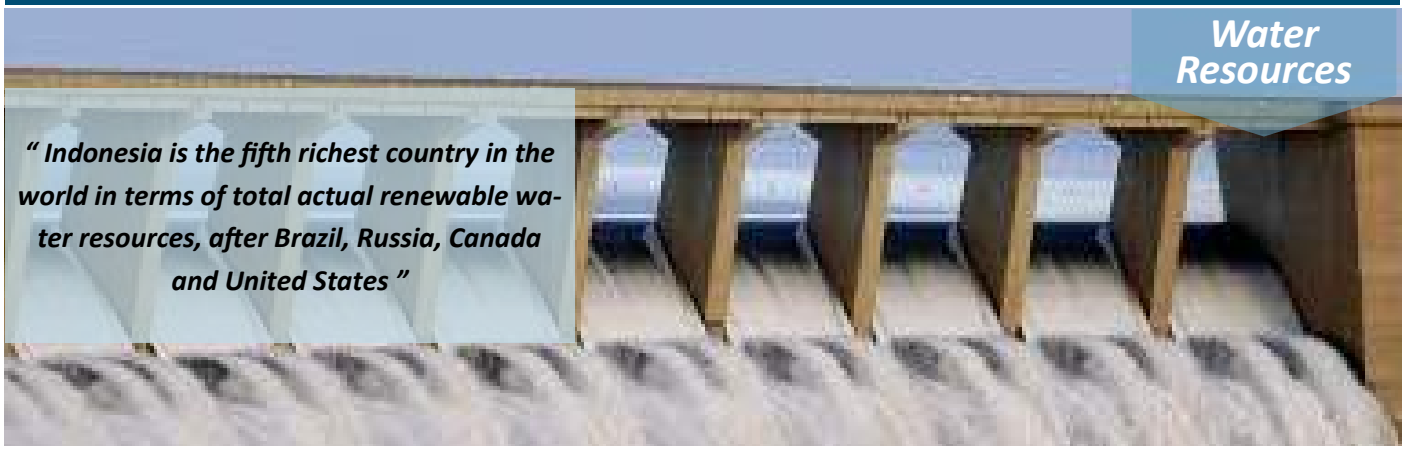
Water Resources



" Indonesia is the fifth richest country in the world in terms of total actual renewable water resources, after Brazil, Russia, Canada and United States "

The availability of clean water is quite complicated problem that is always faced by all nations, including developed countries. The economic and social development is highly dependent on the availability of water, also for the fulfillment of basic human and environmental needs.

It is generally understood that access to water is a basic human right. The International Conference on Water and Environment [ICWE] at Dublin in 1992 confirmed that "...*it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price*."

Population growth is a major cause of pressure on renewable water resources that require development efforts to meet the needs of the population, either directly to meet various needs or indirectly due to the influence of population migration.

The world's population explosion is correlated with the increasing demand for food which causes the demand for water to increase rapidly. The UN Agency for Water (UN-Water) cites the research by some experts saying that it takes 3,500 liters of water to produce 1 kg of rice, 15,000 liters of water to produce 1 kg of beef and even to make a glass of coffee will require 14 liters of water (Hoekstra and Chapagain, 2008). The high demand for water which not offset by the provision of adequate clean water infrastructure causes the emergence of water scarcity. According to UN-Water, approximately 780 million people in the world do not have access to clean water and 80 million of them are Indonesians. In addition, about 2.5 billion people in the world cannot access proper sanitation.

Source: Arcadis

Theoretically, less than 1 percent of the total freshwater resources on Earth or about 200,000 cubic kilometers of water can be used by humans and ecosystems but unfortunately not evenly distributed resulting in water scarcity. Rainfall that occurs on earth on an average every year ranging from a few millimeters per year (desert area) to more than 10 meters per year, which varies according to the location where we are plus climate conditions in the area whether it is dry or wet.

UN-Water uses water resources per capita as indicators to show imbalance between freshwater resources and the population, or the risk of freshwater resource scarcity for the population. Professor Malin Falkenmark, a globally renowned water expert and currently serving as Senior Scientific Adviser at the

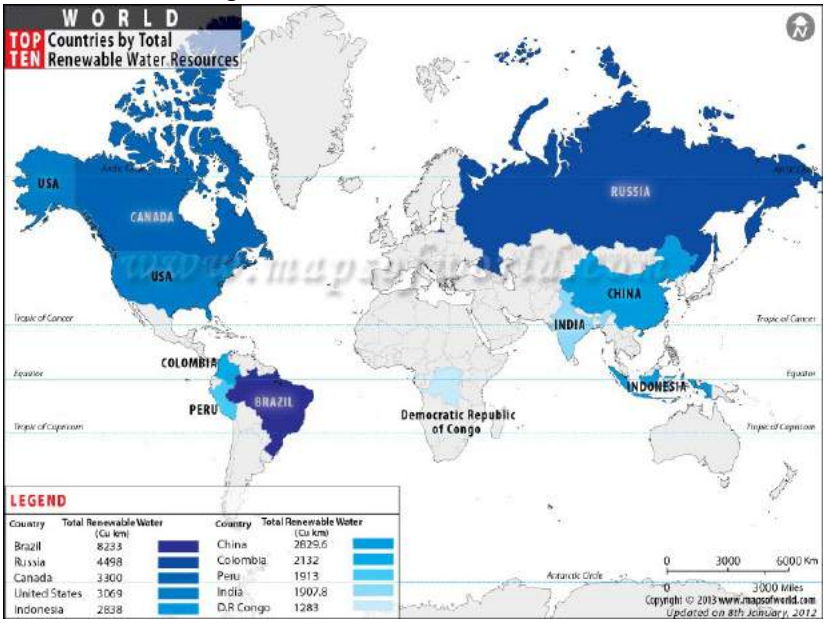
Stockholm International Water Institute (SIWI), states that a country is rich in water if it has more than 1,700 m3 of water per resident per year, while scarce water resource country if below 1,000 m3. If it below 500 m3 per population per year is categorized as a very rare water resource country.

Indonesia Water Resources

Indonesia has a fairly high rainfall and represents around 6% of the total freshwater resources of the world. Quoted from www.goodnewsfromindonesia.id, data released in 2012 stated that Indonesia is the fifth largest country of renewable water resources in the world with water resources of 2,838 cubic kilometers.

However, the abundant water resources are not evenly distributed either by location or by the time to the fulfillment of population needs. Quoted from the Indonesia Water Investment Roadmap 2011-2014 which released by the Ministry of Public Works, only 47.71% of the total population of Indonesia has access to clean water sources. This is partly due to seasonal variation or uneven rainfall throughout the year and geographical conditions that can be very extreme, such as barren land in the Gunung Kidul area that is always have shortage of clean water during the dry season.

Picture 1. World Largest Renewable Water Resources



Source: www.goodnewsfromindonesia.id (2015)

It is estimated that the supply of clean water in Indonesia is mostly (about 60%) done by piped water while the remaining 25% comes from springs water and 15% from ground water.

The demand for water will continue to increase as the region and population grows. Based on data from the Ministry of Public Works, Java and Bali have the highest demand of surface water compared to other areas, both for domestic and irrigation needs, as well as industrial needs. Since the early 1990s, the two islands have experienced a water balance deficit during the dry season.

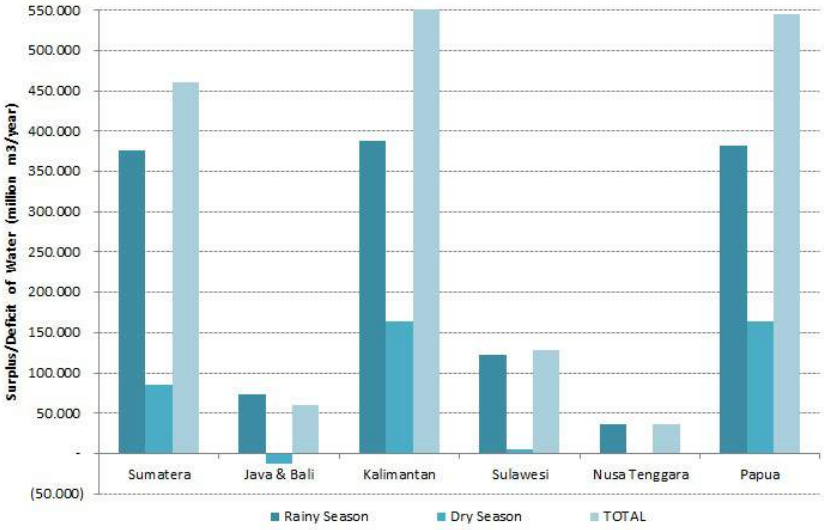
Table 1. The Supply and Requirement of Fresh Water by Island in Indonesia

No	Island	Water Requirement (million meter cubic/year)				Water Supply (million meter cubic/year)			
		Wet Season	Dry Season	TOTAL	% Total National	Wet Season	Dry Season	TOTAL	% Total National
1	Sumatra	8.319,0	11.646,7	19.965,7	18%	384.774,4	96.193,6	480.968,0	25%
2	Java & Bali	27.432,9	38.406,1	65.839,0	59%	101.160,8	25.290,2	126.451,0	7%
3	Kalimantan	2.040,8	2.857,2	4.898,0	4%	389.689,3	167.009,7	556.699,0	28%
4	Sulawesi	6.433,3	9.006,7	15.440,0	14%	129.400,2	14.377,8	143.778,0	7%
5	Nusa Tenggara	1.440,0	4.320,0	5.760,0	5%	37.940,4	4.215,6	42.156,0	2%
6	Papua	57,2	80,0	137,2	0,1%	381.763,9	163.613,1	545.377,0	28%

Source: Directorate General Natural Resources Ministry of Public Works (2003)

This is in line with the population density in Java and Bali islands which reaches 62% of the total population of Indonesia. Java island as the industrial development center also contributes to the water balance deficit and at the same time the fresh water resources in the region is very limited, less than 10% of the total national water availability.

Picture 2. Balance of Water by Islands in Indonesia



Source: Directorate General Natural Resources Ministry of Public Works (2003), processed

As quoted from the "Java Water Balance Analysis" by Sutopo, in 2003 about 77 percent of districts/cities in Java island experienced a water deficit and estimated to increase up to 78.4 percent by 2025. For Jabotabek areas whose water supply is relatively secured, in 2003 about 50 percent of districts and municipalities in the region experienced a water deficit and expected to increase up to 100 percent by 2025. The water balance deficit throughout Indonesia, especially during the dry season, is expected to increase in 2025 if no significant improvements in the national water infrastructure.

The population growth greatly affects the increasing need for clean water. In accordance with SNI standards in 2002, household water demand for urban residents is 120 liters/day/resident, while the rural population is 60 liters/day/resident. The projection of population growth by the Central Bureau of Statistics (BPS) shows that the population of Indonesia is predicted to increase from 238.5 million in 2010 to 305.6 million by 2035. The need for clean water for households in 2010 is estimated of 7.8 billion cubic meters. The household water demand is predicted to continue to increase to 11.15 billion cubic meters in 2035.

Table 2. Projected Water Availability per Capita (in cubic meters per capita per year)

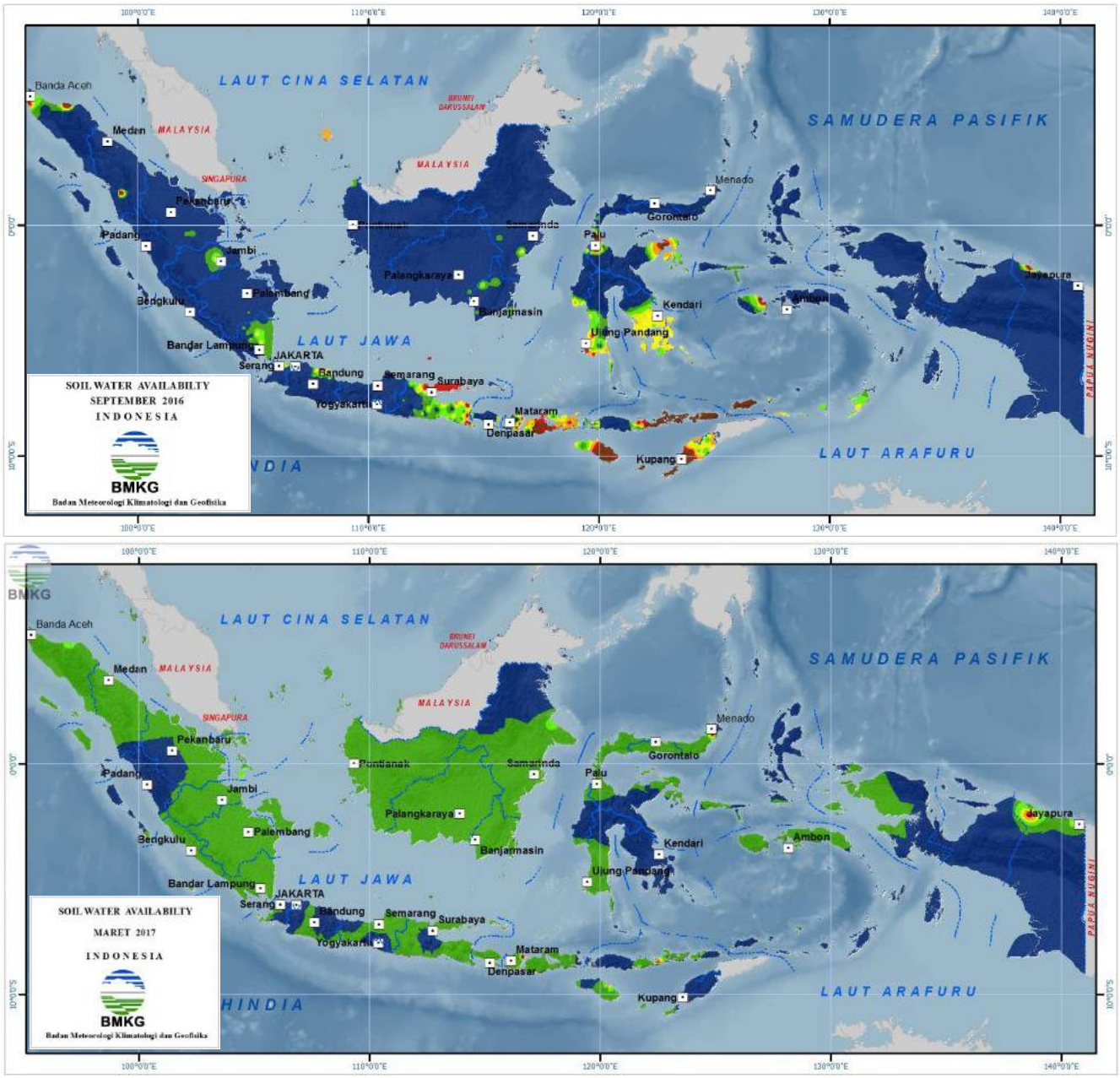
No	Pulau	2010	2015	2020	2025	2030	2035
1	Jawa	1.365	1.288	1.227	1.178	1.142	1.118
2	Bali & Nusa Tenggara	4.570	4.253	3.987	3.766	3.582	3.429
3	Sumatera	14.510	13.352	12.437	11.733	11.192	10.774
4	Sulawesi	14.165	13.192	12.391	11.751	11.251	10.866
5	Kalimantan	72.775	65.698	60.108	55.744	52.326	49.611
6	Maluku & Papua	158.035	142.801	130.315	120.256	112.203	105.700

Source: BPS and Directorate General Natural Resources Ministry of Public Works, processed

In addition to household needs, the water is also needed for industrial and irrigation needs. Based on the report of Directorate General of Natural Resources (2010), the raw water used for urban household is only about 3.7% of total water utilized, while the rest is used for industrial activities (15.8%) and irrigation (80.5%). The demand of raw water for industry is predicted to increase to 276,125 million cubic meters/year in 2030.

The Indonesia's water balance shows that the imbalance between resource and water demand is very high in almost all territory of Indonesia. The data from the Meteorology, Climatology and Geophysics Agency (BMKG) below illustrates the condition of groundwater availability in Indonesia during high and low rainfall .

Picture 3. Ground Water Availability in Indonesia



Source: www.bmkg.go.id

INFORMATION :

Deficit		Sufficient	
	< 0%		60% - 80%
	0 - 20%		80% - 100%
	20% - 40%		> 100%
Moderate			
	40% - 60%		

Less : if ground water availability < 40%
Medium : if ground water availability 40% - 60%
Cukup : if ground water availability > 60%

If the level of groundwater availability is less than 0% indicates the water content in that area is below the point of permanent wilting and if more than 100% indicates there has been a surplus (saturated water)

Point of Permanent Wilting is the lower limit of groundwater availability for plants, where the roots of plants are no longer able to absorb water for growth.

The amount of groundwater is usually measured in percent of moisture content by volume or mass, or as a potential groundwater. Moisture content do not always represent groundwater availability for plants. The information provided by the moisture content is the relative amount of water in the soil.

Source: www.waterfindusa.com.

The level of groundwater availability in a region is calculated by the water balance of the land, which is the difference between the amount of water received by land and the loss of water from the land through the evapo-transpiration process. The assumption used in water balance calculations is that the water received by the land only comes from rainfall and the depth of the soil is 1 meter with homogeneous soil conditions.

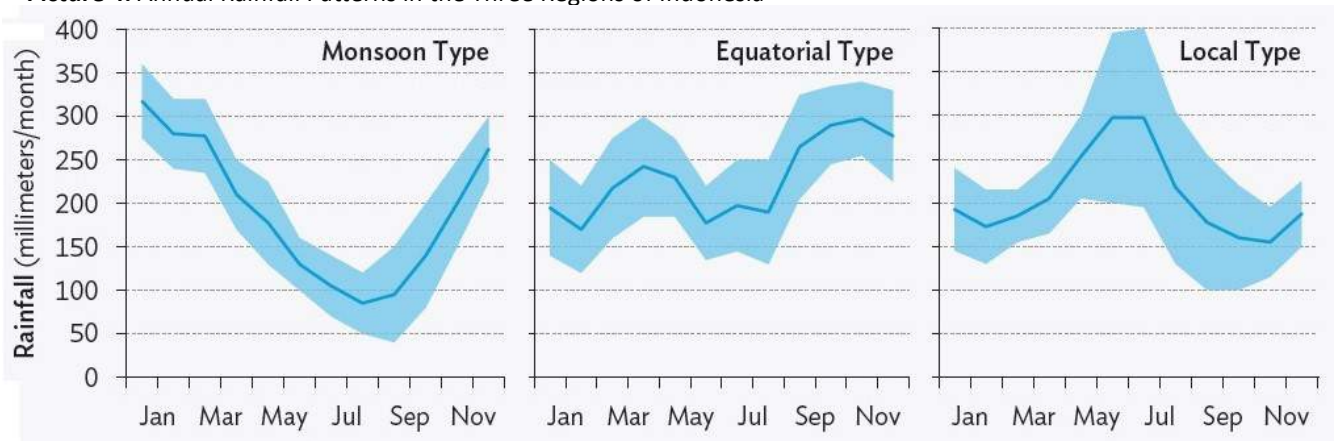
As seen on the normal map of groundwater availability (Picture 3), during the rainy season almost all of Indonesia territory has a water surplus while in dry season, only Papua has abundant ground water resource than other areas. In addition to its higher average rainfall of Papua, population density and industrialization outside Papua are the main reason of high utilization of groundwater for clean water needs outside of Papua.

Rainfall in Indonesia

The Indonesia's average annual rainfall is around 2,350 millimeter per year. Quoted from Journal of Climatology by Dr. Edvin Aldrian and R. Dwi Susanto, 2003, Indonesia territory divided into 3 (three) climatic regions based on distribution of monthly rainfall data that indicates different characteristic. These three regions are :

i. **Southern Indonesia** from South Sumatera to Timor Island, southern Kalimantan, Sulawesi, and part of Papua with monsoon type rainfall. The monsoon rainfall pattern has a clear distinction between the rainy season period (west monsoon) and dry season (eastern monsoon) which are then grouped in the season zone. The rainfall types are unimodial characterized by one peak of the rainy season.

Picture 4. Annual Rainfall Patterns in the Three Regions of Indonesia

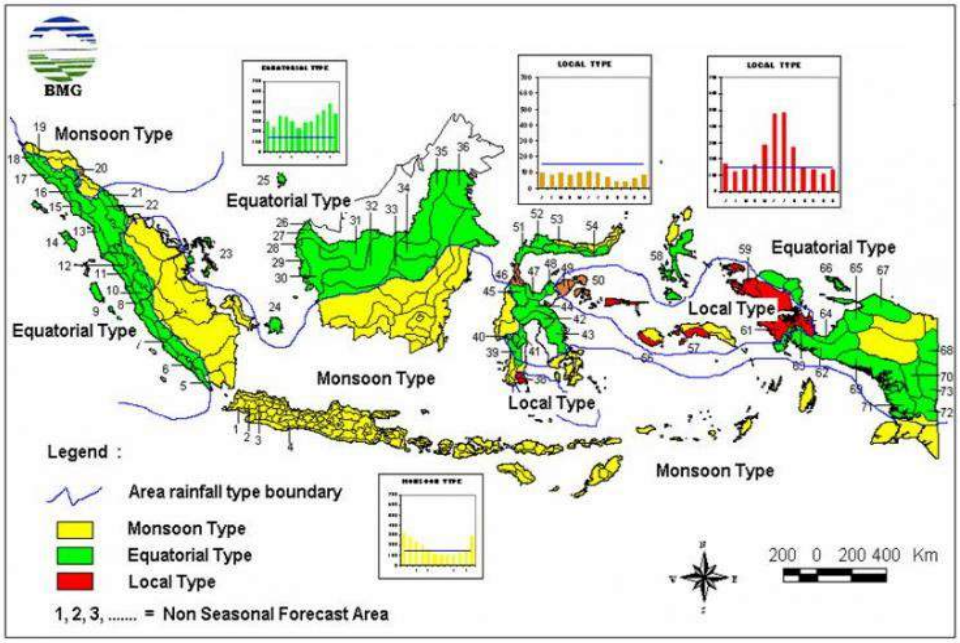


Source: International Journal of Climatology, E. Aldrian and R. Dwi Susanto. 2003. *The shaded area indicates one standard deviation (σ) above and below average*

ii. **Northwest Indonesia** from northern Sumatra to northwestern Kalimantan with equatorial type rainfall. The region has bimodial monthly rainfall distribution characterized by two maximum peak of rainy seasons (generally occurring around March and October) and almost throughout the year considered as in the rainy season category.

iii. **Region of Maluku and northern Sulawesi** with a local type of rainfall. The local rainfall region has a monthly rain distribution in contrast to a monsoon pattern characterized by a unimodial shape (one rain peak) but with an opposite form to the monsoon.

Picture 5. Rainfall Patterns in Indonesia

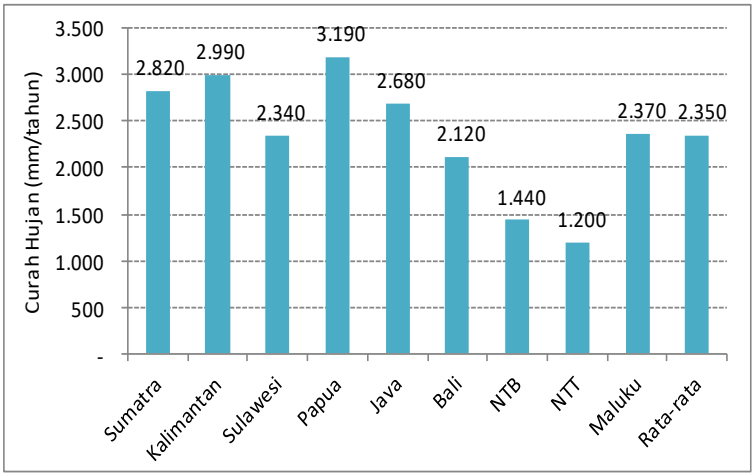


Source: Indonesia Meteorology Agency (BMG)

The rainfall patterns in Indonesia vary widely due to various factors such as geography, topography, and others. So in Indonesia there is no clear boundary between the rainy season and the dry season because the territory of Indonesia is located in the Inter-Tropical Convergence Region.

The annual variation in all regions of Indonesia is quite strong. Nusa Tenggara is the region with the lowest rainfall in Indonesia. Areas with local rainfall types such as Maluku, Sorong and Monokwari Papua have significant correlations between sea surface temperature and rainfall variability making it possible to predict seasonal climate. Figure 6 shows the average rainfall distribution on the main islands of Indonesia.

Picture 6. Average Annual Rainfall for Indonesia's Main Islands



Source: Ministry of Environment. 2013. *Status Lingkungan Hidup Indonesia 2012.*

BOX 1 : Pattern of Rainfall in Indonesia

- The west coast of each island always gets more rainfall than the east coast
- The rainfall in western Indonesia is higher than eastern Indonesia. For example, a series of Java, Bali, NTB and NTT islands linked by narrow straits, and the highest rainfall is in West Java
- Rainfall increases with the height of the place. Most rainfall is generally located at altitudes between 600 and 900 meters above sea level
- In the hinterland of all islands, the rainy falls in the transition season. Likewise in large swamp areas
- The starting time of the rain drops moving from West to East such as:
  1) The west coast of Sumatra island up to Bengkulu gets the most rain in November
  2) From Lampung to Bangka which is located to the east gets the most rain in December
  3) Northern Java, Bali, NTB, and NTT have the most rainfall in January to February
- In eastern part of South Sulawesi, Southeast Sulawesi, and Central Maluku, the rainy season is different, which is from May to June. In that months, other areas were experiencing dry season. The borders of rainy area of western and eastern Indonesia lie in approximately 120° East Longitude

Water Supply System in Indonesia

Source: Tribun Batam

The supply of clean water in Indonesia, especially for urban areas has existed since the Dutch colonial era. For example, the provision of drinking water in Jakarta has existed since 1843 with limited service coverage for only certain parts of the city. Since the independence, most of clean water needs in Indonesia is supplied by Perusahaan Daerah Air Minum (PDAM) which located in every province, regency, and municipality throughout Indonesia. A modern urban water supply systems typically use underwater piping networks. The advantage of using this method is that the distributed water has a safer and healthier quality.

Indonesia water supply system in general can be grouped into 2 system that is: (1) individual system; and (2) communal systems. The individual system is the fulfillment of the need for clean water individually. This system usually uses shallow springs that contain lots of substances and dissolved salts as raw water, making it less feasible for consumption. While the communal system is done in an organized manner by utilizing the services of drinking water companies or community-based institutions. This system uses a lot of ground water as its raw water.

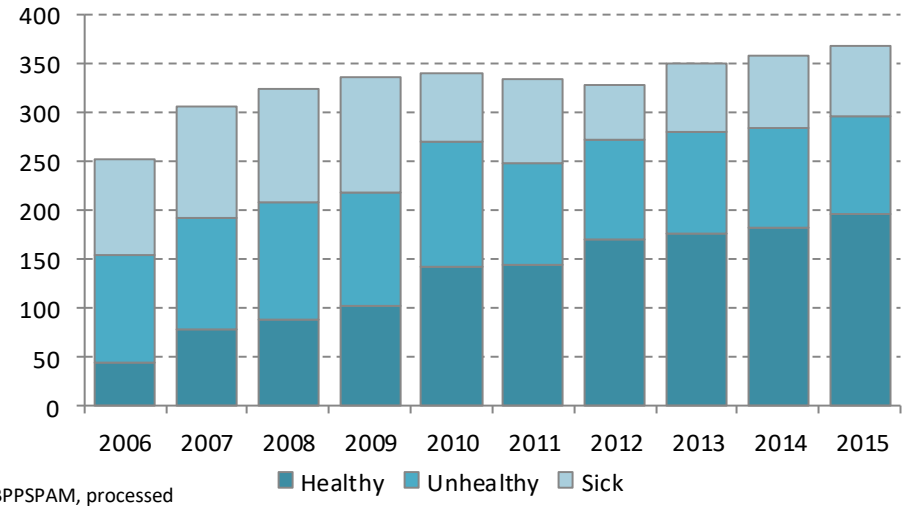
In general, communal systems in Indonesia use PDAM as service providers using piped networks as a feature of modern clean water supply systems. However, this system has not been able to reach all urban areas so that some of the middle-income housing that is not yet reached by this system uses an alternative water source originating from groundwater to meet their needs of clean water in its surrounding. This communal system is relatively better because most of the water has been through the filtration system and other treatment before it is distributed to households that are in this system.

According to the research of Indonesian Consumers Foundation (YLKI) in 2004, around 41% of Indonesia's population lives in urban areas and 51.7% of them (or about 20% of the total population) have been served by piped water service (PDAM). Approximately 90% of them use water to meet domestic water needs (households). While for the population in the rural area, only about 8% of the population has been served by piped water. Currently, almost all districts and cities in Indonesia already have piped water system provided by PDAM. By 2015, the water pipe utilization ratio (the ratio of piped water produced or sold to total installed capacity) is 72.8% of the total capacity of 5,750 million m3 / year. However, most of PDAM operations are suffered losses.

Source: Harian88.com

Every year, BPPSPAM or Water Supply System Development Support Agency evaluates all PDAMs throughout Indonesia to measure the quality and performance of PDAMs in providing drinking water services to the community. The evaluation was conducted based on PDAM performance audit report by BPKP or Agency for Financial and Development Supervision and financial audit by Public Accounting Firm (KAP) by using indicators of four aspects of valuation, i.e. financial, service, operational and human resources aspects (referring to Article 59 of the Minister of Public Works Regulation No. 18 / PRT / M / 2007 concerning the Enforcement of SPAM Development).

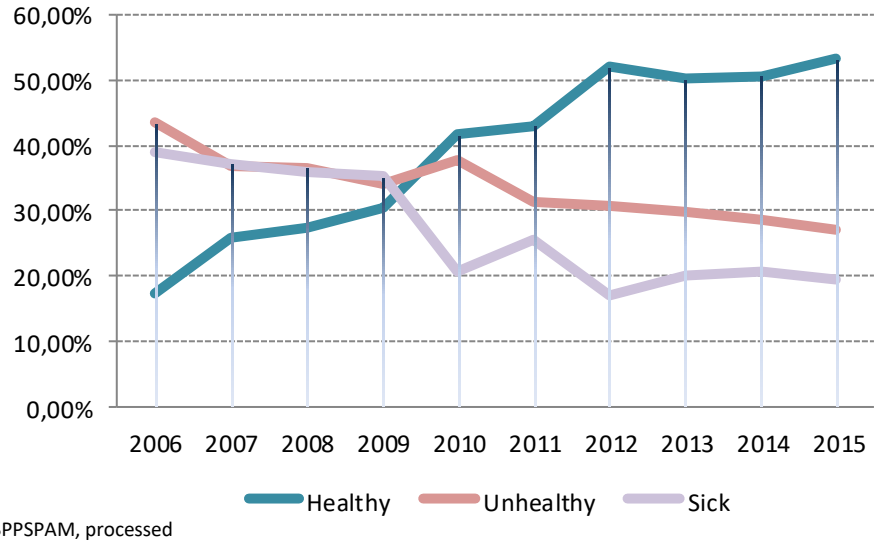
Picture 7. The Development of PDAM Performance 2006 -2015



Source: BPPSPAM, processed

From year to year during the period of 2006 -2015, the number of PDAMs of category "healthy" increased significantly while the number of PDAM category "sick" and "unhealthy" decreased. Based on the PDAM performance evaluation in 2015 over 368 PDAMs in Indonesia, 196 PDAMs (or 53.3%) were categorized "healthy", increased from 2014 by 50.7%. In contrast, the number of PDAMs for "unhealthy" and "sick" categories declined in 2015 to 27.2% and 19.6% respectively compared to previous year of 28.7% and 20.6% respectively.

Picture 8. The Percentage of Healthy PDAMs Continues to Increase



Source: BPPSPAM, processed

BOX 2 : General Issues of PDAM

According to research conducted by Indonesian Drinking Water Companies Association (Perpamsi), the common problems faced by PDAM are as follows :

- Very large debt
- Service Coverage is low
- The level of water loss (Non Revenue Water or NRW) is quite high
- Receivables collection rate is low
- The constituent cost of production has increased
- Water tariffs have not covered cost of production
- Labor inefficiency
- Investment policy is less directional
- The intervention of Local Government and The Regional People's Representative Assembly (DPRD) is quite high in making company policy

The PDAM's performance evaluation by BPPSPAM is divided into four regions, namely Region I (Sumatera Island) consists of 100 PDAMs, Region II (Java Island) of 108 PDAMs, Region III (Kalimantan and Sulawesi Islands) of 110 PDAMs, and Region IV (Bali Island, NTT, NTB, Papua and Maluku) of 50 PDAMs. The distribution and performance status of all PDAM in detail can be seen in Table 3 hereunder.

Table 3. PDAM's Performance by Province and Region in 2015

Area	Province	Healthy	Unhealthy	Sick	Total
I	Aceh	3	6	6	15
	Sumatera Utara	6	6	6	18
	Sumatera Barat	7	7	2	16
	Riau	1	3	2	6
	Kep. Riau	2	1	0	3
	Jambi	2	6	1	9
	Sumatera Selatan	4	4	5	13
	Bangka Belitung	0	2	4	6
	Bengkulu	1	3	3	7
	Lampung	1	3	3	7
II	DKI Jakarta	1	0	0	1
	Banten	6	0	0	6
	Jawa Barat	21	2	0	23
	Jawa Tengah	34	1	0	35
	D.I. Yogyakarta	5	0	0	5
	Jawa Timur	29	5	4	38
III	Kalimantan Barat	1	6	6	13
	Kalimantan Tengah	8	5	1	14
	Kalimantan Selatan	11	1	0	12
	Kalimantan Timur	7	2	0	9
	Kalimantan Utara	4	0	0	4
	Gorontalo	1	3	1	5
	Sulawesi Tengah	4	3	1	8
	Sulawesi Selatan	10	5	8	23
	Sulawesi Barat	1	2	0	3
	Sulawesi Utara	0	5	4	9
	Sulawesi Tenggara	0	4	6	10
IV	Bali	8	1	0	9
	Nusa Tenggara Barat	4	3	1	8
	Nusa Tenggara Timur	7	5	3	15
	Maluku	3	1	2	6
	Maluku Utara	2	3	1	6
	Papua	2	1	1	4
	Papua Barat	0	1	1	2
	TOTAL (NATIONAL)	196	100	72	368

Source: BPPSPAM

PDAMs have a strong internal commitment to change its status from "Sick" or "Unhealthy" to "Healthy" by improving the company performance. Nevertheless, one important key factor is the role of BPPSPAM in providing continuous assistance by directly meeting local government as the owner of PDAMs.

The "Sick" and "Unhealthy" performance of PDAMs illustrates that almost half of the PDAMs operating in Indonesia have an unhealthy financial condition as a result of low operational efficiency and significant debt inducements. Most of the PDAMs suffered losses due to high operational costs when compared to the income they earned. In most of the PDAM operational areas, the water tariff rates are below its production costs so that many PDAMs suffer losses from year to year. In addition, the large portion of the debt causes the high burden of debt obligations to pay interests.

From the 368 PDAMs in Indonesia, nearly half are suspected to suffer losses as a result of inefficiencies in investing financed by debt and also in terms of operations. This causes the PDAM to not perform its duties properly in providing services to the public.

From a technical point of view, the inadequacy of water tariffs against production costs has an impact on:

(i) The water quality provided by PDAM is not sufficient;

(ii) Disruption of investment continuity to expand business so that it can cause complaints from customers as users of PDAM service.

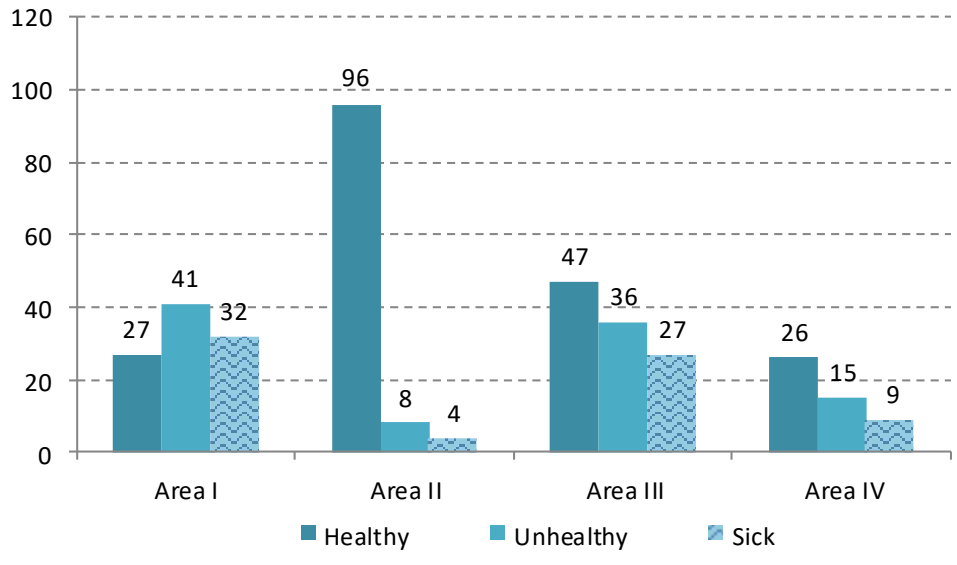
Table 4. The Composition of PDAM's Performance by Operational Areas

Area	Island	Healthy	Unhealthy	Sick	Total
I	Sumatra	27	41	32	100
II	Java	96	8	4	108
III	Kalimantan & Sulawesi	47	36	27	110
IV	Papua, Maluku, NTT, NTB, Bali	26	15	9	50
	TOTAL (NATIONWIDE)	196	100	72	368

Source: BPPSPAM

Meanwhile, regarding the management of PDAM, the management of "Sick" or "Unhealthy" companies cannot be considered efficient. Corporate accountability is considered low because it managed with a closed corporate management model that provides an opportunity for bureaucratic intervention in the company's decision-making process. The implication is that PDAMs tend to be slow in responding to market dynamics. The use of resources is also considered inefficient with a considerable amount of human resources but with low levels of employee productivity. This will further burden the company's financial condition. Ultimately, the financial hardship cycle causes the "Sick" or "Unhealthy" PDAM category to be inoperable to meet the expected performance standards.

Picture 9. The graph of PDAM's Performance Composition by Region



Source: BPPSPAM, processed

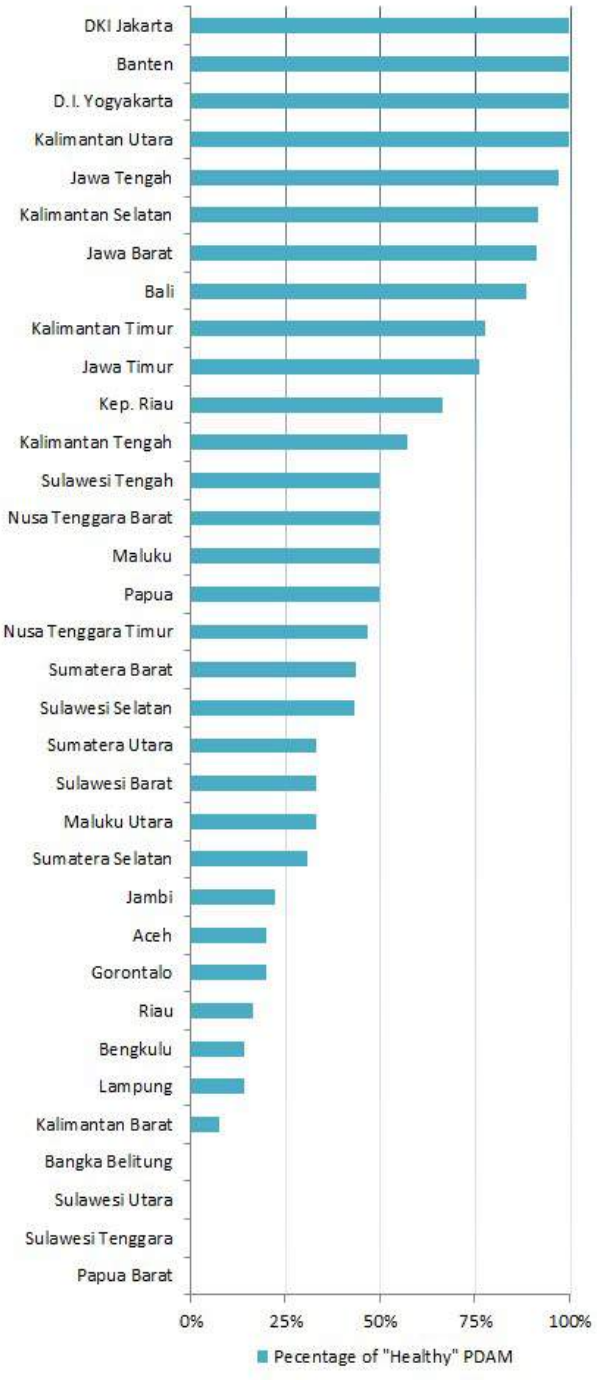
The composition of PDAM's performance by region shows uneven distribution of PDAM's performance throughout Indonesia. Until 2015, Region II covering the area in Java island has the highest percentage of "Healthy" companies with 48.98% followed by Region III which covers the operational area on Kalimantan and Sulawesi islands with 23.98%. The high percentage of healthy PDAMs in the region is highly determined by its better infrastructure and higher water tariff than other regions.

Table 5. PDAM Performance Criteria

PERFORMANCE	ANNOTATION	SCORE
Healthy	PDAM able to grow, capable to manage loans, capable of replacing assets, efficient in carrying out operations, and capable in achieving business profit	> 2.0
Unhealthy	PDAM is less developed, revenue can only cover operating costs, the risk of failure in debt settlement is high	> 1,7 - 2,0
Sick	PDAM is not growing, suffer losses, operations is based on limited resources, having problems of troubled loans settlement	= 1,7

Source: BPPSPAM

Picture 10. "Healthy" PDAM by Province in 2015



Source: BPPSPAM, processed.

The distribution of PDAM's performance by province also shows uneven distribution of PDAM's performance. A number of provinces do not even have PDAMs with "Healthy" performance. These provinces include the Provinces of West Papua, Bangka-Belitung, Southeast Sulawesi, and North Sulawesi. While Banten Province with 6 PDAM, D.I. Yogyakarta with 5 PDAMs, North Kalimantan with 4 PDAMs and DKI Jakarta with 1 PDAM is a province with the largest percentage of "Healthy" PDAMs with the highest performance of 100% or all PDAMs in the region have sound performance.

Until 2015, most of the PDAM companies in Indonesia are still entangled debt problems whose value is quite large of around IDR 4.24 trillion. These debts are mostly obtained from the world's financial institutions such as the World Bank, the Asian Development Bank (ADB) and the Overseas Economic Cooperation Fund from Japan (OECF) which is then forwarded by the central government to PDAMs throughout Indonesia through the Ministry of Finance.

The Government - through APBN-P 2016 which has been passed by the House of Representatives (DPR) in the plenary session on June 28, 2016 – has allocated IDR 3.9 trillion for PDAM's debt exemption program throughout Indonesia to make them healthy and able to serve quickly in providing clean and healthy drinking water for the community. At least, there are 107 PDAMs whose debts and interest are removed with a grant scheme from the central government to the regions, which subsequently becomes Equity Participation of Local Government to the PDAMs. Previously there were 176 PDAMs who were indebted. After going through the restructuring process and some repayment mechanisms ended up leaving only 107 PDAMs whose debts had to be settled by the government .

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