Analysis of the water availability in *Dante Spring* to supply the water needs of the people of Bontongan Village, Enrekang District

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Abstract. Water absorption on the land surface is influenced by several factors, including coverage or area, soil conditions, and vegetation. Drinking water Supply System has not a national policy that aims to increase public access to water with quality ready to drink. By respect to the necessary to supervise the quality of water distribution to the public by the provider of drinking water service. The tightly of surface conditions, the infiltration rate will be smaller and the greater the runoff this happens because the solid soil is difficult to penetrate by water. The soil surface nature determines it is factors; density and the presence of plants. To increase the power of capacity or soil absorption, carried out using tree roots as an alternative to minimize the occur of inundation, so that research was conducted on samples of inundation land grass and tree roots vegetation in the laboratory. The results land natural was runoff obtained 25456.79 ml/minute and while the land with tree cover runoff was 19665.10 ml/minute. Through testing the Rainfall Simulator, tree root material in soil samples can reduce 22.75% of the inundation and while samples with grass cover can reduce as much as 19.35%. From this research, it was concluded that the roots of pucuk merah plant used in testing could be an alternative to the vegetation of land cover to minimize surface runoff.

1. Introduction

Water quality is the most important part of developing water resources. In this case, the water quality includes physical, chemical, and microbiological parameters that can affect the availability of water for human life. Utilization of water resources for industrial, agricultural, and human needs, initially needs to determine the quality of the water [1, 2, 3].

Based on Government Regulation of the Republic of Indonesia No. 16 Tahun 2005, that what raw water for household drinking water, from now on called raw water, is water coming from surface water sources and groundwater or rainwater basins that meet certain quality standards as raw water for drinking water [4, 5].

Water needs always increase both the function and the quantity that are proportional to the time parameters that continue to grow. This increase is by various aspects of activities in the community, both social, economic, and cultural. Water is stored in various forms and methods such as water on the ground surface, underground, organic materials, chemical compounds, and others. The quantity of water on earth is massive and constant. The parameter that always changes is the quantity balance of water [6,7].
The study of calculating water discharge that is the quantitative research using secondary data has been done with the F.J method. Mock [8]. Calculation of the water availability analysis uses the Thornthwaite Mather water balance method with monthly rainfall data [9]. The results of the calculation of water demand projections are based on the population and the annual population growth rate. The population of Palu city in the next 20 years is about 555,977 people in which the need for water is approximately 23.6 liters/second. Prediction of the need for clean water for the IPA service area about 48.83 liters/second by using linear regression method [10]. In addition, analysis of the water availability and necessity using the secondary data that consist of non-spatial and spatial data [11]. The research was held in Bontomangan district, Enrekang region by considering the problem of water deficiency in several areas. The water availability analysis using monthly rainfall data between 2001 and 2010 was estimated by the F.J water balance method. The projection of water availability to calculate the water balance uses rainfall for interval 5, 10, and 20 years. Analysis of domestic water needs uses variable population numbers and family welfare as factors that affect domestic water use.

This study aims to analyze the quality of raw water for clean water in the District of Baraka and calculate the availability and predict water requirements for the next 16 years.

2. Methods

2.1. Location and Design of Research
This research was conducted in Bontongan Village, Baraka Subdistrict, Enrekang District, South Sulawesi Province, on the raw water source, namely Dante Spring. The type of research used is a descriptive quantitative method which aims to get an overview of the availability of water in Dante spring and the water needs of the residents of Bontongan Village who have not yet been supplied with clean water.

2.2. Method of collecting data
The first step in this research is to collect secondary dataset; they are rainfall data, climatology, population number, and literature review from previous researches. After that, primary data are collected from a water sample of performing water debit testing by using manual hydraulic. Furthermore, clean water availability and the water necessity of population who do not access yet to clean water services are counted.

2.3. Data Analysis
The results collected from debit computation then be analyzed to consider and to solve the problems. Data analysis is done by using some parameters influencing the availability of clean water and the water necessity of the population who are unable to access clean water using F.J. Mock [12, 13; 14].

3. Results and Discussions
The results of the research conducted from 15th to 20th August 2017 are discussed in this part. Table 1 shows the results of debit computation by using F.J Mock method. Then, the computation results are ranked to decide the mainstay debit with 90% probabilities. The mainstay debit is minimum debit, which is used for planning, displayed in the attachment of Table 1.

| Year | Annual Debit (liter/second) | Order Number | Annual Debit (liter/second) | Mainstay (%) | Year |
|------|-----------------------------|--------------|-----------------------------|--------------|------|
| 2011 | 4.78                        | 1            | 15.85                       | 10           | 2020 |
| 2012 | 5.72                        | 2            | 11.53                       | 20           | 2017 |
| 2013 | 2.41                        | 3            | 10.49                       | 30           | 2012 |
The last accounting of the availability of water by F.J. Mock. method

| Year | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|------|------|------|------|------|------|------|------|------|
| Debit (liter/second) | 10,49 | 6,44 | 4,69 | 11,53 | 7,52 | 9,80 | 15,85 |
| Projection | 5 | 7 | 5,44 | 5,72 | 2,78 | 6,41 | 45 |
| Water needs | 60 | 2015 | 6 | 2018 | 70 | 2011 |
| Clean Water availability | 80 | 2013 | 9 | 2014 |
| Year | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
| Projection | 100 | 2016 |

The graphs of the availability and the need for domestic and non-domestic water are illustrated in figure 1 and 2.

![Figure 1. The availability and needs of water 2011 – 2018](image-url)
Figure 1 shows that in 2018, 15,388 people use water as 26.23 liter/second every year for their domestic and non-domestic need. Meanwhile, Figure 2 shows that in 2026 total 18,355 of population fulfill both domestic and non-domestic water as 30.73 liter/second every year.

Based on this research, it proves that there are several aspects influencing the water availability, namely water quality, quantity, continuity, and water balance. The requirements of continuity for clean water availability are strongly related to the water quantity available on the earth. The meaning of continuity in this context is that clean water taken sustainably with relatively constant debit fluctuation, in both dry and rainy seasons [15]. The mainstay debit is used as planning with the expectation that the water is always available to maintain the drinking water distribution and to predict the irrigation areas [16]. Furthermore, the quantity and the continuity in this research are the determination of the mainstay water debit 90% as a minimum debit for planning which determined based on yearly debit with probability 90% for 4.78 liter/second of clean water every year.

Water Balance is a correlation between the total water input and output occurred in a watershed which contains some components such as river-flow debit, rainfall, evapotranspiration, percolation, soil moisture, and period [15]. The results of this research show that the correlation between water input of Dante water springs is 4.78 liter/second and output is 30.73 liter/second every year in 2026 and 16 years of the period can be fulfilled for water service until 2016.

The results of this research show that the water needs of each family are different according to the level of family welfare in Bontongan village. The water needs of The Pre-Prosperous family, the prosperous family I, prosperous family II, and prosperous family III, and prosperous family are 32 liters/day, 42 liters/day, 57 liters/day, and 76 liters/day, and 162 liters/day respectively. Projections indicate that the water demand in Bontongan Village increases by 47% in the next 20 years.

The availability of meteorological water that tends to deficit indicates that meteorological water cannot meet the domestic water needs of the Bontongan Village community. Communities need efforts to achieve clean water from wells, springs, or the local water drinking company (PDAM). There are several water sources that can be utilized, among others, the Taru spring which has a production yield of 26, 16 liters / second and Saruran spring which has a yield of 29.56 liters/day [17]. The local water drinking company PDAM of Enrekang District stated that the Bontongan Village community using PDAM services is about 17% of the total population. This shows that the clean
water supply of the community is still not enough. Therefore, the government, together with the community, can support the water supply through the use of groundwater and springs and environmental cleanliness must be maintained so that the quality of raw water can be met. The protection of water resources can be done through water thrift.

4. Conclusion
From the analysis of the availability of the Dante water springs and the population necessity from 2011 to 2016, it can be concluded that the population growth increases along with the raise of water necessity. From projection results of population growth and water necessity until 2026, the availability of the Dante water springs can meet the domestic and non-domestic need until 2026, even for the whole citizens who are unable to access clean water service in Enrekang district. Some points we could advice are the importance of testing towards water quality to ensure that the water is safely decent to be consumed by people around the water Springs. Furthermore, it is crucial to build rain posts in the study area and to prepare excellent human resources in the operation process so that we can collect data more accurate. Finally, further integrated study about water source management in this location is needed.

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