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Analysis of technical evaluation and customer satisfaction of clean water services (case study: PDAM Lematang Enim at Muara Enim Regency, South Sumatra, Indonesia)

Keywords: clean water service, satisfaction, PDAM, water company

Introduction

Water is a basic human need for a variety of residential functions such as drinking, cooking, sanitation, and irrigation. Water has an essential role in human life which is very complex, one of which is to fulfill basic household needs and other activities such as cattle, gardening, crops, food processing, aquaculture, and fisheries (Carrard, Foster & Willetts, 2019). As the years increase, the household's need for clean water will increase due to the number of members in the household. This condition makes water one of the most essential basic needs and cannot be replaced with other resources (Wahyudi, Wahyudi, & Subagya, 2020). Water supply is the distribution of water by governmental utilities, commercial organizations, community efforts, or individuals, typically through a network of pumps and pipes. Public water supply systems are critical to the smooth operation of society. These systems

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provide clean water to people all around the world. Service quality considerations may include supply continuity, water purity, and water pressure. In Indonesia, the regional drinking water company (*Perusahaan Daerah Air Minum* – PDAM), acted as a regional owned enterprise (*Badan Usaha Milik Daerah* – BUMD) – currently manages the need for clean water and drinking water in many areas in Indonesia.

The role of PDAM as a business entity providing clean, healthy drinking water that meets health requirements in an area also focuses on the quality of customer service. Consumer satisfaction with water and service quality does not necessarily correspond to monitored compliance with water and service quality. Consumer satisfaction is defined as contentment or discontent with a service or product based on previous expectations (Qazi, Tamjidyamcholo, Raj, Hardaker & Standing, 2017). Satisfaction can also refer to a person's sentiments of joy or disappointment as a result of comparing a product's performance or results to their expectations (Kotler et al., 2012).

A study by Hakim (2021) indicated that good product quality will affect customer satisfaction, whereas customer satisfaction will affect customer loyalty to PDAM. However, until now, customers are still not satisfied with PDAM services in terms of water quantity, water quality, and water continuity, as well as the increase in water rates (Denantes & Donoso, 2021). The study of Athar, Sutanto and Kusmayadi (2020) presented that drinking water customers are dissatisfied with the quality of service and price, high rate of water loss, clean water distribution and low ability to pay. This problem is expected to reduce the level of customer satisfaction, if the PDAM does not take it seriously (Affandi, Muhammad & Azmeri, 2017).

To fulfill customer satisfaction, PDAM must identify the factors related to customer satisfaction to maximize customer service and company's profits. Customer satisfaction is a buyer's evaluation where the chosen alternative at least provides results (outcomes) equal to or exceeding customer expectations, while dissatisfaction arises if the results obtained do not meet customer expectations (Gunawan, 2022). Service quality factors that have a very high relationship with customer satisfaction are the factors of being responsive and showing sincerity (Syahsudarmi, Tinggi & Riau, 2022), especially in water quality because customers are very concerned about health (Denantes & Donoso, 2021). In additional, the level of customer satisfaction of the PDAM is influenced by water quality, water continuity, water pressure, water meter conditions, repair and maintenance, billing and payment systems as well as water rates and water quality (Dewi & Mursyidah, 2022).

Based on the performance of drinking water company in 2021, the Ministry of Public Works noted that there are 239 PDAMs in the healthy category. Meanwhile, 96 PDAMs are in the unhealthy category and 52 PDAMs are in the sick category. The performance is assessed based on four aspects, namely finance, service, operations,

and human resources. Based on the performance evaluation report, it is stated that the service aspect of PDAM Lematang Enim Muara Enim Regency was inadequate and fell into the sick category. In 2021, PDAM Lematang Enim's ranking is in position 99 out of 108, calculated from the performance value of BUMD drinking water per first distribution region with a performance value of 1.81 and a total number of 35,677 customers (Rachman, 2018). This requires changes in service performance at PDAM Lematang Enim to make the PDAM healthier.

Denates and Donoso (2021) investigated the elements that affected consumer satisfaction such as water service quality offered by water supply and sanitation providers in Chile. This research presented that the organoleptics explained by taste, odor, and clarity indicators, are primarily responsible for customer risk perception. The basic drinking water service criteria are intimately related to consumer satisfaction, particularly in terms of quality, quantity, continuity, and affordability (Budiyono, Pamungkas & Darundiati, 2020). The consumer's opinion of water quality and the payment system have the greatest influence on service quality and price. Furthermore, customer satisfaction with water and service quality are negatively impacted by perceived health risk and service quality. Lyimo and Gindo (2022) studied the water supply and sanitation services in Arusha Urban Water Supply and Sanitation Authority in Tanzania. This study found that the cost of water supply and sanitation services has a substantial association with customer satisfaction. Furthermore, research revealed a substantial association between customer happiness and the accessibility of water supply and sanitation services. Customer satisfaction research is critical for pushing service providers to improve their performance.

There have been a lot of research focusing on customers' satisfaction of water company services worldwide, however, there are very limited research investigating at the local perspectives of water company especially in Indonesia. Therefore, this research aims to identify the indicators as well as analyze performance of customer satisfaction at local water company in Muara Enim Regency at South Sumatra Province in Indonesia. At last, this research is expected to give a recommendation to the local government on how to improve the water company's performance.

Material and methods

This research was conducted at Muara Enim Regency, South Sumatra province, Indonesia in which PDAM Lematang Enim is used as a case study. The selection of research locations was carried out purposively with the consideration of the availability of the required data. Muara Enim is a district in South Sumatra, Indonesia which

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has several large rivers as water sources. The research was conducted from January 2022 to September 2022. Interviews were conducted directly with respondents through the help of a questionnaire containing a list of questions related to the performance, service, water distribution, and customer satisfaction of PDAM Lematang Enim. The questionnaires were given to respondents in terms of the performance, service, water distribution, and customer satisfaction of PDAM Lematang Enim.

This research used a cross-sectional design in which the variables including risk factors and effects were observed at the same time as the method of data collection. The data analysis used consisted of an analysis of the customer satisfaction index (*CSI*) and binary logistic regression analysis. An analysis of the *CSI* was conducted to evaluate the satisfaction level of PDAM Lematang Enim Muara Enim service users. The customer satisfaction index is used to determine the overall satisfaction level of PDAM Lematang Enim Muara Enim service users by looking at the level of performance and the level of importance/expectation of service attributes. The magnitude of the value of *CSI* can be explained as follows (Aritonang, 2005):

1. Determine the mean importance score (*MIS*) or the average importance score. This value is obtained from the average level of interest/expectation of service users:

$$MIS = \frac{\left(\%o_{i=1}^{n} Y_i\right)}{n},$$

where n is the number of respondents, and Y_i means importance value of the i-indicator.

2. Calculate the weighted factor (*WF*). This weight is the percentage of the mean importance score value per indicator to the total mean importance score of all indicators:

$$WF = \frac{MIS_i}{\sum_{t=1}^{p} MIS_i} 100\%,$$

where p is p-th importance indicator.

3. Calculating weight score index (*WSI*) or weighted score. This weight is the multiplication between weighted factor and the average level of performance:

$$WSI = WF_i \cdot MPS,$$

where *MPS* is mean performance score.

4. Determine customer satisfaction index (*CSI*):

$$CSI = \frac{\sum_{t=1}^{p} WS_i}{HS} 100\%,$$

where p is indicator of p-th importance, and HS means the highest scale (the maximum scale used).

If the *CSI* value is beyond 50% indicating that the service user is satisfied. In the meantime, if the *CSI* is below 50% it means that the service user is not satisfied. The *CSI* value was divided into five criteria from dissatisfied to very satisfied as seen in Table 1.

TABLE 1. Customer satisfaction index (*CSI*) value criteria

CSI value	*CSI* criteria
$X > 0.80$	very satisfied
0.66–0.81	satisfied
0.51–0.65	quite satisfied
0.35–0.50	less satisfied
0.00–0.34	not satisfied

Source: Pardiyono and Puspita (2020).

Results and discussion

Technical water analysis

The assessment of services provided by the Lematang Enim Regional Drinking Water Company (PDAM), a regional company that provides clean water services is carried out based on the time of water distribution and the quality of the distributed clean water. Distribution time is quite important because it determines the flexibility of service users in utilizing clean water. The quality of water distribution is also an important factor for PDAM Lematang Enim service users because the quality of water will directly be felt by service users.

As seen in Table 2, the schedule for clean water distribution services was divided into five schedule time to ensure the distributed water discharge run effectively.

TABLE 2. Schedule of clean water distribution of PDAM Lematang Enim

Distribution region	Schedule of water distribution
I	08.00–09.30
II	10.00–17.30
III	18.00–21.30
IV	22.00–02.00
V	02.00–05.30

Source: PDAM Lematang Enim.

Since PDAM Lematang Enim as a local water company in Muara Enim regency in South

Sumatra Province in Indonesia has used the river as the main raw water source, it is important to check the water quality based on physical, chemical and microbiologic tests. Several research highlighted that the ingredients of river water sources usually could meet quality standards in physical, chemical and microbiologic indicator tests (Purwono, Ristiawan, Ulya, Matin & Ramadhan, 2019; Widodo, Budiastuti & Komariah, 2019; Novita, Pradana, Purnomo & Puspitasari, 2020). Water quality assessment is carried out through several stages, starting from conducting water sampling and water quality testing. A sampling of customer clean water is carried out at several sample locations to ensure that the water samples can represent the water quality accepted by customers. Table 3 showed that water quality is in a good standard as indicated by the degree of acidity or alkalinity (pH).

TABLE 3. Customer clean water sampling

Sample location	Turbidity [*NTU*]	pH	Residual chlorine content [ppm]
1	3.31	7.02	0.5
2	4.15	7.15	0.6
3	2.91	6.79	0.6
4	3.53	7.01	0.6

Source: Muara Enim Regency Environmental Laboratory.

Physical and chemical tests were then carried out in more detail on the production of water in PDAM Lematang Enim specifically at the water treatment plant (WTP) Talang Jawa as one of the main water processing plant. The test was carried out using six physical indicators and five chemical indicators. The results of the physical test showed that the odor, turbidity, taste, color, TDS, and temperature of the production water in PDAM Lematang Enim WTP Talang Jawa met the applicable requirements. This indicates that there are no organoleptic problems found when observing the clean water. Chemical water examination was carried out by measuring the levels of chloride, nitrite anion, nitrate oxoanion, fluoride, and water pH for pH, phosphate, iron, manganese, copper, zinc, and chromium-T.

After conducting the physical and chemical tests of water based on water quality standards as mentioned in government regulations listed in Table 4, it can be concluded that all of the test results are still within quality standards. This is to show that the raw water from the treatment plant meets the standards for processing until it can be distributed to customers. Furthermore, the chemical tests also showed that the water does not contain excessive certain substances that can cause health problems for consumers. Subsequent checks were carried out to determine the quality of the water directly received by the community using the service. This inspection is important to ensure the quality of water directly received by service users.

The test was carried out through in-depth microbiological water analysis. The microbiology test showed that the water received by consumers meets clean water

TABLE 4. Results of water treatment plant (WTP) tests

Parameter	Unit	Value	Quality standard	Information
Total suspended solids (*TSS*)	$Mg \cdot l^{-1}$	73.00	50	SNI 6989.03.2019
Total dissolved solids (*TDS*)	$Mg \cdot l^{-1}$	78.00	1 000	SNI 6989.27.2019
pH (Lab)	–	7.00	6–9	SNI 6989.11.2019
Phosphate content	$Mg \cdot l^{-1}$	0.4250	0.2	IK 15.20/IK/LME/2022
Iron (Fe) content	$Mg \cdot l^{-1}$	< 0.0366	0.3	SNI.6989.84.2019
Manganese (Mn) content	$Mg \cdot l^{-1}$	< 0.0126	0.1	SNI.6989.84.2019
Copper (Cu) content	$Mg \cdot l^{-1}$	0.0147	0.02	SNI.6989.84.2019
Zinc (Zn) content	$Mg \cdot l^{-1}$	< 0.0068	0.05	SNI.6989.84.2019
Chromium-T content	$Mg \cdot l^{-1}$	0.0064	0.05	SNI.6989.84.2019

Source: Muara Enim Regency Environmental Laboratory.

quality standards as indicated with the results of coliform LB, MPN, and coliform BGLB (Table 5). The results showed that there was no significant contamination of the water quality that was received directly by the community. Drinking water suitable for consumption is drinking water that is clean from contamination and not contaminated by any substances (Wang, Zhang, Lv, Zhang & Ye, 2018). In addition, DAM-treated water must be free of total coliform and *Escherichia coli* content so that it can be suitable for consumption (Latupeirissa & Latupeirissa, 2022).

TABLE 5. Results of water microbiology test (sample taken at 09.45 on 14 October 2022)

Sample	LB 37°C coliform predictive test [ml]			BGLB coliform affirmation test 37°C [ml]			MPN count per 100 ml sample	BGLB 44°C coliform assertion test [ml]			Fecal coliform count per 100 ml sample	Indicator
	10	1	0.1	10	1	0.1		10	1	0.1		
WIB 84/Labkes (production water)	0	0	0	0	0	0	≤ 2 (ms)	0	0	0	≤ 2 (ms)	5.1.1

Source: Muara Enim Regency Environmental Laboratory.

Besides the laboratory analysis, the field observations were also conducted to enhance the water quality analysis. It can be seen that the quality of water is appropriate for consumption for the consumers as indicated by being odorless when smelled from far or near, tasteless, and colorless (Latupeirissa & Latupeirissa, 2022). The low concentrations of fecal coliform and total coliform (Table 5) also indicate that the local community living around the river has a high awareness not to dispose of human and livestock waste into the river.

Customer satisfaction

Satisfaction is a feeling of pleasure or disappointment from someone who comes from a comparison between the impression of the performance of a product (perceived performance) and expectations (Budhi & Sumiari, 2017). Service quality is one of the most important factors in providing satisfaction for the community, especially for businesses engaged in the public sector (Frinaldi & Eka Putri, 2021).

The service quality has a significant influence on customer satisfaction (Dewi & Mursyidah, 2022). The measure of the success of service delivery is determined by the level of customer satisfaction with the product or service because customer satisfaction is achieved if the customer gets the service according to what is needed and customer expectations (Siregar, Syahril & Hanisah, 2020). Consumer interests relate to consumer feelings, such as liking or preference for a product (Liang & Turban, 2011). This interest is driven by motivation to own a product. If the motivation for the object is high, the perception of interest will also be higher (Kotler & Armstrong, 2010). Research shows that company image and service quality have a significant effect on customer interest in owning these products (Rusmiyati & Hartono, 2022).

Based on the questionnaires, the majority of respondents use PDAM services to meet household needs which is around 97%, while other 3% of respondents use PDAM services to meet business or industry needs. These results indicate that PDAM Lematang Enim's services have not been widely used for industrial or business needs. The level of customer satisfaction in this research is defined as a person's feelings after comparing the performance or results he/she feels compared to his/her expectations. Customer satisfaction used in this research is based on some criteria such as tangible, reliability, responsiveness, assurance, and empathy. Table 6 shows the level of customer interest using mean importance score (*MIS*) and mean satisfaction score (*MSS*). The *CSI* calculation is carried out on the weighting of weighted factor (*WF*) and weighted score (*WS*). Total *WS* will be used as the quantifying factor of the *CSI* calculation. It is known that the bigger the *WS* value, the bigger the *CSI* value. The customer satisfaction index (*CSI*) is a measurement to determine the overall level of customer satisfaction by considering the importance of product or service attributes. The results of the *CSI* analysis show that the *CSI* value of service users can be categorized as satisfied. In general, users of clean water services in this study are satisfied with the services provided by PDAM, even though the value of satisfaction received is not the maximum value of satisfaction that can be achieved.

For colorless criteria, the result of questionnaires showed that there is a fairly high level of importance but a low level of satisfaction. The main reasons for customer dissatisfaction are assumed to be related to sensory properties such as water

TABLE 6. Customer satisfaction index (*CSI*) measured by mean importance score (*MIS*) and mean satisfaction score (*MSS*), weighted factor (*WF*) and weighted score (*WS*)

Variable	*MIS*	*MSS*	*WF*	*WS*
Continuous water supply	4.07	3.17	8.89	28.19
Timely supply (when promised)	4.03	3.18	8.79	27.95
Supply consistency	4.04	3.17	8.81	27.93
Accuracy in meter reading/billing	4.10	3.39	8.96	30.32
There is a security guarantee	3.99	3.36	8.71	29.24
Employee competence guarantees a minimum error rate in customer service	4.03	3.36	8.79	29.51
Burst pipe quick repair and service provider bearing the cost	4.03	3.26	8.79	28.66
Pipe repair does not damage other networks	4.19	3.33	9.15	30.50
No smell	4.48	3.40	9.78	33.25
Tasteless	4.42	3.47	9.65	33.46
Colorless	4.43	3.28	9.67	31.72
	CSI			66.14
Category	Satisfied			

Source: own work.

turbidity, rust color, or unpleasant taste and smell (Wang et al., 2018). Based on the study of Latupeirissa and Latupeirissa (2022), customer satisfaction is mostly influenced by the water clarity, water smell, water taste, chemical content, water availability, operator alertness in installing new connections, water meter readings, repairing damage to water meters, and swiftness or speed in handling piping complaints. Therefore, the water consumption has the characteristics of being odorless when smelled from far or near, tasteless, and colorless (Latupeirissa & Latupeirissa, 2022).

For tastelessness and odorlessness variables as two important indicators that must be maintained, the results showed that there is a high importance and satisfaction values compared to other indicators. However, these two indicators also still require improvement in terms of performance to maximize customer satisfaction. There is an urgency to maintain and even improve performance on these two indicators, because these two indicators are included in the second quadrant (Fig. 1), which has the potential to become a superior service for PDAM Lematang Enim. In this case, customers should not have unpleasant experiences from drinking water, especially in terms of taste and odor (Denantes & Donoso, 2021).

Other indicators such as the accuracy in meter reading or billing, security guarantees, employee competence or knowledge, customer service, and pipe repair are not that much important and have low level of satisfaction based on customers'

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perspectives. These indicators fall into the category of third quadrant – low priority (Fig. 1). Performance improvement in this quadrant needs to be considered, because this attribute is considered as less important influence for customers, and the performance also is not very important (Setyaningrum, 2020). The successful measure of service delivery is determined by the level of customer satisfaction. Customer satisfaction will be realized if the services provided are in accordance with the established service standards or better than the established standards, while dissatisfaction arises when the results obtained do not meet customer expectations (Suandi, 2019; Aulia & Syarvina, 2022).

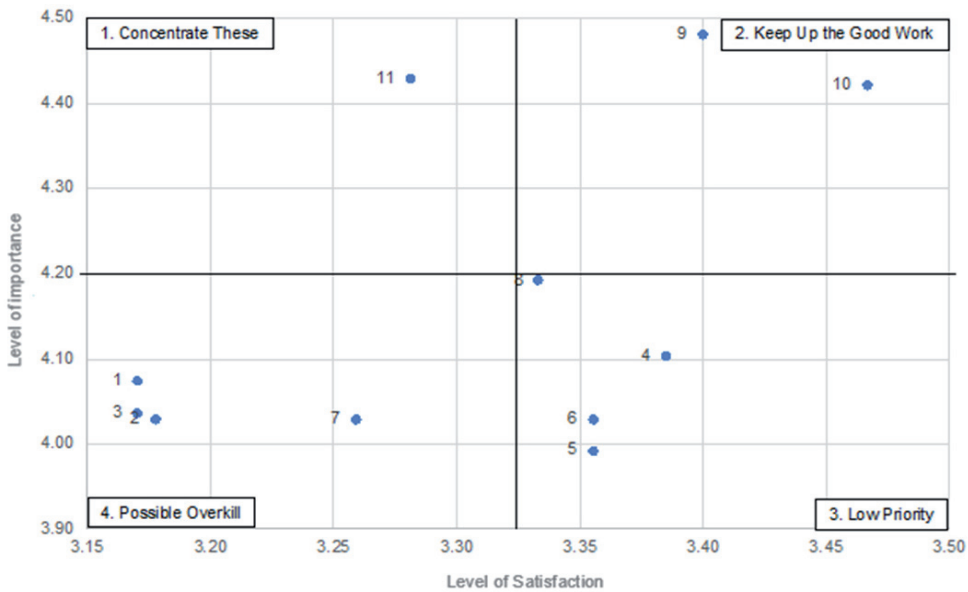

FIGURE 1. Quadrant classification based on level of satisfaction and level of importance
Source: own work.

Improvement of water distribution quality performance is therefore required to improve the service performance of PDAM Lematang Enim. As performance increases, it will increase customer satisfaction, because service quality has a close relationship with customer satisfaction (Tijjang, Nurfadhilah & Putra, 2020). It can be concluded that there is a positive relationship between service quality and customer satisfaction (Nyabundi, Aliata & Odondo, 2021) especially in the aspect of assurance. It is also essential to reduce the service gaps to provide superior service quality to retain existing customers as well as to attract new customers (Nyabundi et al., 2021).

Improvement strategy for customer satisfaction

The way to improve customer satisfaction with the services provided by PDAM Lematang Enim must be carried out to ensure the loyalty of costumers as the service quality has a positive effect on customer loyalty (Hakim, 2021). Therefore, the effective strategies are required to improve the actual conditions of water services. The analysis carried out to support the formulation of the strategy is through a strength, weakness, opportunity, and thread (SWOT) analysis. The strategies developed to improve customer satisfaction formulated based on the SWOT analysis has been conducted to create effective and efficient strategies. In addition, the results of the quadrant analysis are also used to ensure that the strategies are in line with the scale of importance and contribution of PDAM performance perceived by customers.

As seen in Table 7, there are three variables that become the strength to improve customer satisfaction such as the extensive water distribution network, good staff service and good experience of staffs and technicians. This strength can be developed to reduce potential losses due to perceived weaknesses as shown by the variables such as low water discharge, low quality of clean water, low streaming frequency, and short duration of water flow. Nonetheless, potential optimization and threat minimization also need to be carried out to ensure that the existing strategy can run according to the predetermined plan.

TABLE 7. SWOT analysis

Strength	Weaknesses
1. Extensive water distribution network 2. PDAM staff service is good 3. PDAM staff and technicians have good experience	1. Low water discharge 2. Low quality of clean water from the source 3. Low streaming frequency 4. Short duration of water flow per consumer (continuity)
Opportunity	**Threats**
1. The potential of water resources in Muara Enim 2. Community loyalty to PDAM Lematang Enim services	1. The increase in population and disposal sites that threatens the quality of clean water

Source: own work.

The formulation to improve customer satisfaction and loyalty can be done by doing the first job right. In addition, complaint handling is proven to influence customer loyalty (Hermawati, 2022). The water supply companies must improve performance if customer expectations are greater than actual conditions (Anggraini, Shalihati, Bachtiar & Suhendi, 2020). Improving service quality can also be done by mapping the factors that affect customer satisfaction with service quality (Ridha, Marissa & Marpaung, 2020).

Several strategies taken by PDAM Lematang Enim to improve service satisfaction may include focusing on improving relevant variables such as water quality (colored and odorous water), water discharge, water distribution continuity, and efficient and targeted pipe repairs without damaging the existing network. The distribution of resources towards office staff services, and waiting rooms are considered less important to consumers so that they can be diverted towards improving water quality and water continuity. Other strategies to increase customer satisfaction could be done by improving the quality of water supply, replacing water meters regularly, improving the compensation claim system, identifying complaints that have the potential to reduce the PDAM's reputation, and maximizing the use of social media for information tools to customers (Anggraini et al., 2020).

It is also important to use technology and educate the community on the effective and efficient use of clean water, as well as the development of standardized disposal sites. The use of technology in the PDAM system needs to be done to support the improvement of clean water quality and continuity, while education of the community is important to ensure the support from the community to improve the quality of clean water in the regency. The marketing communications can also be done by utilizing digital technology to provide quick information to customers. Social media platforms are one example of digital technology that companies usually use to handle customer complaints, as they can provide quick and detailed responses to customer complaints (Golmohammadi, Havakhor, Gauri & Comprix, 2021). In addition, PDAM Lematang Enim can also educate through the selection of "water ambassadors", as done by PDAM Tirta Pakuan, which is proven to be more attractive and memorable to customers (Anggraini et al., 2020).

Conclusions

PDAM Lematang Enim has generally carried out operational activities quite well. The *CSI* score showed that a value of 66.14 can be grouped in the Satisfied category. The level of customer satisfaction with the services provided by PDAM Lematang Enim can be categorized as good. The performance of PDAM Lematang Enim, in terms of physical evidence, reliability, responsiveness, assurance, empathy, distribution quality, and customer satisfaction according to customers is quite good. Factors that influence customer satisfaction are clean water discharge, clean water quality, and pipe leak repair services by PDAM Lematang Enim. Strategies that can be done to increase customer satisfaction include focusing improvements on variables that are important to the community, using appropriate technology, and educating the community about clean water management systems.

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Summary

Analysis of technical evaluation and customer satisfaction of clean water services (case study: PDAM Lematang Enim at Muara Enim Regency, South Sumatra, Indonesia). The availability of clean water is the responsibility of the local government to the community by one of the regional-owned companies known as the regional drinking water company (*Perusahaan Daerah Air Minum* – PDAM). The company performance will greatly affect community satisfaction. This study aims to analyze the performance of PDAM Lematang Enim and assess customer satisfaction with them. The data used in this study were collected through laboratory analysis and direct surveys of the community. The data were then analyzed using quantitative statistical methods. Customer satisfaction index (*CSI*) analysis and quadrant analysis are used to map customer satisfaction with the services provided. The *CSI* score showed that a value of 66.14 can be grouped in the satisfied category. The level of customer satisfaction with the services provided by PDAM Lematang Enim can be categorized as good. Strategies for increasing customer satisfaction are formulated through strength, weaknesses, opportunities, and threats (SWOT) analysis. The results of the analysis show that customer satisfaction is included in the satisfied category. Water quality variables include that water does not smell and tastes quite good, but customers still feel that the water they receive has a different color. Strategies that can be implemented to increase customer satisfaction include focusing on increasing the most important variables according to customers, reducing spending on less important variables, and optimizing the use of appropriate technology.