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# WATER ACCOUNTING LITERATURE REVIEW: A CASE STUDY AT PDAM BATAM

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**Abstract**

*The struggle for water scarcity is a global issue that becoming a huge concern for every nations in the world, including Indonesia. This study aims to look at the projection of water demand and provide an overview of the application of the concept of water accounting in water supply companies in Batam City, namely PDAM Batam, in order to anticipate the water crisis in the area. The data collection process is conducted through interviews with relevant parties in PDAM Batam and secondary data collection regarding water demand and capacity of PDAM Batam. The results showed that PDAM Batam experienced an imbalance in water distribution, which could potentially worsen the water crisis in Batam City. With proper application of water accounting concept, PDAM Batam can obtain more accurate information to evaluate and plan the water distribution system. This will help in meeting customers' water needs and maintaining the sustainability of water supply for the future, so that the water crisis in Batam City can be resolved more effectively.*

**Keywords**: Water Accounting, Water Crisis, Water Supply

## Introduction

Water is the source of life that every human being needs. FAO (Food and Agriculture Organization) suggests that the average water use per person in developed countries can reach 100-150 liters per day, which includes water use for household activities, bathing, washing, cooking, and others. This high water usage reflects the level of living comfort and water availability in these countries (FAO, 2017). Clean water is a very important basic need for all living things on earth. Without water, there is no life. Almost 60% of the human body consists of water, and our bodies need an adequate supply of water every day for activities. So great is the role of water in human survival that if clean water supply is not available, life on earth will be disrupted and even endangered. In densely populated cities, the availability of clean water is one of the main factors in maintaining public health. In addition, water also plays an important role in the industrial sector, which is the backbone of the city's economy.

However, even though water is a very important life resource, the reality is that there are still problems related to the availability of clean water which is still one of the global problems that continues to be considered, including in Indonesia. According to UN Water (2020), nearly 2.2 billion people in the world still lack access to safe, clean water. Although water is an abundant resource in many regions, its distribution and quality are uneven, causing some regions to experience severe clean water shortages. The Government of Indonesia, together with other members of the United Nations (UN), actively supports the achievement of the Sustainable Development Goals (SDGs) designed with one of the objectives is to ensure the availability of water and maintain the sustainability of water supply for the future so as to anticipate the occurrence of a water crisis. Water sustainability can be achieved by implementing water accounting. The Indonesian government also strongly supports the implementation of water accounting as a tool to manage and monitor the use of water resources more efficiently and sustainably.

PDAM Batam as a company that manages and distributes clean water to the public in Batam City area has not implemented the concept of water accounting. PDAM Batam faces a big challenge in terms of the gap between customer water demand and the capacity of water that can be distributed. The availability of clean water in Batam is not always sufficient to meet the increasing demand. The existing water distribution infrastructure is also not fully capable of reaching all areas of Batam efficiently which causes some areas to experience water supply shortages, while other areas receive excess supply. This study aims to provide education for water supply companies to apply the concept of water accounting so as to ensure the availability and maintain the sustainability of water supply for the future so as to anticipate the occurrence of a water crisis. Previous research has been conducted in several countries such as California, Italy, Brazil by linking water accounting with water governance and also discussing how water

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management achieves the desired results and performance levels (United Sates, Congress, House, & Committee on Natural Resources, 2015; Batchelor et al, 2017 Rome et al, 2018; FAO et al, 2020; Srivastav et al, 2022). This research is conducted to illustrate the application of water accounting concept in PDAM Batam as a government-owned water supply company for Batam City area.

**Sustainability Theory**

Water sustainability theory focuses on the wise and planned management of water resources so that human needs can be met without compromising the ability of future generations to meet current needs. This reflects the basic principle of sustainability, which is to maintain a balance between resource use and nature's ability to restore itself. Water sustainability focuses not only on providing enough water, but also on maintaining water quality so that it remains suitable for various needs. In addition, water sustainability also encompasses the principle of social justice, which ensures that all people have equitable access to clean water, regardless of their economic conditions or geographic location (UNESCO, 2006). Water sustainability is a complex concept, not just about physical availability, but also about management that takes into account ecosystems, communities and the future. By applying the principles of water sustainability, global challenges such as water crisis and population increase can be addressed more effectively.

**Customer Statisfaction Theory**

Service quality is an important element as well as the focus of assessment in reflecting customer perceptions of various specific dimensions in the services provided by a company. In general, service quality covers five main points, namely reliability, responsiveness, assurance, empathy, and physical evidence which serve as indicators that customers will use to assess their experience, which in turn affects their perception of the company or service provider. Thus, service quality not only reflects how well the company meets customer needs but also becomes a benchmark for building long-term relationships with them. Customer satisfaction is a broader concept, this satisfaction is not only influenced by service quality, but also involves various other factors such as the quality provided, whether it is comparable to the price offered. Optimal customer satisfaction affects the company's image which will improve, providing a sustainable advantage. Therefore, understanding the effect of customer satisfaction is an important step. There are several aspects that can significantly affect customer satisfaction, including:

1) Warranty costs. One way companies ensure customer satisfaction is by providing a warranty on the products or services they offer. Some companies calculate warranty costs as a percentage of total sales as well as the company's commitment to provide assurance to customers that the products or services purchased have reliable quality. However, the failure of companies to provide such guarantees is often a major cause of customer dissatisfaction. When customers feel that there is no protection for the product or service purchased, the sense of trust in the company will decrease, potentially leading to loss of customers.

2) Handling complaints from customers. Handling customer complaints is an equally important aspect of maintaining customer satisfaction. Statistically, customer complaints are the main indicator that reflects problems in the services provided. However, companies often realize the importance of handling complaints quickly. Therefore, companies need to build an efficient system for handling complaints, and be more responsive to customer complaints. Because service quality and customer satisfaction are two elements that are mutually sustainable. Improving service quality is not enough if it is not matched by steps to understand and address customer needs thoroughly.

**Water Accounting**

Water accounting is the process of systematically assessing the status and trends of water supply, demand, distribution, accessibility and use within a region, resulting in in-depth and structured information. This information will later be used to support the achievement of sustainable outcomes. Water accounting aims to provide a better understanding of the water cycle in a region, starting from how the water is used, stored, understanding how much water is available and how water is allocated for various needs and ensuring that water is not depleted. According to Rome and Marseille (2018), water accounting is a key function in providing an in-depth understanding of the amount of water available in a region. This includes the evaluation of usable water reserves. Accounting also provides a broad view of how water can be distributed fairly and efficiently, so that water availability will be maintained for the future. In addition, the role of water accounting can also prevent the risk of running out of water resources due to uncontrolled use and poor management. By understanding the pattern of water use and availability, it will be easier to design a much more effective strategy to manage water resources sustainably, because

water accounting can help identify potential conflicts that arise due to water crisis problems, so that solutions can be designed early on to maintain stable water distribution. Therefore, understanding water accounting is an important component in supporting water sustainability that will balance existing water supplies with the water needed by the community.

## Method

This research uses descriptive quantitative method which aims to describe or characterize the phenomena related to clean water sources to be studied. The data used in this research is secondary data obtained from the website of Batam City Central Bureau of Statistics which contains information related to the number of customers of PDAM Batam and the capacity of water supplied. The utilization of secondary data allows researchers to measure, describe phenomena based on quantitative data obtained.

## Result and Discussion

Water is a very important resource for life. With such important benefits, the demand for clean water increases every year. PDAM Batam as a clean water provider also feels the impact of the increasing demand for clean water. In order to meet the needs and ensure the quality of water in Batam, PDAM Batam continues to strive to increase the capacity of water supplied to customers.

**Table 1.**

| Tahun | Jumlah Pelanggan | Jumlah air yang dibutuhkan per tahun ($m^3$) | Total Kapasitas Produksi Air Liter/Detik | Jumlah air yang disalurkan kepada pelanggan |
|---|---|---|---|---|
| 2019 | 275.472 | 10.054.728.000 | 3.610 liter (113.844.960.000/tahun) | 86.016.052 |
| 2020 | 282.805 | 10.322.382.500 | | 14.581.739 |
| 2022 | 282.805 | 10.322.382.500 | | 1.076.567.500 |
| 2023 | 317.000 | 11.570.500.000 | | 1.118.652.000 |

Source: Batam city statistic center website

FAO (Food and Agriculture Organization) suggests that the average water use per person in developed countries can reach 100-150 liters per day, which includes water use for household activities, bathing, washing, cooking, and others. Referring to the data presented, if the clean water demand of one PDAM customer is 100 liters per day, then PDAM Batam must meet the customer's water needs with a total demand of 10.054.728.000 $m^3$ for 2019 (the number of customers is 275.472 customers). However, when compared with the data on the total water production capacity produced, PDAM Batam in the same year is only able to produce water as much as 86.016.052 $m^3$. This will certainly be an inevitable conflict between the Batam PDAM and the customer. Based on the research results above, it can be seen that the fact that occurs in PDAM Batam is an imbalance between the amount of water demand and water production within 3 years. This certainly affects the operation and future of PDAM Batam. If this imbalance continues without any systematic improvement, it will have a detrimental impact on the PDAM and of course the community at large. PDAM management can also make projections for the coming year using historical data to determine the trend of customer growth, water demand and water production. Method used today is the least square trend method, which simplifies the square method which simplifies the formula of the moment trend method with the assumption that ΣX = 0 (Munandar, 1998:67). This method will be used to project the number of customers, water demand and water production for the next 5 years. The formula used to calculate least square trend method is the following equation:

$Y' = a + Bx$

$a = \frac{\Sigma Y}{n}$ dan $b = \frac{\Sigma XY}{X^2}$

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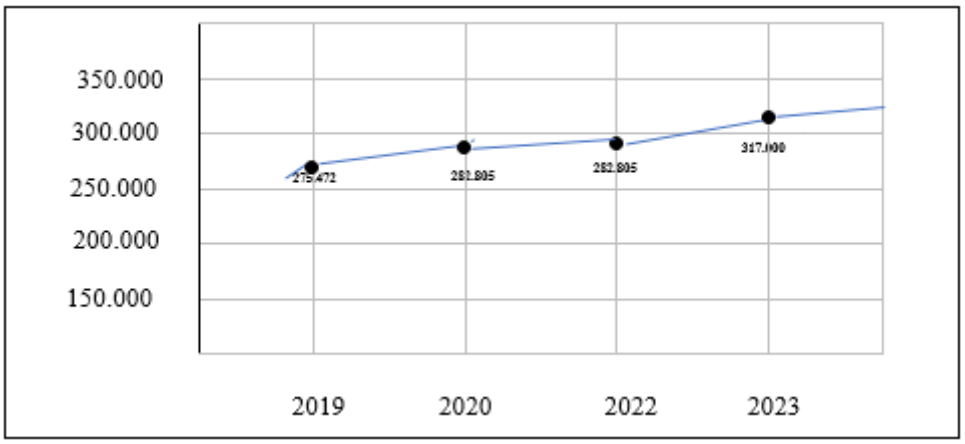
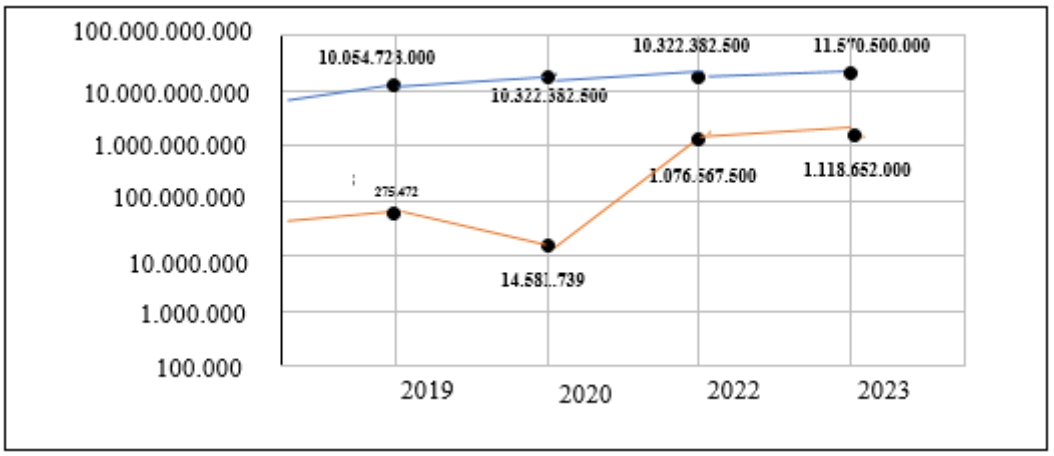



Source: processed by yourself

**Chart 1: projected number of customers**

It can be seen from graph 1 above, that the number of customers of PDAM Batam has increased every year which is certainly in line with the increasing number of population growth in Batam city. In relation to water sustainability theory, the increasing number of customers will challenge PDAM Batam to apply the social principle of ensuring that all people have equitable access to clean water, regardless of their economic condition or geographical location (UNESCO, 2006). Given the trend of increasing number of customers in recent years, PDAM Batam should pursue various ways to meet customers' water needs. The application of sustainable water accounting concept will provide quality information with the aim of evaluating the current water management, by prioritizing the principle of water sustainability which will reduce the problem of water crisis in Batam City. So that clean water sources can still be inherited and the benefits can be felt by future generations.




Source: processed by yourself

**Chart 2: projected water demand and production**

It can be concluded from the explanation of graph 2 above, the increase in customers will affect the demand for clean water needs. From the projection results above, it is clear that in 2020 there was a drastic decrease from the previous year. But the fulfillment of water needs is again sought in 2022, as well as in 2023, there is a slight increase that is quite stable. Even so, when compared to the need for clean water according to FAO, that the need for water per person is 100 - 150 liters per day, then PDAM Batam still has a lot of shortages in the amount of clean water production that must be distributed to customers.

On the other hand, the water crisis in Batam City occurs due to several factors, one of which is due to water pipe leakage, and the second factor is due to technical problems. These problems will cause complaints and decrease the level of customer confidence in PDAM Batam.

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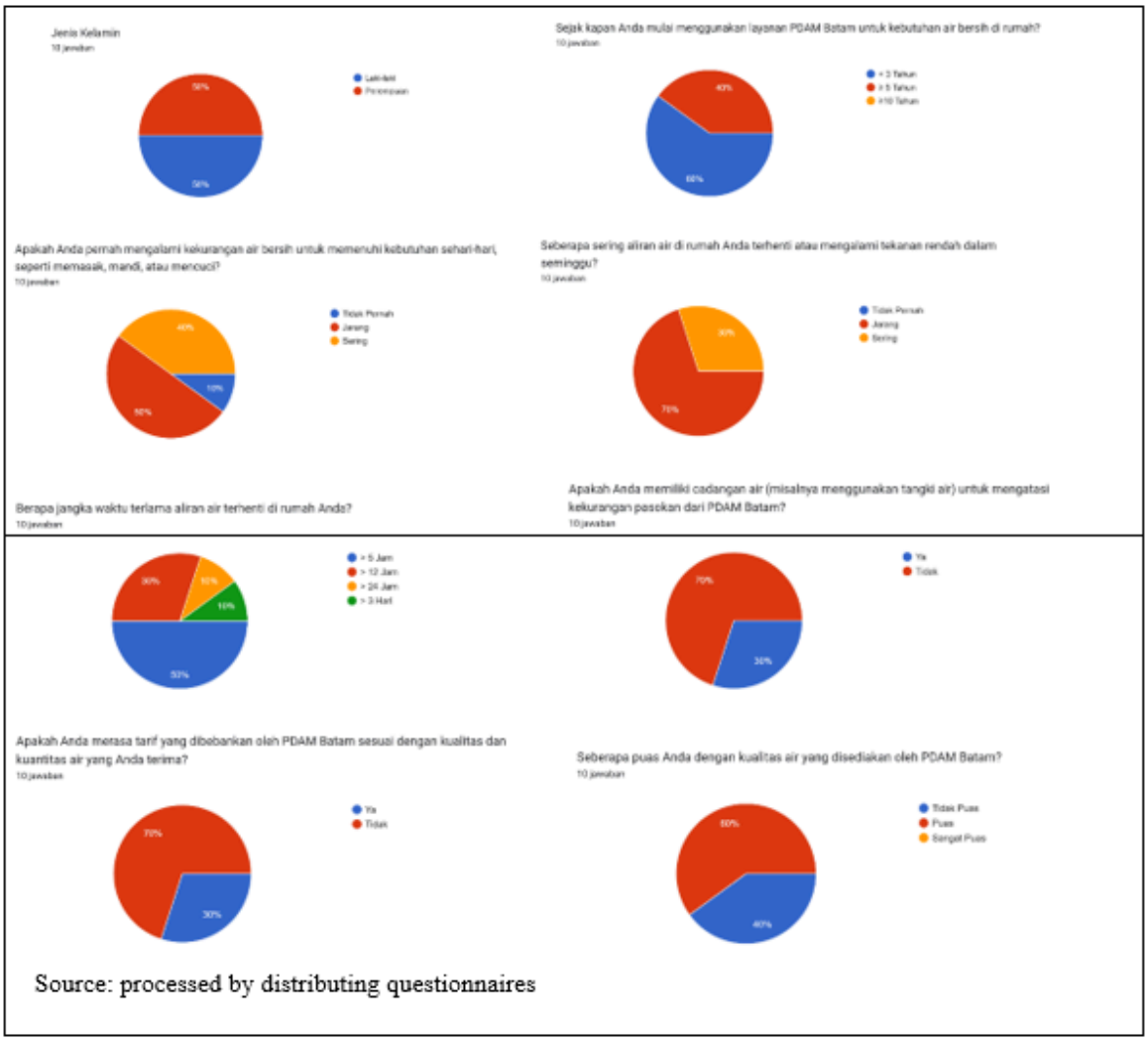


Source: processed by distributing questionnaires

**Figure 1**

The diagrams above are responses from ten customers describing their level of satisfaction with PDAM Batam. The results clearly reflect that customers' needs for clean water sources are far from being met. The inability of PDAM Batam to provide optimal service indicates that there are serious problems in infrastructure provision and water management. One factor that worsens the situation is that not all customers have water storage facilities or water tanks. The absence of water tanks means that customers have to spend more money to buy gallon water, tank water to fulfill water needs when there is a water flow interruption, hence it becomes a double inconvenience.

**Conclusion**

By looking at the projections presented and the diagrams shown, if the concept of water accounting is applied, PDAM Batam will have a clearer picture of water resources management, water treatment and distribution. With measurable and transparent data, PDAM Batam can identify major problems such as water pipe leakage, inefficient use, or lack of water treatment capacity.

Through water accounting, PDAM Batam can map areas with high water demand, as well as identify areas that are vulnerable to water supply disruptions. Thus, the company can allocate resources more effectively and reduce distribution inequalities. In addition, the data generated from water accounting can be used to design strategies in water treatment investments, such as the repair of distribution pipes, or the provision of backup water tanks for customers.

e-ISSN: xxxx-xxxx/Vol.1/SI-ISCEBE (2024)

The concept also helps PDAM Batam improve operational efficiency by identifying potential water losses, both due to physical leakage and administrative losses. In the long run, the application of water accounting will help PDAM Batam formulate data-driven policies to meet water demand. With measurable data, PDAM Batam can build customer trust while ensuring that strategies are aligned with customer needs and sustainable water resources management principles. This concept is an important foundation for efforts to improve service quality and operational sustainability of PDAM Batam.

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