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Identification of shallow ground water use in district Martapura, South Borneo, Indonesia

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Abstract

In general source of water comes from surface water, ground water and rain water. Ground water sources consist of shallow ground water and deep ground water. 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 and economically. In this study will be analyzed magnitude of shallow groundwater use and quality of ground water in the district Martapura. Method used is sampling to conduct observations and questionnaires distributed citizenship of citizens in 22 village scattered in the District Martapura, one sample representing a neighborhood association. Testing shallow quality by ground water sampling in community water supply wells in the District of Martapura and tested in the laboratory by using a U-50 HORIBA. From the analysis of shallow groundwater know the needs in District Martapura of 151 liters/person/day. Whereas the shallow ground water needs annually by 3.382.077m^3/ year. Water quality is almost all eligible for water that can be used as raw water. Only pH values ineligible for Sekumpul and Indrasari village and the turbidity level that does not qualify as 13 NTU is Tambak Anyar Ulu village.

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Introduction

Groundwater resources consist of shallow ground water and deep ground water (Binay *et al*, 2015; Aziz and Muhammad, 2016). 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 (Azita and Amirpouya, 2015; Azita & Maryam, 2014; Saadane *et al*, 2017). Increased water needs as technology develops and the population so that the necessary attention to the presence of the water resources given the importance of the role of water for humans (Moa *et al*, 2014).

Martapura is one of the districts in Banjar, South Kalimantan province whose inhabitants take advantage of shallow ground water to meet the daily needs. Martapura sub-district consists of 26 village that is Cindai Alus, Sungai Sipai, Sungai Paring, Jawa, Tanjung Rema Darat, Indra Sari, and more. Martapura Subdistrict Population in 2012 reached 104.355 inhabitants by the number of households by 26.749 households. Judging from the level of density, District Martapura can be said quite dense region where the density reaches 2.483 inhabitants /km^2 (Bappeda, 2012).

Ground water storage is a crucial part in the development of natural resources in the District of Martapura. Groundwater as part of water resources are most in demand by the public. The existence of ground water is abundant and of good quality to be one of the human factor makes the high interest ground water into a source of water to meet the need. Therefore because it required the use of shallow groundwater studies in Martapura to see the condition of ground water utilization research.

Once we know the shallow ground water use by all the people in Martapura Subdistrict, the research will be continued by calculating the amount of water that can be naturally recovered. If the amount of water absorbed naturally less than the water taken then it is necessary to further research how to add water that seeps into the soil to occur water balance (Seyed, 2015; Paul, 2011).

If excessive groundwater extraction is not balanced with efforts to increase the groundwater reserves there will be drought in the area (Sahar, 2014).

Material and methods

Overall amount of water on this planet is relatively constant over time. Water in the Earth experienced a cycle through a series of events that take place constantly, where we do not know when and from where it starts and when it will end anyway. A series of events is called the hydrologic cycle. Given that most of the water is in the oceans, it would be nice if the explanation of the hydrologic cycle starts from the sea.

Water evaporates from the surface of the ocean as a result of solar thermal energy. The rate and amount of evaporation vary, greatest near the equator, where solar radiation is stronger (Elnaz *et al*, 2013). Water vapor is pure, because of the time taken up into the atmosphere of salt left. The resulting water vapor moving airborne. In conditions permitting, the vapor condenses and forms drops of water, which in turn will fall back as precipitation in the form of rain or snow. No precipitation that falls in the ocean, on land and partially evaporates before reaching the earth's surface.

Precipitation that falls on the earth's surface spread to different directions in different ways. Most temporary hold on the earth's surface as ice or snow, or puddles, which is known to deposit depression (Dostdar *et al*, 2015). Most rainwater or snow melt will flow into the channel or river. It is called runoff. If the surface is porous soil, some water will seep into the ground in what is called infiltration. Some will return to the atmosphere through evaporation and transpiration by plants.

Beneath the surface of the soil, the soil pores filled with water and air. This area is known as capillary zone or aeration zone. Water stored in this zone is called the soil moisture or capillary water. Under certain conditions water can flow laterally on the capillary zone, this process is called interflow. Water vapor in the capillary zone can also be returned to the soil surface and then evaporates.

Excess soil moisture will be drawn in by gravity, this process is called gravity drainage. At a certain depth, the pores of the soil or rock is saturated with water. The upper limit of water-saturated zone is called the water table. Water stored in a water-saturated zone is called groundwater. The ground water moves as groundwater flow through rock or soil layers to finally come to the surface as the water source (spring) or as seepage into lakes, reservoirs, rivers or the sea.

Water flowing in a channel or river can be derived from surface runoff or groundwater from seeping in the bottom of the river. The contribution of groundwater in river flows is called base flow, while the total flow of so-called discharge (runoff). The water stored in reservoirs, lakes and rivers is called surface water (Suripin, 2004).

Groundwater comes from rain water which seeped through various media infiltration, are as follows the cavities in the soil due to the melting of the various crystals that freezes in the winter. The cavities in the soil that made the animals (worms and termites). Cracks in the layer of soil during the dry season and the rainy season becomes very wet and muddy, such as clay and mud. The pores of the soil loose or weak structures will absorb more water than solid ground. The cavities due to the collapse of rooted plants are great.

Groundwater is distinguished on the location of depth, first namely shallow ground water, the ground water which is below ground level and is above the impermeable rock or layers that cannot pass water. This water is an aquifer above or often called freatis water, which is used by the inhabitants to make a well. Second namely deep groundwater, the groundwater under a layer of shallow groundwater, and located between impermeable layer. This water is an aquifer below, are used as sources of drinking water residents of the city, industrial, hospitality and so on.

In the hydrodynamics there are two types of aquifers (N. Sedaei *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.

Resource of ground water has an important role as a water supply for the various development sectors, including drinking water / urban, industrial water, irrigation water and others. Excellence groundwater resources are In hygienic healthier because it has undergone filtration processes naturally, reserves are relatively fixed throughout the year, and quality is relatively fixed.

If ground water is available, can be obtained on the spot, without expensive equipment. Shortage of groundwater resources are there are below ground level, to its utilization should be done with dug wells/drill, the availability of water at any place is uneven and limited reserves, for the purposes of urban drinking water or irrigation water or industrial large enough, it may be insufficient reserves.

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 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.

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.

Materials and methods

Primary data is data obtained by conducting a review or field surveys. Direct observation in the field is done by making observations and distributing questionnaires on the following matters:

1. To determine the depth of the wells and groundwater levels in the area.
2. Water sampling for laboratory testing.

Secondary data is data obtained from agencies or institutions associated with the sites. These data were obtained from field surveys conducted by the Central Bureau of Statistics Martapura, in the form of a general overview of the study area, the number of *RT* (Neighborhood association) to be taken as a sample questionnaire as many as 289 *RT*.

Results and discussion

The shallow soil water identification survey in Martapura Sub-district was held on 23 January 2017 until 30 January 2017. The survey results can be seen in table 1.

From the table 1 can be concluded the lowest well 3 m and deepest 13 m with the average depth of 6 m, water depth in wells average 4 m. There are 32% of the wells being dug back due to reduced groundwater even 10% of the wells have ever dried (Emmanuel, 2012).

The Survey for water need with questionnaire in Martapura Sub-district was held on 23 January 2017 until 30 January 2017. The questionnaire results can be seen in table 2.

From the table 2. we can see that the lowest water consumption needs are at the Village Bincau of 25 liters/person/day, while the use of needs the highest water contained in Keraton village of 750 liters/person/day. The average of shallow ground water use in the district of Martapura obtained at 151 liters/person/day this is in accordance with the standards of household water needs based on the type of city and the population of the Ministry of Public Works.

Table 1. Statistical Analysis Martapura Subdistrict.

No	Village	Well Depth (m)	Water level in rainy season (m)	Water level in drought season (m)	ever dug wells (%)	The well runs dry (%)
1	Keraton	7,47	5,63	1,45	13%	2%
2	Jawa	6,08	3,54	1,15	75%	25%
3	Pasayangan	3,88	3,13	1,13	-	-
4	Murung Keraton	4	3	1,5	-	-
5	Sekumpul	8,54	5,62	1,65	19%	20%
6	Sungai Paring	7,79	5,47	1,95	42%	0%
7	Tanjung Rema Darat	5,82	3,65	1,18	35%	12%
8	Pasayangan Utara	6,2	4,8	1,4	-	-
9	Pasayangan Selatan	5,57	4,29	1,14	29%	-
10	Pasayangan Barat	4,75	3,75	1,25	50%	-
11	Bincau	7,57	4,86	1,21	56%	-
12	Labuan Tabu	4,5	3,5	1,3	67%	-
13	Indrasari	8,83	5,17	1,17	50%	-
14	Tungkaran	8,17	4,50	1,17	-	0.17%
15	Sungai Sipai	6,16	4,8	1,76	48%	16%
16	Cindai Alus	8,18	6,45	2	45%	27%
17	Murung Kenanga	5	3,83	1,17	17%	33%
18	Tanjung Rema	6,18	3,91	1,09	18%	-
19	Tambak Anyar Ulu	6	4,8	1,4	20%	20%
20	Tambak Anyar Tengah	5	4	1	50%	-
21	Tambak Anyar Ilir	5	3,33	1	67%	-
22	Jawa Laut	3,67	2,67	1	8%	8%

Table 2. Calculation of Water Need.

No	Village	Water Need (liters/person/day)		
		Min	Max	Average
1	Keraton	60	750	236,20
2	Jawa	62,5	200	103,82
3	Pasayangan	60	125	83,75
4	Sekumpul	41,67	500	200,56
5	Sungai Paring	50	600	238,75
6	Tanjung Rema Darat	50	375	170,12
7	Pasayangan Utara	150	250	200
8	Bincau	25	500	208
9	Labuan Tabu	171,43	171,43	171,43
10	Indrasari	80	188	133
11	Tungkaran	94	150	122
12	Sungai Sipai	50	300	144
13	Cindai Alus	75	200	135
14	Murung Kenanga	94	94	94
15	Tanjung Rema	83	200	150
16	Tambak Anyar Ulu	60	120	90
17	Jawa Laut	86	86	86
	Average			151

To calculate how much shallow groundwater use is in Martapura Sub-district, it is assumed that shallow groundwater users are all residents who are not PDAM (local water company) customers. Percentage of households served by PDAM 42,65% (PDAM, 2012). Then the next calculation can be seen as follows:

- Number of Households not served by PDAM:

= (100% - percent of PDAM service) x Number of Households of Martapura Sub-district.

= (100 - 42,65) % x 26.749.

= 15.341 Household

- Number of people in 1 Household:

= population / number of Households

= 104.355 / 26.749 = 3.90 ≈ 4 persons / household

- Population not served by PDAM:

= Number of Households not served by PDAM x Number of people 1 Household

= 15.341 x 4 = 61.364 people

- Annual water use:

= Population not served by PDAM x Average water requirement x 365 days

= 61.364 persons x 151 liters/person/day x 365 days
= 3.382.076.860 liters/year
= 3.382.077 m^3/year

The use of shallow ground water in Martapura Sub-district 3.382.077m^3/year. Data of shallow groundwater quality in community water supply wells in the District of Martapura City by using the U-50 HORIBA (multi water quality checker). Water sampling is taken 1 RT wells for each.

Village or village in Sub Martapura City. The water quality data obtained from the test well water samples were tested at the Laboratory of Hydraulics Faculty of Engineering, Lambung Mangkurat University on January 23, 2017 until January 30, 2017.

The water quality data retrieval by dipping tool U-50 HORIBA (multi water quality checker) into the water sample you want to know the parameters contained in the water can be seen in Table 3.

Table 3. Results of Water Quality Data Collection for pH.

No	Village	pH	PP RI No. 82 Year 2001	Permenkes No. 492 Year 2010
1	Keraton	6,46	Class 1	6,5-8,5
2	Jawa	5,17	Class 4	-
3	Pasayangan	5,97	Class 4	-
4	Murung Keraton	6,69	Class 1	6,5-8,5
5	Sekumpul	4,85	-	-
6	Sungai Paring	5,94	Class 4	-
7	Tanjungrema Darat	5,37	Class 4	-
8	Pasayangan Utara	5,57	Class 4	-
9	Pasayangan Selatan	6,81	Class 1	6,5-8,5
10	Pasayangan Barat	6,88	Class 1	6,5-8,5
11	Bincau	5,79	Class 4	-
12	Labuan Tabu	6,56	Class 1	6,5-8,5
13	Indrasari	4,51	-	-
14	Tungkaran	6,28	Class 1	-
15	Sungai Sipai	5,66	Class 4	-
16	Cindai Alus	5,05	Class 4	-
17	Murung Kenanga	6,10	Class 1	-
18	Tanjungrema	5,98	Class 4	-
19	Tambak Anyar Ulu	6,14	Class 1	-
20	Tambak Anyar Tengah	6,01	Class 1	-
21	Tambak Anyar Ilir	6,89	Class 1	6,5-8,5
22	Jawa Laut	6,59	Class 1	6,5-8,5

From the above table we can see, only 8 villages from 22 villages whose water qualify as pH as drinking water according to *PERMENKES*. There are even two villages whose pH is below 5 ie Sekumpul and Indrasari Village. pH value is eligible for water that can be used as raw water, just two village that pH values are ineligible for Sekumpul and Indrasari village.

Table 4. Results of Water Quality Data Collection for Turbidity (NTU).

No	Village	Turbidity (NTU)	PP RI No. 82 Year 2001	PERMENKES No. 492 Year 2010
1	Keraton	0,0	-	5
2	Jawa	0,0	-	5
3	Pasayangan	0,0	-	5
4	Murung Keraton	0,1	-	5
5	Sekumpul	0,5	-	5
6	Sungai Paring	0,0	-	5
7	Tanjungrema Darat	0,0	-	5
8	Pasayangan Utara	0,0	-	5
9	Pasayangan Selatan	0,0	-	5
10	Pasayangan Barat	0,0	-	5
11	Bincau	2,7	-	5
12	Labuan Tabu	0,0	-	5

No	Village	Turbidity (NTU)	PP RI No. 82 Year 2001	PERMENKES No. 492 Year 2010
13	Indrasari	0,0	-	5
14	Tungkaran	0,0	-	5
15	Sungai Sipai	1,6	-	5
16	Cindai Alus	0,0	-	5
17	Murung Kenanga	0,0	-	5
18	Tanjungrema	0,0	-	5
19	Tambak Anyar Ulu	13,0	-	5
20	Tambak Anyar Tengah	3,0	-	5
21	Tambak Anyar Ilir	0,6	-	5
22	Jawa Laut	0,0	-	5

From the above table we can see that the turbidity level that does not qualify as 13 NTU is Tambak Anyar Ulu. The phenomenon of algae is suspected as the cause of rising turbidity in water (Kheiralla *et al*, 2014). Turbidity in shallow groundwater is usually lower than surface water because it has been through the filtration process by the soil itself. Turbidity in shallow groundwater is usually lower than surface water because it has been through the filtration process by the soil itself. On surface water the turbidity value is usually high due to erosion and sedimentation occurring along the stream.

Table 5. Results of Air Quality Data Collection for TDS.

No	Village	TDS (g/L)	PP RI No. 82 Year 2001	PERMENKES No. 492 Year 2010
1	Keraton	0,115	Class 1	0,5
2	Jawa	0,107	Class 1	0,5
3	Pasayangan	0,231	Class 1	0,5
4	Murung Keraton	0,248	Class 1	0,5
5	Sekumpul	0,195	Class 1	0,5
6	Sungai Paring	0,062	Class 1	0,5
7	Tanjungrema Darat	0,110	Class 1	0,5
8	Pasayangan Utara	0,152	Class 1	0,5
9	Pasayangan Selatan	0,143	Class 1	0,5
10	Pasayangan Barat	0,206	Class 1	0,5
11	Bincau	0,029	Class 1	0,5
12	Labuan Tabu	0,171	Class 1	0,5
13	Indrasari	0,081	Class 1	0,5
14	Tungkaran	0,113	Class 1	0,5
15	Sungai Sipai	0,168	Class 1	0,5
16	Cindai Alus	0,112	Class 1	0,5
17	Murung Kenanga	0,271	Class 1	0,5
18	Tanjungrema	0,111	Class 1	0,5
19	Tambak Anyar Ulu	0,154	Class 1	0,5
20	Tambak Anyar Tengah	0,136	Class 1	0,5
21	Tambak Anyar Ilir	0,159	Class 1	0,5
22	Jawa Laut	0,167	Class 1	0,5

From the above table we can see that the dissolved solids are qualified water quality in accordance with applicable regulations. TDS is one of the important parameter as it measures the combined content of organic and inorganic substancesTDS also cause salinity in water which makes it unsuitable for drinking purposes (Fariah *et al*, 2017). With a high TDS rate it needs to be followed up, and further examination is done. Generally, high TDS is caused by potassium, chloride, and sodium content dissolved in water. These ions have short-term effects, but toxic ions (such as arsenic, cadmium, nitrate and many others) are also dissolved in water.

From these data it can be concluded that the shallow groundwater wells in the district community Martapura by *PP RI* No. 82 of 2001 and No. 492 *PERMENKES* in 2010, water quality is almost all eligible for water that can be used as raw water, just pH values are ineligible for Sekumpul and Indrasari village, while the turbidity level that does not qualify as 13 NTU is Tambak Anyar Ulu.

Conclusion

There are 32% of the wells being dug back due to reduced groundwater even 10% of the wells have ever dried. The need for shallow ground water in the district average Martapura of 151 liters/person/day. Whereas the shallow ground water needs annually by 3.382.077 m^3/ year. Shallow groundwater wells in communities in the District Martapura by *PP RI* No. 82 year 2001 and *PERMENKES* No. 492 year 2010, the water quality is almost all eligible for water that can be used as raw water, pH value that are not eligible are Village of Sekumpul and Indrasari, while the turbidity level that does not qualify as 13 NTU is Tambak Anyar Ulu.

Recommendation

This research can be done not only with samples 1 *RT* 1 questionnaire, can be done with the population, which took up the whole sample.

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