

Functions and Needs of Green Open Space as Recharge area in The North Jakarta

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2. RESEARCH PURPOSE

The purpose of this research is to build Green Open Space Management Model as a Regional Catchment Area in order to increase water availability in North Jakarta. The objectives of are:

1. Studying the existence of the existing green open space and its ability to meet the needs of domestic groundwater
2. Prepare a map of the allocation of green open space potential as the recharge area in North Jakarta area
3. Develop Open Space Management Model Green as Regional Catchment area in North Jakarta
4. Develop a scenario that required ground water adequacy in the management of green open space as a water catchment areas in North Jakarta to maximize water absorption
5. To formulate policy recommendations as the management of green open space Catchment areas water in North Jakarta.

3. METHODOLOGY

The data required are obtained from the data: Secondary data data ground water infiltration rate distribution maps, spatial data Lansat image, data on the number and rate of population growth, supply capacity of PAM and rainfall; Primary Data Field study using GPS in green space sites in North Jakarta. Rainfall data used are rainfall data hourly with the listing from 2003 to 2007 (Data Center area Ciliwung Cisadane, Directorate General of Natural Resources Dep. PU) and monthly rainfall data from 1997 to 2006 from the observation station Meteorological Maritim Tanjung Priok.

The steps taken in this research procedure as follows:

1. Literature Review
2. Surveys and Data Collection
3. Analysis and Discussion

The calculation of the water needs of domestic (household) and domestic groundwater supplies in North Jakarta area on the basis of assumptions as follows:

1. Domestic water needs in North Jakarta area accounted for 10 years, from 2006 to 2016
2. The need of water per capita in North Jakarta area amounted to 150 liters / day / person or 54.75 cubic meter per year per people.
3. Ground water to meet domestic water demand in North Jakarta is obtained from the existing green space (2006), green space plans and other potential originating from the lake or that there are in North Jakarta
4. Take into account also supplies piped in North Jakarta as a reduction of ground water needs

To take into account the existing green space area (in 2006) in North Jakarta with spatial analysis of land suitability map that is in the image interpretation Lansat image Path / Row 122 064 1 October 2006 using Erdas E 8.5 and Arc View 3.3.

4. RESULTS AND DISCUSSION

The presence of green space that is in 2006 in North Jakarta area Based on the map of Jakarta lansat in 2006 created spatial maps of land based on its designation of North Jakarta area. Spatial data processed using Erdas 3.3 perwilayah 85 and Arcview project with the result:

Table 1 : Land Based Year 2006 Per-Purpose Zone Resapan in North Jakarta area

No.	Infiltration Area	Land Area (m ²) in 2006			
		Green Open Space (RTH)	Open Space	Lake	River
1	R8d	4,477,832.77	618,594.63	177,384.49	23,411.15
2	R9d	5,607,871.00	818,489.84	244,016.22	518,647.03
3	R10d	2,278,085.04	323,253.96	277,332.09	879,719.01
4	R11d	2,359,123.64	287,236.81	145,869.48	911,234.02
5	R12d	4,117,661.22	369,175.84	67,532.17	1,271,405.56
6	R13d	8,848,514.51	1,414,573.76	1,128,237.37	7,649,143.25
North Jakarta		27,689,088.19	3,831,324.84	2,040,371.82	11,253,560.02

Green Open Space Area in 2006 is 27,689,088.19 square meters (19.4 %) of the broad area of North Jakarta. Area of Land is open or 3,831,324.84 square meters or 2.75% Jakarta Area North of Area.

Table 2 : Area of green space to the Area of North Jakarta in 2006

No.	Zone Catchment Area	Land Area (square meter)		Percentage Green Open Space (%)	coefficient
		Green Open Space	Total Area		
1	R8d	4,477,832.77	11,857,036.09	37.77	0.3777
2	R9d	5,607,871.00	20,168,429.36	27.81	0.2781
3	R10d	2,278,085.04	10,997,421.20	20.71	0.2071
4	R11d	2,359,123.64	14,271,947.07	16.53	0.1653
5	R12d	4,117,661.22	27,398,537.19	15.03	0.1503
6	R13d	8,848,514.51	54,862,229.09	16.13	0.1613
North Jakarta		27,689,088.19	139,555,600.00	19.84	0.1984

Potential green space allocation map as Regional Catchment Area in North Jakarta

Allocation as a potential green space catchment areas in North Jakarta is based on the value of the final infiltration rate, ground water, population density and vast open areas in North Jakarta. The result can be seen in the following table.

Table 3 : Allocation of green space as a Regional Resapan Potential of Soil and Water Front Catchment area in North Jakarta area

No	Catchment area in North Jakarta	final infiltration rate (cm/minute)	Surface Ground Water (m)	Open Land Area (square meter)	Catchment Area Potential	Information
1	R9d	0.4	1 - 5	1,413,900.00	IV	Low Potential
2	R10d	0.35	1 - 5	618,300.00	IV	Low Potential
3	R11d	0.25	1 - 5	818,100.00	IV	Low Potential
4	R12d	0.15	1 - 5	323,100.00	IV	Low Potential
5	R13d	0.1	1 - 5	287,100.00	IV	Low Potential
6	R8d	0.45	1 - 5	369,000.00	IV	Low Potential

Table 4 : Allocation of green space as an Area of Potential Resapan of Population Density in North Jakarta area

Sub District	Area (square meter)	y Catchment Area in North Jakarta					
		R8d	R9d	R10d	R11d	R12d	R13d
Pademangan	122.80						
Penjaringan	50.17						
Cilincing	60.01						
Tanjung Priok	124.48						
Kelapa Gading	66.36						

Based on the above table, the areas with the potential to be used as green space area in North Jakarta is an area that still has an open area, has a low density medium (51-100 people / hectare) and medium potential areas and above (ground water > 6 m) for North Jakarta area does not exist.

4.1. Green Open Space Management Model as a Regional Territory Catchment Area North Jakarta

Dynamic Model Management as a Regional Resapan green space in North Jakarta area is made by taking into account the domestic water needs for 10 years in the year 2006 to 2016 with per capita water demand amounts to 150 liters / day / person or 54.75 cubic meter per year per person. Ground water to meet domestic water demand is obtained from the existing green space (in 2006), green space plan, other potential originating from the lake or that there are in North Jakarta and also taking into account the supply of PAM in North Jakarta as a reduction of ground water needs. By Stella Research 8 Dynamic Management Model is prepared as a regional green space Catchment Area in North Jakarta area as shown in Figure below.

Based on the above table, the areas with the potential to be used as green space area in North Jakarta is an area that still has an open area, has a low density medium (51-100 people / hectare) and medium potential areas and above (surface ground water is

more 6 meter) for North Jakarta area does not exist.

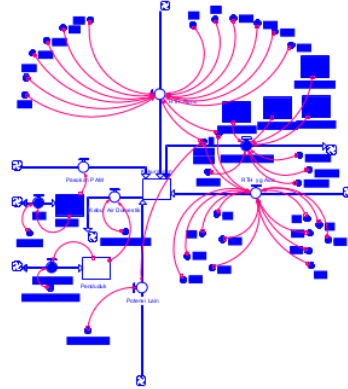


Figure 1 : Model Management Green as Regional Open Space District, North Jakarta

Results from the model calculation above obtained results as follows:

- The population of North Jakarta for 10 years (2006-2016)
- The number of domestic water needs of residents of North Jakarta for 10 years (2006-2016)
- Number of supply PAM North Jakarta residents for 10 years (2006-2016)
- The amount of ground water supplies from lakes or there in North Jakarta for 10 years (2006-2016)
- The amount of ground water supplies of green space in 2006 in North Jakarta

The results of model calculations presented in the following table:

Table 5 : Total Population of North Jakarta for 10 years (2006-2016)

Year	Population Growth (people/year)	Population in North Jakarta (people/year)
2006	1,180.97	1,180,967.00
2007	1,182.15	1,182,147.97
2008	1,183.33	1,183,330.11
2009	1,184.51	1,184,513.45
2010	1,185.70	1,185,697.96
2011	1,186.88	1,186,883.66
2012	1,188.07	1,188,070.54
2013	1,189.26	1,189,258.61

Table 6 : Number of Domestic Water Supplies Residents in North Jakarta for 10 years (2006-2016)

JAKARTA CENTER			
Years	Population Growth	Population	Domestic Waters Needs
2006	1,494.16	878,918.00	48,120,760.50
2007	1,496.70	880,412.16	48,202,565.79
2008	1,499.25	881,908.86	48,284,510.15
2009	1,501.79	883,408.11	48,366,593.82
2010	1,504.35	884,909.90	48,448,817.03
2011	1,506.90	886,414.25	48,531,180.02
2012	1,509.47	887,921.15	48,613,683.03
2013	1,512.03	889,430.62	48,696,326.29
2014	1,514.60	890,942.65	48,779,110.04
2015	1,517.18	892,457.25	48,862,034.53
2016	1,519.76	893,974.43	48,945,099.99
Final		895,494.19	

Table 10 : Groundwater Supply of the existing green space in 2006 and Supply Lake / lakes in 2006 in North Jakarta area

Year	Water need in North Jakarta
	(m3/thn)
2006	64,657,943.25
2007	64,722,601.19
2008	64,787,323.79
2009	64,852,111.12
2010	64,916,963.23
2011	64,981,880.19
2012	65,046,862.07
2013	65,111,908.93
2014	65,177,020.84
2015	65,242,197.86
2016	65,307,440.06

Table 11 : Total Supply PAM Residents in North Jakarta for 10 years (2006-2016)

Year	Increase Demand PAM	Supply PAM in North Jakarta
	(m3/thn)	(cubic meter/year)
2006	-226,206.18	72,969,734.00
2007	-225,504.94	72,743,527.82
2008	-224,805.87	72,518,022.89
2009	-224,108.97	72,293,217.02
2010	-223,414.23	72,069,108.04
2011	-222,721.65	71,845,693.81
2012	-222,031.21	71,622,972.16
2013	-221,342.92	71,400,940.95
2014	-220,656.75	71,179,598.03
2015	-219,972.72	70,958,941.27
2016	-219,290.80	70,738,968.56

Table 12 : Number of Ground Water Supply from Lake or Situ in North Jakarta area for 10 years (2006 to 2016)

Year	t
	(cubic meter/ year)
2006	3,178,899.30
2007	3,178,899.30
2008	3,178,899.30
2009	3,178,899.30
2010	3,178,899.30
2011	3,178,899.30
2012	3,178,899.30
2013	3,178,899.30
2014	3,178,899.30
2015	3,178,899.30
2016	3,178,899.30

Table 13 : Number of Ground Water Supply of green space in 2006 in North Jakarta area

Year	Existing Green Open Space Area in 2006 (square meter)	Volume of Ground water from existing Green Open Space in 2006 North Jakarta (cubic/year)
2006	27,689,088.18	43139599.38
2007	27,689,088.18	43139599.38
2008	27,689,088.18	43139599.38
2009	27,689,088.18	43139599.38
2010	27,689,088.18	43139599.38
2011	27,689,088.18	43139599.38
2012	27,689,088.18	43139599.38
2013	27,689,088.18	43139599.38

Scenario Management of green space as an area of North Jakarta District Resapan Based on the results management model for processing of green space as a catchment area in North Jakarta is prepared 5 alternative green space management scenarios in order to meet the needs of domestic groundwater that is with the following result

Scenario Management of green space as an area of North Jakarta District Resapan Based on the results management model for processing of green space as a catchment area in North Jakarta is prepared 5 alternative green space management scenarios in order to meet the needs of domestic groundwater that is with the following results:

Scenario 1: Area of green space like a vast green space there in 2006 and the Supply Lake / lakes in 2006 Area of existing green space in the year 2006 amounted to 27,689,088.18 m² or 19.84% by volume of ground water produced by 43,139,599.38 m³/thn while other potential volume of supply from the lake / it amounted to 3,178,899, 30 m³/thn. So the existing green space in 2006 and other potential of the lake / there is only capable of supplying the domestic needs of ground water in 2006 until 2016 approximately 70.92% -71.64%, just as shown in following table.

Table 14 : Groundwater Supply of the existing green space in 2006 and Supply Lake / lakes in 2006 in North Jakarta area

2012	242,058.04	407,843.60	15,193,730.73	14,785,887.13
2013	242,058.04	407,843.60	16,188,375.38	15,780,531.78
2014	242,058.04	407,843.60	17,148,960.45	16,741,116.85
2015	242,058.04	407,843.60	18,076,768.72	17,668,925.12
2016	242,058.04	407,843.60	18,973,034.82	18,565,191.22

No	Zone Catchment Area	Land area (square meter)		Percentage Open Area (%)	Coef.
		Open Area	Total Area		
1	R6c	186,267.71	2,851,949.97	6.53	0.0653
2	R7c	43,192.51	1,453,701.09	2.97	0.0297
3	R7d	17,996.88	1,928,883.90	0.93	0.0093
4	R8c	9,898.28	5,950,003.25	0.17	0.0017
5	R8d	22,496.10	4,222,189.92	0.53	0.0053
6	R9c	2,699.53	2,945,797.28	0.09	0.0009

Scenario 2: Relying on domestic water supply needs of the population only from PAM alone North Jakarta PAM supply capable of supplying the domestic needs of ground water exceeds the needs of approximately 108.32% - 112.86%, just as shown in the table below. So the needs of domestic groundwater North Jakarta had to be fulfilled from the supply of PAM alone.

Domestic Water Supply Needs

Table 15 : : Residents only from PAM alone in North Jakarta area

Year	Supply PAM North Jakarta cubic meter/ year	Kebut Air Domestik Jakarta Utara (m3/thn)	Persen- tase Keter- cukupan %
2006	72,969,734.00	64,657,943.25	112.86
2007	72,743,527.82	64,722,601.19	112.39
2008	72,518,022.89	64,787,323.79	111.93
2009	72,293,217.02	64,852,111.12	111.47
2010	72,069,108.04	64,916,963.23	111.02
2011	71,845,693.81	64,981,880.19	110.56
2012	71,622,972.16	65,046,862.07	110.11
2013	71,400,940.95	65,111,908.93	109.66
2014	71,179,598.03	65,177,020.84	109.21
2015	70,958,941.27	65,242,197.86	108.76
2016	70,738,968.56	65,307,440.06	108.32

Scenario 3: At ¹ of green space like a vast green space available in 2006, Supply Lake / lakes in 2006 and PAM Ground water supplies from the existing green space in 2006, another potential of the lake / situ, North Jakarta, PAM is able to supply the needs of domestic groundwater exceeds the needs of approximately 179.24% - 184.49% only, as shown in the table below.

Groundwater Supply

Table 16 : ¹ The existing green space in 2006, Supply Lake / lakes in 2006 and PAM in North Jakarta area

Tahun	Volume Air Tanah dari RTH Jakarta Utara (m3/thn)	⁷ Volume Air Potensi Lain (Danau/Situ) Jakarta Utara (m3/thn)	Pasokan PAM Jakarta Utara (m3/thn)	Total (m3/thn)	Kebut Air Domestik Jakarta Utara (m3/thn)	Persen- tase Keter- cukupan %
2006	43.139.599,38	3.178.899,30	72.969.734,00	119.288.232,68	64.657.943,25	184,49
2007	43.139.599,38	3.178.899,30	72.743.527,82	119.062.026,50	64.722.601,19	183,96
2008	43.139.599,38	3.178.899,30	72.518.022,89	118.836.521,57	64.787.323,79	183,43
2009	43.139.599,38	3.178.899,30	72.293.217,02	118.611.715,70	64.852.111,12	182,90
2010	43.139.599,38	3.178.899,30	72.069.108,04	118.387.606,72	64.916.963,23	182,37
2011	43.139.599,38	3.178.899,30	71.845.693,81	118.164.192,49	64.981.880,19	181,84
2012	43.139.599,38	3.178.899,30	71.622.972,16	117.941.470,84	65.046.862,07	181,32
2013	43.139.599,38	3.178.899,30	71.400.940,95	117.719.439,63	65.111.908,93	180,80
2014	43.139.599,38	3.178.899,30	71.179.598,03	117.498.096,71	65.177.020,84	180,28
2015	43.139.599,38	3.178.899,30	70.958.941,27	117.277.439,95	65.242.197,86	179,76
2016	43.139.599,38	3.178.899,30	70.738.968,56	117.057.467,24	65.307.440,06	179,24

¹ Scenario 4: Area of green space consists of green space plus a plan on potential areas of existing green space in 2006, Supply Lake / lakes in 2006 and PAM Because in scenario 3 ground water supply exceeds domestic needs which is about 179.24% - 184.49%, is not needed anymore additional green space plan, as shown in the table below.

Table 17 : Water Supply Plan Land of green space, green space available in 2006, Supply Lake / lakes in 2006 and PAM in North Jakarta area

year	Green Open space Plan Area, North Jakarta (m2)	Percentage luas (%)	Volume Green Open Space plan, North Jakarta (m3/year)	Vol PAM + RTH 2006 + Another Potential North Jakarta (m3/year)	Total (m3/year)	Domestic water needs (m3/year)	Adequacy Percentage (%)	Excess North Jakarta (m3/year)
2006	0	0	0	119,288,232.68	119,288,233	64,657,943.25	184.49123	54,630,289.43
2007	0	0	0	119,062,026.50	119,062,027	64,722,601.19	183.95742	54,339,425.31
2008	0	0	0	118,836,521.57	118,836,522	64,787,323.79	183.42558	54,049,197.78
2009	0	0	0	118,611,715.70	118,611,716	64,852,111.12	182.89569	53,759,604.58
2010	0	0	0	118,387,606.72	118,387,607	64,916,963.23	182.36775	53,470,643.49
2011	0	0	0	118,164,192.49	118,164,192	64,981,880.19	181.84176	53,182,312.30
2012	0	0	0	117,941,470.84	117,941,471	65,046,862.07	181.31769	52,894,608.77
2013	0	0	0	117,719,439.63	117,719,440	65,111,908.93	180.79556	52,607,530.70
2014	0	0	0	117,498,096.71	117,498,097	65,177,020.84	180.27534	52,321,075.87
2015	0	0	0	117,277,439.95	117,277,440	65,242,197.86	179.75703	52,035,242.09
2016	0	0	0	117,057,467.24	117,057,467	65,307,440.06	179.24063	51,750,027.18

Scenario 5: Area of green space plan consists of green space, green space available in 2006, Supply Lake / lakes in 2006, PAM and supply of green space plus another Region

Under scenario 4 domestic ground water supply exceeds demand there is for m3/thn 51,750,027.18 - 54,630,289.43 m3/thn. Excess domestic supply of ground water can not be used to supply other areas because of the hydrologic aspects of the North Jakarta does not affect other areas because it is an area which is the bottom of the release area. Existing ground water can be used as filler to prevent ground water intrusion of sea water.

Table 18 : Excess Water Supply Area of Land in North Jakarta

Year	Excess North Jakarta (cubic meter/year)
2006	54,630,289.43
2007	54,339,425.31
2008	54,049,197.78
2009	53,759,604.58
2010	53,470,643.49
2011	53,182,312.30
2012	52,894,608.77
2013	52,607,530.70
2014	52,321,075.87
2015	52,035,242.09
2016	51,750,027.18

Recommendations Management of green space as an area of North Jakarta District Catchment Area

Based on the model and scenario management of green space as a catchment area in North Jakarta to recommend any of the following :

1. you rely on the existing green space area and the potential of the lake and there is ground water that is produced do not meet domestic water needs of North Jakarta area residents because ketercukupannya years 2006-2016 only 70.92% - 71.64%
2. Supply PAM North Jakarta has been very inadequate domestic water needs of the population, so that you no longer need additional green space plan
3. While the existing green space in 2006 (19.84% area of North Jakarta) should be maintained because the ground water produced can be used as filler to prevent ground water intrusion of sea water.

5. CONCLUSIONS AND SUGGESTIONS

5.1. Conclusion

Based on the analysis and discussion that has been done, it can be concluded among other things:

1. The existence of the existing green open space (yr 2006) in North Jakarta amounted 27,689,088.19 m² (19.84% area of North Jakarta) and its ability to meet the needs of domestic groundwater.
2. Green Open Space Allocation potential as the recharge area in North Jakarta area who still have an open area, has a low density medium (51-100 people / ha) and medium potential areas and above (ground water > 6 m) to the North Jakarta area does not exist .
3. Scenario adequacy of ground water required in the management of green open space as a water catchment areas in North Jakarta to maximize water absorption is as follows:
 - a. Scenario 1: Area of green space like a vast green space there in 2006 and the Supply Lake / lakes in 2006 Existing green space in 2006 and other potential of the lake / there is only capable of supplying the domestic needs of ground water in 2006 until 2016 approximately 70.92% -71.64% only
 - b. Scenario 2: Relying on domestic water supply needs of the population only from PAM alone North Jakarta PAM supply capable of supplying the domestic needs of ground water exceeds the needs of approximately 108.32% - 112.86% only
 - c. Scenario 3: Area of green space like a vast green space available in 2006, Supply Lake / lakes in 2006 and PAM Ground water supplies from the existing green space in 2006, another potential of the lake / situ, North Jakarta, PAM is able to supply the needs of domestic groundwater exceeds the needs of approximately 179.24% - 184.49% only
 - d. Scenario 4: Area of green space consists of green space plus a plan on potential areas of existing green space in 2006, Supply Lake / lakes in 2006 and PAM Domestic ground water supply exceeds demand which is about 179.24% - 184.49%, is not needed anymore additional green space plan
 - e. Scenario 5: Area of green space plan consists of green space, green space available in 2006, Supply Lake / lakes in 2006, PAM and supply of green space plus another Region Excess domestic supply of ground water can not be used to supply other areas because of the hydrological aspect of the North Jakarta does not affect other areas because it is an area which is the bottom of the release area. Existing ground water can be used as filler to prevent ground water intrusion of sea water.
4. Recommendations green open space management policy as a water catchment areas in North Jakarta area while maintaining the existing green space that serves as a regional ground water charging to prevent the intrusion of sea water and add green space located on the edge panatai in the form of mangrove forests to prevent abrasion.

5.2. Advice

Based on the results of research, discussion and conclusions, it is necessary to recommended further research is needed about the function and need for green space in North Jakarta in order to prevent intrusion of sea water.

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