Spatial Variation of Water Supply Provision in Bandung Metropolitan Area

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Abstract

World is rapidly urbanizing. The urban population significantly grows and expands to its surrounding areas; forming a metropolitan area. It leads some problems such as difficulty in integrating water supply provision. This paper is intended to explore the conditions and problems of water supply provision in metropolitan area. This paper explored water supply condition in the Bandung Metropolitan Area (BMA), which is divided into the core area, peri–urban, and rural areas. By knowing the conditions and problems of infrastructure provision, right solution to overcome the existing problems is expected to be proposed. Using descriptive statistic, analysis was done by comparing criteria of water service coverage, quantity of water consumed, quality of water consumed, continuity of water supply, and average cost with existing condition based on the location (the core area, the peri–urban area, and the rural area) as well as type of customer: PDAM customer and non–PDAM customer. By comparing those five criteria based on location and type of customer, the condition of water provision in BMA can be analyzed. Moreover the problem of water supply provision can be identified.

Keywords : Bandung Metropolitan Area; spatial variation; water supply provision.

Introduction

World is rapidly urbanizing. This immense growth cannot only be accommodated by the core areas, particularly in the context of land availability. As a result of lack of land availability in the core areas, peri–urban areas start developing. Allen, *et al.* (2004) projected that for the next five decades most of the growth in the world's population will be in urban areas and much of this growth and the accompanying spatial expansion will be in peri–urban areas of medium–sized cities and metropolitan regions. Population growth in the urban centers have significantly declined, whereas in the adjacent areas population growth is relatively high, which may reflect the rapid spillover of population growth in the urban centers to the surrounding areas. The peri–urban areas are currently experiencing the most active urbanization (Shia, *et al.*, 2012).
The emergence of the peri–urban areas bring on some phenomena in various spatial dimensions such as spatial segregation, structural fragmentation, and infrastructure deficiency that occur between different new towns built by different developers as well as between the new towns and their surrounding areas (Firman, 2004; Hudalah, *et al.*, 2007). As a consequence, it is difficult to integrate the infrastructure provision. Moreover, some of the peri–urban areas are not served yet with the infrastructure and services.

The imbalances in access to all sorts of essential infrastructure and services not only occur between core and the peri–urban areas but also between urban (consisting of the core areas and the peri–urban areas) and the rural areas within metropolitan areas. In accordance with UNESCAP (2001), there are significant disparities between urban and the rural areas within the countries of Asia and the Pacific such as in the form of access to essential infrastructure and services. Furthermore, according to Satterhwaite (2000) in UN–Habitat (2008), access to infrastructure and services in the rural areas is more limited than in urban area largely caused by: (1) the distance; (2) low density; and (3) limited capacity to pay.

Household water supply problem is one of the major challenges faced in developing countries (Palamuleni, 2002). Some developing countries have been unable to match investments and maintenance in urban infrastructures especially in urban water (Keener, *et al.*, 2010). This mismatch has led to a slow down and in some cases a complete halt in the expansion of service delivery to informal settlement (Jimenez–Redal, *et al.*, 2014). This problem is not only due to financial problems (Ferguson and Navarrete, 2003) but also technical and social (Jimenez–Redal, 2014) as well as lack of political will (Davis, 2004) therefore the government must be really selective in determining the service priority (Ferguson and Navarrete, 2003).

As explained before, it seems complicated to meet the needs of basic service delivery such as water supply in the context of metropolitan areas. For that reason, interventions for water provision are required to ensure adequate water to all (Nickson, 2002).

This research is conducted in BMA which in 2012 has 8,194,645inhabitants that spread in a 2,308.028 km^2 area. Spatial pattern of BMA can be classified into core area, peri–urban area, and rural area (see Fig. 1). The classification is based on the proportion of built up area, number of population, and economic activity.

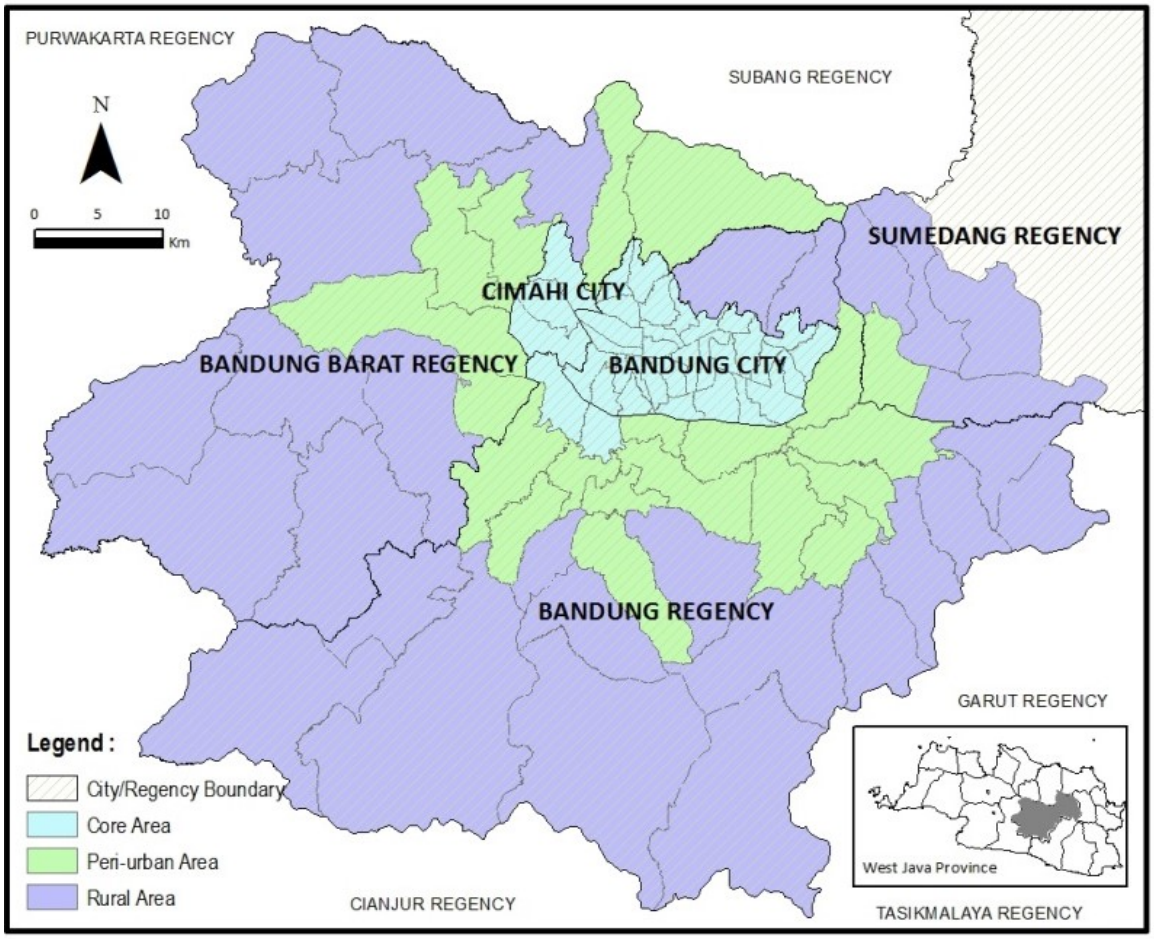

Figure 1. Spatial Pattern of Bandung Metropolitan Area

Public water supply provision in BMA is managed in region or city level by local water enterprise, namely Perusahaan Daerah Air Minum (PDAM). There are three PDAMs that operate the water service delivery in BMA. They are PDAM Tirtawening which serves Bandung City, PDAM Tirta Raharja which serves Bandung Regency, Cimahi City, and West Bandung Regency, and PDAM Tirta Medal which serves Sumedang Regency. From 8,194,465 populations in BMA, only 2,342,876 or 28.59% were served by PDAMs. PDAM Tirtawening has the largest coverage compared to other PDAMs in BMA which is 21.84% of total population in BMA, followed by PDAM Tirta Raharja (6.46%), and PDAM Tirta Medal (0.28%).

Material and Methods

The data used in this research consist of primary and secondary data. Primary data was collected through distributing 176 questionnaires to the households in the core, peri–urban and rural area of BMA. The questionnaires were designed in order to gather information related to water supply condition in each area that was evaluated based on criteria developed by WHO (1997): (1) water service coverage, (2) the quantity of water consumed; (3) the quality of water consumed; (4) the continuity of water supply; and (5) the average cost. Analysis was done by comparing the five criteria with existing condition based on the location (the core area, the peri–urban area, and the rural area) as well as type of customer: PDAM customer and non–PDAM customer.

Results and Discussion

Characteristics of Respondents

Characteristics of respondents can be categorized as PDAM customer and non–PDAM customer. For PDAM customers, according to housing ownership, most respondents are the homeowners (94%) and mostly number of family member is four. The education level of the head of household for PDAM customers in this study varied and ranged from those who have never been school to those who have completed high school education. The majority of the head of households have attended high school. The average of total income of all respondents is Rp 4.5 million per month with the minimum amount is Rp 0.6 million per month and the maximum is Rp200 million per month.

For non–PDAM customers, most respondents are the homeowners (92%) and mostly there are four people (members of the family) that live in a house. The majority of the head of households have attended high school and the range of income earned is between Rp 0.35 million to Rp 35 million per month, with the average income of all households is Rp 3.7 million per month.

Water Service Coverage

Public water supply which is operated and managed by PDAMs has not served the entire population in BMA yet. As explained in Table 1, only 28.59% of population in BMA served by PDAM. This coverage was below the national target that had been set by the central government, which was 60% for urban areas and 25% for the rural areas (see Table 1). In general, there are several obstacles that impede the target achievement of the service area coverage among such being minimal investment and trouble in sourcing water resources (VNG International, 2008).

Table 1. PDAMs service coverage based on spatial pattern

Area	PDAM Tirtawening	PDAM Tirta Raharja	PDAM Tirta Medal	Total	Population Served by PDAM	Population	Coverage (%)
The core area	150,684	15,453	–	166,137	1,921,282	3,239,755	59.3
The peri–urban area	–	44,362	1,881	46,513	421,594	4,954,890	8.51
The rural area	–	6,322	3,834	10,156			
Total	150,684	66,407	5,715	222,806	2,342,876	8,194,645	28.59

Source: PDAM Tirtawening, 2012; PDAM Tirta Raharja, 2012; PDAM Tirta Medal 2012

Some of PDAM customers not only acquire water from PDAM but also from multiple water sources from groundwater and bottled water. For those who do not use PDAM as primary source of water, the main sources of water in the peri–urban and in the rural area of BMA area are individual pumped water and piped water network provided by collectively–managed piped water schemes using groundwater and spring as source of water. On the other hand, in the core area, the households mostly acquire safe water from individual well and small proportion of piped water network run by community using groundwater. Some part of the area actually serves by PDAM pipeline, however there are several reasons why households do not want to be PDAM customer or use PDAM as primary source. Water quality, quantity, and continuity in their area are better compared to water from PDAM. Besides, cost of water from PDAM is more expensive compared to others. For those who neither use PDAM as primary source of water nor PDAM customers in the core area, they use secondary sources of water from vendors, bottled water, PDAM, groundwater, and communal system.

Quantity of Water Consumed

The total amount of water consumption by those used water from PDAM is nearly in accordance with the national planning average range between 150–190 liters per person per day. It can be seen that water consumption in the peri–urban area is the highest compared to other areas. Most respondents in all area perceived that the quantity of water consumed is sufficient for them.

Most households used water from PDAM acquires drinking water from other sources. It is because water supplied by PDAM cannot fulfill their needs in term of quantity and or quality. Apart from consuming safe water supplied by PDAM as the primary source, PDAM customers consume safe water from other alternative sources, such as bottled water and groundwater from wells.

Unlike those served by PDAM service, households which do not use water from PDAM have more flexibility to use water they need. It is because there is neither the calculation of the amount of acquiring water nor the water tariff structure for each volume of water consumed. Almost 100% of respondents who do not have access to PDAM perceived that the quantity of water consumed is sufficient for them.

Table 2. Average water consumed based on type of service

Water source	Type of service	Average water consumed (liters/person/day)		
		Core	Peri–Urban	Rural
PDAM	Only primary source	169	190	185
	Primary and secondary source	192	208	149
Non–PDAM	Only primary source	307	260	235
	Primary and secondary source	314	260	235

Quality of Water Consumed

Water quality in this research is assessed from physical indicators. All of respondents using water from PDAM stated that there were not any problems regarding taste and temperature (see Table 3). To fulfill the need of safe water without any risks, most PDAM customers both in the peri–urban area and in the rural–area also derive water supply, especially for drinking, from groundwater (wells and/or pumps).

Table 3. Quality of water consumed by households

Water source	Quality	Percentage by its location (%)		
		Core	Peri–Urban	Rural
PDAM	Colorless	95	37	77
	Odorless	81	53	43
	Tasteless	100	100	100
	Normal temperature	100	100	100
Non–PDAM	Colorless	87	94	94
	Odorless	91	97	100
	Tasteless	91	100	100
	Normal temperature	100	100	100

Table 3shows that households using primary source of water from non–PDAM perceived the quality of water better than that use primary source of water from PDAM. The existence of odor in water from PDAM is usually caused by the addition of chlorine in order to remove the bacteria in the water. Lower quality of water requires more quantity of chlorine. For those who are not PDAM customers, water quality is not a problem. If one source of water is in bad quality, they will find the better one. Sometimes the condition of water quality which is better compared to PDAM causes them not to be PDAM customers. Regarding the location, the quality of water for those using PDAM as primary source of water is better in the core area than in the peri–urban and rural area, meanwhile for those using non–PDAM as primary source of water, the quality of water is better in the rural and peri–urban area compared to those in the core area.

Continuity of Water Supply

As described in Table 4, continuity of water supplied by PDAM is worse than that of non–PDAM and overall the continuity in the core area and the peri–urban area performs better than in the rural area. One of the reasons of the unstable continuity of water supply is PDAM's lack of capacity to get raw freshwater from upstream water bodies. The problem is PDAM does not manage water smartly (IRSDP BAPPENAS, 2011). The unmanaged water bodies (river basin, lakes, and water retentions ponds) have caused reduced amount of raw freshwater for the water treatment plant intake (Juliman, 2014) thus causing limited availability in distributing safe water to the costumers at the same time.

For this case, PDAM priorities to build the facilities such as water treatment plant and reservoir in the core area and they are extended to the peri–urban area and the rural area. It is one of some factors causing difference performance between the locations for PDAM service. Since safe water produced is limited, the households in the core area get the priority. Besides, since there are three different PDAMs operating in BMA, the differences can be caused by the different service performance itself.

Table 4. Continuity of water supply

Water source	Service duration	Location		
		Core	Peri–Urban	Rural
PDAM	24–hours per day	80%	80%	53%
Non–PDAM	24–hours per day	96%	100%	87%

Cost

Table 5 shows most respondents in BMA can afford to pay the average monthly bills to get water services from PDAM. It is also known that the average monthly spending for PDAM users is higher than non–PDAM users. The proportion of respondents with monthly water spending less than 3% of income is

also smaller for group of PDAM than non–PDAM. Based on the location, households in the rural area pay less compared to those in other areas. It can be caused by less volume of water consumed in rural area than those in the core area and the peri–urban area. In addition, different water tariff for each PDAM (for those using water from PDAM as primary source) is one of the aspects that make the difference of average monthly cost of water consumed as well.

Table 5. Cost of water and ability to pay

Water source	Water cost	Location		
		Core	Peri–Urban	Rural
PDAM	Average monthly cost	99,000	101,000	74,000
	Percentage of respondents with Water spending < 3% of income	95%	80%	93%
Non–PDAM	Average monthly cost	26,000	24,000	13,500
	Percentage of respondents with Water spending < 3% of income	96%	97%	100%

Conclusion

Water service provided by PDAM in Bandung Metropolitan Area is still limited and concentrated in the core area. Households both in the peri–urban area and the rural area have less access to water supply provided by PDAM compared to them in the core area. In some areas, although it is easy to get a PDAM connection, the communities are not preferred to acquire safe water from PDAM as a primary source. In many cases, the households reveal that quantity, quality, continuity of safe water provided by PDAM are as not as good compared to other water sources that they are able to use. Moreover, the cost of water supplied by PDAM is higher compared to other sources such as individual water provision system and communal water provision system.Although most households in BMA are not PDAM customer, they can acquire safe water with good quantity, quality, continuity, and cost. The quantity of water used by a non–PDAM customer is greater than a PDAM customer, with better continuity and cost than the services provided by PDAM. For quality of water, the proportion of non–PDAM customers which perceive the water with good quality is larger than PDAM customers.

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