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by

Submission date: 08-Mar-2021 04:51PM (UTC-0800)
Submission ID: 1527905778
File name: article_-Ticate_confrence.pdf (505.25K)
Word count: 3227
Character count: 15645

Feasibility of Well Water as a Source of Clean Water in the Coastal Coastal Settlement Area

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Abstract

In coastal areas, well water experiences heavy pressure due to various things, such as increased community needs, the occurrence of reduced water discharge in the dry season, pollution by various pollutants from community domestic activities, and seawater intrusion. Even though clean water is very important for community survival, the wells in the settlement are expected to be one of the springs which appear to be less able to help meet all the community's clean water needs. Based on that reason, the research objective is to find out how well water can be a source of clean water for the community. The method used is through in-situ and laboratory measurements. In-situ measurements to determine the water pH and salinity, and laboratory measurements of water testing at the physical, chemical, and microbiological test contents. Also, make observations to determine conditions around the water spring that might affect the composition of the well water content. The result is that some wells have high salinity values, in addition to that the water content exceeds the standard clean water value from physical, chemical, and microbiological tests so that it is less suitable for consumption, other findings the well water distance from the sea has less effect on the well water salinity level.

Key Word: water well, water quality standards, physical, chemical and microbiological tests

1. Preliminary

Based on the Minister of Public Works Regulation and Spatial Planning No. 14 / PRT / M / 2010 [1] regarding the minimum standard of clean water requirements, it states that the average water demand is 60 liters/person/ day normally. In arid and semi-arid regions, clean water sources become limited, and almost all groundwater resources are under heavy pressure. Future demands will not be met by traditional water resources such as surface water and groundwater to meet community needs, and this is even more severe in coastal areas, where ground/surface water has experienced increased salinity levels due to brine intrusion into settlements.

Settlements located in coastal areas and directly adjacent to the sea have generally been entrusted by seawater. Seawater is a mass of saltwater with relatively high salt content (an average of 3.5%), which influences the level of water that will flow. Seawater intrusion has even reached more than 100 m from the highest tide limit, but there is a phenomenon wherein some wells that are located closer to the highest tide limit have zero salinity. This encourages researchers to study this and hope that in the future the community can consume well water in settlements.

Water quality is a quality characteristic that is needed in the utilization of water by what is intended. Groundwater quality is determined by three main properties, namely: Physical, Temperature, and chemical properties. Salinity is the concentration of all saline solution obtained in seawater. b. Dissolved oxygen (DO), is a basic need for plant and animal life in the water. Dissolved oxygen can originate from the photosynthesis process of aquatic plants. c. The degree of acidity (PH), water that has a pH of 7 is neutral, whereas a pH greater than / smaller than 7 is called alkaline / acidic [2].

2. Method

The study uses direct observation methods through field and laboratory measurements of the well water content. Field measurements on the PH and water salinity values, this is done because both can change quickly for various reasons. For laboratory analysis, the objective is to determine the physical, chemical, and microbiological content of well water that cannot be done directly (in situ

measurements). The well water is brought to the Makassar Research and Development Agency (BBIHP) for analysis. In situ and laboratory test results become secondary materials that will strengthen the reasons for the hypothesis of using well water as drinking water. Other direct observations are on the conditions around the well, such as the presence of vegetation that may affect the level of water salinity because the wells are located in coastal areas that are lagging against intrusion of sea water that has high salinity.

3. Result and Discuss

South Sulawesi

Bangkala District

Pantai Bahari Settlement

Figure 1. Research Location

The study was conducted in the coastal marine village, Bangkala District, Jeneponto Regency. Sul-Sel.

Well 1

Well 3

Well 4

Well 5

Well 6

Well 8

Well 9

Well 11

Well 12

Well 13

PH measuring instruments and refractometers

Figure 2. Well sample in Pantai Bahari settlement

There are 13 draw wells used as samples in the settlement, the depth of the wells on the Pantai Bahari is an average of 2,5-3 m with concrete walls, while at the end of Kassi it is only 2m-2.5 m. From the physical aspect, the water looks clear and translucent to the bottom of the well, has no smell, some are tasteless, and the other feels sality.

Table 1. Measurement of salinity and PH values of in situ water

Well	Salinity Value	PH Value	Depth of	Location	Ambient condition
Well 1	0.3 0.25 0.3	7.17 7.08 7.07	2.5 m	About 105 m from the highest tide	Beside the village chief's house. Without plants around the well
Well 2	0.00 0.00 0.00	7.04 7.07 7.06	2.5 m	About 130 m from the highest tide	Without plants around among houses, close to the garden
Well 3	0.1 0.1 0.05	7.4 7.33 7.31	2.5 m	About 70 m from the highest tide	Without plants around between houses
Well 4	0.2 0.1 0.1	7.45 7.35 7.32	2.5 m	About 67 m from the highest tide	Without plants around between houses
Well 5	0.1 0.1 0.1	7.35 7.24 7.18	2.5 m	About 100 m from the highest tide	There are plants around the well
Well 6	0.15 0.1 0.15	7.30 7.21 7.18	2.5 m	About 105 m from the highest tide	Without plants, position under the house
Well 7	0.2 0.2 0.1	7.41 7.21 7.17	2.5 m	About 105 m from the highest tide	Without plants, position under the house
Well 8	0.3 0.3 0.3	7.27 7.07 7.05	2.5 m	About 100 m from the highest tide	Without plants around between houses
Well 9	0.0 0.0 0.0	7.46 7.27 7.25	2.5 m	About 40 m from the highest tide	Without plants around between houses
Well 10	0.3 0.3 0.25	7.5 7.39 7.38	2.5 m	About 20 m from the highest tide	Without plants around between houses
Well 11	0.2 0.15 0.15	7.23 7.18 7.17	2.5 m	About 25 m from the highest tide	The tree is 5 m from the well
Well 12	0.0 0.0 0.0	6.99 6.90 6.95	2.5 m	About 50 m from the highest tide	There is a tree with a diameter of 40 cm
Well 13	0.0 0.0 0.0	7.05 6.96 6.98	2.5 m	About 50 m from the highest tide	Around there are banana trees and Java-Java

The condition of well water generally feels salty, so residents only use it for bathing (washing, washing, and using latrines) for cooking and drinking needs. People buy gallon water for Rp. 3000 / gallon (refill). But there is an interesting thing, although the location of the well is near the beach about 40 to 50 m from the highest tide limit, but not salty (not tasteless). This was influenced by the presence of vegetation around the well.

Table 2. Results of laboratory measurements of water physical, chemical and microbiological tests

Parameter	Unit	Result				Quality Requirements	Test Method
		S1	S2	S3	S4		
Odor	-	Odorless	Odorless	Odorless	Odorless	Odorless	IK-MT. 30.01
Dissolved Solids (TDS)	mg/l	3034	2353	1973	1991	1500	SNI 06-6989.27-2005
Kekeruhan	NTU Scale	<0.01	<0.01	<0.01	<0.01	2,5	SNI 06-6989.25-2005
Fell	-	Fell	Fell	Not Fell	Not Fell	Not Fell	IK-MT. 30.02
Temperature	^{o}C	30.25	32.30	32.25	28,40	air temperature ±3^{o}C	SNI 06-6989.23-2005
Colour	TCU	2.5	2.5	2.5	2.5	50	SNI 06-6989.24-2005
Dissolved Mercury (Hg)	mg/l	<0.0003	<0.0003	<0.0003	<0.0003	0,001	SNI 06-6989.78:2011
Dissolved Arsenic (As)	mg/l	0.0007	0.0061	0.0009	<0.0002	0,05	
Dissolved Iron (Fe)	mg/l	0.0361	<0.03	0.0548	<0,03	1,0	SNI 06-6989.4:2009
Fluoride (F)	mg/l	0.6651	<0.1	<0.1	<0.1	1,5	SNI 06-6989.29-2005
Dissolved Cadmium (Cd)	mg/l	<0.003	<0.003	<0.003	<0.003	0.005	SNI 06-6989.16:2009
Hardness (CaCo3)	mg/l	1648	1442	1339	1236	500	SNI 06-6989.12:2004
Chloride (Cl)	mg/l	1087,32	865,831	453,051	392,644	600	SNI 06-6989.19:2009
Krom Hexavalen	mg/l	<0,0004	<0,0004	<0,0004	0,0023	0,05	SNI 06-6989.71:2009
Dissolved Manganese (Mn)	mg/l	0,0089	<0,008	<0,008	<0,008	0,5	SNI 06-6989.5:2009
Nitrat (No3)	mg/l	1,3396	0,8514	2,1274	11,9857	10	APHA 4500 NO_3,22nd Edition 2012
Nitrit (No2)	mg/l	0,1796	0,0145	<0,003	<0,003	1,0	SNI 06-6989.9:2004
PH	-	7,37	7,35	7,38	7,36	6,5-9,0	SNI 06-6989.11-2004
Dissolved Selenium (Se)	mg/l	0,0492	<0,003	<0,003	<0,003	0,01	SNI 06-2475-1991
Dissolved Zinc (Zn)	mg/l	<0,022	<0,022	<0022	<0,022	15	SNI 06-6989.7:2009
Cyanide (CN)	mg/l	0,002	<0,002	<0,002	<0,002	0,1	SNI 19-1504-1989
Sulfate (So4)	mg/l	19,5929	10,4964	12,4903	10,3867	400	SNI 06-6989.20-2009
Dissolved Lead (Pb)	mg/l	0,0155	<0,002	<0,002	0,0036	0,05	SNI 06-6989.8-2004
Detergent	mg/l	<0,05	<0,05	<0,05	<0,05	0,5	SNI 06-6989.51-2005
Organic Substances (KmnO4)	mg/l	8,8505	11,3128	7,3280	9,0446	10	SNI 06-6989.22-2004
Total Coliform	Amount /100ml	8	16	34	22	10(piped water) 50 (not	APHA 9222 B 22nd Edition 2012

piped water)

Minister of Health Decree No. 907 / MENKES / SK / VII / 2002 [3]. Lampiraan II Permenkes No. 416 / MENKES / PER / IX / 1990 List of Clean Water Quality Requirements [4]. Taking/receiving samples 26 June 2019; Issuance of July 23, 2019Makassar BBIHP Testing Laboratory..

3.1. Water Salinity Level

Based on in situ measurements shown in table 1, that generally, well water feels salty, this indicates that seawater has been an intrusion into the settlement, and has reached 100 m from the highest tide limit. Likewise, laboratory test results show that sample wells 3 and 4 (sample wells 12 and 13 in the in situ tests were tasteless). But in some cases, even a short distance from the highest tide limit does not mean salty well water. Based on field observations, we can see that tasteless wells are surrounded by shady trees around it, while wells that have no taste are found around the trees. This is shown in Figure 2.

Speaking about vegetation, according to Yuliantoro [5] spring protection techniques that can be applied one of them is by vegetative techniques with various forms of planting trees. Vegetative spring protection can be done in 2 ways, namely planting around a spring (radius 10-15) as spring protection; and planting in recharge areas as spring protection. The purpose of planting around the spring is more to protect the spring from all pollutants and damage due to human/animal activity. While planting in groundwater recharge areas are expected to help absorb rainwater into the ground which in the long run can fill aquifers, and not become surface runoff. It is hoped that the planting of trees will protect the springs from pollutants, bacteria and harmful chemicals.

Hydrology Trees have a number of hydrological effects. These include reducing erosion and improving water quality through interception of pollution. Perhaps the most important effect in Britain at present, given the trend for increasing winter flooding, is the reduction in ground water runoff. One study has estimated that for every 5% increase in tree cover area, run-off is reduced by 2% [6].

3.2. Water PH

Drinking water quality standards in terms of a pH smaller than 6.5 and greater than 9.2 can cause some chemical compounds to turn into poisons that are very detrimental to health [7].

Minister of Health Letter No. 907 / Menkes / SK / VII / 2002 [8], which is called drinking water is water that meets health requirements and can be drunk directly namely microbiological, physical, chemical, and radioactive requirements. PH is used to distinguish the alkaline and acidic properties of a solution measured on a scale from 0-14. The minimum PH value which is in accordance with the general health standard is 6.5-8.5, while based on SNI 06-6989.11-2004 [9] is 6.5-9.0. So it can be concluded that all well water in the Panai Maritime settlement has a pH that is in accordance with the standards.

3.3. Physics, Chemistry and Microbiology Test

Laboratory tests were taken on 4 wells representing wells that were salty and non-salty, 2 wells respectively. Well 1 (S1), Well 8 (S2), well 12 (S3), and well 13 (S4) show the content that generally the test results show values below the threshold of water quality standards, but in some items such as dissolved solids (TDS), taste, hardness, chloride, nitrate, organic matter (KmnO4), total coliform looks higher.

Fardiaz [10] in Hapsari [11] states, the increase in the value of TDS in waters is strongly influenced by rock weathering, soil runoff, and anthropogenic effects (domestic waste). According to Said [12] groundwater or surface water close to the coast, the content of TDS has a chore level of salinity. Seawater seeps into the surrounding wells which cause the TDS of the well water to increase. High TDS causes scale in household appliances [13]. This correlation also occurs in coastal marine settlements. In the lab test shows sample 1 TDS 3034 value and the average salinity value is 0.285,

sample 2 TSD 2353 average salinity value 0.3; sample 3 TDS 1973 and sample 4 1991 both have salinity 2. So that the correlation is seen that the higher the salinity level, the higher the TDS content.

High levels of hardness in water can cause problems for households. Hard water is used for washing will be difficult to foam so it will cause waste of detergent and if the water is boiled will cause crust on household appliances [14]. Hard water has an impact on health that can cause cardiovascular (heart blood clogging) and urolithiasis (kidney stones).

Chloride levels generally increase with increasing mineral levels. High chloride levels, which are followed by high levels of calcium and magnesium, can increase the water's corrosivity. This resulted in the occurrence of metal rusting [15] in [11], which could occur naturally and as a result of human activities and seawater intrusion in coastal areas [16].

The increase in nitrate pollutants is partly due to the absence of a good sanitation system [17]. The sanitation system is hardly found in settlements, the dirty household wastewater flows into the surrounding environment/yard so that it will pollute the environment. Water will be easily contaminated by human activities for various purposes so that it can easily be polluted (Darmono, 1995) [18]. According to arsono [19], the quality of dug well water can be influenced by household wastewater seepage, laundry waste, river water seepage, and so on).

The results of total Coliform measurements show that the observation station has an increasing tendency due to the presence of domestic activities in the vicinity. According to Fardiaz [10] and Yu [20] in Hapsari [11], a high amount of Total Coliform can occur due to high pathogenic bacterial contamination from the digestive tract of humans as well as animals and other pathogenic agents. Total Coliform that exceeds the requirements will cause diarrhea [21].

4. Conclusion

Seawater has intruded into settlements up to more than 100 m. but not all salty wells, some do not taste even though it is located close to settlements, it is affected by the presence of trees around it. There are also several items from the results of physical, chemical, and microbiological tests contained in wells exceeding clean water standards that will have an impact on humans, household furniture, and the environment.

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