Contributions of dug wells, taps, and tank cars (case study clean water needs of Ampera settlement, Merauke city)

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Abstract. The ability of a residential area has different characteristics in supplying clean water needs. The uniqueness of the terrain of the city of Merauke only depends on two main sources, one puddle of swamp water is called the blue swamp which is the source of the local water company (PDAM) and infiltrate groundwater with dug wells. Blue swamp and dug wells later became sources of new business types of tank car water orders directly. Research has been carried out in the scope of the city of Merauke precisely in the complex of Ampera1 up to Ampera5 which aims to explore the ability to contribute the three water source variables using direct survey and interview methods. The results show that estimation comparison of PDAM = 1,573 m$^3$ or (25.98%) contribution, supply from tank cars is = 730 m$^3$ or (12%), and the supply from the dug well is 3,750 m$^3$ or (61.95%). While the level of urgency of the need for dug wells is seen every decade of excavation from the 1960s = 1 unit, 1970s = 4 units, 1980s = 14 units, 1990s = 37 units, 2000s = 21 units, and 2010an 17 units. Dug turns out to be the biggest contributor to clean water. Hope and dependence the digs are getting stronger every year. During the dry season, the well is the only one hope the people of Merauke city.

1. Introduction
The screams of the weak economic community of the city are seeking clean water to become a routine throughout the annual dry season. This is because water sources are only sourced from swamp pools managed by PDAMs and dug wells sourced from the community's private initiative to fulfill the urgency of their clean water needs.

If you look closely at the water sources of swamp ponds and wells, you can also extract one of them, namely rainwater which then becomes a pool of swamps and groundwater recharge. The source of the blue swamp is approximately 80 kilometers from outside the city. The model of transporting clean water from the blue swamp of the Sota District using tank cars likes Pertamina tank cars. With this water tank transportation, the chain of clean water prices will increase, so that the clean water consumption can only be enjoyed by middle and upper economic circles. For intermediate and lower economic circles are forced to use the dug well facilities closest to their occupancy. In critical droughts, this momentum has turned into a very promising business opportunity. The tank car keeps moving to fulfill the order, while the Jergen retailer with a crowded cart pops up to benefit from consumers. Tank cars and Jergen carts operating in Merauke city all rely on well water discharge. Extreme dry conditions of the tanker will go to Sota, which is 80 km outside the city.

In practice daily during the dry season, sometimes there are also dug wells that are dry and which are not dry, there are also dry and non-dry brackish water wells in the dry season. Residents must travel short distances and long distances from their residential locations to get clean water. If there are freshwater dug wells that are not dry near the dwelling then they are in the category of lucky dwelling
groups. Likewise, if there are freshwater dug wells that are not dry away from the dwelling, they are forced to incur additional costs for car transportation or carts.

![Figure 1. Car business clean water tank](image1)

![Figure 2. Business retail / clean water](image2)

Some government efforts to meet the needs of water in the form of borehole assistance have been carried out at several points, but some of them contain more sulfur so that they cannot be used as consumption materials. The soil structure consisting of the type of clay in the surface makes it difficult for technicians to manually drill wells to pull back the drilling pipe because the clay clamps which are stronger than the ability to pull up cause the pipes and drill eyes to be left behind in the ground.

Data from the Merauke BPS shows that the population growth of the Merauke Regency in 2014 was 213,484 people with an area of up to 46,791.63 Km2 so that the population density in Merauke Regency was 4.56 people / Km2 [1]. In 2014 the population growth rate of Kab. Merauke reaches 2.37% per year. Especially for the area in the city of Merauke, the population ranges from 95,562 people or around 44.76% of the population of Kab. Merauke [1].

Another more worrying though is the issue of administrative regional expansion. The expansion of the region is a political effort to make the City of Merauke (Mayor) Administrative Region and also includes a plan to establish the Province of South Papua. With the issue of regional expansion, the condition of the region will automatically be burdened in fulfilling access to necessities of life such as daily clean water needs.

Based on the population growth rate of the existing Merauke coupled with an estimated population surge due to regional expansion, the daily supply of water needs will be seriously taken care of. The general term of the emergency status can be an alert if the government neglects to anticipate it from now on.

The practical concept illustrates that the supplies of the Merauke swamp area for water needs are constant, the characteristics and number of dug wells do not all support the dry season needs, the soil structure has a varied recharge and cannot be ascertained where the point is guaranteed to provide freshwater supply. for the weak or middle-income economy, they must prepare themselves to scream again at the next dry season and again.

The results of the field survey in December 2015, showed that the presence of dug wells not far from the coast of the sea gave good freshwater, while the dug well points which were some distance from the coastal shore even some of the wells were salty and brackish. Likewise, the results of the January 2016 data and information survey at the PU office as a technical agency, about the pattern of groundwater recharge in Merauke are also not yet available.

One concept of alternative solutions offered in this study is how to know the pattern of freshwater infiltration in the soil layer in the city of Merauke to fulfill water needs by studying the characteristics of existing dug wells. There must be suspicion at any point or zone that can provide freshwater supply. The inner city scope is taken considering the distance of access to the water point so that it can be closer and cheaper.

The research zone was carried out in the densest zones in the City of Merauke namely Ampera I, Ampera II, Ampera III, Ampera IV, and Ampera V. The Amperazone is a very crowded population zone, dense housing, and the most boarding house complex. Ampera Complex in the area of Maro District, Merauke District, Merauke Regency.

When viewed from the form and technique, a clean water supply system can be divided into an individual water supply system and a municipal water supply system. Individual water supply systems
are used for individual use and limited services, while community or urban clean water supply systems are clean water supply systems which are limited to a certain environment or housing or industrial complex and ideally are comprehensive including domestic, urban, and industry [2]. This community clean water supply system is complex which consists of three main components, namely water sources, transmission systems, and distribution systems [3]. As stated by Noer Bambang and Morimura regarding the clean water supply system which is divided into the following three systems:

1) Clean water production or processing system is a processing installation from raw water to clean water that is ready to be given to consumers.
2) A transmission system is a system that is given to consumers. A transmission system is a system that starts from a collection system to a clean water treatment plant or starts from a source that has met the quality requirements or the building for processing clean water to a reservoir (shelter).
3) The distribution system is a distribution system of clean water from the reservoir to its service areas.

In Indonesia, the population's clean water needs can be met by various means, including by subscribing to PDAMs, digging wells, and taking water directly to water sources. This can be caused by several factors which according to Pramono six factors that influence the management of clean water which includes the following [4].

1) Topography
2) Geographical conditions
3) Water Source Pollution
4) Productivity
5) Basic water rates
6) Water loss

While Triweko explained that clean water management is influenced by many factors [5] such as:

1) Physical Environment;
2) Social Environment
3) Technology;
4) Institution;
5) Finance;
6) Service; And
7) Management Efficiency.

2. Methodology
This study used a field survey method and direct interviews with each resident's house within the scope of the Ampera Meruke complex. The surveyor team is equipped with questionnaires and measuring instruments that refer to the target data to be achieved as follows:

| Data                          | Source                          | How to get                      |
|-------------------------------|---------------------------------|---------------------------------|
| Well dimensions               | Every well location             | Measurement: Meter + earring strap|
| Water depth                   | Every well location             | Measurement: Meter + earring strap|
| Coordinate point well         | Well owner/citizen well users   | GPS                             |
| Dry history and not well      | Every PDAM meter per house unit population | Direct interview               |
| PDAM water                    |                                 | Direct recording / payment slip PDAM |
discharge
History water In every house Direct interview
purchase by car population
tank
History of the Every well location Direct interview
year excavation well

Table 2. Data analysis

| Analysis                                      | Product analysis                                                                 |
|-----------------------------------------------|-----------------------------------------------------------------------------------|
| Coordinate data.                             | Mapping with Google Earth.                                                        |
| Data on well water discharge dig and with     | Conversion of an estimated amount of effective water discharge wells dig into the percentage consumed by residents |
| water volume equation                        |                                                                                  |
| effective well = debit - debit Min debit      |                                                                                  |
| well water dig.                               |                                                                                  |
| Order water data from the tanker.            | Conversion of an estimated amount of internal discharge percent.                  |
| Water usage data PDAM.                       | Conversion of an estimated amount of internal discharge percent.                  |
| Data of excavation year well                  | Indication of the rate of increase in well needs dig it out.                      |

3. Results and discussion

3.1. Characteristics of years of digging wells

Table 3. Characteristics of years of digging wells (93 units)

| Well number | Digging year/decade | Number of units |
|-------------|---------------------|-----------------|
| 62          | 1960s               | 1               |
| 21.64.65.92 | 1970s               | 4               |
| 5.6.17.22.37.45.47.73.79.83.84.91.70.3 | 1980s | 14 |
| 1.2.9.10.13.14.15.19.20.23.27.30.31.32.34.36.38.40.41.42.6.54.55.56.72.74.81.82.85.86.93.18a.18b.26.67.4 | 1990s | 37 |
| 12.24.25.48.49.57.58.59.60.61.63.66.68.69.75.76.80.87.11.53.90 | 2000s | 21 |
| 39.88.8.50.51.52.77.89.7.78.71.16.28.33.35.43.44 | 2010s | 17 |

It can be seen in Table 3. that began in the first decade of the 1960s only 1 unit found and it seems that the population in that year did not yet need a well dig it out. Entering the second decade of the 1970s data obtained 4 digging wells and started to show symptoms of increasing levels of clean water needs. In the 3rd decade of the 1980s, there were an additional 14 units and the community seemed to be familiar with it dig well. The 4th decade period of the 1990s saw a significant surge of 37 units. This provides information that pressure has begun between the population and the availability of clean water in the Ampera region is reviewed. From here it seems there are an effort residents who can meet their clean water needs personally, even from Visual data obtained from the position of the dug well is not only in the yard but some are digging wells in the body of the house. Following the 5th decade of
the 2000s still seen a surge in the addition of wells of 21 units. the impression is still the same as the decades 1990s namely the need for water sources. Likewise, in the 6th decade found excavations 17 units. Expectations and dependence on wells are getting stronger.

3.2. Characteristics of the coordinates of the well dug

Figure 3, is a yellow balloon placemark image indicating the location of well coordinate points surveyed 93 units spread between polder roads, amperes 1, 2, 3, 4, 5, and the ermasu road. The dug wells are all housing-based so that the position of the wells follows the left and right sides of the road network. The surveyed area has a total of ± 284 housing units. Number of successful homes detected has a dig well of 93 units and each well number is given the same identity starting from well number 1 to well number 93

3.3. Characteristics of dimensions and discharge of wells dug

| No well | Depth (m) | W max (m) | Average W min (m) | diameter (m) | Well round | Well box | Large (m²) | Q W max | Q W min |
|---------|-----------|-----------|-------------------|--------------|------------|----------|------------|---------|---------|
| 5       | 1.5       | 1         | 0.2-0.5           | 0.5          | √          | 0.2      | 0.2        | 0.04    |         |
| 15      | 1.5       | 1         | 0.2-0.5           | 0.5          | √          | 0.25     | 0.25       | 0.05    |         |
| 31      | 2.5       | 1.9       | 0.2-0.5           | 0.5          | √          | 0.2      | 0.37       | 0.04    |         |
| 34      | 3.1       | 2.6       | 0.2-0.5           | 0.5          | √          | 0.2      | 0.51       | 0.04    |         |
| 64      | 3.1       | 2.8       | 0.2-0.5           | 0.5          | √          | 0.2      | 0.55       | 0.04    |         |
| 90      | 4         | 2.5       | 0.2-0.5           | 0.5          | √          | 0.2      | 0.49       | 0.04    |         |
| 93      | 3.1       | 2.4       | 0.2-0.5           | 0.5          | √          | 0.2      | 0.47       | 0.04    |         |
| 65      | 2.7       | 2.5       | 0.2-0.5           | 0.6          | √          | 0.36     | 0.90       | 0.18    |         |
| 79      | 3.5       | 2.5       | 0.2-0.5           | 0.6          | √          | 0.28     | 0.71       | 0.06    |         |
| 82      | 1.6       | 1.5       | 0.2-0.5           | 0.6          | √          | 0.28     | 0.42       | 0.06    |         |
| 25      | 2.5       | 1.3       | 0.2-0.5           | 0.7          | √          | 0.49     | 0.64       | 0.13    |         |
| 10      | 2         | 1         | 0.2-0.5           | 0.75         | √          | 0.44     | 0.44       | 0.09    |         |
| 12      | 1.5       | 1         | 0.2-0.5           | 0.75         | √          | 0.56     | 0.56       | 0.11    |         |
|   | 3.5 | 2.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
|---|-----|-----|---------|-----|----|------|-----|------|
| 3 | 2   | 0.8 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 6  | 2.5 | 2.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 8  | 1.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 9  | 2.5 | 1   | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 18a | 2.5 | 1   | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 18b | 2.5 | 1   | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 27 | 2   | 1   | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 30 | 2   | 1   | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 35 | 2.1 | 1.8 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 38 | 2.5 | 2.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 39 | 2.5 | 1.6 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 61 | 5.5 | 4.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 76 | 2   | 1   | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 78 | 2   | 1.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 80 | 2   | 1.1 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 89 | 2.2 | 1   | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 92 | 2.5 | 2.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 93 | 2.5 | 2.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 70 | 4   | 2.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 72 | 2   | 1.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 74 | 2   | 1.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 80 | 2   | 1.1 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 89 | 2.2 | 1   | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 92 | 4.1 | 2.8 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 93 | 2.5 | 2.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 70 | 4   | 2.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 72 | 2   | 1.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 74 | 2   | 1.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 80 | 2   | 1.1 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 89 | 2.2 | 1   | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 92 | 4.1 | 2.8 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 93 | 2.5 | 2.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 70 | 4   | 2.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 72 | 2   | 1.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 74 | 2   | 1.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 80 | 2   | 1.1 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 89 | 2.2 | 1   | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 92 | 4.1 | 2.8 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 93 | 2.5 | 2.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 70 | 4   | 2.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 72 | 2   | 1.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 74 | 2   | 1.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 80 | 2   | 1.1 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 89 | 2.2 | 1   | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 92 | 4.1 | 2.8 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
| 93 | 2.5 | 2.5 | 0.2-0.5 | 0.8 | √ | 0.64 | 1.6 | 1.32 |
The column dimension of the well consists of the depth of the well from the surface of the ground floor of the building, water maximum, air minimus, and circle diameter or width of the well box. In Table 4, the above is sorted from the smallest diameter width to the largest which is then prepared for each column the area (m$^2$) so that it can be estimated for each number of maximum and minimum debits each well.

3.3.1. Debit max. surface. The maximum surface discharge refers to a fixed or fixed water level constant based on weather conditions when reviewed, namely the situation in August 2017 with Direct measurement because there are differences in the weather conditions of a particular month. Estimated the maximum number of discharges is 93 wells of 143.81 m$^3$.

3.3.2. Debit min. surface. The minimum surface discharge is taken from the observation of the well's owner during an extreme drought he had experienced. Usually by paying attention to the pipe end of the water sucking machine about 20 cm above the bottom of the well. The estimated total minimum discharge of 93 wells is estimated at 18.50 m$^3$.

3.3.3. Effective well discharge. Understanding of effective well discharge is maximum discharge - minimum discharge, so the estimation results are obtained 143.81 m$^3$ - 18.50 m$^3$ = 125.31 m$^3$. This effective debit is used and which is experiencing recovery springs or seepage after suctioning the water machine (the Sanyo) or by the bucket.
3.4. PDAM and tank car

Table 5. Accumulation of cubication conversion results of PDAMs and tankers

| well | total | conversion PDAM (Q) | conversion tanker | PDAM 11,750 / Q |
|------|-------|---------------------|-------------------|------------------|
| 93   | 45    | 48                  | 1,539             | 8,580,000        |
|      |       |                     |                   | 18,488,000       |

The conversion result of cubication to rupiah shows that the estimated expenditure of 45 houses who has a PDAM connection of IDR 18,488,000 divided by the price of PDAM cubication IDR 11,750 / Q, then monthly water use is ± 1,573 m$^3$. As for purchases tank car water IDR 8,580,000 / 11,750 to obtain estimates of water use for a month of ± 730 m$^3$. While the effective discharge of the dug well is obtained from the explanation table 5.3 is 125 m$^3$ with recovery period after suction phase 1 x 24 hours taken an hour. Thus 125 m$^3$ x 30 = 3,750 m$^3$ in a month. Estimated total water use a month 1,573 (25.98%) + 730 (12%) + 3,750 (61.95%) = 6,053 m$^3$, which is used by 1,187 users.

4. Conclusion

Estimated comparison of the contribution of clean water use:

a) PDAM = 1,573 m$^3$ or (25.98%),
b) Supply from water tankers = 730 m$^3$ or (12%),
c) Supply of digging wells = 3,750 m$^3$ or (61.95%) of the total usage data totaling 6.053 m$^3$.

The level of urgency is seen based on decades of excavation:

a) In the 1960s = 1 Unit Sumur Gali
b) In the 1970s = 4 Unit
c) In the 1980s = 14 Unit
d) In the 1990s = 37 Unit
e) In the 2000s = 21 Unit
f) In the 2010s = 17 Unit

Dug turns out to be the biggest contributor to clean water. Hope and dependence the digs are getting stronger every year. During the dry season, the well is the only one hope the people of Merauke city.

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