Article

Study on the Domestic Water Utilization in Kota Metro, Lampung Province, Indonesia: Exploring Opportunities to Apply the Circular Economic Concepts in the Domestic Water Sector

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Abstract: Providing reliable public water service is a big challenge in Indonesia, especially for small cities, due to various constraints such as budget, regulation, and technical problems. Besides, people's preferences play a significant role in domestic water utilization. This research particularly aims to identify factors influencing public preferences for domestic water use in Kota Metro, Lampung Province, Indonesia to find the reason why public water service is less preferable in this city. We did a household survey and performed a multinomial logistic regression and multiple correspondence analysis to investigate the preferable domestic water source and influential factors determining the choice. We found that accessibility and water quality are the two strongest motives in choosing domestic water use. Our analysis also shows that the respondent's choice is influenced by his or her income, family size, and proximity to the pipe network. Subsequently, we synthesized our empirical findings and the existing situation of the domestic water fulfillment in Kota Metro to suggest an improvement proposal inspired by the circular economy concepts. We recommend a mixture of a pipe water service and community-based water management to improve the current domestic water fulfillment.

Keywords: domestic water utilization; influential factors; Kota Metro; public preferences

1. Introduction

In 2019 the Badan Pusat Statistik (Central Bureau of Statistics—BPS) recorded that 89.27% of households in Indonesia have already had access to decent drinking water [1]. Not only that, but Indonesia has been noticed by WHO and UNICEF as a country that successfully achieved 90 percent of accessing drinking water at the basic level [2]. In Kota Metro, which is a small city located in Lampung Province, Indonesia, the data shows that 79.48% of 42,298 households have already had access to water but only 5.05% of them are served by piped water service provided by the local government [3]. This is below the average percentage of households that utilize piped water at the national level, which is 10.37% [4].

Indeed, providing a reliable public water service is a big challenge, which requires a big investment and involves various interests [5]. In the context of Indonesia, the responsibility to provide this basic need belongs to the city governments, yet it is still under the coordination of the national government. Thereby, developing domestic water infrastructure is much more challenging especially for small cities where their limited budget cannot afford the big investment required. For instance, Nepal required USD 11.684 million to develop infrastructures and supporting facilities to provide basic water supply

services for 90,397 households in 2012 [6]. The Indonesian government, in particular, allocated IDR 950 billion (approximately USD 63.780 million) to expand the water pipelines targeting for 290,000 households in 2018 [7]. Despite this big effort, the piped water still shares a less significant portion of the domestic water fulfillment in Indonesia and becomes less preferable year by year [8]. Therefore, this tendency causes the domestic water sector to be economically unattractive for investment because of the small revenue from customers. From the perspective of resource utilization, excessive and uncontrolled groundwater abstractions degrade the environment and threaten the sustainable water supply. Then, it is exacerbated by the extract-use-dispose practice in domestic water utilization and the wastewater has not been well managed.

Many studies revealed the negative impacts of excessive groundwater abstraction [9,10]. In Indonesia, specifically, a similar phenomenon appears. For example, Chussard et al. [11] detected the appearance of land subsidence due to rapid groundwater abstraction for industrial and agricultural uses. Moreover, domestic uses also contribute significantly to groundwater depletion resulted from rapid population growth and land-use change [12]. Indeed, human activities cannot be simply separated from the issue of the water requirement and the land-use change that subsequently contributes to the groundwater depletion [13]. In the case of Indonesia, BPS recorded a 255.6 million population in 2015, which is projected to increase with 1.07% population growth [14]. Moreover, the Welfare Statistics 2019 [1] reported that 65.17% of households in Indonesia access their domestic water by individual groundwater abstraction. This report also noted that 33.37% of households consume bottled water for potable needs and the percentage is far higher compared to the last 10 years. In 2009, it was recorded that 66.21% of households exploit individual groundwater wells and 13.05% of households consume bottled water for potable needs [15]. The trend of the population growth and the domestic water utilization commonly appear in all regions of Indonesia including Kota Metro. At first glance, there is not a big problem regarding the issue of domestic water utilization, and the current reports shows positive data on the achievement of domestic water fulfillment. However, the big portion of the individual groundwater abstraction, which has not been significantly changed year by year, combined with the increasing population trend is an alarming situation considering the negative impacts caused by excessive groundwater exploitation. Moreover, the significant change in bottled water consumption for potable needs might also be viewed as one of the indicators for the degradation of water quality. Aside from the problem that seemingly does not exist nowadays, this research is motivated by a concern to anticipate potential problems that may appear in the future. Furthermore, the situation could be worse in small cities where resources to provide reliable public water services are limited.

Apart from the low capacity of the service provider, public preferences can probably be highlighted as the reason why the piped water service is less preferable [16,17]. Moreover, to choose preferable domestic water sources, people are driven by various factors such as household socio-economic background [16,17], spatial characteristics [18], water price [19,20], and the seasonal water availability [21]. These studies suggested that the assessed factors significantly influence people's opinions and decisions in choosing preferential domestic water use and can be an essential consideration in the development of the domestic water sector. Moreover, the issue of public preferences in the development of the domestic water sector is likely overlooked in Indonesia.

This research specifically aims to investigate factors influencing the community to choose a preferable domestic water source. We viewed that the current trend on domestic water utilization should have a certain reason attached to the choice. The exploration of this issue is expected to reveal the community's perception and opinion related to domestic water use. Subsequently, the results can be used as inputs to formulate improvement strategies. Furthermore, many alternatives can be taken for improvement strategies either from the perspective of the supply-side or the demand-side. For example, the supply-side management can be done by conserving water resources, rain harvesting, improving public water service provision, and so forth. Meanwhile, demand-side management can be done by various measures such as changing consumption patterns, educating the community to use water efficiently, etc. In this paper, we expanded the discussion with the exploration of the possibilities

to apply the circular economic concepts in dealing with domestic water provision considering the merits offered by the concepts. Heshmati [22], for instance, argued that the circular economy concept could be used to deal with problems related to limited resources and growing demand. In the circular economy concept, environmental or resource problems can be managed not only by technological advancement but also through efficient allocation [23]. As a matter of fact, many studies reported the merits of circular economic concepts in the field of commercial enterprises [24,25]. However, studies exploring the role of public sectors in the circular economy focused more on regulating the transition while few of them discuss the issue in the context of the organizational level [26]. Moreover, study [27] suggested that the economic and social benefits gained from the circular economy activities are more effective when implemented at the regional level. From this point of view, expectantly, the findings of this research can be used as a valuable input to formulate alternatives to overcome the dilemma, which the local government frequently faces, in fulfilling domestic water needs. Not only that, but the discussion might widen the perspective of the circular economy at the micro level starting from the issue of community preferences for domestic water utilization.

We took Kota Metro in Lampung Province as the case study area to represent small or medium-sized cities in Indonesia. To inform, there are two types of administrative regions in Indonesia namely kabupaten and kota. It is recorded that there are 416 kabupaten and 98 kota in Indonesia. The kabupaten is characterized by a less dense population with a usually larger area than kota. The main economic activities in kabupaten are usually agriculture while trading and services are the main activities that commonly appear in kota. Furthermore, the main distinction between kabupaten and kota is the structure of the governmental apparatus. In kabupaten, at the lowest level (village), the village leader is directly elected by the village inhabitants every 5 years but in Kota, the leader of the village, which is called kelurahan, is appointed by the Mayor. Despite their difference, both are responsible for the upper tier of the governmental body, which is called kecamatan. Thus, the governmental structure consists of kabupaten/kota, kecamatan, and village/kelurahan. Furthermore, based on city categorization in Indonesia, Kota Metro is categorized as a medium-sized city, which is defined as a city with a population of 100,000 to 500,000 and Kota Metro is one of 72 cities that are in this category [28]. Although Kota Metro is categorized as kota, agricultural activities still exist in this city. It can be said as a transition from rural to urban areas. Like other cities, Kota Metro faces similar challenges to undergo rural-urban shifting and to manage the transition in the case of the public service provision. Unlike kota, kabupaten is considered to have a slower pace in the development of the public service and receives more support from the national government to accelerate the development. However, this assumption is not fully correct since many cities (kota) are struggling to develop their public service including domestic water provision.

In detail, we started our study by collecting information about the current achievement of the domestic water fulfillment in Kota Metro to grasp the initial understanding of the public water sector in the case study area. Then, we did a household survey after setting the expected respondents calculated from the existing population data. We interviewed 599 respondents coming from 22 kelurahan in Kota Metro. The kelurahan is an administrative entity that is the same level as a village. To simplify, we would like to use the term village to indicate the kelurahan. The 599 respondents were proportionally distributed following the proportion of each village population to the total population of Kota Metro. We started the interview by gathering information about the respondent's socio-economic background i.e., gender, age, education, occupation, family size, and monthly income. Afterward, we asked the respondents about the type of domestic water source mainly used every day, and the reason for the choice. To analyze the relationship between the respondent's choice on the domestic water use and the reason, we employed a multinomial logistic regression. Furthermore, we collected information about the availability of pipe networks surrounding respondents' residences. Indeed, we did not measure the exact distances but asked the respondents' opinions about the proximity of the piped water network. Then, we analyzed factors influencing the respondent's choice of domestic water use based on the respondent's socio-economic data and the availability of pipe networks using a

multiple correspondence analysis. The next issue that we explored is the water shortage experienced by the respondents and whether this occurrence encourages them to shift their current water use into public water service. We were motivated by a concern on the possible environmental degradation (indicated by the water shortage occurrence) and efforts to reduce individual groundwater exploitation. Eventually, we explored the circular economy concepts to be synthesized with empirical findings and the current status of public water service in Kota Metro to conceptualize alternatives in dealing with dilemmas in the domestic water fulfillment.

2. Materials and Methods

In conducting this study, we firstly collected the secondary data from the reports or other documents that were launched by the government of Kota Metro or other institutions. From this stage, we received initial information about the population of Kota Metro and current achievement in the domestic water fulfillment before setting up the plan for the field survey. Secondly, we estimated the number of expected respondents based on the population of Kota Metro. We started the estimation by setting the confidence level, the sample proportion, and the margin of error. Then, the sample size was calculated according to the following Equation (1) [29]:

$$n = \frac{\frac{z^2 p(1-p)}{e^2}}{1 + \frac{z^2 p(1-p)}{e^2 N}} \quad (1)$$

where n is the sample size, z is the z-score associated with a level of confidence, p is the sample proportion expressed in decimal, e is the margin of error expressed in decimal, N is the population size.

To specify, we set the confidence level at 95%, which corresponds to the z score of 1.96. The sample proportion (p) was defined at 50% and the margin of error (e) was desired at 4%. The population size that we used as the basis of the calculation was the population data of the Kota Metro launched by the city government. It was recorded that the population of Kota Metro in 2018 was 165,193 people [30]. The calculation resulted in 599 expected respondents that were proportionally distributed to all villages in Kota Metro following the relative percentage of the respective village population. In detail, the respondent distribution is illustrated in Table 1.

Besides functioning as proportional representation, the respondents' spatial distribution that is shown in Table 1 is an attempt to reduce potential common method bias. The availability of a pipe network, which is not available in every *kelurahan*, is one of the considerations of this respondent's spatial distribution setting. We also referred to previous works such as [17], to observe household attitude toward tap water service and [18], to explore the relationship between the household's socio-economic background and the domestic water choice. In addition, the result of our preliminary study [8], which was conducted through an online survey, was an important consideration to design the questionnaire. Furthermore, we also performed Harman's single-factor test, which is well known as a simple tool to recognize common method bias [31,32], with the assistance of the statistical software (SPSS version 23). The computation shows that the score of the assessed variables was 13.189%, which was far less than 50%. It implied that there was no threat of common method bias.

Thirdly, we conducted a household survey in November 2019. We followed the formal definition of the household defined by BPS, which is commonly used in the census. A household is defined as an entity composed of one or more people who occupy a housing unit. BPS recognizes two types of households, which are ordinary and special. A person who lives with his or her spouse, children, and/or relatives is categorized as an ordinary household. Additionally, a single person who rents a house or a room and provides his or her daily needs such as food, water, electricity, and so forth is also categorized as an ordinary household. Meanwhile, a special household is defined as a group of people living in the same building, and their daily needs organized by a certain institution. Boarding schools and orphanages are the two examples of special households. In this research, we only took ordinary households as our samples. Additionally, the term family size in the discussion refers to the

number of people who live in the house and do not show the family relationship with the respondents. Furthermore, we focused our survey on households that do not have major commercial activities in their houses. Thus, the water consumption is still in the context of domestic use. Nevertheless, it is difficult to separate domestic and commercial uses in some cases. In the case study area, some houses also function to run businesses, small restaurants, or kiosks. In the southern and northern parts of the Kota Metro, which are rural areas, some households also function their front yard to cultivate vegetables, fruits, or flowers for additional income. In selecting the respondents, we tried to avoid households who run business that required a large amount of water (e.g., restaurant or laundry) in the house to minimize the bias between domestic and commercial uses. However, households with kiosks that only sell products were still acceptable. Additionally, households with small plots for vegetables or flowers were also acceptable because this is a common practice in rural areas. We considered this an additional activity since their primary agricultural activities are in the rice field. To inform, the water requirement for rice cultivation utilizes surface water through the irrigation system provided by the national government.

Table 1. Population figures of each village in Kota Metro in 2018 and the numbers of expected respondents.

Subdistrict	Kelurahan	Area (km ²)	Population (People)	Relative Population Percentage (%)	The Numbers of Expected Respondents
Metro Pusat	Metro	2.28	14,405	8.77	54
	Imopuro	1.19	6849	4.11	28
	Hadimulyo Barat	1.50	14,012	8.53	44
	Hadimulyo Timur	3.37	8602	5.24	31
	Yosomulyo	3.37	8294	5.05	30
Metro Timur	Tejosari	3.76	2855	1.74	11
	Tejoagung	1.55	5671	3.45	21
	Iringmulyo	1.89	15,387	9.37	55
	Yosorejo	1.22	7610	4.63	27
	Yosodadi	3.36	8155	4.97	34
Metro Barat	Mulyojati	2.95	9601	5.85	32
	Mulyosari	3.03	2915	1.78	10
	Ganjar Agung	2.88	6798	4.14	24
	Ganjar Asri	2.42	9426	5.74	32
Metro Utara	Banjarsari	5.75	10,236	6.23	40
	Purwosari	2.55	5536	3.37	19
	Purwoasri	3.62	3996	2.43	12
	Karangrejo	7.72	8494	5.17	32
Metro Selatan	Sumbersari	4.25	2971	1.81	13
	Rejomulyo	4.75	4729	2.88	19
	Margodadi	2.87	2687	1.64	11
	Margorejo	2.46	4964	3.02	20
Total		68.74	165,193	100	599

In conducting the survey, we visited respondents' houses and interviewed with them through a prepared questionnaire. We firstly asked the respondents about their socio-economic background including gender, age, education, occupation, family size, and the total income in the household. Subsequently, we summarized the data on the respondents' socio-economic background to grasp the initial information regarding the respondent's characteristics. We considered the respondent's information as embedded attributes that could potentially influence opinion and perspective on the domestic water issues.

Fourthly, we elaborated on the respondent's main water source that was used daily for domestic purposes and the reason for choosing the preferable one. We asked the respondents about this issue

and summarized the data into a cross-tabulation table. To analyze the relationship between these categorical data (the choice of water and the reasons), we conducted a multinomial logistic regression with the assistance of statistics software (SPSS version 23) to perform the computation. The multinomial logistic regression was chosen because this method can be used as a predictive analysis tool to explain the relationship between 1 nominal dependent variable and 1 or more independent variables in the categorical data [33].

Furthermore, we analyzed factors influencing the respondent's preferences on the domestic water source using Multiple Correspondence Analysis (MCA). The MCA's ability to analyze an individual's characterization and contribution to the whole collected sample is MCA's strong feature making it preferable [34]. Not only that, but MCA also enabled us to quantify the respondent's preference, leading to a meaningful interpretation [35]. Additionally, visual illustrations derived from the calculation in MCA facilitates readers to more easily understand data features. We set our assumption regarding factors determining the respondent's choice of the domestic water needs in 3 aspects. These were the quantity of water requirement, the availability of public water service, and the respondent's purchasing power. Due to data unavailability, we associated the number of water requirements with the respondent's family size since the 2 aspects are positively correlated. Moreover, the existence of the pipe network surrounding the respondent's residence was considered to represent the availability of public water. It is interesting to assess whether the pipe network contributes to influencing the respondent's decision since this facility has not been fully available for all regions in Kota Metro. Further, we also explored the issues regarding the respondent's economic characteristic, which was represented by the monthly income. This was important because the financial aspect is an essential factor in the decision-making process, including choosing a preferable domestic water source.

The next issue that we explored was the water shortage experienced by the respondents and whether that occurrence could encourage them to shift their current domestic water utilization. We asked the respondents about their willingness to change their domestic water use into the public water service. It is motivated by the idea to reduce individual groundwater exploitation that is widely practiced in Kota Metro. Finally, we ended the interview with the respondent by confirming the reasons for those who are not willing to use public water service. We considered the importance of their opinions as valuable inputs to evaluate the public service performance and to formulate alternatives for improving domestic water fulfillment in the case study area.

Eventually, in the discussion section, we explored the principles of the circular economy and best practices in the implementations. Then, we revisited our findings to be confronted with the circular economy concepts. Combined with the current situation of the domestic water provision in Kota Metro, the findings were used as inputs to conceptualized possible alternatives following the principles of the circular economy activities, which are, creating a loop, slowing flows, and narrowing flows of the resource utilization [36].

3. Results

3.1. The Respondents' Socio-Economic Characteristics

To introduce, Kota Metro is a small city located in the southern part of Sumatera Island, Indonesia. Administratively, this city is a part of Lampung province. The area of Kota Metro is 68.74 km² inhabited by a population of 165,193 [30]. Regarding domestic water utilization, most residents use individual groundwater wells, which are constructed on their properties, to fulfill their domestic water needs. The report shows that 68.73% of households in this city rely on the individual groundwater well for potable uses [37]. Meanwhile, the pipe water subscribers are only 5.05% of the households. Figure 1a illustrates the map of Kota Metro and its existing piped water network. It can be seen that the population of Kota Metro is concentrated in the central part of the city, where the downtown is located. The economic activities in this area are dominated by the trade and service sectors. By contrast, the southern and the northern parts, which are characterized by rural areas, have less

density. The populations of these areas are mostly farmers cultivating rice and vegetables. To inform, the water requirement for agricultural activities is fulfilled by the irrigation system utilizing surface water as the main water source (as is illustrated by Figure 1b). The Ministry of Public Works is responsible for the irrigation networks and operates the facilities. Meanwhile, the city government is responsible for the domestic water service provision. Currently, the domestic water service is delivered through piped water networks that also mainly utilize surface water.

Figure 1. (a) The map of Kota Metro and the existing pipe network; (b) the agricultural irrigation system in Kota Metro; (c) water treatment plant for domestic water service in Kota Metro.

We started the interview by asking the respondents about their socio-economic backgrounds such as gender, age, education, occupation, family size, and monthly income as is summarized in Figure 2. The data shows that our samples were dominantly male, which was 72.79% of the total respondents coming from various groups of age ranging from teenagers to elderly. Regarding this issue, our sample was dominated by the respondents from the group of age 30 to age 60. In total, their proportion was almost three-quarters of the total samples. To specify, the respondents who were in their 40s had the biggest proportion, which was 29.55% of the total samples. Then, it was followed by the respondents who were aged in their 50s and 30s, which was 24.04% and 19.70%, respectively. On the other hand, the smallest portion, which was only 1% of the sample, was occupied by the elderly.

Figure 2. The socio-economic description of the respondents ($n = 599$).

Further, other socio-economic attributes that we elaborated on are the respondent's educational background and occupation. From the survey, our respondent's educational background was dominated by senior high school, which was 53.59% of the total sample. By contrast, there was only 0.33% of the total respondents who had a doctoral degree. The second-largest percentage in the category of educational background was the respondents with a bachelor's degree. This group shared 15.86% of the total samples. In the case of the respondent's occupation, we obtained many nomenclatures expressed by respondents regarding their occupation. To summarize this diversity, we grouped respondent's answers into several types of occupations, namely, government employee, private company employee, farmer, self-employed, student, and others. To explain, self-employed refers to the type of work where people work for their own business such as small traders, street vendors, and so forth while people who could not be grouped in any categories (such as retirees, housewives, informal workers, etc.) belonged to the category of others. The data shows that self-employed appeared dominantly, which was 37.73%, among all types of jobs, and was followed by the 'other' category (21.37%) and government employees (12.02%). On the contrary, private company employees shared the least percentage (7.85%).

Moreover, we explored the information about respondent's family size and monthly income to interpret the amount of their domestic water requirement and purchasing power. The respondents' answers on the issue of their family size were varied ranging from one to nine people living in the house. The respondents who answered 'one' were usually students who rent a room or live in the dormitory. The dataset shows the composition was dominated by the respondents with three, four, and five family members. These three groups contributed more than three-quarters of the total respondents. In detail, the highest percentage (35.88%) belonged to the respondents with four people living in the

house. Then, it was followed by households with three and five family members, which were 25.16% and 18.02%, respectively. When we asked the respondents about their monthly income, the answers were also widely varied, ranging from IDR 2,000,000 to IDR 10,000,000 (approximately USD 135 to USD 675). To simplify, we grouped the respondent's monthly income into several intervals as is illustrated in Figure 1. It can be seen that the respondents mostly came from the middle to low-income groups, which was dominated by the respondents with USD 136 to USD 270 monthly income (50.49%). Then, it was followed by the respondents who had the least income (27.60%) and the third least income category (12.82%).

3.2. The Respondent's Choice of the Domestic Water Utilization

After gaining respondent's socio-economic figures, we elaborated on the respondent's daily water utilization. We received 616 answers from 599 respondents since some of them use more than one type of water source. In general, five categories of water sources with the respective reason for the use were noticed from the interview. We grouped the respondents' main domestic water sources and the reason for using them as is summarized in Table 2. To inform, both individual boreholes and dug wells are exploiting groundwater but they are different in their depth and technical construction. The borehole is constructed by mechanical drilling with approximately 15 cm diameter and 40 m (or more) in depth. Meanwhile, the dug well is built usually by manpower with an approximately 1 m diameter and around 10 m in depth.

Table 2. The cross-tabulation of the respondent's main water sources and the reason for water use ($n = 616$).

Main Water Sources	Reason for Water Use (%)					Total
	Reliable Quantity	Good Quality	Affordable Price	Easy Access	No Other Choice	
Pipe water	0.49	0.32	0.16	1.14	0.49	2.60
Public well	0.00	1.30	0.16	0.00	0.16	11.62
Individual borehole	4.54	10.88	0.49	7.31	1.30	24.51
Individual dug well	1.14	10.88	11.20	35.23	11.53	69.97
Bottled water	0.00	1.14	0.00	0.00	0.16	1.30
Total	6.17	24.51	12.01	43.69	13.64	100

Table 2 shows the biggest proportion of the domestic water utilization belonged to individual groundwater exploitation such as individual dug wells and boreholes, which was 69.97% and 24.51%, respectively. The users of these types of domestic water sources had various reasons. To specify, the most common reason for choosing an individual dug well was easy access (35.23%). The absence of regulation to obligate people to have permits in abstracting groundwater individually in their property might be the cause of this phenomenon. Furthermore, the second most frequent reason expressed by the individual dug well users was 'no other choice', which was 11.53%. It means that the respondents have no access to the public water service and other water sources such as borehole and bottled water seem to be economically unaffordable. Unlike the dug well users, the individual borehole users tended to choose their water source because of the water quality issues. It was recorded that 10.88% of respondents who use individual boreholes admitted that they use this water source because of its good quality compared to others. However, the respondents defined the good quality of the water by simple observation on water clarity and odor without any laboratory water test.

Subsequently, we utilized a multinomial logistic regression model to analyze the correlation between the chosen water source and the reasons for this, as illustrated in Table 3. The table shows the parameter estimation to relate the respondent's choice on the domestic water use and the motive

behind the choice. In this computation, pipe water was treated as the referent group and therefore estimated a model for other types of domestic water sources relative to pipe water. Furthermore, the B scores in the third column are the estimated multinomial logistic regression coefficients for the model. The B score indicates the likelihood of the assessed respondents' reason to choose their main water source compared to pipe water. For instance, the respondents who answered reliable quantity ($B = -18.356$) and easy access ($B = -16.410$) compared to the respondents with other reasons (with positive B coefficient) were less likely to choose the public well than pipe water. The same interpretation can be applied to other types of water sources. The individual borehole, for example, has a positive B coefficient for all reasons. It shows that the respondents uniformly are more likely to choose individual boreholes than pipe water and the good quality is the strongest reason for the choice because of its large B coefficient (2.531). In the case of the individual dug well, reliable quantity ($B = -2.317$) is the only reason that made respondents less likely to choose this type of domestic water source than pipe water. On the other hand, good quality ($B = 2.351$) is the only reason for bottled water users to choose bottled water than pipe water.

Table 3. The parameter estimation for the respondent's water sources and reasons.

Main Water Source ^a		B	Std. Error	Wald	dF	Sig.	Exp (B)	95% Confidence Interval for Exp (B)	
								Lower Bound	Upper Bound
Public well	Intercept	−1.099	1.155	0.905	1	0.341			
	Reliable quantity	−18.356	9679.634	0.000	1	0.998	1.067×10^{-8}	0.000	^b
	Good quality	2.485	1.399	3.153	1	0.076	12.000	0.773	186.362
	Affordable Price	1.099	1.826	0.362	1	0.547	3.000	0.084	107.447
	Easy access	−16.410	2395.068	0.000	1	0.995	7.471×10^{-8}	0.000	^b
	No other choice	0	0	0	0	0	0	0	0
Individual borehole	Intercept	0.981	0.677	2.099	1	0.147			
	Reliable quantity	1.253	0.910	1.897	1	0.168	3.500	0.589	20.813
	Good quality	2.531	0.987	6.580	1	0.010	12.563	1.817	86.860
	Affordable Price	0.118	1.339	0.008	1	0.930	1.125	0.082	15.506
	Easy access	0.880	0.790	1.242	1	0.265	2.411	0.513	11.330
	No other choice	0	0	0	0	0	0	0	0
Individual dug well	Intercept	3.164	0.589	28.816	1	0.000			
	Reliable quantity	−2.317	0.908	6.517	1	0.011	0.099	0.017	0.584
	Good quality	0.347	0.929	0.140	1	0.708	1.415	0.229	8.737
	Affordable Price	1.070	1.167	0.841	1	0.359	2.915	0.296	28.713
	Easy access	0.270	0.703	0.147	1	0.701	1.310	0.330	5.200
	No other choice	0	0	0	0	0	0	0	0
Bottled water	Intercept	−1.099	1.155	0.905	1	0.341			
	Reliable quantity	−18.579	0.000	0	1	0	8.538×10^{-9}	8.538×10^{-9}	8.538×10^{-9}
	Good quality	2.351	1.406	2.798	1	0.094	10.500	0.668	165.114
	Affordable Price	−16.071	5348.582	0.000	1	0.998	1.049×10^{-7}	0.000	^b
	Easy access	−16.633	2677.768	0.000	1	0.995	5.977×10^{-8}	0.000	^b
	No other choice	0	0	0	0	0	0	0	0

a. The reference category is pipe water. b. The floating-point overflow occurred while computing this statistic. Its value is therefore set to system missing.

The fourth column consists of the standard errors of the individual regression coefficients for the two respective models estimated while the fifth column indicates the Wald Chi-square test that tests the null hypothesis. Furthermore, the sixth column is the degree of freedom and the seventh column shows the significance with an associated Wald Chi-square test. If the significance is defined at 0.05, the null hypothesis would be rejected for individual borehole and good quality (sig. = 0.010) and individual dug well and reliable quantity (sig. = 0.011) but other rows failed to reject since their significance score was more than 0.05. However, the good quality is the reason for the public well and bottled water users that have significance scores of nearly 0.05 (0.076 for public well and 0.094 for bottled water).

Moreover, the Exp. (B) is the exponentiation of the B coefficient, which is called the odds ratio. The negative B coefficient would generate an odd ratio < 1 while the positive B coefficient would

generate the odd ratio > 1 . In the category of public well, for instance, the odds ratio for good quality is 12.000 which means that the respondents who pose this answer are 12-times more likely to choose public wells than pipe water (as the referent group). By contrast, the respondents who have easy access reasons are 7.471×10^{-8} times less likely to choose the public well than pipe water. The highest odds ratio for the easy access reason, in general, belonged to the category of the individual borehole (the odds ratio = 2.411) even though the most preferable reason in this domestic water source was good quality (the odd ration = 12.536). The same interpretation can also be applied for individual dug well and bottled water users by viewing the odds ratio of the respective row.

3.3. Factors Influencing Community Preferences

The next step that we conducted in this research was investigating factors that influence the preference by analyzing the respondent's characteristics. We set our assumption by referring the recognized reasons to the respondent's socio-economic dataset from the previous discussion. For instance, the quantity and quality aspects were related to the community's demand. Therefore, we set the assumption that these issues refer to family size since the amount of water requirement was positively correlated to the number of consumers although the assumption seems to be less appropriate for the quality issue. Furthermore, we assumed the affordable price is closely related to the household's income and the accessibility is represented by the availability of piped water networks surrounding the respondent's house. The data are summarized in Table 4.

Table 4. The cross-tabulation for the respondent's socio-economic characteristics and their main domestic water source ($n = 616$).

Socio-Economic Characteristics	Respondent's Main Domestic Water Source (%)					Total
	Pipe Water	Public Well	Individual Borehole	Individual Dug Well	Bottled Water	
Family size						
One	0.32	0.16	0.16	2.76	0.00	3.41
Two	0.49	0.00	1.95	7.14	0.00	9.58
Three	0.81	0.16	7.79	16.23	0.16	25.16
Four	0.49	0.81	8.44	25.81	0.32	35.87
Five	0.32	0.49	4.55	12.18	0.49	18.02
Six	0.00	0.00	0.65	3.73	0.00	4.38
Seven	0.16	0.00	0.49	1.79	0.16	2.60
Eight	0.00	0.00	0.16	0.16	0.16	0.49
Nine	0.00	0.00	0.32	0.16	0.00	0.49
TOTAL	2.60	1.62	24.51	69.97	1.30	100
Monthly income						
<US \$135	1.14	0.32	2.60	23.21	0.32	27.60
US \$136 to US \$270	0.81	1.14	10.71	37.66	0.16	50.49
US \$271 to US \$405	0.32	0.16	4.87	7.14	0.32	12.82
US \$406 to US \$540	0.00	0.00	2.11	0.97	0.16	3.25
US \$541 to US \$675	0.32	0.00	1.95	0.65	0.00	2.92
>US \$676	0.00	0.00	2.27	0.32	0.32	2.92
TOTAL	2.60	1.62	24.51	69.97	1.30	100
Access to the pipe network						
Yes, close distance	2.43	0.00	9.58	22.73	0.81	35.55
Yes, far distance	0.16	0.00	3.08	8.93	0.16	12.18
No access	0.00	1.46	8.12	27.44	0.32	37.50
Do not know	0.00	0.16	3.73	10.88	0.00	14.77
TOTAL	2.60	1.62	24.51	69.97	1.30	100

Table 4 illustrates the cross-tabulation between the respondent's socio-economic attributes and the preferable water source. Each intersection cell indicates the proportion of the assessed attribute and the respondent's choice of water. It can be seen that the private dug well was the most preferable for all categories. To specify, in the category of the family size the biggest percentage (25.81%) belonged to the family with four family members. Meanwhile, in the category of monthly income, the private dug

well was mostly preferred by the families which had a monthly income from USD 136 to USD 270 (37.66% of the total respondents). Additionally, the individually dug well was also chosen by 27.44% of the total respondents, who do not have access to the pipe network.

The same analysis can be done to observe all intersection cells in Table 4 to observe the respondent's choice of the domestic water source based on the attached socio-economic attributes. However, all assessed categories are naturally interlinked with each other in a multidimensional direction and Table 5 cannot clearly describe the relationship. To overcome this problem, we employed a multiple correspondence analysis (MCA) to analyze the data. The basic principle of MCA is to identify more influential elements by reducing synthetic dimensions [38]. Unlike the ordinary Cartesian coordinate system, the graphical representation of data in MCA illustrates the contribution of each assessed element out of all samples rather than showing a functional relationship. Graphically, the distance between the two categories depends on their frequencies. Moreover, [39] stated that individuals who share more similarities are located closely and smaller frequencies of disagreement categories implicate on the farther distance between individuals. Besides, less frequent categories are located farther from the origin and they give a smaller contribution to overall propensity.

Table 5. Correlations transformed variables.

Dimension: 1				
	Main Water Source	Family Size	Monthly Income	Access to Pipe Water
Main Water Source	1.000	0.157	0.395	0.058
Family Size	0.157	1.000	0.231	−0.002
Monthly Income	0.395	0.231	1.000	0.158
Access to Pipe Water	0.058	−0.002	0.158	1.000
Dimension	1	2	3	4
Eigen value	1.570	1.005	0.845	0.580

In this research, our dataset was iterated by statistics software (SPSS version 23) and resulted in two major dimensions with the variance accounted for 39.2% and 34.4% inertia (as is illustrated in Figure 2). To describe, the graph shows that almost all categories flock surrounding the origin. It implies that the data has less variance and is concentrated to a certain tendency. On the other hand, points that are located relatively far from the origin have less frequency based on the survey. In this case, respondents with eight family members are rarely found in the field survey and so are respondents who mainly consume bottled water and who are with income 6 (>USD 676). To inform, we codified the category of income by numbering with income 1, income 2, and so forth following the ascending order in Figure 1 to simplify the presentation.

Moreover, the coordinates of the points can be used to analyze their significance. For instance, income 2 is closely located to the origin, meaning that the respondents from this income group shared the most significant contribution to the whole sample, which is then followed by income 1. In the category of family size, the data is dominated by respondents with three, four, and five family members. The three dots corresponding to the data are located closely surrounding the origin. On the other hand, in the category of pipe network availability, the dots approximately have the same distance to the origin. It implies that the data is rather equally distributed among all categories.

Figure 3 can also be used to analyze the correspondence between categories where the closer the distance is, the closer the relationship is. For example, bottled water is located close to income 6 but does not have proximity to other categories. It implies that the bottled users inclusively correspond to this income group. On the other hand, private dug well is closely surrounded by many dots e.g., income 1, income 2, family size 4, and the respondents who do not have access to the pipe network. Furthermore, the individual borehole is closely located to income 3, income 4, and the respondents

who have access to pipe networks either near or far. By contrast, the distance between the pipe water availability to pipe water users is farther than to the individual water source (dug well or borehole). It indicates that the piped water network empirically did not significantly encourage people to choose pipe water service. To analyze how significant each category influences the choice, we completed a cross-tabulation as presented in Table 5.

Figure 3. The scatter plot graph of the multiple correspondence analysis (MCA).

Table 5 is essentially a symmetrical matrix consisting of four rows and four columns. The software sets the main water source category as a reference (dimension 1) so that other categories are calculated relatively to the referent category. Furthermore, the values in the intersection cells express the correlation between two interlinked categories. That is why the scores in the intersection cells involving the same category (the diagonal) are 1.000, implying that they are perfectly correlated. For further interpretation, the second column can be used to measure the correlations. It can be seen that monthly income has the biggest coefficient (0.395) then is followed by family size (0.157) and access to pipe water (0.058). The scores imply the rank of influential factors in choosing a certain type of domestic water use. In other words, when a respondent's decision is influenced by monthly income (purchasing power), family size (water demand either quantity or quality), and access to pipe water (accessibility).

3.4. Respondent's Water Shortage Experience and Willingness to Shift the Main Water Source

We continued our survey by elaborating on the respondents' water shortage experience when using their main water source and revealing their efforts to overcome the problems as well as the willingness to shift their main water source. Table 6 summarizes the data on the issue of the water shortage categorized by the respondent's main domestic water sources.

Table 6. On the water shortage based on the main water source ($n = 616$).

Water Shortage Experience	Main Water Source					Total
	Pipe Water	Public Well	Individual Borehole	Individual Dug Well	Bottled Water	
Yes	4	0	6	89	0	99
No	12	10	145	342	8	517
Total	16	10	151	431	8	616

Table 6 shows that 99 out of 616 (16.07% of total replies) respondents experienced water shortage when using their domestic water source. Most of them come from the respondents who utilized individual dug wells. This is understandable since the availability of water of the shallow dug wells depends very much on the seasonal rainfall rate. For those who encountered the water shortage, we further asked about what they did to overcome the problem. We grouped various respondents' answers into four classifications which are doing nothing, asking a favor from neighbors or relatives, accessing water from public facilities (such as mosques, community centers, public tap, etc.), and installing more water sources (such as deepening the dug well, constructing a borehole well, subscribing pipe water, or purchasing water from vendors). The respondents who were doing nothing to overcome the problem could tolerate the water shortage and they just adapted to the situation such as reducing water consumption or simply waited for their shallow dug well to be naturally recharged. This group of respondents usually came from small size families but had a low monthly income. Thus, they did not have much money to have another water source but could still manage their water needs. The summary of the respondent's answers is listed in the following table.

Table 7 shows the majority of the respondents asked a favor from their neighbors or relatives who had a better situation to cope with water shortage problems. Mostly, the shallow dug well users asked a favor from those who had a deep borehole. The spirit of togetherness and solidarity in the society, which still appeared especially in rural areas, enabled the community to help each other. Furthermore, we also found that the respondents who had a middle to high monthly income prefer to install more facilities (e.g., borehole, piped water, etc.) in their house to overcome the water shortage problems. The data shows 12.12% of respondents chose to have this measure. On the other hand, 19.19% of respondents who experienced the water shortage chose to take water from public facilities as illustrated in Figure 4. To inform, the government of Kota Metro has built 82 units of public groundwater wells from 2010 to 2014 that are distributed in all villages in Kota Metro [40]. This kind of facility is built based on the community's requests. It costs approximately IDR 80,000,000 (around USD 5400) to build one unit of this public groundwater facility.

Table 7. Respondent's measures to overcome the water shortage ($n = 99$).

Measures Done by the Respondent	Percentage (%)
Doing nothing	8.08
Asking for a favor from neighbors or relatives	60.60
Accessing water from public facilities	19.19
Installing more water sources	12.12

Furthermore, we asked the respondents whether they have an intention to move to public water service to reveal their willingness to forsake individual groundwater exploitation. We simply distinguished the respondent's willingness to shift to public water service with a "yes" or "no" answer. In this issue, we gave more attention to the respondents who are not willing to shift to public water service since respondents who want to become public water service subscribers gave a similar answer, which is to anticipate water shortage in the future. By contrast, the respondents who said "no" gave various expressions to show their reasons. Therefore, we classified the respondents' reasons and

codified them with R1–R5 to simplify the presentation of the data. The respondent's responses are illustrated in the following figure.

Figure 4. Public groundwater wells provided by the government of Kota Metro: (a) located near the village office in Kelurahan Yosomulyo; (b) located in one of the mosques in Kota Metro.

To specify, R1 means respondents are satisfied with their current water source. Meanwhile, R2 shows respondents answer related to economic reasons such as financial incapability, unaffordable water price, and so forth. Moreover, issues related to the unavailability of the pipe network and other supporting facilities surrounding the respondent's residence is classified into R3. Another reason why respondents hesitate to move to the public water service is their doubt about the quality of the public water service. Respondents thought that their current water source is far better than pipe water in both its quantity and quality so that shifting to public water service is something unnecessary. We classified these types of reasoning into R4. Then, R5 is for those who did not specify their reason. Generally, only 38 out of 600 respondents (6.33%) who are non-pipe water users like to move to public water service although some of them had ever encountered water shortage. On the contrary, the majority of respondents (93.67%) are not willing to move to public water service for various reasons.

If the category of the domestic water source is ignored, the numbers in the boxes with the same color can be summed to see the proportion of each reason. Among all categories of the main water source, the satisfaction with the current main water source (R1) was the strongest reason why respondents are not willing to move to public water service. It was recorded that 331 respondents (55.17%) have this kind of reason. Moreover, economic reason (R2) was the second strongest reason where 81 respondents (13.50%) explained that financial factors are the main constraint of shifting their water source into the public water service. Then, the percentage was followed by R5 (65 respondents/10.83%), R3 (55 respondents/9.17%) and R4 (30 respondents/5.00%). Thus, if respondents who did not express their reason are excluded, the respondent's priority in accessing the public water service can be arranged as follows: satisfaction (in both quantity and quality of water), price, supporting infrastructures, and service quality.

Despite the unavailability of the official report about the water shortage in Kota Metro, the respondent's answers about this issue (Table 6) can be interpreted as an alarming situation regarding the availability of the water source. It cannot be merely viewed as a natural phenomenon in the dry season but many factors play important roles. For example, the land-use change resulted from urban growth can shift areas that used to be the catchment areas into other functions that cannot accommodate groundwater recharge. Adipka et al. [41], for instance, noted that in Kota Metro, 879 ha of the agricultural land, which enable them to function as a catchment area, have been converted into nonagricultural uses such as settlements and commercial buildings during the period 2000 to 2015. A similar tendency also occurs in other places in Indonesia [42,43]. From a hydrological perspective, this trend disturbs the discharge-recharge mechanism that threatens the sustainability of the water source availability. It then might be exacerbated by unpredictable events such as climate change. However, the water shortage experience did not automatically encourage the respondents to shift their current water utilization. The most surprising evidence shows that 78 out of 89 individually dug well users do not have an intention to shift their current water source even though they admitted that they experienced the water shortage (Figure 5). It can be interpreted as low awareness of the respondents to current dynamics environmental trends and considering the water shortage occurrence as a usual natural event. It is reflected from the answer that the main reason for their reluctance is they are satisfied with the current domestic water source. Besides, the economic reason is also a major reason for not shifting into public water service. They consider that public water service is more expensive because they have to pay a monthly bill while they can get the water free from their individual dug well.

Figure 5. Respondent's willingness to shift to public water service.

Furthermore, actions that were taken by the respondents to deal with the water shortage (Table 7) are interesting to elaborate on. The majority of the respondents replied that they asked a favor from neighbors or relatives to fulfill their water need when their water source could not suffice their daily needs. Then, the percentage is followed by the use of water sources in public facilities such as mosques, community centers, and so forth. This phenomenon can actually be a starting point

to encourage community awareness of the current situation as well as to formulate improvement strategies. For example, community-based domestic water fulfillment or communal groundwater use can probably be promoted considering the spirit of togetherness and solidarity that still exists in the community of Kota Metro. We elaborated on this issue in the next part of this paper.

4. Discussion

The findings from our survey show a tendency that the community has less intention to subscribe to public water service and prefer individual groundwater exploitation. This is an alarming trend considering the multidimensional impacts of excessive groundwater exploitation [44–48]. The study by Kooy et al. [49] also shows that individual groundwater use might negatively influence the inclusive development of urban water service. Combined with the reasons summarized in Figure 5, the low service coverage area of the public water service in Kota Metro can probably explain why the community is reluctant to subscribe to public water service. Indeed, the public water service provider is struggling to be able to provide reliable service while the revenue from customer's water bills is very limited to cover the operational and maintenance cost. Further, the absence of the rule to regulate individual groundwater utilization enables the residents of the Kota Metro to have more options to fulfill their water needs instead of piped water service provided by the local government. In most cases, individual groundwater wells are preferred over the piped water due to their superiority in accessibility and cost.

Nevertheless, some opportunities have not been optimally utilized to improve the current situation. For example, Meijerink and Huitema [50] noted that the introduction of participatory governance through a decentralization system in Indonesia, which was in line with the political regime shifting in 1998, is a window of opportunity to stir a transition in the water governance. The decentralized water system potentially brings advantages to reduce negative environmental impacts as well as to improve water service quality even though legislation, administrative structure, and community involvement are challenges that are supposed to be highly considered [51]. Along with water resource scarcity, participation and the scale of water service should be well managed in formulating approaches in the water governance [52]. Furthermore, the local municipality has significant roles to encourage community involvement in water-related activities [53].

In the context of Kota Metro, the development planning process, in general, follows the principles of community participation as suggested by the national directive. Collaborative planning is highly promoted as a result of paradigm-shifting in the development planning regime [54]. In practice, public aspirations are accommodated from the very beginning of the development planning process at the community level. At this stage, the community can articulate their aspiration by submitting a proposal to the city government. Then, the city government conducts public discussion to synchronize the proposals with the funding availability. After a series of public discussions (village, sub-district, and city-level), the city government encloses the selected proposals to the annual development program to be discussed with the city legislative body. Once the annual development program is officially approved, the community proposals are subsequently executed. In the case of community water fulfillment, communal groundwater wells (as is illustrated in Figure 3) are the most common facilities requested by the community. Moreover, the transition in the planning process practiced in Kota Metro enables the city government to have a significant role in multiple stakeholders' engagement, which is essential for the circular economy opportunities [55]. Essentially, the community is invited to actively participate in the development planning process and the city government accommodates their interests.

However, critical reviews might be addressed to the whole process. Evidently, we found that the community mostly uses communal groundwater facilities, which they proposed, for an emergency (drought season) or specific purposes (e.g., religious activities in mosques) rather than for daily needs. Thus, the facilities have not been able to significantly reduce individual groundwater abstraction but merely for limited utilization. Indeed, recognizing the common problem and achieving consensus to overcome the problem is the main challenge in the community participation process. The unequal

socio-economic status that frequently appears in the community might lead to the decision being strongly determined by a more powerful group. Thus, it does not reflect the real problem to be dealt with but only a certain interest. Moreover, the development proposals should compete with each other at the city level due to financial limitations belonged to the city government. Up to this point, the role of the more powerful figures also strongly influences the decision-making process. The city government often faces a dilemma in deciding which proposals or villages should be prioritized when different interests are supported by various powerful parties. Furthermore, we also found that the communal groundwater construction is not followed by community capacity building to manage the facility so that post-construction management is overlooked. Thus, the community is not prepared to manage the facilities that they proposed. The city government seems to focus more on satisfying community interest rather than sustaining their proposal and raising community awareness. Additionally, the existing communal groundwater wells are technically standalone buildings, which are not equipped with the pipe connection to the community's houses. Therefore, this type of domestic water source is less preferable because the community is unwilling to spend more collection time or other efforts to bring water to their houses.

Combining our findings and observation on the existing situation of the domestic water fulfillment in Kota Metro, we tried to suggest a sort of improvement proposal following the principles of the circular economy. However, the current trend of research interests on the issue of the circular economy is still dominated by commercial business fields at a national or even global scale [56,57]. Meanwhile, the discussion at small scale organizations in nonprofit sectors is still limited. Despite this constraint, we tried to bring the basic concepts of the circular economy to explore the domestic water utilization issues on the community scale. To specify, the existing piped water service could be combined with the community-based domestic water provision through communal groundwater facilities.

Then, we referred to the improvement stages proposed by the Ellen MacArthur Foundation [55], which are vision, engagement, urban management, economic incentives, and regulation, to stir the transition. Firstly, sufficing reliable domestic water needs for all residents in the Kota Metro along with the reduction of the individual groundwater abstraction is set as the vision of the improvement strategies. In the issue of engagement, community participation in the development planning process could be viewed as an essential starting point to accommodate various interests from stakeholders. Borrowing Lacy's terminology [58], the existing condition of the domestic water utilization in the Kota Metro could be characterized as the emerging stage of maturity in the circular economy implementation. Further, awareness-raising and capacity-building are two things that have not been well managed. Thereby, we suggested an intensive campaign of the use of public water sources to raise public awareness on the negative impacts of individual groundwater exploitation. Meanwhile, public doubt of the public service quality (as is illustrated in Figure 4) should also be properly responded to support the vision. The level of service quality provided by the piped water service provider should be boosted to gain public trust as well as to encourage public enthusiasm. On the other hand, the community-based water provision can be strengthened by maintaining the existence of those who proposed the communal groundwater facilities and assisting them with the training to manage small scale water provision. The government agency can also involve universities to transfer their knowledge and enhance the capacity of either community or piped water provider to manage their water source [59]. Besides, the existing communal groundwater facilities can be upgraded by installing a pipe network to the surrounding neighborhood (e.g., one groundwater well for twenty to thirty houses) so that the water can be directly delivered without spending any effort to bring the water to the house. Then, the users contribute to pay the operational and maintenance cost of the communal facility. The significant percentage showing that the respondents asked a favor from neighbors or relatives to overcome the water shortage problem (Table 7) indicates the spirit of togetherness and solidarity among society. This valuable social capital can also be utilized in managing the communal facility.

Furthermore, the communal groundwater facility could be upgraded by adding a small-scale wastewater treatment facility, which can also be managed by the community. This approach is

promoted by the national government but it has not been well delivered at the implementation level [60]. Therefore, the community can also be educated to implement 3R (reduce, reuse, recycle) principles in domestic water utilization. For instance, household domestic wastewater such as from the shower or laundry can be treated using simple technology that can be operated and managed by the community. Then, recycled water can be used for activities that do not require high-quality water such as gardening or cultivating fruits and vegetables. Indeed, products from household-scale farming can be an additional income for households. To inform, areas in Kota Metro where the pipe network is not available are mostly rural areas with communities who conduct household-scale farming cultivating vegetables, fruits, or flowers as an additional income. This model should be accommodated in urban management through urban planning and asset management to anticipate potential conflict with the existing piped water service. The spatial arrangement of the areas served by piped water service or community-based water provision, for example, is the key element to apply the model and to gain economic incentives for either community, piped water service provider, or the city government. Otherwise, the development of the community-based water provision might discourage the development of the piped water service and vice versa. Eventually, the proposed model is supposed to be encapsulated with formal regulation as a rule of the game in urban water management. At the national level, the government has launched Law Number 17/2019 [61] as a general directive. This regulation accommodates public engagement in managing water resources. Thus, the city government can break down this law into operational guidance at the community level.

Moreover, the proposal to combine the existing pipe water service and community-based water management can also be viewed from the perspective of the Creativity Knowledge Innovation (CKI) model. Some attributes introduced in the CKI model [62,63] are fruitful to explain the phenomenon that appears in the study area as well as to formulate suitable approaches to improve the current situation. For instance, combining the current pipe water service need to consider the issue of institutional changes. This is because the current public water service in Kota Metro only recognizes formal pipe water service, which is a part of the governmental structure. The proposal might be an alternative for the technical and financial problem in fulfilling the residents' need but it remains challenges in the institutional arrangement. Therefore, the ultimate goal to provide reliable water service is supposed to be well articulated and understood by all relevant stakeholders to reduce potential conflict of interests. Moreover, the spirit of togetherness and solidarity when facing the water shortage, as we found in the survey, is an embedded socio-cultural value that can be viewed as a potential that makes the community-based water provision is promising to be implemented. Indeed, the impact of the proposed alternative has not been thoroughly assessed in the CKI perspective (i.e., macroeconomic, institutional, socio-cultural, and corporate). However, this is a valuable insight to develop future research.

5. Conclusions

To sum up, some notable findings can be highlighted in this study. First, the community preference of domestic water utilization is attached for certain reasons i.e., reliable quantity, good quality, affordable price, easy access, and no other choice. In detail, easy access was the most frequent reason expressed by individual dug well users and piped water subscribers. On the other hand, the respondents who used public well, individual borehole, or bottled water admitted that its good quality is the strongest reason to consume. Furthermore, our analysis of factors influencing the community preferences using the multiple correspondence analysis showed that the respondent's monthly income, family size, and access to pipe water influence the respondent's preference.

In the case of the water shortage, 99 out of 616 responses confessed that they ever experienced the water shortage in utilizing their main domestic water source. To deal with this occurrence, they undertook various strategies such as asking a favor from neighbors or relatives, accessing public facilities, or installing more water sources. Some respondents even did nothing to tackle this problem. Nevertheless, the water shortage experience has not been able to trigger the community to leave the individual groundwater abstraction because of several causes such as economic reasons or pipe

network unavailability. This phenomenon raises the question of the level of community awareness about the current dynamics of the environmental event. The government of Kota Metro, as the authorized party, should carefully manage this issue to anticipate worse situations in the future. Along with excessive groundwater abstraction, the land use shifting that apparently occurs in the Kota Metro, which is an implication of urban growth, can potentially exacerbate the situation.

Furthermore, we compiled our findings and the current status of the domestic water utilization in Kota Metro to formulate an improvement proposal inspired by the circular economy concepts. We proposed a mixed-method, which consists of piped water service and community-based domestic water management considering constraints belonged to Kota Metro and potentials that can be utilized. Not only is the improvement strategy formulation, but the discussion is also expected to be able to elaborate on the principles of the circular economy to be implemented in the small-scale administration and nonprofit organization, which has not been widely discussed. Indeed, this theoretical exploration should be followed by further studies on the more detail issues such as cost-benefit analysis, optimum scaling of each element in a mixed water provision system, spatial arrangement, legislation, and so forth to verify the possibilities of applying the concepts of the circular economy in the domestic water sector.

Findings on the ways in which the respondent deals with water shortage experiences and the motives to change current water use are essential to elaborate on possible solutions for improving the current situation. The existing pipe network and communal groundwater wells are also important assets. These elements can be used as inputs to formulate a strategy mixing pipe water and community-based water service. The pipe water can be optimally utilized in the more densely populated area while the community-based water management can be applied in the area with less density. The next agenda is to assess the optimal proportion of the respective method as well as their spatial distribution. Eventually, the mix of pipe water service and community-based water management can potentially be taken as alternatives in the development of domestic water provision in the cities that have similar characteristics with Kota Metro.

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