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Determining water rate of the HIPPAM system

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Abstract. The increasing demand for drinking water demand in Indonesia is mainly determined by the rapid population growth. In overcoming the issue, the development and rehabilitation of water supply system are necessary. The tariff or rate of water is a price assigned by water authorities on water supplied and distributed to their customers through the pipe network. A tariff is not only to recover the full costs of its supply and production, but also to incorporate the operation costs. Hence, it establishes the continuity of the water supply in the future. This research aims to determine tariff or water rate in HIPPAM System with the case study at Salawaty District – Sorong Regency. The tariff should be adjusted to the ability to pay of customers, and it is based on the income and the amount of water paid in a month. Besides, the next parameter is the willingness to pay that can be obtained from the customer survey. The results show that the majority of customers are willing to pay the water rate at the low price of IDR 1500/m3. On the other hand, the research suggests that the most appropriate tariff in the study area is IDR 2456,1/m3. This tariff is assumed to be able to guarantee the continuity of the drinking water supply system in the future. Keywords: tariff, water supply, HIPPAM, Salawati District, Sorong Regency

1. Introduction

All human activities require water, such as agriculture, industry and domestic needs. Although it is considered to be geophysically abundant, only a small portion can be used directly [1]. As the population grows, human activities increase and require more water. As a result, the economic and social functions of water are disrupted by increasingly critical water supplies, while demand for water continues to increase.

Humans can fulfil their water needs in various ways, but humans have the desire to get maximum quantity with the little amount of payment. Urban communities in Indonesia generally get clean water from the Regional Drinking Water Company or the PDAM, but some urban communities also use well water to meet their needs [2]. Communities in rural areas generally use groundwater or well water and surface water to meet the needs of clean water. Besides being managed by the PDAM, the clean water supply system can also be managed by the community or community groups. In this case, the basic provision of a drinking water system in the form of an intake, processing and distribution network is prepared by the government while the operation and management and development are carried out by certain communities or community groups. This system is commonly called the HIPPAM System or the Association of Drinking Water User. The problem of water availability, both qualitatively and quantitatively, is now frequently rising. It does not only occur in urban communities but also in rural communities that have abundant natural resources. Funding limitations often become obstacles in the management of these natural resources, so it is feared that someday these natural resources will experience degradation, which will harm various parties.

Therefore, studies on the financial and economic aspect of water supply management are still necessary and open for further investigation. Many research and studies regarding the field include the study of procurement, provision of facilities and infrastructures and management of operation and management including non-revenue water [3, 4, 5, 6].

Salawati District in Sorong Regency is one of many districts that are not yet served by clean water supply. Therefore, the local government forms clean water supply management by the community to meet their demand. The community activities include collecting, processing, purifying and distributing clean water to the local community. In carrying out their activities, the community must function in two sides; as a company that must carry out good company principles by gaining business profits and on the side it must develop social functions by helping the availability of clean water to meet the needs of the community.

Also, people in that area are often faced with a policy dilemma in determining water tariffs. On the one hand, the clean water tariff that is imposed must be able to break even to cover production costs and provide benefits to the community. On the other hand, the tariff applied must also be able to reach the purchasing power and capability of all levels of society. Household customers are the largest class of customers in water use. Therefore, the issue of tariff is very important in managing the asset because it also supports the operational activities of the asset. According to Leong [7], the main part of asset management is related to asset cost management. Asset management also includes the process of financial management; financing, budgeting and cost recovery through financing. This study aims to analyse and determine clean water rates in the HIPPAM system in Majener Village, Salawati District in Sorong Regency.

2. Methodology

Research on the basic prices and cost components of water pricing was conducted in Salawati District, Sorong Regency. The location of the study was determined purposively with the consideration that water consumption in the Salawati District of Sorong Regency experienced a rapid increase in line with population growth. The components of the transaction costs of the clean water tariff policy are also in question. Based on existing location data, Sorong Regency, especially the Salawati District is in dire need of clean water where people have only used uses shallow well water or water obtained from the reservoir when it rains which does not meet the standard as clean water. The data used in this study are primary data and secondary data.

- Primary data is data from the results of the questionnaire as references in determining clean water tariffs at the study area. Questionnaires were given to some people with clean water connections.
- Secondary data is data obtained from various related agencies or the results of previous research studies related to this research.

The calculation and determination of clean water tariffs by institutions to be formed by the community are based on:

- Affordability and fairness
- Quality of service
- Cost recovery
- Water use efficiency
- Transparency and accountability

Customers are people who are registered as recipients of clean water services to meet their own needs. Consumption of clean water customers includes the consumption of clean water to meet the standards for basic needs and usage above the standard for basic needs. Clean water consumption to meet the basic needs standard is grouped in a block, while the consumption of clean water for use above the standard basic needs can be divided into several blocks. Clean water customers can be grouped into:

- Group I, which is a group that accommodates types of customers who pay low tariffs to meet basic water need standard.
- Group II, which is a group that accommodates types of customers who pay basic tariffs to meet basic water need standard.
- Group III, which is a group that accommodates types of customers who pay full tariffs to meet basic water need standard.
- Special groups are groups that accommodate the types of customers who pay tariffs based on the agreement outlined in the agreement. Special Groups consist of commercial and non-commercial groups. The special commercial group is charged at least the same as the full tariff, while the special non-commercial group is charged at least the same as the basic tariff.

The basic costs required to produce every cubic meter of clean water are calculated based on operating costs divided by the volume of produced water minus the standard volume of water loss in one year. The volume of produced water is calculated based on the total volume of water produced by the production system that is ready to be distributed to consumers within one year. While the standard volume of water loss is calculated based on the percentage standard established by the Minister who carries out government affairs in the field of water resources multiplied by the volume of produced water. Business costs are calculated by adding up the total costs of managing the organisation managed by the community, which includes:

- Operating and maintenance costs
- Depreciation / amortization costs
- Loan interest costs
- Additional costs
- Reasonable profit

3. Results and discussion

3.1. Existing Condition of Clean Water Supply in Sorong Regency

Existing Clean Water Supply Infrastructure in Salawati District, Sorong Regency includes solar cell pump, electric power pump, simple water treatment plant (WTP) in the form of 2 up-flow/down-flow coarse filter structures, two slow sand structures, and two reservoirs. Surface water sources in the form of reservoir taken by using solar cell pumps and electric power pumps which are then accommodated in reservoir tanks with a volume of 114 m3 after going through a simple filter installation in the form of up-flow/down-flow coarse filter and slow sand, then distributed to the community through house connections, distribution pipes and transmission pipes to 550 house connections.

Based on the results of interviews, about 90% of the community incurred costs for water consumption of IDR 10000 to IDR 20000 per month while another 5% spent around IDR 20000 to 30000 thousand per month. The average water usage for a month is 95% using 300 litres to $\geq$ 400 litres. The results also showed that all Salawati District residents confirmed that they wanted a clean water management system. Most of the Salawati District residents also want the clean water management system to be managed through a Non-Governmental Organization where the workforce needed is between 6-8 people, and their work ties are part-time (not bound/free) which means that they want to manage clean water management without interfering with their other work. Salawati District residents are willing to pay for clean water management at a relatively low price of <IDR 1500 / m^3. They are willing to pay for clean water supply due to several factors, namely polluted groundwater, high demand for clean water which is inversely proportional to the availability of clean water and to obtain facilities in obtaining clean water for daily needs.

3.2. Comparison of Water Consumption Expenditures from Revenues

The allocation of clean water consumption is averaged from the total expenditure of all respondents divided by the number of respondents. Data on the allocation of respondents' clean water consumption can be seen in tables 1 and 2.

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Table 1. Comparison of clean water consumption allocation between respondents in RK I, RK II, RK III, and RK IV.

No.	Category	Number of respondents (Person)	Total water consumption of all respondents (liter/month)	Total expenditure for water consumption of all respondents (IDR/ month)	Average water rate (IDR/litre)
1.	RK I	30	8800	350.000	39,772
2.	RK II	25	7100	290.000	40,845
3.	RK III	25	6300	360.000	57,142
4.	RK IV	20	6400	470.000	73,437

Tabel 2. Comparison of the proportion of clean water consumption allocation between respondents in RK I, RK II, RK III, and RK IV against income.

No.	Category	Average household income (IDR/ month)	The average expenditure for water consumption per household (IDR/ month)	Percentage of expenditure for water consumption to income (%)
1	RK I	2.160.000	20.588,23	0,953
2	RK II	2.040.000	20.714,28	1,015
3	RK III	2.120.000	22.5	1,613
4	RK IV	2.200.000	23.5	1,681

Table 2 shows that the average household income of respondents in RK I was IDR 2,160,000.00 per month, in RK II amounting to IDR 2,040,000.00 per month, in RK III IDR 2,120,000.00 per month, and in RK IV is IDR 2,200,000.00 per month. The average water consumption per respondent household in RK I is IDR 22,588.00 per month, in RK II respondent households IDR 20,714.00 per month, in RK III respondent households amounting to IDR 22,500.00 per month, and in RK IV is IDR 23,500.00 per month. The average percentage of water consumption to income in respondent households in RK I is 0.953%, in RK II respondents is 1.015%, in RK III respondents is 1.613%, and in RK IV respondents is 1.681%. Based on these data, it can be concluded that in nominal terms water consumption expenditure in RK IV's house is the largest and in RK I is the smallest. It shows that the clean supply system in the area can run if it is done in a self-managed or non-profit manner so that the HIPAM program can have a positive impact on the community, namely the savings on water expenditure.

3.3. Clean Water Tariff Calculation

Water tariff is one of the determining elements to obtain revenue from water sales, while revenue is very important for operational financing operations to be sustainable. The size of the income depends on the size of the tariff imposed. Revenue flow is limited due to high operational costs and the large volume of water lost. The income of each community-based clean water supply program mainly comes from tariff setting, which is a source of funding for the operational costs of the clean water supply provision. However, the position of the clean water supply program, which is a national government program that is also public-oriented becomes difficult to raise tariffs. The tariff determination of the clean water supply program at the research location is carried out through a mechanism involving one area in Salawati District, Majener Village, as an autonomous region.

The production of clean water by the community-based clean water supply program requires regular costs which are incurred each period by the Facility Management Agency for the community-based clean water supply program. Routine costs incurred for the community-based water supply program include two components, namely direct costs and indirect costs. Direct costs consist of costs directly related to water production, namely electricity usage costs, technician costs, water inspection fees, maintenance costs and other additional costs, as shown in Table 3. Indirect costs include manager salary costs, manager training fees and other costs.

Table 3. Recapitulation of operational costs.

Part	Type of operational cost	Unit	Operational cost (IDR)
		Operational cost for Intake	
A	Electric Cost for Pump	IDR/ month	500.000,00
	Maintenance cost for control Panel of pump house	IDR/ month (every 3 month)	500.000,00
	Maintenance cost for solar cell	IDR/ month	-
	Total costs	IDR/ month	1.000.000,00
		Operational cost for treatment	
		Cost of aggregate for WTP	
B	Coarse aggregate/coral for 6 m3	IDR/ month (every 6 month)	616.666,67
	Fine aggregate/sand for 4 m3	IDR/ month	1.733.333,33
	Replacement cost for pal fiber filter	IDR/ month (every 3 month)	1.666.666,67
	Maintenance cost for distribution network	IDR/ month	2.000.000,00
	Total costs	IDR/ month	6.016.666,67
		Institutional operational cost	
C	Salary for chairman	IDR/ month	3.500.000,00
	Salary for secretary	IDR/ month	3.000.000,00
	Salary or account officer	IDR/ month	3.000.000,00
	Salary for maintenance section (3 person)	IDR/ month	8.250.000,00
	Salary for distribution section (3 person)	IDR/ month	8.250.000,00
	Salary for security section (3 orang)	IDR/ month	4.500.000,00
	Institutional operational cost	IDR/ month	1.525.000,00
	Total costs	IDR/ month	32.025.000,00

Based on the Sorong Regency Government Decree that 12 people will manage the community-based clean water supply program in the Salawati District, Majener Village, Sorong Regency, which consists of 1 chairman, one secretary, one treasurer, three maintenance sections, three distribution sections and three security section people. Table 1 shows a recapitulation table of operational costs that will be used as a reference for calculating basic costs and then determining low, basic and full tariffs.

The operational costs that are intended in this study are comprised of 3 main topics, namely the operational costs of the intake, operational costs of distribution and institutional operational costs. This research assumes a base year of 0 and a projected year of 10 years.

Tabel 4. Calculation of basic cost.

X	Base year	0

Y No.	Projected year Item	Unit	Period	Notation	10 Formula	Results
1	Operation and maintenance cost	IDR/year	X	BOP	Total operation and maintenance cost	468,500,000
2	Maintenance cost for pumps, WTP and reservoirs	IDR/year	X	BDA	Maintenance cost for pumps	56,800,000
3	Loan interest	IDR/year	X	BBP	Loan interest	0
4	Other operational cost	IDR/year	X	BOL	General cost excluding depreciation/ amortization	72,200,000
5	Total operational cost	IDR/year	X	TBU	TBU = BOP + BDA + BBP + BOL	597,500,000
6	inflation factor	%/year	X	I	(1 + I)	1
7	Total operational cost on tariff period	IDR/year	Y	YTBU	YTBU = TBU × (1+I)^(y-x)	597,500,000
8	The volume of water production	m³/year	X	VAP	Historical data	294912
9	Standard of water loss	%/ year	X	TKAS	Percentage of water loss based on the regulation of the Ministry of Public Works	0.2
10	Volume of water loss	m³/ year	X	VKAS	VKAS = TKAS × VAP	58,982.40
11	Basic cost	IDR/m³	Y	BD	BD = YTBU/(VAP-VKAS)	2,532.54

Based on table 3 it can be seen that the total costs required for operational costs of intakes are IDR 1,000,000.00 per month, operational distribution costs are IDR 6,016,666.67 per month, and institutional operational costs are IDR 32,025,000.00 per month so that the total operational costs are IDR 39,041,666.67 for each month. Based on the existing operational costs, the basic cost, low tariff, basic tariff and full tariff are then calculated referring to the Regulation of the Minister of Home Affairs No. 23 of 2016 concerning Technical Guidelines and Procedures for Regulating Drinking Water Tariffs in Regional Water Companies [7]. Each water management body is given the freedom to determine the policies of the types of customers for each group based on objective conditions and characteristics of customers in their respective regions as long as in accordance the abovementioned regulation. The basic tariff calculation for the study area can be seen in Table 4, while the low tariff calculation can be seen in table 5.

From the two tables, it can be seen that in the community-based water supply program in the Salawati District, Majener Kelurahan, Sorong Regency, the tariff is not subsidised by the government because this program is a program from the community, by the community and for the community. Therefore low tariffs and basic tariffs are found to be the same as a basic tariff of IDR 2,532.54 / m3.

Tabel 5. Calculation of low tariff.

X	Base year			0		
Y	Projected year			10		
No.	Item	Unit	Period	Notation	Formula	Results
1	Basic cost	IDR/m^3	Y	TD	Total operation and maintenance cost	2,532.54
2	The volume of water sold to the special group	m^3/ year	X	VTR	Historical data	294912
3	Percentage of subsidy	%/ year	Y	PSb	Regional subsidy policy	0
4	Subsidy 1)	IDR/m^3	Y	Sb	Sb = …% × TD	0
5	Total subsidy	IDR/ year	Y	TSb	TSb = Sb × VTTR	0
6	Average subsidy	IDR/m^3	Y	RSb	RSb = TSb/VTTR	0
7	Low tariff	IDR/m^3	Y	TR	TR = TD - RSb	2,532.54

3.4. Correlation between Community Desires with Clean Water Rates

The willingness of residents of Majener Village, Salawati District, Sorong Regency to pay for clean water can be seen in the following graph.

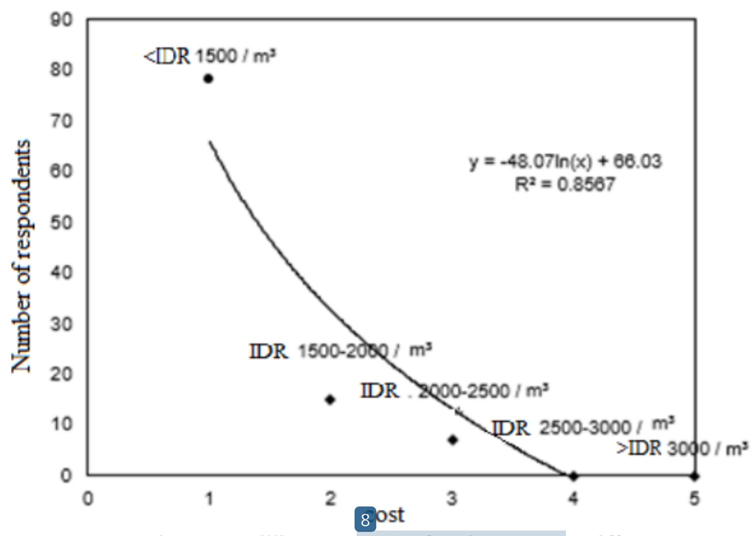

Figure 1. Willingness to pay for clean water tariffs

The majority of respondents from RK I were only willing to pay <IDR 1500, 23 of the 25 respondents were willing to pay <IDR 1500 / m^3 for RK II, 15 out of 25 respondents are willing to pay <IDR 1500 / m^3 for RK III and 16 of the 20 RK IV respondents are willing to pay <IDR 1500 / m^3. There are around 78% of respondents willing to pay the cost of providing clean water <IDR 1500 / m^3, 15% of respondents, charged IDR 1500-2000 / m^3, and 7% are willing to pay for prices ranging from IDR 2000-2500 / m^3, and no respondent is willing to pay the cost of clean water IDR 2500-3000 / m^3 and> IDR 3000 / m^3. Figure 1 confirms the finding of community willingness to pay. It means that most of the population only wants to pay low for the purchase of clean water. Based on this, it shows that the people in Salawati District, Sorong Regency are willing to pay cheaply, that is <IDR 1,500.00 / m^3 and want to get maximum clean water.

Meanwhile, according to the calculation of clean water tariff, the price per m^3 is IDR 2,532.54 / m^3 where this rate has taken into account all operational costs and maintenance costs. With the willingness to pay from the community for the supply of clean water managed by community institutions formed

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by the local government, the provision of clean water can be fulfilled in terms of quantity, quality and continuity. So the calculation of the tariff of IDR 2,532.54 / m3 can be applied, because in the calculation of clean water tariffs it does not take into account the profit in the institution that manages it but only takes into account the cost of the ongoing institution, as well as operations and maintenance in the supply of clean water from the intake to the house connection.

Conclusions

- Provision of clean water in Salawati District, Majener Village, Sorong Regency before 2017 only utilised shallow wells and rainwater to meet daily needs. However, with the increasing population and the proximity of the location to the sea, the existing water sources are oily, odour and salty.
- Based on the calculation of basic costs, low tariffs and basic rates calculated using the Minister of Home Affairs Regulation no. 23 of 2006 are obtained on IDR 2,546.10 / m3.
- The majority of prices desired by the community are 1500 / m^3. It is the basic tariffs need to be socialised with the explanation that the price of the community that is imposed by the community will not be able to cover the operating costs and maintenance of clean water network systems so that one day the service can be disrupted.

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