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Spring water as the water source for Cirebon, Kuningan, and Majalengka region

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Abstract. Water is a primary substance in the world yet the amount of usable freshwater is limited. Spring water is one of freshwater supply although it is not as common as river or reservoir or groundwater due to its limited existence. Cirebon Municipality, Cirebon Regency, Kuningan Regency, and Majalengka Regency are some regions who depend heavily on spring water for their water supply. People on those regions consume water from springs for domestic use, drinking, industry, and irrigation. However, with the growing population and the change in land use, it is likely that springs alone cannot meet the water demand in future. Groundwater extraction and river intake are the easiest solutions yet they have their shortcomings which render both approaches infeasible. The most feasible solution are to gradually detach from spring as water source for large regional scale and to build more water reservoirs to keep up with the escalating regional water demand.

1. Introduction

Humans need freshwater for their daily life in sufficient quality and sufficient quantity. Either for drinking, sanitation, household chores, industry etc, clean freshwater must be readily available whenever people need it. Earth contains abundant water within, however, clean freshwater is not accessible by many people, creating water scarcity in some parts of the world. Mekonnen and Hoekstra reported that about 4 billion people severely lack water and Indonesia is also included [1]. World Economic Forum also listed water crises as the number one risk in the world in terms of impact [2]. These are but few examples to point out that exploitable freshwater is an invaluable resources which must be consumed astutely and conserved wisely.

There are two most common freshwater sources i.e. groundwater and surface water (e.g. river, lake, reservoir etc). Water spring holds special place as it sits somewhere between them. Spring water is usually classified as groundwater, but instead of being extracted or pumped as how groundwater is typically utilised, it bursts out to ground surface due to its pressure and its corresponding geological formation (note that from this point forward, the term “spring water” refers to the water which is utilised as it emerges from ground, not by being extracted or pumped from underground).

Spring water is rarely utilised as the primary water sources as springs are quite few, let alone large-scale springs to supply populous region. Nonetheless, there are people on Earth who completely depend on spring water for their daily activity. The examples are small rural village Minas Gerais in Brazil [3], German spring and Mosel spring which serve 20.000 and 50.000 people respectively in Buea, Cameroon [4], and Xin’an spring with its average flow of 10,10 m³/s, supplying Changzhi city, China [5] whose population is more than 3 millions.



2. Literature Review

2.1. Regional Administration and Demography

Cirebon Municipality, Cirebon Regency, Kuningan Regency, and Majalengka Regency are the municipality/city and the regencies which are located on the northside of the West Java Province, Indonesia. Cirebon Municipality and Cirebon Regency are located near the coast while Kuningan Regency and Majalengka Regency are located near the Mountain Ciremai. Those four regions are adjacent to each other as displayed on Figure 1.



Figure 1. The map of Cirebon City, Cirebon Regency, Kuningan Regency, and Majalengka Regency from Google Earth (slightly edited as Mt. Ciremai is inserted)

The characteristics of each region are presented in Table 1. The figures are collected from Cirebon Municipality in Figures [6], Cirebon Regency in Figure [7], Kuningan Regency in Figures [8], and Majalengka Regency in Figure [9]

Table 1. The statistics of Cirebon Municipality, Cirebon Regency, Kuningan Regency, and Majalengka Regency (based on the regional official statistics)

	Cirebon Municipality	Cirebon Regency	Kuningan Regency	Majalengka Regency
Area (km ²)	37,34	990,36	1.195,71	1.204,24
Population (in 2016)	310.486	2.143.000	1.061.886	1.188.004
Population growth (2015-2016, %)	1,08	0,79	0,61	0,50

2.2. Existing Regional Water Supply System

The review of the existing water supply system for each region will be elaborated here, compiled from the references as follow and displayed in Table 2 :

- The Masterplan of The Drinking Water Supply System of Cirebon Municipality [10];
- The Masterplan of The Drinking Water Supply System of Cirebon Regency [11];
- The Infrastructure Profile of The Drinking Water Supply System of Kuningan Regency [12]; and
- The Masterplan of The Drinking Water Supply System of Majalengka Regency [13]

Table 2. The summary of the existing regional water supply system (compiled from the various sources)

	Cirebon Municipality	Cirebon Regency	Kuningan Regency	Majalengka Regency
Population (years varied)	310.486	2.143.000	1.061.886	543.446
Population distributed by the state water	245.045	269.482	Estimated < 200.000	108.630
Service coverage (%)	79,00	14,63	Estimated < 20	19,99
Notable freshwater source	Paniis spring (910 litre/s)	a. Cikahalang spring (100 litre/s) b. Cibodas spring (70 litre/s) c. Cipujangga spring (50 litre/s)	a. Cibulakan spring (75 litre/s) b. Cigorowong spring (750 litre/s) c. Cibacang spring (500 litre/s)	a. Cipadung spring (75 litre/s) b. Cipada spring (581 litre/s) c. Cigimpur spring (348 litre/s)

The entire Cirebon Municipality solely relies on Paniis spring for its water supply [10]. The spring is located at the foot of Mt. Ciremai in Kuningan Regency and it is about 8,2 km apart from the municipality. It discharges approximately 910 litre/s of water and the long pipeline was constructed to distribute the spring water toward the state-owned water company (later will be referred as PDAM or Perusahaan Daerah Air Minum) of Cirebon Municipality then distributed to the entire region. Not everyone receives the service from PDAM though as there is still 21 % of population who is not connected with PDAM's water pipeline.

Cirebon Regency utilizes various water sources to meet its water requirement [11]. PDAM of Cirebon Regency extracts the water from multiple springs to fulfill the people's water demand. The three biggest one are mentioned in Table 2 i.e. Cikahalang, Cibodas, and Cipujangga (the other smaller springs are not mentioned). Most of the springs are located in Kuningan Regency. It is staggering that only 14,63 % of the entire Cirebon Regency population receive the water from PDAM while the rest extract the groundwater by themselves. Due to its large population (implying massive water demand) and large area combined with contaminated rivers, saltwater intrusion, and no reliable large water springs, Cirebon Regency regularly suffers water shortage almost every year.

Most of the people in Kuningan Regency also are not connected with state-owned water pipeline [12]. PDAM Kuningan only utilizes the water from Cibulakan spring (providing 75 l/s) and distributes it to the nearby area. However, they generally do not suffer water scarcity like Cirebon Regency does as Kuningan regency has a lot of natural springs. From the inventory of springs listed by the Public Works Service of Kuningan Regency [14], there are more than 500 springs with varied discharge, ranging from 1 litre/s to hundreds of litre/s. The largest springs recorded are Cigorowong spring and

Cibacang spring, their normal discharge are 750 l/s and 500 l/s respectively. Since there are many springs available, the people of Kuningan Regency rarely suffer water shortage by as they draw spring water by themselves.

The situation in Majalengka Regency resembles Kuningan Regency. PDAM Majalengka extracts the water from Cipadung spring for the nearby area while the rest of people utilize water from natural springs. There are about 400 springs and the largest two are Cipadung spring and Cigimpur spring, normally providing 581 litre/s and 348 litre/s respectively. Generally, the people of Majalengka regency have their water demand sufficed by exploiting spring waters by themselves.

3. Analysis

Kuningan and Majalengka are on the foot of Mt. Ciremai which is the national conservation park. The pristine environment allows the large quantity of groundwater reserve in the area hence there are so many natural springs at its surrounding i.e. in Kuningan and Majalengka. Most of them are unprotected spring and the people are free to use it. The abundance of water guarantees the water availability for the locals and the water even can be exported to neighbouring regions such as Cirebon Municipality and Regency.

Cirebon (both Municipality and Regency) are mostly located on lowland and coastal area. The distance is very far from Mt. Ciremai hence there are only very few springs in the regions. Therefore, in order to meet their water demand, Cirebon rely on the large springs in Kuningan and Majalengka. To date, the water from Paniis spring is still sufficient for Cirebon Municipality, but this is not the case with Cirebon Regency. The water from multiple springs from Kuningan and Majalengka cannot suffice the water demand of Cirebon Regency's large population.

Thus, in order to satisfy their water requirement, most Cirebon Regency people extract groundwater by themselves while few others utilize the water from rivers or streams. However, both approaches have the drawbacks :

- The excessive groundwater extraction will cause land subsidence and seawater intrusion. While land subsidence has not been the main issue, seawater intrusion has been a constant public outcry for years.
- The water from rivers or streams has been heavily contaminated from upstream. Furthermore, the discharges are not sufficient for the entire population of Cirebon Regency especially during dry season.

From the paragraphs above, we can deduce the characteristics of spring water when it is utilised for mass water source. Its advantages and disadvantages are :

- It is markedly less polluted than surface water like lake or river as the water is concealed beneath ground before it resurfaces.
- The discharge is quite stable, there is less discrepancy in its discharge between wet season and dry season.
- It is very easily exploitable. Unlike groundwater which requires digging/drilling and automatic pump (or mechanical pulley), people simply take the water from spring either by manual labor or by piping it toward recipient area.
- However, it takes certain site characteristics to form a spring, let alone a large spring which is adequate to supply the water in mass scale. In this case, it requires a well-conserved land (the example here is Ciremai National Park) and a certain geological formation in order to allow water to emerge at ground surface.
- Land use change from forest or any conserved land to settlement or industry will diminish the discharge coming out of spring significantly. It is very likely to happen especially in a country with massive rate of deforestation like in Indonesia.
- Spring's discharge is relatively small hence it cannot provide water for large population.

4. Conclusion and Recommendation

Spring water is the main source of clean water for Cirebon Municipality, Kuningan Regency, and Majalengka Regency. Kuningan and Majalengka people can easily access the clean freshwater. Meanwhile, Cirebon must build a very long pipeline (8,2 km) in order to transport the spring water.

In the meantime, the majority of Cirebon Regency must rely on groundwater while the minority rely on river flow. However, seawater intrusion and land subsidence are becoming major issues if the groundwater is kept being extracted excessively. Meanwhile, the rivers in Cirebon Regency tend to be polluted especially in the downstream and there is little water available during dry season.

Spring water typically only has local coverage such as nearby rural area due to its relatively small discharge. Even the large spring like Paniis spring can only provide for a region with relatively low population. It is quite improbable to rely on spring water to meet the water demand of people when the order of the population is already at millions.

In order to fulfill the water demand of the people, especially in future when the population will be larger than now, it is important to build reservoirs in the aforementioned regions. The government already built Jatigede dam which will supply 3.500 litre/s of water for domestic use (and for 90.000 ha farm and 690 GWh/year electricity) and several other dams. Furthermore, small reservoir (often called situ or embung) also must be constructed so the people do not need to depend on large dams if the distance between the supply and the demand is very far. If the small reservoirs are available, the locals in vicinity will be able to easily utilize water by themselves.

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