3	mg/l	5.2	4.4	5.1	5.4	4.9	5.5
4	mg/l	5.2	4.8	6.5	7.3	6.3	4.2

Based on the analysis from Table 3, the average distribution of the highest dissolved oxygen (DO) at station 4 is 5.71 mg / l and is lowest at station 1, which is 3.57 mg / l. Different DO values in the river section, transitions and reservoirs are caused by differences in physical conditions in each water body [6]. The decrease of dissolved oxygen is mainly caused by the decomposition of organic compounds [7]. Based on [3], states that the standard for fisheries activities is 4 mg / l. The range of DO values in the Jatigede Reservoir can still run well for fisheries activities.

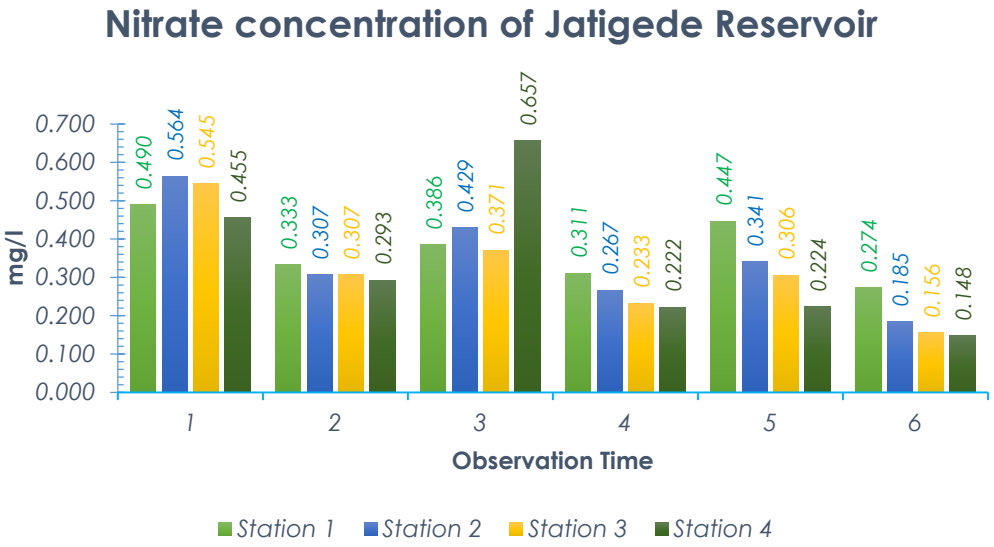

Fig. 2. Nitrate concentration of Jatigede Reservoir

During the study nitrate concentrations ranged from 0.148 to 0.657 mg / l (Fig. 2). Based on [3], the range of nitrate in the waters of the Jatigede Reservoir is still below the threshold. Nitrate concentration in waters is influenced by nutrient input from agricultural and agricultural wastes [8]. Based on [9], in the Jatiluhur Reservoir get a nitrate range of 0.05 - 0.64 mg / l. In his research the high concentration of nitrate was at the station which was agricultural land and found organic waste and floating net cage cultivation activities. So that in this study station 1 has a higher nitrate value than other stations because besides found several floating net cage cultivation station 1 also gets nutrient input from the Cimanuk River.

Based on analysis in Figure 3, the highest average phosphate concentration at station 1 was 0.188 mg/l and the lowest at station 3 was 0.160 mg/l. Based on [3], the range of phosphate concentrations in the Jatigede Reservoir is still within the required threshold. According to [10] in his research in the Sengguruh Reservoir, the phosphate range was 0.102-0.103 mg/l. The phosphate concentration in the Sengguruh Reservoir is an industrial waste, agricultural activities and domestic waste entering the reservoir. In this case, the Cimanuk River is the main input that brings waste to the Jatigede Reservoir.

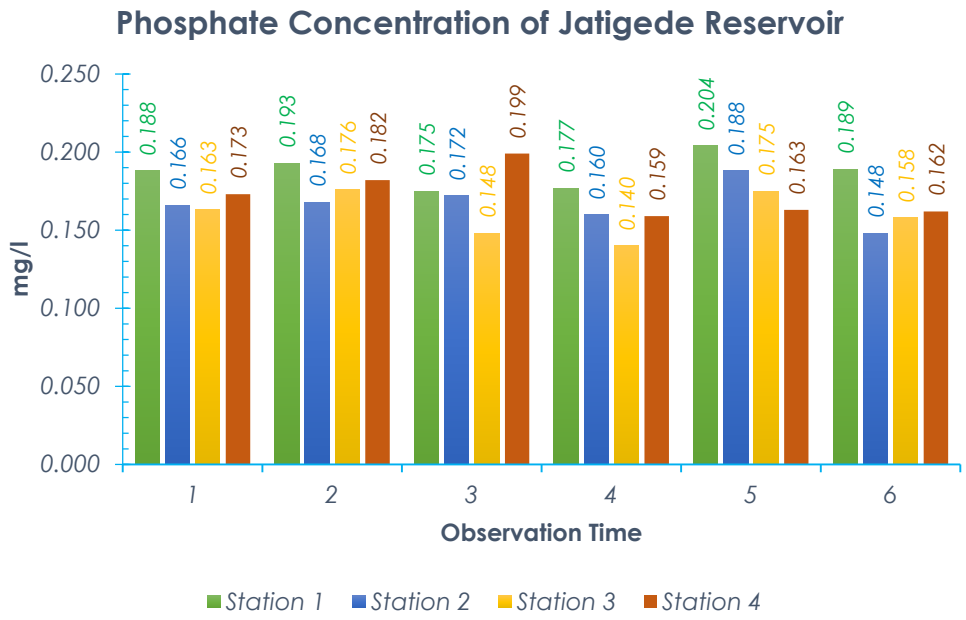

Fig. 3. Phosphate Concentration of Jatigede Reservoir

Based on the results obtained, the concentration of chlorophyll-a in the waters of the Jatigede Reservoir during observation has fluctuating values ranging from 2.06 - 25.79 mg / m3 (Fig.4). The highest chlorophyll-a concentration is highest at station 1 and the lowest at station 3. The high concentration of chlorophyll-a at station 1 can be due to the high nutrient level carried by the Cimanuk River stream. Based on [11], in the research carried out in the Jatibarang Reservoir there was a high nutrient content due to the process of decomposing water weeds and erosion stacks from upstream areas. increasing nutrient levels in the waters will increase primary productivity so that the chlorophyll-a concentration becomes high [12].

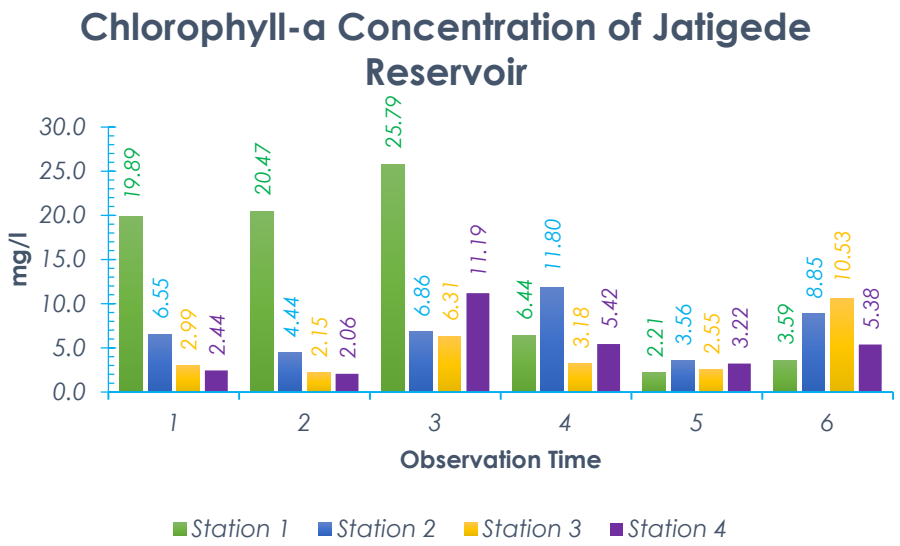

Fig. 4. Chlorophyll-a Concentration of Jatigede Reservoir

The average value of the fourth chlorophyll-a concentration of the stations ranged from 4.62-13.06 mg/m^3. Based on this, the Jatigede Reservoir is currently in mesotrophic-eutrophic status. 4.62-13.06 mg/m^3. When the reservoir conditions are in mesotrophic status characterized by moderate algal growth, moderate deoxygenation in the hypolimnion layer, low levels of pollution and a small possibility of deterioration of the reservoir. In eutrophic conditions, algae growth is high, deoxygenation is high in hypolimnion, significant increase in pollution and a considerable potential decrease in use of reservoirs [13].

CONCLUSION

Overall the condition of the Jatigede Reservoir waters is in mesotrophic - eutrophic status which is seen from the average concentration of chlorophyll-a 4.62 - 13.06 mg/m^3. So the Jatigede Reservoir is still relatively good and suitable for the survival of the organism. However, some indications that cause some parameters to increase such as nitrate, phosphate and chlorophyll-a can be referred to as reservoir management. Management of nutrient input from the Cimanuk River needs to be considered because it contains materials such as organic waste, factory waste, household waste, agriculture, and other pollutants that will accelerate eutrophication in the reservoir.

Acknowledgment

I want to thank the research colleagues and supervisors at the Faculty of Fisheries and Marine Sciences who made this article well resolved.

REFERENCES

[1] R. A. Vollenwider, A Manual on Methods for Measuring Primary Production in Aquatic Environment (second edition) IBP Handbook No. 12, Oxford: Blackwell Scientific Publication, 1974.

[2] Boukari, O.T., D. Mama., Y. Abou., and M.L. Bawa, "Physico-Chemical Features of The Kpassa Reservoir, Northern Benin, with Emphasis on Its Trophic State," *ournal of Environtment Protection,* vol. 7, no. 1, pp. 2067-2080, 2016.

[3] Anonim, "Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air," Government of the Republic of Indonesia, Jakarta, 2001.

[4] C. Boyd, Water Quality in Warmwater Fish Ponds, Auburn, Alabama: Auburn University, 1979.

[5] Rao, G.S. and Rao, G.N, "Study of Ground Water Quality in Greater Visakha-Patnam City, AP India," *Journal of Environmental Science and Engineering,* vol. 52, no. 1, pp. 137-146, 2010.

[6] W. Muriasih, Penyebaran Oksigen Terlarut Dari Sungai Cicendo Di Waduk Cirata, Jawa Barat, Bogor: Institut Pertanian Bogor, 2012.

[7] Wang, X., Lu, Y., Han, J., He, G. and Wang, T, "Identification of Anthropo-Genic Influences on Water Quality of Rivers in Taihu Watershed," *Journal of Environmental Sciences,* vol. 19, no. 1, pp. 475-481, 2007.

[8] Fried, S., B. Mackie, E. Nothwehr, Nitrate and Phosphate Levels Positively Affect The Growth of Algae Species Found in Perry Pond, Grinnell: Grinnell College, 2003.

[9] D. Kusumaningtyas, "Analisis Kadar Nitrat dan Klasifikasi TingkatKesuburan Di Periaran Waduk Ir. H. Djuanda, jatiluhur, Purwakarta," *Better Teach Learning,* vol. 8, no. 2, pp. 49-54, 2010.

[10] F. B. Umami, Pendugaan Status Trofik Berdasarkan Trophic Index (TRIX) Di Waduk Sengguruh, Desa Sengguruh, Kecamatan Kepanjen, Kabupaten Malang, Jawa Timur, Malang: Universitas Brawijaya, 2018.

[11] Alam, O. T. Y., A. Sarminingsih., W. D. Nugraha, "Pengaruh Waduk Jatibarang Terhadap Kualitas Air Sungai Garang Di Intake PDAM Semarang," *Jurnal Teknik Lingkungan,* vol. 5, no. 2, pp. 1-9, 2016.

[12] Linus, Y., Salwiyah., dan N. Irawati, "Status Kesuburan Perairan Berdasarkan Kandungan Klorofil-a Di Perairan Bungkutoko Kota Kendari," *Jurnal Manajemen Sumber Daya Perairan,* vol. 2, no. 1, pp. 101-111, 2016.

[13] Anonim, Eutrophication of water, monitoring assessment and control, Paris: Organization for Economic Cooperation & Development, 1982.

[14] A. Pitoko, "Waduk Jatigede Beroperasi Penuh," April 2017. [Online]. Available: https://properti.kompas.com/read/2017/04/07/220000521 /waduk.jatigede.beroperasi.penuh.html.

[15] Tammi, T., N.T.M. Pratiwi., S. Hariyadi., N. Radiarta, Aplikasi Analisis Klaster dan Indeks Trix untuk Mengkaji Variabilitas Status Trofik Di Teluk Pegametan, Singaraja, Bali, Jatinangor: Fakultas Perikanan dan Ilmu Kelautan. Institut Pertanian Bogor, 2015.

[16] H. Sanusi, "Karakteristik Kimiawi dan Kesuburan Perairan Teluk Pelabuhan Ratu pada Musim Barat dan Timur," *Jurnal Ilmu-ilmu Perairan dan Perikanan Indonesia,* vol. 11, no. 2, pp. 93-100, 2004.

[17] Sutrisyani and S. Rohani, Panduan Praktis Analisis Kualitas Air Payau, Jakarta: Pusat Riset Perikanan Budidaya, 2006.

[18] Y. Wahyudin, Interviewee, *Pengelolaan Waduk Jatigede.* [Interview]. 6 August 2018.

[19] Purwanto, E.A., and D.R. Sulistyatuti, Metode Penelitian Kuantitatif untuk Administrasi Publik dan Masalah-masalah Sosial, Yogyakarta: Gava Media, 2007.