Groundwater level based on the characteristics of the distribution of dug wells in the Ampera settlement zone, Merauke City

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Abstract. Efforts to find water by digging well-shaped soil surface encountered several problems, namely the groundwater level was too difficult with manual excavation. Another problem is that there is well water but experiences drought according to the dry season. The case of drought wells during the dry season is due to the tendency not to match the depth of the well with the groundwater level so that the ideal depth needs to be estimated so that it does not dry out over the dry season. For this reason, research has been carried out to obtain groundwater information in Ampera Merauke settlements based on the characteristics of dug wells using direct survey and interview methods. The results of the study on the scope of Ampera settlement were 175,000 m² and 93 wells were found. The depth of the well is 1 to 5.5 m. There are 2 units experiencing drought with a depth of 1 m. Other general depths are around 2.5 m. Based on well water discharge data, determination of the original land surface, and sea tidal height, information on the depth of the groundwater is obtained about 1 meter below the ground floor of the building or almost parallel to the original swamp soil. Therefore, to get well water discharge from the dug, the excavation depth should be at least 4 m from the ground floor of the building, with a minimum diameter of 1 m so that the surface of the seepage is biased wider.

1. Introduction
The terrain of the surface of the earth has many ways to prepare water needs for all creatures that are sustaining life on it. Some of them are in the form of basins and valleys that turn into lakes or swamps, rivers, waterfalls from mountain cliffs, and even some that are stored in plants. Then, based on the development of experience, humans go through a struggle across the dry season and look for water sources, until they realize that there are water reserves below the surface that can be obtained by excavation. Until this modern era, drilling can be carried out to hundreds of meters to get clean water.

There are several reasons why humans prefer to excavate wells, among others, the first is just armed with a hoe or crowbar, someone can do excavation on his own land to get water, the second is more practical than having to commute long distances carrying water every day third, cheaper than drilling and other reasons. However, the problem that arises later is whether each dig of a well is guaranteed that there will be water? the answer is, of course, there is no guarantee that every dig will get water, by that information is needed how the characteristics into the groundwater in each zonation.

Groundwater is water that occupies rock pores under the surface of the soil in the water saturation zone [1]. Groundwater resources can be renewed naturally because groundwater is an integral part of the hydrological cycle [2]. The presence of groundwater can be found in almost all places on the surface of the earth, even under the ice sheet that freezes groundwater can be found [3].
Shallow groundwater occurs due to the process of absorption of water from the ground. The mud will be held back, as well as bacteria, so that shallow groundwater looks clear but contains a lot of chemicals because through 12 layers of soil that have certain chemical elements for each layer of soil. The soil layer functions as a filter [4].

After filtering, after encountering impermeable layers or meeting water, groundwater will be used as a source of clean water. Shallow water has a depth of up to 15 meters [5].

Various advantages possessed by groundwater attract people to prefer this type of water to meet their needs. The dependence of the community on groundwater will increase if they find out that the availability of groundwater in their land is quite abundant and the extraction is relatively difficult. Moreover, if there is no water service from the government at all, the community will continue to use groundwater. The advantages possessed by groundwater are as follows [6]:
- Has a wide tamping power capacity
- There is almost no evaporation
- Does not require a special place for groundwater reservoirs
- There is no failure of the building structure
- Cleaner, free of bacteria
- Directly acts as an introduction to the place that needs it

In the earth, there are approximately 1.3 - 1.4 billion km³ of water, of which 97.5% is seawater, 1.75% is ice, and 0.3% are in the land as river water, lake water, groundwater, and so on. And only 0.001% in the form of water vapor in the air [7].

The high and low water in the groundwater (aquifer) is very dependent on the local topography, geological formation and the amount of water content. The water level that occurs in this dug well is the same as the water level in the aquifer. This well is often known as a shallow well [8].

The specifications of the dug well are intended as a reference for the organizers of the construction of dug wells to meet the needs of raw water for household clean water, to provide technical requirements for dug wells as a source of raw water for clean water protected from pollution. Dug wells for clean water sources are means for tapping and storing groundwater from aquifers which are used as a source of water as much as at least 400 liters every family day, made by digging [9].

The availability of groundwater depends on the presence or absence of rock layers that can store groundwater. Groundwater is in a geological formation called an aquifer. Aquifers are formations that can store and drain sufficient amounts of water, which means they can drain a well, river, and spring [10]. The amount of groundwater that can be stored in aquifers depends on the characteristics of the aquifer as well as the extent of coverage and infinite frequency [11].

2. Methodology
To obtain groundwater information based on the characteristics and distribution patterns of dug wells in the Ampera zone of Merauke city, direct survey and interview methods were used. The survey process is divided into 4 stages. Stage 1) namely the preparation of materials and tools, stage 2) preparation of the survey team. The survey team must be trained to obtain the desired data nature, stage 3) verification of the technical skills of the survey team.

Verification of the technical skills of the survey team is divided into 4 parts, namely: 1) how to determine the coordinates of the well dug with android software, 2) a simple way to measure the dug wells with earrings and meters, 3) the ability to distinguish unfamiliar well water tastes, or brackish, 4) assisting the survey team to standardize understanding.

3. Results and discussion
3.1. Location and extent of the land surface reviewed
In Figures 1, 2 and 3 direct the location of observation of the surface of the land where the locations of dug wells have been observed/surveyed in the city of Merauke. The total area reviewed is around 175,000 square meters including Ampera1, 2, 3, 4, and 5 roads which are surrounded by (A) Ermasu.
road with a length of 500 m, (B) 350 m long Ali Arkam road, (C) Polder road along 500 m, and (D) the 350 m Paulus Napi road, the Maro District of Merauke District as shown in Figure 3.

3.2. Distance measuring results of coast and river lines

Figure 4 below shows the distance of the survey location from the coastline of about 4 kilometers (A) to the south, the distance of the Maro river line to the port around 1 kilometer (B) to the north, then the distance of the Maro river section (C) is about 3 kilometers towards the east. Also besides, the width of
the river Maro from two sides is far apart around an average of 500 meters. It appears that the city of Merauke is flanked by two sides of the Maro river and one beachside of Lampu Satu.

3.3. Results of the original land surface livelihood survey

The original land-based livelihood survey includes activities that are very important in searching for the characteristics of the dug later because it relates to the level of confidence of the actual dug wells to be reviewed. The interview shows that the land surface of the Ampera and surrounding settlements is a former swamp, and the owner of the original wildlife habitat is a type of deer animal. Some residents remain as pioneer residents who live on the road to Ampera Merauke, saying the same thing.

As is usually the case with the growth of settlements both from the development of residents and immigrants, each of them is trying to fulfill the housing needs. Historically specifically the construction of housing in the Ampera neighborhood has experienced an average of twice building ground floor storage over the past 2 decades. The second hoarding of the ground floor of the building is caused by the overflow of floodwater during extreme rain. Other factors that cause the increase in the ground floor of the building are the basic foundation of the road which is getting higher.

In addition to detecting the height of the embankment trace from the original swamp, it is then identified based on the rise of the road body as shown in figures 7 and 8. In figure 7, the height of the road body
before being paved is about 50 cm. While in figure 8 taken from Ampera2 also gives an indication of an altitude of about 50 cm. Seen in figure 8, the white line shows the Ali Arkam road. This indicates that the first road on Ali Arkam is the first height increase calculated from the original swamp base. The yellow line in figure 8, shows the second increase in the road surface height of about 50 cm again calculated from the surface of Ali Arkam road. This fact provides information that the rise in the road surface in the Ampera neighborhood rises about 1 meter from the bottom of the swamp.

The increase in road body height is generally always followed by the height of the ground floor of the building because the height of the road body during the rainy season also functions as a water retaining-dam which causes a flood of stagnant water to enter people's homes. To avoid these conditions there is no other way unless residents raise the floor of the building parallel to the road if they still have the economic capacity, or accept the risk of rainwater flooding every year.

3.4. **Data collection results of the coordinates of the well dug**

Figure 10, is a yellow balloon placemark image indicating the location of the well coordinate points that have been surveyed as many as 93 units that spread between the Polder road, Ampera1, 2, 3, 4, 5, and the Ermasu road. The dug wells that are reviewed are all housing based so that the existing well position follows the left and right sides of the road network.

For example, with a well number identity: 012 / Kelurahan: Maro / Owner: Budi Tri (excavated in 2000s) / Property rights: Private / Location of coordinates: Lat -8.484200, Long 140.396520 / Form of
excavation: deker box / dimension wells: (1.5m well depth) (1m max water) (min water 0.2-0.5m) (0.75m diameter) / taste of water: fresh brackish (slobar) / dry condition: not dry / water use: MCK / Number of water users: 3 people / PDAM connection: none.

The surveyed area has a total of ± 284 housing units. The number of houses that have been detected has a dug well of 93 units and each well number is given the same identity starting from well number 1 to well number 93 as in figure 10.

3.5. Results of data collection on the depth of the well and the height of the well water

Table 1. Characteristics of dimensions and discharge of wells dug (93 unit)

| No well | Depth (m) | W Max (m) | Average W | W min |
|---------|-----------|-----------|-----------|-------|
| 5       | 1.5       | 1         | 0.2-0.5   |       |
| 15      | 1.5       | 1         | 0.2-0.5   |       |
| 31      | 2.5       | 1.9       | 0.2-0.5   |       |
| 34      | 3.1       | 2.6       | 0.2-0.5   |       |
| 64      | 3.1       | 2.8       | 0.2-0.5   |       |
| 90      | 4         | 2.5       | 0.2-0.5   |       |
| 93      | 3.1       | 2.4       | 0.2-0.5   |       |
| 65      | 2.7       | 2.5       | 0.2-0.5   |       |
| 79      | 3.5       | 2.5       | 0.2-0.5   |       |
| 82      | 1.6       | 1.5       | 0.2-0.5   |       |
| 25      | 2.5       | 1.3       | 0.2-0.5   |       |
| 10      | 2         | 1         | 0.2-0.5   |       |
| 12      | 1.5       | 1         | 0.2-0.5   |       |
| 1       | 3.5       | 2.5       | 0.2-0.5   |       |
| 3       | 2         | 0.8       | 0.2-0.5   |       |
| 6       | 2.5       | 1.8       | 0.2-0.5   |       |
| 9       | 2.5       | 1         | 0.2-0.5   |       |
| 18a     | 2.5       | 1.5       | 0.2-0.5   |       |
| 27      | 2         | 1         | 0.2-0.5   |       |
| 30      | 3         | 1.5       | 0.2-0.5   |       |
| 35      | 2.1       | 1.8       | 0.2-0.5   |       |
| 38      | 3.5       | 2.9       | 0.2-0.5   |       |
| 39      | 2.5       | 1.6       | 0.2-0.5   |       |
| 61      | 5.5       | 4.5       | 0.2-0.5   |       |
| 76      | 2         | 1.1       | 0.2-0.5   |       |
| 78      | 2         | 1.5       | 0.2-0.5   |       |
| 80      | 2         | 1.1       | 0.2-0.5   |       |
| 89      | 2.2       | 1         | 0.2-0.5   |       |
| 92      | 4.1       | 2.8       | 0.2-0.5   |       |
| 33      | 2.5       | 1.5       | 0.2-0.5   |       |
| 70      | 4         | 2.5       | 0.2-0.5   |       |
| 2       | 2.5       | 2         | 0.2-0.5   |       |
| 4       | 1         | 0.8       | 0.2-0.5   |       |
| 7       | 2         | 1.5       | 0.2-0.5   |       |
| 8       | 1.4       | 1         | 0.2-0.5   |       |
| 11      | 2.5       | 1         | 0.2-0.5   |       |
| 13      | 2.5       | 1.8       | 0.2-0.5   |       |
| 14      | 3.5       | 1.8       | 0.2-0.5   |       |
| 16      | 2.5       | 1         | 0.2-0.5   |       |

| No well | Depth (m) | W Max (m) | Average W | W min |
|---------|-----------|-----------|-----------|-------|
| 17      | 3         | 3.5       | 2.9       | 0.2-0.5 |
| 18      | 2         | 1         | 1.5       | 0.2-0.5 |
| 19      | 2.5       | 1.5       | 1.5       | 0.2-0.5 |
| 24      | 2.5       | 1.5       | 1.5       | 0.2-0.5 |
| 26      | 3.7       | 3         | 3         | 0.2-0.5 |
| 28      | 2.5       | 1.2       | 1.2       | 0.2-0.5 |
| 32      | 4.7       | 3.5       | 3.5       | 0.2-0.5 |
| 36      | 1.9       | 0.5       | 0.5       | 0.2-0.5 |
| 37      | 3         | 2         | 2         | 0.2-0.5 |
| 40      | 4         | 3.1       | 3.1       | 0.2-0.5 |
| 41      | 2.5       | 2.1       | 2.1       | 0.2-0.5 |
| 42      | 2.5       | 1.1       | 1.1       | 0.2-0.5 |
| 43      | 2.2       | 0.7       | 0.7       | 0.2-0.5 |
| 44      | 2.5       | 1.8       | 1.8       | 0.2-0.5 |
| 45      | 3.5       | 2.5       | 2.5       | 0.2-0.5 |
| 48      | 2.7       | 1.5       | 1.5       | 0.2-0.5 |
| 49      | 2.5       | 1.8       | 1.8       | 0.2-0.5 |
| 50      | 2.5       | 1         | 1         | 0.2-0.5 |
| 51      | 2.5       | 2.2       | 2.2       | 0.2-0.5 |
| 52      | 3         | 2.1       | 2.1       | 0.2-0.5 |
| 60      | 2         | 1         | 1         | 0.2-0.5 |
| 63      | 3.5       | 2.5       | 2.5       | 0.2-0.5 |
| 71      | 1.8       | 1.5       | 1.5       | 0.2-0.5 |
| 73      | 3         | 1         | 1         | 0.2-0.5 |
| 81      | 2         | 1         | 1         | 0.2-0.5 |
| 84      | 3         | 0.5       | 0.5       | 0.2-0.5 |
| 89      | 2.5       | 1         | 1         | 0.2-0.5 |
| 46      | 3.5       | 2.5       | 2.5       | 0.2-0.5 |
| 47      | 3         | 2         | 2         | 0.2-0.5 |
| 54      | 3.8       | 2         | 2         | 0.2-0.5 |
| 57      | 2.1       | 1.5       | 1.5       | 0.2-0.5 |
| 59      | 1.9       | 1.5       | 1.5       | 0.2-0.5 |
| 72      | 2.7       | 1.5       | 1.5       | 0.2-0.5 |
| 86      | 4.5       | 2.6       | 2.6       | 0.2-0.5 |
| 83      | 3.5       | 3.1       | 3.1       | 0.2-0.5 |
| 22      | 4         | 2.8       | 2.8       | 0.2-0.5 |
| 29      | 2.6       | 1.5       | 1.5       | 0.2-0.5 |
| 55      | 2.8       | 2         | 2         | 0.2-0.5 |
| 56      | 3.8       | 1.5       | 1.5       | 0.2-0.5 |
| No well | Depth (m) | W Max (m) | Average W min |
|--------|-----------|-----------|---------------|
| 62     | 3         | 2.1       | 0.2-0.5       |
| 69     | 3         | 1.9       | 0.2-0.5       |
| 53     | 2.8       | 2         | 0.2-0.5       |
| 20     | 2.8       | 2         | 0.2-0.5       |
| 23     | 1.8       | 1.1       | 0.2-0.5       |
| 58     | 3         | 2.1       | 0.2-0.5       |
| 66     | 1         | 0.7       | 0.2-0.5       |
| 67     | 3         | 2.5       | 0.2-0.5       |

The results of the survey data obtained two wells that experienced drought at the bottom of the well, namely wells number 4 and no 64. Both of these dry wells were 1 meter deep. Other wells do not experience drought at the bottom of the well and the depth exceeds 1 meter. Almost all of the wells that taste the water taste brackish or the local term taste of slobar. The answers from the owner of the well said that when the first well was dug out it was very salty but because everyday water was taken it eventually became brackish / slobar.

3.6. The observations of tides from the main and tertiary canals

The 5 meter wide Ampera drainage channel is directly connected to the sea at the sluice near the port of Merauke. The channel path is adjacent to the Ampera road body which is then connected again with the tertiary channel following the Ali Arkam road side and the Paulus Napi road.

The flow of seawater through tidal and tidal activities every day comes splitting and circling the Ampera zone. Based on the trail of the tide and low tide on the trunk showing the water level with the original land surface only about 1 meter.

**Figure 11.** Main Channel From And Towards The Sea Splits Ampera

**Figure 12.** The tertiary channel is the way of the prisoner Paulus

**Figure 13.** Tertiary channel on Ali Arkam Road
4. Conclusion
   a. There are 2 wells of 1-meter depth and the basic conditions are dry during the dry season. Deepest well as deep as 5.5 meters. The depth of the 2.5 meters well dominates as many as 22 units.
   b. The face of groundwater averages 1 meter deep from the surface of the ground floor of the building. If it is reduced by the result of the increase in the building floor and 1-meter high road, then the groundwater level will be parallel to the original swamp base. Likewise, the tidal water level is about 1 meter from the original land surface.
   c. Based on the characteristics of collected well data and geographic assessment provide two potential trends. The bargaining potential mixed in the wells comes from the precipitation of rainwater stored in the cavities and pores of the soil layer. The salt content in the soil layer will always be there because every day the surface of the Ampera soil is directly connected to the sea. The potential for this trend has almost uniform effects of brackish / slobar in all wells reviewed.
   d. To get an adequate digging well discharge, the excavation depth should be at least 4 meters from the ground floor of the building, so that the effective depth reaches 3 meters from the original land surface, with a minimum diameter of 1 meter so that the seepage surface can be wider.

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