Analysis availability on the clean water

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ANALYSIS AVAILABILITY ON THE CLEAN WATER INFRASTRUCTURE AT PDAM TERNATE

Nani Nagu

Civil Engineering Department, Khairun University, Ternate, Indonesia
e-mail: nani.nagu09@gmail.com

ABSTRACT

This research was aimed to analyze the existing condition of clean water infrastucture at Ternate Municipal Waterworks (PDAM Ternate), North Maluku and projecting water demands of society to the availability of raw water of PDAM. Field survey with a cross-sectional survey and interview are the data collecting include quantitative and qualitative data in form of identification of the existing based on quality, quantity and analysis of the projected demands of clean water. The results shows that the condition of the availability of clean water of PDAM was not currently sufficient to 70.85% service coverage by the number of inhabitants served as many as 143,633 people. Mounted on the intake capacity of 446 l/sec, can not meet water demands of society. System maintenance of water infrastructure did not lead to poorly maintained infrastructure conditions in several locations, and resulting in leakage and disrupt service system due to water loss. The demands of clean water can not reach areas with high topography and the presence of public complaints against the water quality and continuity. For the future source of raw water available was insufficient for the demands of the community water so it takes a raw water source alternative.

KEYWORDS

Clean water infrastructure; water demand; service coverage; availability of cleanwater

INTRODUCTION

Water is a natural resource which is needed concerning for many people lives, even by all living things. Water has a strategic role and should remain available and sustainable, so as to support life in the present and the future. Difficulty to obtain adequate sources of raw water is a major constraint. According to Hehanusa and Bakti (2005), Ternate is one of the volcanic island that has a volcano Gamalama where the existence and potential of water resources is determined by the tectonic history of the region, the morphology of climate, land cover and a geographic position in the order of the regional climate. This causes difficulty in obtaining adequate raw water sources especially the absence of rivers that can be used as an alternative water source.

The existence of two lakes, Tolire and Ngade are still need to be assessed as an alternative water source. The source of water used comes from ground water to make the wells pump. Ternate city is an island with an area of 42 km^2 with the population distribution in rural areas generally beach or mountain foot, due to the well pump that constantly feared could lead to sea water intrusion. The issue is getting difficult because people had trouble getting clean water taps, especially in the location of high topography. Not to mention the various problems of water quality and the salty smell and murky areas of society complained District of North Ternate. Therefore, the aims of this study are to analyze the existing condition of PDAM infrastructure and to predicting the demands of public on ten years later.

METHODS

Data Collection

Data was collected by direct observation. This way to identification of the availability of clean water infrastructure and interview to obtain information directly from the source. The respondents were interviewed is the customer and the staff of PDAM. The study of literature, hydrology and others data used to support this study has been collected as a secondary data.

Data analysis

To analyze the existing condition of water supply system that serves at Ternate City, includes intake, reservoir, transmission and distribution network, carried out by the method of direct observation and analysis of secondary data. while, to projecting water demands based on population projection used methods Geometric and development plans to increase service coverage planned for the next ten years.

RESULTS AND DISCUSSION

Water supply system of PDAM:

a. Intake

Source of raw water taken from groundwater located in various locations that are considered viable quality, quantity and continuity. It consists of shallow wells and wells in broncaptering with a total capacity 446 ltr /sec and production capacity 398 liters /sec. The number of taps system used by 7 units in which the operation and service of each Operations Center (PO) using pumping from the water source to the reservoir. Operation and service of each PO water sources using the same power from electricity company 147 KVA.

During the measurements of data by PDAM, water level has not been too showed a decrease in significantly under the influence of the rainy or dry season. Intake construction made of concrete with a width dimension 1.5 m and a length 1.5 m with a depth varying in each well. The construction of intake overall is still good, but routine maintenance is not carried out, especially on the intake, which are located close to the settlement like in Skeep village. Table 1, shows the Water Resources and Capacity of all Intake as a source of raw water for PDAM.

Tabel 1. Water Resources and capacity

No	Location	Type resources	Capacity	
			Built (l/sec)	Production (l/sec)
1	Akegaale	Shallow wells	150	120
2	Kalumpang	Shallow wells	108	108
3	Skeep 2	Shallow wells	70	62
4	Ubo-ubo	Shallow wells	64	64
5	Falaraha	Shallow wells	34	34
6	Togafo	Shallow wells	10	6
7	Ngade/Fitu	Intake Laguna Lake	10	4
			446	398

Sources : PDAM, 2013

b. Transmission Network

Transmission pipeline is a pipe used to drain the water to consumer. Overall, length of pipeline transmission is 6550 m and the types of materials from PVC pipe and pipe GIP with diameters 250 mm to 315 mm.

Table 2. Main Transmission Pipeline

No.	Model	Diameter (mm)	Lenght (m)	Condition
1	PVC/GIP	315	800	medium
2	PVC	250	1.418	medium
3	PVC	200	3.505	medium
4	PVC	160	975	medium
5	PVC	110	2.066	medium
6	PVC	200	1.200	Good
7	PVC	200	750	BAIK
8	PVC	315	1.100	BAIK

Sources : PDAM, 2013

The diameter of Transmission pipeline from intake was 250-315 mm with a total length of 6550 m. Water produced from each well through the transmission pipeline will be pumped directly into the reservoir to conform to the service area. Based on the results of field observations shows that the condition of transmission pipeline is still good, and the maintenance had been done every month.

c. Reservoir

Currently, PDAM has 10 units of the reservoir, which had been already functioned as many as six units, while two units of reservoir has not yet in operation. Akegaale, one of the source of water, accommodated in the reservoir Pacei Village where located at ± 69 m from sea level with a production capacity 500 m^3. From this reservoir, water will be distributable to its service area includes Gamalama village, Pacei village and Tarau village.

Whereas, the reservoir at Skeep village is located at ± 51 m from sea level with a capacity 1680 m^3. The area services include Mangga Dua village and Bastiong village. Furthermore, Tabahawa reservoir, is located at an elevation ± 143 m from sea level with capacity 500 m^3. the services area include Skeep village, Jerbus village and Jati village. The other reservoir, Ubo-ubo reservoir, is located at ± 68 m from sea level with capacity of 500 m^3. The services area include Mangga Dua village to Kayu Merah village.

Furthermore, Falaraha reservoir was made at ± 67 m from sea level and a capacity 100 m3, to service the area of Kalumata village. And the last, Ngade reservoir is located at an elevation of ± 52 m from sea level with a capacity of 150 m3, where the services area covers Ngade village to Jambula village. In table 3 shows the reservoir and its capacity as a sources of water.

Table 3. Reservoir and capacity

No	Reservoir	Capacity (m3)	Elev. (m)	Built at	Information
1.	Res. Pacei	500	69	1993	operated
2.	Res. Tabahawa	500	143	1993	operated
3.	Res. Skeep	1680	51	1982/1993	operated
4.	Res. Ubo-ubo	500	68	1999	operated
5.	Res. Falaraha	100	67	1996	operated
6.	Res. Ngade	150	52	1976	operated
7.	Res. Moya	100	278	2001	not yet in operation
8.	Res. Jan	100	194	2001	not yet in operation

Sources : PDAM, 2013

Condition of the reservoir building was good. The construction made of concrete (ground reservoir), with different dimensions and average minimum water level ± 3.5 m. But, in the reservoir pipe at Pacei village, the condition is not maintained and rusty. Routine maintenance was rarely done except painting.

d. Distribution Network

Distribution of clean water use gravity drainage system from 6 units of reservoir. This serves customers at an altitude of ± 0-90 m from sea level. The total length of the pipeline distribution network was ± 193 814 m with varying diameters and types of materials from PVC (table 4).

Tabel 4. Type of Pipe Distribution

No.	Typr of Pipe	Diameter (mm)	Lenght (m)	Built in	Condition
1	PVC dan GIP	315	1.276	1980	Moderate
2	PVC dan GIP	250	2.382	1980 / 1999	Moderate
3	PVC dan GIP	200	9.643	1980 / 1999	Moderate
4	PVC dan GIP	160	15.141	1980 / 1999	Moderate
5	PVC dan GIP	110	26.758	1980 / 2000	Moderate
6	PVC dan GIP	90	27.189	1980 / 2006	Moderate
7	PVC dan GIP	75	39.445	1980 / 1999	Moderate
8	PVC dan GIP	63	49.789	1985 / 1999	Moderate
9	PVC	50	12.067	1985 / 1999	Moderate
10	PVC	160	1.500	2006	Good
11	PVC	63	1.464	2007	Good
12	PVC	315	1.100	2008	Good
13	PVC	90	1.002	2008	Good
14	PVC	63	2.772	2008	Good
15	PVC dan GIP	160	1.908	2008	Good
16	PVC dan GIP	110	378	2008	Good

Sources : PDAM, 2013

The Conditions of the distribution pipeline with a total length of service area ± 148.102 m and diameter 63-315 mm highly variable. It can be seen on some locations where the pipe was old, rusty and have not experienced turnover. It can give the impact on leakage of pipes and affect the quality of water distributed.

e. Capacity Services of PDAM and Non Revenue Water (NRW)

According to the data, total production of water by PDAM was 11.248.275 m^3 / year and total water used by customer's was 7.032.481 m^3 / year. Therefore, the total consumption of water each day was 19.267.071,23 l/day. If the population at Ternate in 2013 was 191.053 peoples (BPS,2013) and the service coverage at 70.85%, so the average of services for a peoples a day was 142.34 l/people/day. Finaly , it can be seen that the water distributed to the public amounted to 142.34 l/people/day. This suggests that the capacity produced from NSPM standards ranged between 130-150 l/people/day, with the water pressure was distributed to the customer more than 5 mcw.

Continuity of clean water drainage based on the results of the survey showed that there are some people especially those living in South Ternate district that the drainage water is not available especially in the dry season. So, the water was not distributed to the customer. Based on the analysis of existing conditions where low water distributed to the public caused by the pipeline network is not affordable, less water pressure (<5 mcw) and is unable to serve areas at high topography, besides the continuity of the low water flow is not serving for 24 hours.

On the other side, NRW from distribution and consumption was very high compare with standart 20%. Base on this study, the total water was distributed per year 11.091.607 m3/year and total water has been consumed per year 7.032.481 m3/tahun. Therefore, the losses of water was 36.59%.

f. Water Demand

The demand of clean water in the city of Ternate can be calculated based on the number of customers and the demand of each people. In assumption, if each average family consists of 6 people and an average water consumption 16-30 m3 / month or 88.89 to 166.67 l / people/day, so the average of water demand for each people a day is 127.78 l /people/day.

In the planning of the clean water demand, standard of NSPM for the city where city with population between 100.000 to 500.000 was 150 l/people/day. Therefore, to estimating the real water demand for domestic connections used based on the amount that is 21.923 SR. In order to obtain domestic connection for 21.923 SR x 6 peoples x 127.78 l/people/day or 136.35 l /sec. Thus obtained total domestic demand of 194.54 l / sec. Non domestic demand an estimated 20% of the domestic demand in the amount of 38.91 l/sec, so the total demand of clean water for Ternate city is 233.45 l/sec.

g. Projection of Water Demand

To projecting of water demand from 2014 to 2023, we calculate based on data from Ternate PDAM customers during the last 1 year that the water service coverage from 70.85% in 2013 to 90.85% of the total population in 2023. Firstly, we predicts the total population at Ternate in 2023 use geometric method and found that the rate of growth was 7.39% every year. Thus the number of population at Ternate in 2023 is 434.846 peoples (Figure 1).

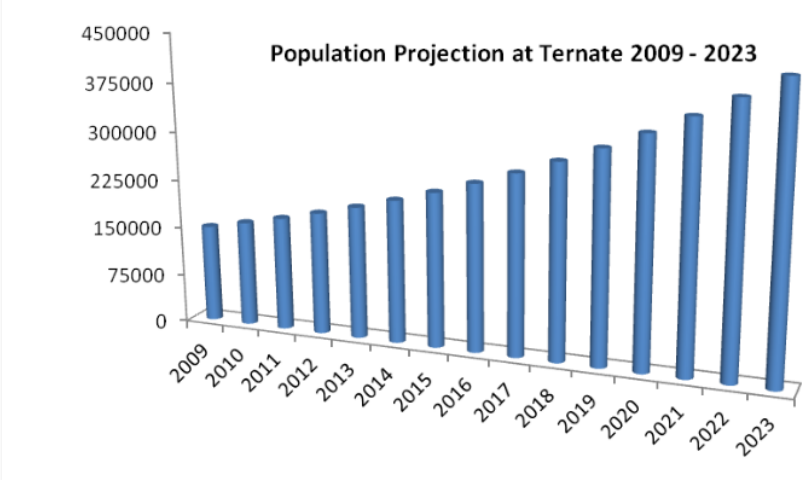

Figure 1. Population Projection at Ternate 2009-2023

And finally,to predict the water demand that adjusted to the availability of the population. From these results seen an increase in the number of people significantly then PDAM must improve their services by increasing the number of house connections, offset by the addition of public hydrants or tanker to serve areas of high altitude. Also there will be an increase in water demand both domestic and non-domestic necessitating a new source of raw water due to the availability of raw water conditions that exist today, PDAM will not be able to serve the needs of society. The overall calculation results can be seen in Table 6.

Tabel 6. Projrction of Water Demand at Ternate until 2023

Description	Unit	Year					
		*2013	2015	2017	2019	2021	2023
	people	202728	236156	275095	320455	373294	434846
Service coverage							
a. Level of services	%	70,85	74,85	78,85	82,85	86,85	90,85
b. Service coverage	people	143633	176762	216912	265497	324206	395058
Household							
a. Level of services	%	92	95	95	95	95	95
b. service coverage	people	131538	167924	206067	252222	307996	375305
c. consumption	l/p/sec	134,14	150	150	150	150	150
d. number of people	people	6	6	6	6	6	6
e. number of household	unit	21923	27987	34344	42037	51333	62551
f. water demand	l/sec	204	292	358	438	535	652
Public Hydrant (PH)							
a. level of services	%	8	5	5	5	5	5
b. service coverage	people	12095	8838	10846	13275	16210	19753
c. consumption	l/o/h	30	30	30	30	30	30
d. number of people/PH	people	100	100	100	100	100	100
e. number of PH	unit	51	88	108	133	162	198
f. water demand	l/sec	4	3	4	5	6	7
Total of Domestic Demand	l/sec	**208**	**295**	**362**	**442**	**540**	**658**
Non Domestic Demand							
a. Percentage of demand.	%	20	20	20	20	20	20
b. Non Domestic demand	l/sec	42	59	72	88	108	132
Domestic + Non Domestic Demand	l/sec	250	354	434	531	648	790
NRW	%	36,59	32,00	28,00	24,00	20,00	15,83
Perc. Domestic + Non Domestic Demand	l/sec	92	113	121	127	130	125
Total of Demand	l/sec	342	467	555	658	778	915
Maximum Demand							
Maximun Day (F1)		1,1	1,1	1,1	1,1	1,1	1,1
	l/sec	376	513	611	724	856	1007
Peak Hour (F2)		1,5	1,5	1,5	1,5	1,5	1,5
	l/sec	512	700	833	988	1167	1373
Capacity of Intake							
Kap. Intake	l/sec	446	513	611	724	856	1007

Source; Analysis result, 2014

CONCLUSION

1. The condition of the availability of clean water taps Ternate infrastructure that serves water in the city of Ternate can be expressed as follows:
   a) Low PDAM service coverage that looks at the number of people served in the amount of 70.85% or 143 633 inhabitants of 202 728 inhabitants in 2013.
   b) Mounted on the intake capacity in 2013 is 446 l / sec this concern cannot meet the water demands of people in Ternate who predicted in 2023 reached 1,007 l / sec.
   c) Maintenance of water infrastructure system that includes intake, transmission pipeline, reservoir and distribution pipes that are not routinely lead to poorly maintained infrastructure conditions at several locations resulting in leakage and disrupt service system due to water loss.
2. Alternative increase service coverage to reach 90.85% in the year 2023. It is necessary to increase the intake capacity of 561 l /sec. Increase of household number connection as much as 4063 connections / year and the installation of public hydrants location where clean water reached 147 units. In addition to avoiding raw water crisis due to the increase in the number of people it is necessary to look for alternative sources of raw water.

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