International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Carrying Capacity of Water Resource Optimization Kediri

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Abstract

The purpose of this study was to determine the potential and the carrying capacity of water in Kediri. Kediri there is two sources of water that is the Brantas River and groundwater. Currently the utilization of ground water is more dominant (95% of the total population use ground water) on the surface of the water, this is because the surface water has been polluted so that the necessary treatment before use. Kind of research method used is quantitative method, but the type of data used in this study, there are two types of primary data and secondary data. Potential surface water (river Brantas) reliable in the town of Kediri can reach 44.62 m3 / sec. Based on the projection, the potential for surface water in the town of Kediri can only provide water until 2022.

Keywords: carrying capacity; water resources; sustainable Kediri city.

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1. Introduction

Kediri city lies in the Watershed (DAS), the DAS Brantas and three subzone is subzone Grantham, subzone and the subzone Kedak Tawang, which now functions as a drainage channel. Thus, water resources assessed the potential for the town of Kediri is the Brantas River (Figure 1).

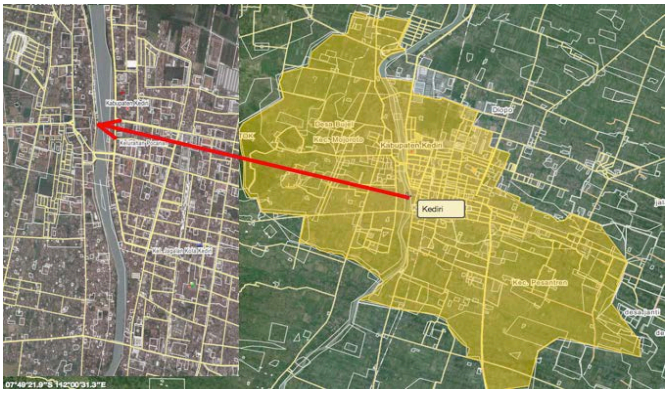

Figure 1: Kediri City Maps and Watersheds (DAS) Bantas [8].

However, based on local environmental status of Kediri in 2012, water quality in the river Brantas already in polluted conditions. The quality of the river water can no longer be used as a source of clean water because the concentration of suspended solids, Fe, Mn, Nitrite, Ammonia, BOD, COD and fecal coli has exceeded the quality standards established [1]. Good water needs for domestic and non-domestic currently sourced from surface water and groundwater are processed by the Regional Water Company (PDAM) Kediri and then distributed to customers. Number of people served by public water utilities in 2012 reached 12%, with service coverage is 25%. Based on these data, it can be concluded that 88% of the population using groundwater Kediri city. Even people who are already customers of PDAM still many who use well water for washing and bathing water, in other words the water from the taps is used for cooking and drinking water. People's reliance on groundwater indicates a condition that should not continue, because recharging groundwater is not comparable to exploitation. Changing land into smaller plots did not wake up, causing infiltration of rainwater into the soil becomes increasingly reduced, because more rain water which becomes the flow of runoff. In addition, watershed damage as a result of the change of area protection and spatial planning policies that are less expensive functions causing the decrease absorption of water carrying capacity of an area [2].

Data obtained from PDAM Kediri and Environmental Office of Kediri showed groundwater damage has occurred in the eastern region of the river Brantas. When linked with a number of Permit to take water (SIPA) of the Department of Mines and Energy of Kediri, Intake of groundwater by industry Kediri region Eastern most compared to other regions, due to the condition of ground water in several regions in Kediri East (Village Pakelan, Village Pocanan, Village and Village Balowerti Dandangan) has reached a critical condition in the aquifer 35-78 meters at a depth of 17-26 meters of ground water [3].

The continued supply of water to an area at least meet the three conditions, namely from the aspect of adequate quality, sufficient quantity of aspects and facets kontuinitas can continue. Conditions that exist today in the town

of Kediri in terms of the three aspects is based on secondary data collected and preliminary observations made in the field can be described as follows [4]:

a. From the quality aspect, which is a potential source of water in the town of Kediri is Brantas river, the condition is not eligible to be used as a source of raw water to clean water, because it has been contaminated. So to use it required processing beforehand at a cost which is quite expensive, as long as there are no institutions that carry out the processing.

b. From the aspect of quantity, surface water discharge that can be processed at this time is still considered insufficient because the results of the simulation conducted by Perum Jasa Tirta, until 2020 the water supply for the City and Kediri still be provided through the Weirs Motion Waruturi Tunggorono (BGWT). As for the town of Kediri, based on secondary data that has been collected there is no picture (data simulation) the amount of discharge that can be relied upon and the amount of water that needs to be provided. While the potential of water from the Brantas river cannot be utilized optimally to reduce people's reliance on groundwater.

c. From the aspect of continuity, the condition of carrying capacity of water (water supply) for the town of Kediri feared would not be continuous. This is due to the water supply through BGWT dependent. Dilution of the Brantas River as a result of the supply of BGWT is a condition of Kediri dependence on other regions. Though the town of Kediri passed Brantas River which debits may still sufficient for local needs of Kediri, but due to the quality of contaminated, the necessary dilution, the burden of taps for water supply heavier.

2. Research Methods

Kind of research method used is quantitative method, but the type of data used consisted of quantitative and qualitative data. The research method chosen with consideration, in this study to analyze the problem of the study, researchers used test equipment statistical and secondary data that is quantitative, other than that researchers will refer to the theory of carrying capacity of urban water and theory of hydrology to guide researchers found the research problem and then analyze the data with appropriate methods. Researchers will use deductive analysis to answer the research problems. Stages of the data analysis in this study are as follows:

2.1. Analysis of the Population of Kediri

a. Descriptive analysis of population of Kediri do to get a picture of the distribution of the population in the town of Kediri for the purpose of determining the orientation of the category of Kediri city area and the trend growth.

b. Calculation of Kediri city population projections up to 2025, with the base year used is 2010. To determine the method of population projections, the calculation of the value of the correlation coefficient closest one (r = 1) of the arithmetic method, Least Square method, and Geometric methods.

2.2. Analysis of Regional Conditions of Kediri

Do to get a picture of the orientation regions in Kediri. Furthermore the final result obtained is a region-oriented grouping of urban, rural and transition based on land use. The method used is the method of interpretation of a map of land use in the town of Kediri in 2010.

2.3. Calculation of water demand (domestic and non-domestic)

a. Domestic water requirement calculations: calculated by multiplying the number of residents with the needs of water per person per day. The amount of water consumption per person per day is calculated through analysis of water usage per customer taps, assuming per subscriber lines consist of 4 people.

b. The water needs of non-domestic: grouped by the type of activities in the town of Kediri, namely agriculture, livestock, flushing of the city and landscape, the need for a fire, the need for industry, trade or commercial, the water needs for public and social facilities, maintenance and flushing the river.

2.4. Analysis of Water Supply in the town of Kediri

To estimate the potential for ground water adjusted to the availability of data, due to data on groundwater Kediri very limited. Some of the references used are: a. Secondary data such as information flow augmentation and groundwater flow is not depressed obtained from Map Basin Groundwater Indonesia, b. Secondary data such as category information of ground water control zones on a map control groundwater for conservation Kediri and surrounding areas from the Department of Energy and Mineral Resources Directorate of Environmental Geology, 2009, c. Secondary data classification aquifer vulnerability on aquifer vulnerability zone map [5], d. Secondary data on groundwater zoning Kediri western and eastern parts [2]. Based on the data to be acquired, the calculation of the potential for groundwater Kediri done in stages as follows: Calculation of absorption coefficient (recharge coeffisient), the volume of rainfall that flows as water infiltration to the total rainfall, which dihutung by the formula:

C = (I x 365 x A) / (P x A) by: …….[6]

I : infiltration with units of m / day

A : catchment area (m^2)

P : annual rainfall (m)

The next step is to calculate the rate of groundwater recharge annually (R), using the formula:

R = Σ (AxPxC) …….[4]

R : the rate of groundwater recharge annually (10^6 m^3)

A : surface area of absorption (10^6 m^2)

P : annual rainfall average catchment area (m)

C : absorption coefficient in the study area (%)

Analysis of potential Brantas river water was conducted using debit mainstay (dependable flow). Debit mainstay is a massive discharge at a control point in a river that is a combination of direct runoff and base flow. Debit reflects a number that can be expected to occur at the control points associated with the time and the value of reliability. Reliability debit card used in this study was 90%, meaning that the probability of such discharge to be equaled or exceeded by 90% and the rate of discharge failure occurs the chances are 10%. This may imply that in 10 years there is the possibility of one year failed.

Determination probability of 90% is done with a frequency analysis to determine the ranking. Analysis of the frequency used to use formulas Weilbul, namely:

P = m / N 1 ……[7]

P : probability
N : the number of data
M : ranking

The next step is to state the condition of the water carrying capacity of Kediri based on water availability and water needs. In this study the condition of the water carrying capacity of Kediri would otherwise be exceeded, ie when the required amount of water is greater than the availability of water and otherwise not exceeded, when the amount of water demand is equal to or less than the amount of water available.

3. Results and Discussions

Based on the analysis of the condition of Kediri city area currently classified as a region is entering a period of transition (transition) of the area which used to have characteristics identical to the land use in rural life into an area that has been heavily influenced by urban life style. Although the terms of the total population can already be classified as urban areas, domestic water requirement calculations Kediri in 2012 can be seen in the table below.

Non domestic water needs are grouped by the type of activity that was in the town of Kediri, namely agriculture, livestock, flushing of the city and landscape, the need for a fire, the need for industry, trade / commercial, the water needs for public and social facilities. The result of the calculation of water demand in Kediri city can be seen in the table below. Based on the results of the processing of the daily discharge data obtained from NRM Kediri, it can be seen fluctuation times brantas very dependent on rainfall. Maximum discharge occurs in May and a minimum flow occurs in September. Comparison between Qmaks and Qmin or commonly indicate the regime of the river (coefficient of river regime / KRS). KRS calculation results in Kediri DAS showed readings below 50, which means watershed conditions Kediri still good and there was no significant difference in minimum and maximum river discharge. Thus, it can be seen that the real major problems that occur in Kediri

adalan Brantas river pollution in water bodies.

Table 1: Projected Domestic Water Needs of Kediri

Year	Projected Domestic Water Needs	
	(Liters / day)	(m3/year)
2011	273052437	99664139
2012	283974534	103650705
2013	295333516	107796733
2014	307146856	112108603
2015	319432731	116592947
2016	346551710	126491374
2017	360413778	131551029
2018	374830329	136813070
2019	374830329	136813070
2020	389823542	142285593
2021	484711135	176919564
2022	504099580	183996347
2023	524263564	191356201
2024	545234106	199010449
2025	567043470	206970867

Source: data analysis research

Table 2: The percentage of water needs by type

No	Type Amenities	Water Needs (m3/year)	Precentage (%)
1	Domestic water needs	95830903.00	43.959
2	Public facilities and social needs	9143731.80	4.194
3	Trade and services	2838882.50	1.303
4	Industry (process and domestic water needs)	66140923.25	30.340
5	Irrigation	76800.00	0.035
6	Livestock and fisheries	229509.88	0.105
7	Maintenance river / flushing	615462.00	0.282
8	The water needs to fire	13416326.42	6.154
9	Garden city / greening	2874927.09	1.319
10	Water loss	26832652.84	12.308
The total water requirement in 2012 (m3 / year)		218001118.78	100
The average water needs in 2012 (m3 / sec)		6.91	

Source: results of the analysis

The potential of water resources in the town of Kediri currently consists of groundwater and surface water. Of secondary data, the potential for ground water in the town of Kediri is as follows:

a. Free ground water recharge amount is 1.483 billion m3 / year (47.0256 m3 / sec)

b. The amount of ground water flow pressure is 6,000.000 m3 / year (0.190 m3 / sec).

Based Map Control of groundwater from the department of Environment Kediri city, then the city of Kediri included in zone III, which is a safe zone for groundwater aquifer to a depth of more than 40 meters below the rmuka ground, discharge is allowed up to a maximum of 300 m3 / day / wells, whereas groundwater aquifer to a depth less than 40 meters BMT intended for drinking water purposes and households making up to 100 m3 /month/well. To optimize the rate of groundwater recharge can be reached by controlling land development is not awakened into smaller plots, particularly areas that function as water catchment areas and protected areas. Next make infiltration wells of collective or individual catchment wells.

Optimization of surface water function (in this case the Brantas river) can be reached by improvements in the quality of river water is to tighten regulation and oversight of the maximum load of waste that may be discharged into the river Brantas and cooperation with other regions, in particular the downstream part of the watershed Brantas Kediri. PDAM optimization function can be done by creating a zoning area PDAM services, with the aim to facilitate the development of networks, clustering based on network availability taps before. Besides zoning also made phasing plan for the development of the network with the target service performance is 85% until 2025.

4. Conclusion

Kediri city water carrying capacity of this condition has not exceeded and is highly dependent on underground water supplies and taps. The water needs in the town of Kediri in 2012 amounted 95,830,903.00 m3 / year, while based on the projection until 2025 the city's water needs Kediri amounted to 206,970,866.68 m3 / year. Conditions carrying capacity of surface water resources (Brantas River) this center has not been exceeded, but the condition of the carrying capacity will be exceeded in 2022.

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