INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 12, No. 5, p. 347-353, 2018
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Study of shallow groundwater usage and it's quality in Banjarbaru Utara sub District, South Kalimantan, Indonesia

Holdani Kurdi, Achmad Rusdiansyah, Ulfa Fitriati*, Sumiati

Civil Engineering Department, Faculty of Engineering, Lambung Angkurat University, Indonesia

Article published on May 30, 2018

Key words: Water requirement, Shallow groundwater, Water quality

Abstract

Water has a very important role for human life. Water is a primary human need. In the past, water needs can be easily met from shallow groundwater sources, because it is thrifty and practical. The problem is in line with the development and the high population growth, soil water balance starts to be disrupted and the quality decreases. The study aims to see how big the use of shallow groundwater in the Banjarbaru Utara Sub district and then analyze it to determine the quality of the water. This research was conducted by direct field observation conducted by distributing questionnaires to the community. The results of this study found that the average shallow groundwater needs in Banjarbaru Utara Subdistrict amounted to 320 liters/person/day. While the annual requirement of 3,259,888 m^3/year. Water quality is eligible for water that can be used as raw water for drinking water. Only the pH value is not eligible which is about 30.435%.

***Corresponding Author:** Ulfa Fitriati ✉ ufitriati@ulm.ac.id

Introduction

Water has a very important role for human life so that a good source of water is needed in terms of quality and quantity. In general, water sources come from surface water, groundwater and rainwater. The groundwater source consists of shallow groundwater and deep ground water (Panigrahy *et al*, 2015; Rahman and Sabir, 2016 or Fitriati and Suryanur, 2017). The use of groundwater is one alternative that humans do to meet the needs of shallow water for household needs, as well as easy to obtain is also very economical (Behbananinia and Sarraf, 2015; Behbahaninia and Faharani, 2014; Djorfi *et al*, 2017). Water demand always increases with technological developments and population growth, while water availability is relatively constant. So we need to consider the balance between water demand and water availability (Megersa *et al*, 2014).

The large volume of rainwater that seeps into the soil will determine whether or not the balance of groundwater conditions is achieved. The balance or sustainability of groundwater will be achieved if the groundwater input is equal to the groundwater output or in other words the volume of groundwater retrieval equals the volume of additional groundwater discharge (Sedai, 2014).

In the present reality, groundwater balance will be disrupted if the use of ground water over time increases. The need for water always increases with the development of development and the growing number of people (Ghalandarzadeh *et al*, 2013). Development of development in Banjarbaru City, will reduce the water absorption so that the amount of water entering the soil to replace the ground water that comes out to be reduced (Fitriati and Ma'ruf, 2017). On the other hand the use of groundwater as a source of water increases with increasing population. This condition causes the volume of groundwater to decrease (Fitriati, Rusliansyah and Ma'ruf, 2017).

Therefore, it is necessary to study the condition of shallow groundwater usage in Banjarbaru Utara Subdistrict.

The purpose of this research is to know the amount of water usage and to analyze shallow ground water quality in Banjarbaru Utara Subdistrict.

Material and methods

Water

Water is one of the most essential needs of human beings and is the most abundant natural resources on the surface of the earth (Oyinloye and Jegede, 2004), while groundwater is the largest reservoir of drinkable water and due to the natural filtration, it is less contaminated as compared to surface water (Aiyesanmi *et al.*, 2004). Groundwater is an important source of water for agricultural and domestic use especially in developing countries like study area, due to long retention time and natural filtration capacity of aquifers. However, leachate from municipal, solid waste, landfills is potential sources of contamination of both surface water and groundwater (Odukoya *et al.*, 2002). Chemical characteristics tend to be more specific in nature than some of the physical parameters and are thus more immediately useful in assessing the properties of a sample. It is useful at this point to set out some basic chemical definitions (Tebbut, 2002).

Water Balance

Population growth, expansion of business activity, urban development, water pollution, climate change and drought have contributed to increased water scarcity in many parts of the world. It is estimated that a fifth of the world's population live in areas of physical water scarcity, where there is not enough water to me*et al*l demands. One third of the world's population does not have access to clean drinking water. A further one fourth of the world's people live in areas of economic water scarcity, where poor management makes it impossible for authorities to satisfy the demand for water (Molden, 2007). In Europe, at least 11% of the population and 17% of the territory have been affected by water scarcity to date. The number of areas and people affected by droughts increased by almost 20% between 1976 and 2006 (European Union Publications Office, 2010). In 60% of European cities with more than 100,000 people, ground water is being used at a faster rate than it can be replenished (Europe's Environment Agency, 1995).

Groundwater

In the hydrodynamics there are two types of aquifers (Sedai *et al.*, 2014), first namely unconfined aquifer (aquifer is not depressed or free aquifers). The aquifer is limited by an impermeable layer at the bottom and at the top there is no overburden or water-resistant coating. At the free aquifer known term groundwater table free which means it is the depth of water that will be encountered if we do a digging or drilling. Free ground water level depth is affected by the shape or topography of the surrounding ground level and also by the condition of water infiltration into aquifer. In the area of topography sloping and hilly, the depth of the groundwater gets deeper. In the dry season, when rainwater penetrates deep into the ground is reduced, then the free groundwater level will go down. Generally free aquifer located at shallow depths and groundwater conducted using wells or shallow drilled wells. Second namely confined Aquifer. An aquifer that is the top and bottom layers are limited by akifug or akiklud. In the confined aquifer artesian well known term that means the water pressure in the aquifer exceeds atmospheric pressure. This led to the depth of the water level in a confined aquifer boreholes will exceed aquifer depth. If the ground water level did not exceed the ground surface is called artesian negative, whereas if the ground water level exceeds the soil surface is called positive artesis. Ground water pressure is not too affected by the condition, so it is generally in the dry season flow of water flowing is no different than the current rainy season (Fitriati and Suryanur, 2017).

Groundwater Recharge

To keep groundwater sustainability is ensured, it is necessary to note the following points are saving concept (reduce) that the use of groundwater arranged as needed. For watering the plants should not use ground water using surface water (river/lake/reservoir). The concept of use (reuse) that use ground water that suits your needs and not excessive and the use of land in a river basin should be taken into account the impact and benefit. The concept of functioning (recovery) the reopening bin-bin of water by preserving the existence situ and lakes as well as keeping functions of the forest in order to avoid imbalance waterworks. The concept of process (recycle) is a treat wastewater into clean water using chemical methods so that used again and tighten the implementation of environmental impact assessment (EIA), particularly to groundwater. The concept of filling (recharge) is the concept of rain water entering into the soil and this can be done by making infiltration wells or holes biopore (Suripin, 2001).

Water Requirement

Water needs in question is used to support the needs of all human activities that include the needs of domestic and non-domestic water. Clean water is used to meet the needs of domestic water needs for use in private residential areas to meet the daily needs such as cooking, drinking, washing and other domestic purposes. Unit used is liters/person/day. Per capita water requirement is affected by physical activity and habits or level of well-being. Therefore, in estimating the domestic water requirements necessary to distinguish between water needs for residents of urban areas and rural areas. Non domestic water needs for clean water outside the household. Non-domestic water requirements. Among others are commercial and industrial usage is the use of waters by commercial agencies and industries and the common use is the use of water for buildings or public facilities, such as hospitals, schools, houses of worship and others (Fitriati and Suryanur, 2017).

Quality of Water

For the quality of water in Indonesia in accordance with *PP RI* No. 82 year 2001 about water quality and water pollution control and *PERMENKES RI* No. 492 year 2010 about water quality requirements (Minister of Health, 2010).

Methods

The location of the research was conducted in Banjarbaru Utara Subdistrict, Banjarbaru City, South Kalimantan. Banjarbaru Utara Subdistrict has 4 urban villages, there are Komet Village, Loktabat Utara Village, Mentaos Village and Sungai Ulin Village (The Central Bureau of Statistics, 2015).

The authors collect data research in the form of primary data and secondary data. Primary data is data obtained by conducting a review or field survey. Direct field observation was conducted by observing and distributing questionnaires on the following matters to view the location and dimensions of the well and to know the depth of the well and the height of the water table in the area. In addition, the primary data are collected in the form of water sampling for laboratory test and photo documentation. Secondary data is data obtained from agencies or institutions related to the research location. These data are obtained from field survey conducted by the Central Bureau of Statistics of Banjarbaru City, in the form of general description of research area, population of 2014 and the number of RT (*Rukun Tetangga*) to be taken as a sample of 126 questionnaires.

Results

The Shallow Soil Water Study Survey in Banjarbaru Utara Subdistrict commenced on May 13, 2017 until May 16, 2017. The sampling of the well water was taken in 1 urban village and Questionnaire was taken 1 RT for each Village (*Kelurahan)* located in Banjarbaru Utara Subdistrict.

Table 1. Water Usage at Banjarbaru Utara Subdistrict.

No	Village	Water Usage (liters/person/day) Min	Max	Average
1	Komet	240	400	330.32
2	Sei Ulin	200	400	320.00
3	Mentaos	200	400	293.78
4	Loktabat Utara	200	400	334.93
			Average	320

The average use of shallow ground water in Banjarbaru Utara Subdistrict is 320 liters/person/day.

- Percentage of Households served taps 42.65%
- Number of Households not served by PDAM:
  = (100% - percent of PDAM service) x Number of Households
  = (100-42.65)% x 14.504 = 8,319 Household
- Number of people in 1 Household:
  = 48,664/14.504 = 3.355 person / household
- The population that is not served taps: l.
  = Number of Households not served by PDAM x Number of insiders 1 Household
  = 8,319 x 3.355 = 27,910 people
- Annual water needs:
  = Population not served by PDAM x Average water requirement x 365 days
  = 27910 persons x 320 liters/person/day x 365 days
  = 3,259,888,000 liters/year
  = 3,259,888 m^3/year

To collect shallow ground water quality data in community water wells in Banjarbaru Utara Subdistrict using U-50 HORIBA (multi water quality checker). The sampling of well water is taken by 1 subdistrict for each village or village located in Banjarbaru Utara Subdistrict .

This water quality data is obtained from the test results of well water samples tested at the Hydrolika Laboratory Faculty of Engineering Lambung Mangkurat University.

Table 2. Water Quality at Shallow Ground Water Wells.

No	Sampel Code	Temperatur (°C)	Acidity pH	Conduc-tivity mS/cm	Turbi-dity NTU	Dissolved Oxygen DO mg/L	Total Dissolved Solid TDS mg/L
1	*Rt 02 Rw 02 (Komet)*	28.47	6.06	0.17	0.00	8.56	110
2	*Rt 01 Rw 04 (Komet)*	28.58	5.51	0.15	0.00	8.56	100
3	*Rt 04 Rw 03 (Komet)*	28.65	6.19	0.17	0.00	8.50	110
4	*Rt 02 Rw 01 (Komet)*	28.78	6.23	0.14	0.00	8.46	90
5	*Rt 01 Rw 06 (Komet)*	28.75	6.57	0.27	0.00	8.43	170
6	*Rt 01 Rw 05 (Komet)*	29.04	5.57	0.15	0.00	8.33	90
7	*Rt 35 (Sungai Ulin)*	28.20	6.01	0.14	0.00	8.64	90
8	*Rt 29 Rw 07 (Sungai Ulin)*	28.38	4.90	0.09	0.00	8.60	50
9	*Rt 34 (Sungai Ulin)*	28.30	5.66	0.06	0.00	8.63	40
10	*Rt 14 Rw 04 (Sungai Ulin)*	28.48	4.09	0.04	0.00	4.08	20
11	*Rt 06 Rw 02 (Sungai Ulin)*	28.75	5.21	0.16	0.00	4.05	100

No	Sampel Code	Temperatur	Acidity	Conduc-tivity	Turbi-dity	Dissolved Oxygen	Total Dissolved Solid
		(°C)	pH	mS/cm	NTU	DO mg/L	TDS mg/L
12	*Rt 07 Rw 02 (Sungai Ulin)*	28.57	3.71	0.15	0.00	4.08	100
13	*Rt 03 Rw 04 (Mentaos)*	27.58	6.19	0.17	0.00	9.06	113
14	*Rt 01 Rw 02 (Mentaos)*	27.61	5.78	0.17	0.00	8.96	110
15	*Rt 17 Rw 05 (Mentaos)*	27.58	3.95	0.07	0.00	4.23	40
16	*Rt 03 Rw 05 (Mentaos)*	27.61	3.87	0.10	0.00	4.05	60
17	*Rt 02 Rw 01 (Mentaos)*	27.68	7.31	0.11	0.00	4.16	70
18	*Rt 42 Rw 09 (Loktabat Utara)*	28.19	4.44	0.16	0.00	4.13	100
19	*Rt 10 Rw 09 (Loktabat Utara)*	28.18	3.73	0.13	0.00	4.37	80
20	*Rt 16 Rw 07 (Loktabat Utara)*	28.19	6.21	0.17	0.00	9.09	113
21	*Rt 26 Rw 10 (Loktabat Utara)*	28.14	6.28	0.13	0.00	4.13	80
22	*Rt 46 Rw 12 (Loktabat Utara)*	28.19	6.19	0.17	0.00	9.09	113
23	*Rt 28 Rw 13 (Loktabat Utara)*	28.14	6.18	0.17	0.00	9.10	113

Discussion

From table 1. we can see that the lowest usage of water requirement is 200 liters/person/ day, while the highest water demand is 400 liters/person/day. In Indonesia the standard metropolitan city of domestic water use of 190 liters/person/day (Cipta Karya PU, 2007).

This amount is very high when compared to the average standard of water use (Jorgen *et al*, 2015; Kossierisa *et al*, 2014; Shan *et al*, 2015 or Vieiraa *et al*, 2015). There are more than 3 million cubic meters of shallow groundwater taken every year for household water needs in Banjarbaru Utara Subdistrict.

From the water quality data collection obtained results for the pH value there are about 8 samples who do not meet the requirements of PP RI No. 82 year 2001 and *PERMENKES* No. 492 Year 2010, which is 4 samples in Sungai Ulin village, 2 samples in Mentaos and 2 samples in Loktabat Utara village. While the value of turbidity (NTU) All water samples meet the requirements of PP RI No. 82 year 2001 and *PERMENKES* No. 492 Year 2010. (Mohammed, 2017 or Pia *et al*, 2017). For the value of the amount of dissolved solids (TDS) in the regulation of PP RI No. 82 Year 2001 included in grades 1-3 and PMK No. 492 The year 2010 is 500 mg/L including the allowable level.

Conclusions

The average shallow groundwater usage in Banjarbaru Utara Subdistrict is 320 liters/person/day. Whereas the shallow groundwater requirement per year is 3,259,888 m^3/year.

Shallow groundwater at community wells in Banjarbaru Utara District according to Government Regulation No. 82/2001 and *PERMENKES* No. 492 Year 2010, water quality is almost all qualified for water that can be used as drinking water. Just pH values that do not meet the requirements of 8 samples or about 30.435%.

Acknowledgement

This research was funded from research grant PNBP Lambung Mangkurat University 2017.

Reference

Aiyesanmi AF, Ipinmoroti KO, Oguntimehin II. 2004. Impact of automobile workshop on groundwater quality in Akure Metropolis. J. Chem. Soc. Nig. (Supplement to 2004 Proceeding) p. 420-426.

Behbahaninia A, Farahani M. 2014. Investigation of leaching process heavy metals (Fe, Zn) in the soil under sewage sludge application by using hydrus-1D. Journal of Biodiversity and Environmental Sciences (JBES) Vol. 5, No. **4**, p. 35-41.

Behbahaninia A, Sarraf A. 2015 Simulation of Nickel in soils affected by wastewater and sludge by using Hydrus 1D. Journal of Biodiversity and Environmental Sciences (JBES) Vol. 6, No. **1**, p. 51-55.

Cipta Karya PU. 2007. Buku Panduan Pengembangan Air Minum, Rencana Program Investasi Jangka Menengah (RPIJM) Bidang PU/Cipta Karya.

Djorfi S, Guechi S, Beloulou L, Lahmar K. 2017. On the water quality degradation of the séraïdi springs, Edough mountain (NE of Algeria). Journal of Biodiversity and Environmental Sciences (JBES) Vol. 10, No. **3,** p. 194-203.

European Environment Agency (EEA). 1995. Europe's Environment: The Dobris Assessment.

European Union Publications Office. 2010. Water Scarcity and Drought in the European Union. http://ec.europa.eu/environment/water/quantity/pdf/brochure.pdf

Fitriati U and Ma'ruf MA. 2017. Proof that Canal Blocking at Peatlands in Sungai Ahas Central Kalimantan not Improve Water Quality. International Journal of ChemTech Research (IJCRGG) Vol. 10, No. **32017,** p. 24-31.

Fitriati U, Rusliansyah and Ma'ruf MA. 2017. Canal Blocking to Maintain Groundwater Level at Peatland Central Kalimantan. Journal of Applied Environmental and Biological Sciences (JAEBS) Vol. 7, No. **4 2017,** p. 111-117.

Fitriati U, Suryanur F. 2017. Identification of Shallow Ground Water Use in District Martapura, South Borneo, Indonesia. Journal of Biodiversity and Environmental Sciences (JBES) Vol. 11, No. **4 2017,** p. 178-186.

Ghalandarzadeh E, Mohammadinasab AD, Amini R, Shakiba MR. 2013. Water use efficiency of red kidneybean affected by mulch and irrigation treatments. Journal of Biodiversity and Environmental Sciences (JBES) Vol. 3, No. **11,** p. 126-132.

Jorgea C, Vieiraa P, Rebeloa M, Covas D. 2015. Assessment of water use efficiency in the household using cluster analysis. Procedia Engineering 119 (2015) 820-827. 13th Computer Control for Water Industry Conference, CCWI 2015.

Kossierisa P, Panayiotakisb A, Tzoukaa K, Gerakopouloua P, Rozosa E, Makropoulosa C. 2014. An eLearning Approach for Improving Household Water Efficiency. Procedia Engineering 89 (2014) 1113-1119. 16th Conference on Water Distribution System Analysis, WDSA 2014.

Megersa M, Beyene A, Ambelu A, Woldeab B. 2014. The use of indigenous plant species for drinking water treatment in developing countries: a review. Journal of Biodiversity and Environmental Sciences (JBES) Vol. 5, No. **3,** p. 269-281.

Minister of Health. 2010. Ministry of Health Republic of Indonesia No. 492/Menkes/PER/ IV/2010, the Ministry of Health, Jakarta.

Mohammed AJA. 2017. Groundwater water quality with special emphasis on chemical properties, Zamzam camp, North Darfur, Sudan. International Journal of Agriculture, Environment and Bioresearch (IJAEB) Vol. 2, No. **2 2017,** p. 24-37.

Molden D. 2007. Water for food, Water for life: A Comprehensive Assessment of Water Management in Agriculture. Earthscan/IWMI, 2007.

Odukoya OO, Arowolo TA and Bamgbose O. 2002. Effect of Solid Waste. Landfill on underground and surface water quality at Ring Road, Ibadan. Global J. Environ. Sci., Vol. 2 No. **2,** p. 235-242.

Oyinloye AO, Jegede GO. 2004. Geophysical Survey, Geochemical and Microbiology Investigation of ground well water in Ado–Ekiti, North, South Western Nigeria. Global J. Geol. Sci., Vol. 2, No. **2,** p. 235-242.

Panigrahy BP, Singh PK, Tiwari AK, Kumar B, Kumar A. 2015. Assessment of heavy metal pollution index for groundwater around Jharia coalfield region, India. Journal of Biodiversity and Environmental Sciences (JBES) Vol. 6, No. **3,** p. 33-39.

Pia HI, Aktar M, Sarkar S, Rahman A, Rayhan ABMS, Islam MM and Hassan M. 2017. Assessment of water quality varies between premonsoon and post-monsoon season of the typical contaminated river of Bangladesh. A case study of Shitalakhya River, Dhaka. International Journal of Agriculture, Environment and Bioresearch (IJAEB) Vol. 3, No. **1 2018,** p. 129-141.

Rahman AU and Sabir MI. 2016. Ecological Risk Assessment of Ground Water Quality of Two Industrial Zones of Karachi, Pakistan. British Journal of Applied Science & Technology **14(2),** 1-8, 2016, Article no.BJAST.23064, NLM ID: 101664541 Sciencedomain international, DOI: 10.9734/BJAST/2016/23064.

Sedaei N, Solaimani K, Seyyed JS, Tahmasbi R. 2014. Quantity investigation of groundwater in Ghaemshahr-Jouibar Aquifer. Journal of Biodiversity and Environmental Sciences (JBES) Vol. 5, No. **3,** p. 262-268.

Shan Y, Yang L, Perren K, Zhang Y. 2015. Household Water Consumption: Insight from a Survey in Greece and Poland. Procedia Engineering 119 (2015) 1409-1418. 13th Computer Control for Water Industry Conference, CCWI 2015.

Suripin. 2001. *Pelestarian Sumber Daya Tanah dan Air*. Andi Offset. Jakarta.

Tebbut THY. 2002. Principle of WATER QUALITY CONTROL, (5 Eds), Linacre House, Jordan Hill, Oxford OX28DP.

The Central Bureau of Statistics. 2015. The Banjarbaru Utara Subdistrict In Frame 2015, The Central Bureau of Statistics Banjarbaru, Banjarbaru.

Vieiraa P, Jorgea C, Cova D. 2015. Novel performance assessment indices for domestic water use. Procedia Engineering 119 (2015) 813-819. 13th Computer Control for Water Industry Conference, CCWI 2015.