

Evaluation of The Potential of Circular Compact City Concept in Kampung Kota (Case study: Kampung Braga, Bandung)

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Abstract. Current days, resources production and consumption behavior pattern within city is seen as one that called linear system, where resources are extracted, processed, distributed and consumed before being disposed as waste. This system burdens the environment in its all stages. Aside of it, there is another pattern called circular system, where resources in the production and consumption process will be rethought and processed back into the cycle, so that it will never be waste to the environment. Cities in Indonesia, mostly have the so called *kampung kota* as its integrated part in its development stage. It is a dense area within city which still have the traditional culture in it. It is mostly seen as an unplanned area, highly populated, and low-quality environment and infrastructure. Nevertheless, *kampung kota* is seen has quality of compactness and circularity which can be potential to the development of sustainable city. The aim of this study is to explore more about the potential of circularity and compact city concept in *kampung kota* with Kampung Braga as the case study, through further evaluation based on particular criteria, questionnaires, and observation. Therefore, the result of this study could contribute to the future discussion regarding circular compact city concept.

Keywords: *circularity, city development, compact city, kampung kota, sustainability.*

1 Introduction

From data published by UNEP in [1], cities globally occupy only about 2-3 % of the earth's surface, but consume around 70-75% of its natural resources. UN in [2] states that 55% of the world's population currently lives in urban areas, which is mentioned by World Bank Group in [3] as around 4.2 billion. This number is projected to increase around 68% by 2050, with an additional 2.5 billion people. It is further stated that 90% of the total population is in Asia and Africa. Given this trend, it is certain that cities will face major challenges to meet the needs of their growing populations. Natural resources will continue to be exploited in order to sustain the life of the population.

The perspective that exists in the city until now still assumes that the resources available in nature are unlimited. This perspective causes the formation of a linear “take-make-dispose” pattern of production and consumption, that is, resources are extracted, processed, distributed, consumed, then left over as pollution burdening the natural environment. The impact of this linear pattern on the environment, among others, will be the scarcity of non-renewable resources in nature due to continuous exploitation which will ultimately affect environmental condition and climate change. Apart from the linear perspective mentioned above, there is a circular concept, which in urban application is called a circular city. This concept views the city as a living organism, like nature, in which the cycle of life revolves and is closed. Organisms in nature live and develop and then die. The remains of organisms that die become a resource or nutrition for the survival of other creatures. Likewise with the circular pattern in urban areas, the resources extracted and processed in the production process for consumption do not end up as waste or pollution, but can be processed again to become resources for the needs of other sectors, and so on in a circular and closed cycle so as to reduce or ideally can get rid of trash.

2 Literature Review

To support this study few literatures is needed to be reviewed regarding the basic theory of circular city and compact city to get an understanding of those concepts. This section summarizes it as follow.

2.1 Circular city

The definition of circular city is summarized from few literatures by Ellen MacArthur Foundation in [4], ICLEI in [5] and Wenzel in [6] as a city that embeds the principles of a circular economy in all aspects of urban design and functions, namely by creating a compact city structure, which has increased density with a shorter reach to the city’s main facilities which shortens the distribution and mobility system thereby reducing pollution due to dependence on motorized vehicles, maintaining the highest value of assets in their use, encouraging city development by prioritizing the reuse of existing land rather than opening new land, regenerating natural systems and maximizing the use of digital technology to support circular processes, thereby creating prosperity and resilience economic, social and environmental for the city and its inhabitants. Ellen MacArthur Foundation in [4] mentioned the elements of circular city as built environment, energy system, an urban mobility system, an urban bioeconomy, and production system. Furthermore, they mentioned that at least there are three principles of circular economy, namely: design out waste and pollution in the cities, keep products and materials in use in cities and maintain their values, and regenerate natural systems in and around cities. Added to that,

the World Economic Forum in [7] mentioned 9R strategy in circular city known as refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, and recover.

2.2 Compact City

According to Grau in [8], circular city can be an alternative approach to sustainable urban design, by designing a compact city, where the main facilities for people needs can be reached on foot from wherever they work or live, so that trip will be shorten, energy consumption and pollution level will decrease in line with reduced dependence on motorized vehicles. The term compact city was first introduced by Dantzig and Saaty [9] in Kumar in [10] with three main characteristics, namely compact city based on morphology (high density, less dependence on motorized vehicle, clear boundary), based on spatial (mixed land use and heterogeneous lifestyle), and based on social function (social equality, independence in daily life, independent regional management).

There are various definitions of a compact city. Among them, as stated by Rogatka and Rebeiro in [11], a compact city is an urban spatial structure characterized by a compact urban area with urban agglomeration. In compact city, everything must be easily accessible by all residents because the shape of a compact city affects the urban environment and social quality. In addition, a compact city improves urban sustainability. Another definition from Burton [12] in Bibri, Krogstie and Karrholm in [13] is that the term compact city means a city with a relatively high density of mixed functions, based on efficient public transportation systems and dimensions that encourage walking and cycling activities. Furthermore, Rogatka and Rebeiro in [11] mentioned elements of compact city that is related to urban design concepts, those are: mixed land use and high density, comprehensive service facilities, short distances, reduced pollution, car dependency, encouraging cycling, social interactions, high population density, encouraging walking, accessibility, efficient public transport, well-organized urban infrastructure, and energy performance. On the other hand, Bibri, Krogstie, and Karrholm in [13] summarized the design principles of compact city as compactness, density, mixed land use, sustainable transportation, green structure, and intensification.

3 Methodology

The method in this study is exploratory-evaluative. According to Sheppard in [14], exploratory research is carried out on a topic to answer the researcher's curiosity about the subject and to better understand the phenomena that occur for further deeper studies. This study was conducted with a qualitative approach, where this approach is generally process-oriented. True understanding, rather

than information based on prediction, is based on understanding action and on interpretive meaning of that action.

The method was conducted on stages as mentioned below:

1. Conduct a literature review on the theories of the the characteristic of circular city and compact city as the basis used to determine the evaluation criteria.
2. Study location selection based on the criteria of *kampung kota* typology.
3. Collecting information through interviews with related parties, such as RW leaders and several administrators or residents, followed by field observations to see the real conditions of Kampung Braga.
4. The collected information is then evaluated based on the predetermined circular city and compact city concept criteria.

The expected result is to known the characteristic and application of the circular compact city concept in the *kampung kota* through a case study of Kampung Braga.

3.1.1 Location Selection

Based on *kampung kota* typology mentioned by Widjaja in [15], which is then determined as location selection criteria. Kampung Braga is one of *kampung kota* that meet those criteria, namely being in a very strategic location in supporting city function; is a residential area of the majority of low-income people; is a densely populated environment; is a village that is passed by the river and the main access; and is an environment that is largely inaccessible by four-wheeled vehicles. Table below shows that Kampung Braga's condition meets the criteria of location selection.

Table 1 Summarized analysis of study location selection of Kampung Braga based on *kampung kota* typology by Widjaja in [15] as criteria

<i>Kampung Kota</i> Typology as Location Selection Criteria	Kampung Braga
<i>Kampung kota</i> that existed on the very strategic location in supporting city functions. For this location, the community can possibly improve the environmental conditions at their own expense by taking advantage of the strategic location.	√
<i>Kampung kota</i>, which is the residential environmental of the majority of low-income people, who are in transition areas or suburbs. In general, it began to be developed around the 1940s to 1950s on private communal land. Village density can reach 500 people /Ha. Usually, most of the villagers live on private land which is sometimes not officially registered or without a permit because at first it was communal. Community with strong social ties who develop their own environmental infrastructure and facilities independently.	√

Inner city slum, namely <i>kampung</i> is a community environment that existed before the colonial period, where they were workers to serve the European population. Due to urban development, these villages are isolated and stagnate and subsequently experience environmental degradation into slums. These <i>kampung</i> are usually close to access points or traffic lanes, mostly clustered in river areas that cross the city and are located in downtown areas. It has a density of 100,000 people/Km².	✓
The type of <i>kampung</i>, with houses located inside, is mostly inaccessible by car or motorbike. This type is the type of old or original settlement of cities in Indonesia.	✓

3.1.2 Questionnaires and Field Observation

In conducting interview, questions are divided into categories with particular purpose. This table below gives the sample of questions in each category with its purpose.

Table 2 Sample of categorized questions for interview

Categories	
Social	Facilities
Purpose: To get an idea of the socio-cultural character of the people who live in Kampung Braga.	Purpose: - To find out the life behavior of the residents in Kampung Braga. - To find out the extent of the availability of life support facilities that exist in Kampung Braga.
Question samples: - Is there any unused vacant land in this area? Why? - Is every land in this area is used as residential/living space or also for other function such as shop, restaurant, rent room, <i>warung</i>, etc?	Question samples: - Do you stay in your own house or in a rented house or room? - How do you do your daily activities and reach the place you work?
Transportation	Circularity
Purpose: - To get an overview of the movement pattern of residents and the form of transportation used as support. - To find out the ease of access and movement of Kampung Braga's residents in reaching the location of their daily activities.	Purpose: To find out the behavior of Kampung Braga's residents in accordance with the application of the circular city concept.
Question samples: - Can this area be accessed by car or four-wheeled vehicles? - Do you use public transportation to reach destinations?	Question samples: Is there any gardening activity by the residents? If so, is this activity carried out together or separately?

	Is there any recycling activity carried out in this environment, either individually or collectively?
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To complement the information obtained from interviews, field observation was carried out with several focused on the physical conditions of Kampung Braga's environment, such as: street structure (finishing material, condition, etc.), nodes within *kampung*, distances between *kampung*'s edges, infrastructure condition, river function which cross the *kampung*, the connectivity inside the *kampung*, the most utilized street or corridor by the residents, condition of walking on outdoor space in this *kampung* environment, ease of accessibility from and to *kampung*, quantity of main access from and to *kampung*. The information obtained from interviews and observation is then analyzed as supporting data for further evaluation.

3.1.3 Evaluation Criteria

The criteria used to evaluate *kampung kota* in this study is determined by referring to the principles, elements, and strategies of compact city and circular city. The principles are referred as criteria, while the elements and strategies are referred as indicators. Those criteria can be seen in tables below.

Table 3 Evaluation criteria and indicators of compact city concept referred to Rogatka & Rebeiro in [11], and Bibri, Krogstie, & Karrholm's principles, elements and strategies of compact city in [13]

Criteria	Indicators	
Design Principles	Elements	Compact City Strategy for Sustainability (Environment, Economy, Social)
Compactness	Short distances, social interactions, Mixed land use and high density, Comprehensive service facilities, Well-organized urban infrastructure	Build and develop centrally, concentrate on strategic nodes, complement and mix, strengthen public transport, reserve outer city areas for future development.
Density	High population density	High density of built objects in designed and emergent compact urban form, diverse scales of built objects, distribution of building footprints with frequent larger buildings, greater density in strategic nodes, prioritization of density close to the central points of strategic nodes, high-density hand in hand with multidimensional mixed land use.
Mixed land use	Mixed land use and high, Comprehensive service facilities	Physical land use mix, economic mix, social mix, greater mix of housing, business, and facilities in strategic nodes, multidimensional mixed land use hand in hand with sustainable transportation.

Sustainable transportation	Short distances, Well-organized urban infrastructure	Cycling and walking, public transport, mobility management, increased accessibility through public transport infrastructure improvements, sustainable transportation hand in hand with multidimensional mixed land use and high density, network structure of link areas to connect the major nodes of the transport system, separate lanes for the public transport for faster journey time and a punctual and reliable system, more service along the main corridors for greater frequency, an easy to understand, safe, and secure system for guaranteeing quality and service, multi-model travelling in strategic nodes to support their dense, mixed use central points.
Green structure	Social interactions	Green areas and parks, green areas hand in hand with density, protection and integration of natural, agricultural, and cultural areas through intensification.
Intensification	Comprehensive service facilities, Energy performance, High population density.	Increase in population, increase in redevelopment of previously developed sites, subdivisions and conversions, and additions and extensions, increase in development of previously undeveloped urban land and buildings, increase in density and diversity of sub-centers, investment in and improvement of transport infrastructure and services.

Table 4 Evaluation criteria and indicators of circular city concept referred to Ellen MacArthur Foundation and WEF's principles, elements and strategies of circular city.

Criteria	Indicators	
Principles	Elements	Circular City Strategies
Design out waste and pollution from cities	An urban bioeconomy	R9 Strategies: (R0) refuse, (R1) rethink, (R2) reduce, (R3) reuse, (R4) repair, (R5) refurbish, (R6) remanufacture, (R7) repurpose, (R8) recycle, (R9) recover
Keep products and materials in use in cities and maintain their values	Production system, an urban bioeconomy, built environment.	
Regenerate natural systems in and around cities	Energy system, an urban mobility system, an urban bioeconomy.	

4 Location Overview

Braga is an area that has a long history and has been known since colonial times. Initially, the function of land in Braga area was in the form of housing intended for Europeans. Behind the splendor of Jalan Braga which has a very European impression, there is a traditional indigenous village that was founded in 1826. In 1925, it became the residence of official horse guards, wagon drivers, and laborers. At this time, the area of the village is a dense settlement in the middle of the city of Bandung called Kampung Braga [16].

Kampung Braga is a part of Braga sub-district, Sumur Bandung District, Bandung. Of the 8 RWs in Braga sub-district, RW 03, 04, 07 and 08 were determined as the focus of research locations. From measurements using Google Earth software, the study location has an area of about 12 Ha, which consists of residential areas including 2.2 Ha covering RW 03 and 07, 1.5 Ha covering RW 04 and 08, and 8.3 Ha is a commercial block area at its perimeter. From the information obtained from the RW's administrator, the total population in Kampung Braga is 3,124 people.

According to its location, this study area has a very strategic position, where within a 2 Km radius of the location existed several landmarks of the city of Bandung, such as the *Alun-alun* and the Great Mosque in the South, Paskal Mall in the West, and the Bandung City Government Office in the North. This location is also surrounded by main roads, such as Asia Afrika road and Jendral Sudirman road in the South and Ottista road in the West, including several other main routes that surround it as area boundaries, namely Suniraja road on the North side, Braga Road on the East side, ABC road on the South side and Banceuy road on the West side. Inside this location flows the Cikapundung river which divides the two areas into the East side (RW 04 and 08), and the West side (RW 03 and 07). Both sides of the area are connected by a bridge on the Cikapundung alley section.



Figure 1 Kampung Braga Map. Source: Google Earth map.

5 Study Result

From the evaluation, there are findings regarding the potential of compact city and circular city concept in Kampung Braga as discussed in this section.

5.1 Evaluation Based on Compact City Criteria

- **Criteria 1 – Compactness:** There are few findings in Kampung Braga based on these criteria, such as Kampung Braga can be said as a walkable area with the distance affordability from its edge to edge is approximately 380 to 400 m

away. Kampung Braga is an area with high permeability, where there are eight main gates spread on all of its sides, with one connector bridge for two divided areas by the river, and many internal narrow alleys, approximately 1 m wide, functioned like neural network that connects all parts of the *kampung* which can bring users anywhere within it. There are few public open spaces which are functioned as social nodes and center for activities and facilities (PAUD, Karang Taruna, POSYANDU, etc.). In Kampung Braga can be found many local economic units such as stalls or *warung*, food stalls, food shops, etc., as an indication of the local economy sustainability which is reciprocal between residents (buyers and sellers are from residents themselves), as well as the availability of daily necessities which can be reached at any time on foot. Kampung Braga also can be seen as a very strategic location where city's main facilities, such as schools, mosques and churches, *puskesmas* and hospitals, police stations, fire fighters, etc., exist in the radius of 1 to 1.5 Km and can possibly reached on foot.

From the interviews, it was found that most of the residents carried out their activities in the village, such as trading fried foods, organizing, or doing any kind of business. For residents who work outside the village, they still have other small business activities in Kampung Braga area. This confirms the previous statement, that there is a reciprocal economic cycle in the village, namely sellers and buyers or producers and consumers are residents of the village itself. With this reciprocal cycle, the village has the potential to become an independent area in the middle of the city, not a burden but a resource.

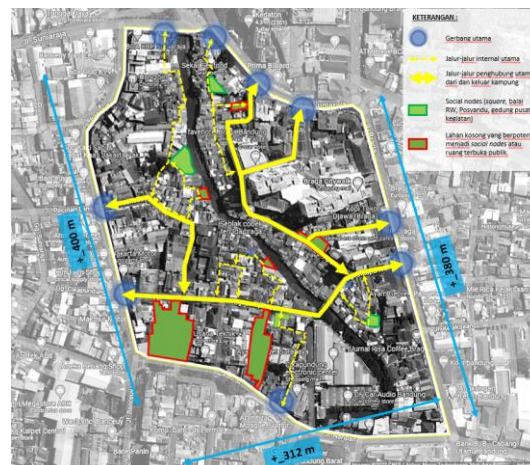


Figure 2 Structure of Kampung Braga, analyzed from google earth map photo.

- **Criteria 2 – Density:** The very dense condition of Kampung Braga makes some parts of the environment dark and crowded. Air and sunlight needed for healthy environmental conditions cannot be obtained in these corners. In addition, the very crowded conditions do not leave many spaces for social nodes which are ideal for residents and can be dangerous in the event of a fire, because it will quickly spread.

However, if viewed from the perspective of compact city potential in Kampung Braga, in other parts of it, a more ideal density condition can be found, where houses are adjacent to the width of the street that is not too narrow still allows for active space in front of the residence, without a motorized vehicle, as a space for social interaction between residents. Given this condition, several positive things can be noted for further study, including: the formation of compactness and strong social bonds between residents, the rapid exchange of information that is useful for the development of citizens' knowledge, the potential to create a pollution-free environment motorized vehicles, as well as the creation of a safe environment because the front of the neighborhood is active and supervised by all residents.



Figure 3 Narrow alley as social space of residents in Kampung Braga. Photo's taken from personal collection.

- **Criteria 3 - Mixed Land Use:** The discussion related to these criteria is closely related to the discussion on the compactness section and some of the findings that have been presented previously, namely the discovery of heterogeneous functions in *kampung* other than residential homes, namely in the form of business units of *warung*, food stalls, workshops or electronic service providers, etc. From the results of interviews, several residents mentioned that there are other functions besides housing in Kampung Braga besides those mentioned above, namely home-based businesses such as cake making and catering, and boarding houses or rented houses. In addition, if we look at the overall delineation of the study locations, the composition between

the functions of commercial and residential land is almost balanced. Thus, the whole area of Kampung Braga can be said to be an area with mixed functions.

- **Criteria 4 - Sustainable Transportation:** From the information obtained, it shows that most residents carry out daily mobility by walking, then by public transportation or online taxi to reach places far outside the *kampung* for reasons of practicality and affordability. Around this location, there are also Trans Bandung Raya bus stops which can still be reached on foot. From this, it can be identified the potential of Kampung Braga as an environmentally friendly area, where some of its residents feel comfortable and safe walking in the *kampung* area so that it meets the potential of public transportation criteria as a sustainable mode of transportation for economic and environmental aspects.
- **Criteria 5 - Green Structure:** The discussion of the green structure criteria does not only indicate green open areas in the form of parks and green paths planted with plants or flowers as a greening of the environment, but further looks at the existence of open spaces where social interaction can occur in the middle of the Kampung Braga area. In Kampung Braga, there are open spaces that have functioned as a centre for social activities and a common garden of medicines and spices. Judging from its composition, the open space as a centre for social activities is quite minimal in the midst of the density of existing settlements. However, there is also an indication of the potential to increase green areas from the behaviour of residents who are willing to use the remaining land around the *kampung* as green areas such as gardens and parks. Another potential is that there are still abandoned vacant lands in the middle of the *kampung* that can be considered as green open spaces for its residents.



Figure 4 Utilizing residu space in Kampung Braga as green structure for common use. Photo's taken from personal collection.

- **Criteria 6 – Intensification:** From the results of interviews with residents, it was stated that there were houses that were used as rental accommodation, such as boarding houses and contract houses, as well as the existence of small houses occupied by more than one family head. This is an indication of an increase in population in the Kampung Braga. Strategic location in the middle of the city, which is passed by various public transportation modes, with

affordability to major facilities, especially the location of Kampung Braga which is directly adjacent to the old town commercial area, making Kampung Braga a very attractive location for many migrants who work in the vicinity and need a temporary place to live. This is one of the potentials of *kampung kota* as a support for the sustainability of urban development.

5.2 Evaluation Based on Circular City Criteria

From the evaluation conducted through interviews and observations in the field, it was found that there were residents' behaviors that were in accordance with the circular city criteria. However, this behavior has not been carried out based on knowledge and awareness of the circular city concept itself, so that the benefits of this activity are not known for oneself and more broadly for the sustainability of the urban environment. However, this can be seen as potential that needs to be encouraged so that it has a more significant impact on the life of the urban environment. Below is the evaluation of circularity behavior that found in Kampung Braga based on the three criteria of circular city concept.

- **Criteria 1 - Design Out Waste and Pollution from Cities:** waste centralization to be sorted and resold as additional income for residents; the creativity of plastic waste into decoration; utilization of plastic waste or used objects, such as tires as children's toys; reuse of plastic waste as ornamental planting media in small gardens, both in residual land and in the yard.
- **Criteria 2 - Keep Products and Materials in Use in Cities and Maintain Their Values:** activities of buying and selling used tires; the creativity of cardboard or used paper becomes a costume that is contested between RWs, reuse of used wood into LINMAS post furniture or hedges; reuse of used objects as supporting tools for daily needs; processing coffee packaging into new creative works for resale.
- **Criteria 3 - Regenerate Natural Systems in and Around Cities:** utilizing the remaining land in the *kampung*, such as streetside land, the dividing walls of the *kampung* and the surrounding buildings, river bank walls, as a garden for medicines and common kitchen spices processed by the PKK organization; utilization of disputed land for gardening and raising laying hens and raising catfish which is managed by the RW and supervised by the city government, where the results are sold back to the residents at a more economical price; establishment of a clean water system that can be shared by residents.



Figure 5 Kampung Braga's residents' behavior of reusing used material and utilizing residu space as green structure. Photo's taken from personal collection.

6 Conclusion

From this study, we can have conclusion as below:

1. From the perspective of compact city, based on the evaluation, despite all of its advantages and disadvantages, Kampung Braga can be seen as a compact area. This table below contents the evaluation of Kampung Braga based on compact city criteria.

Table 5 Summarized of evaluation result of compact city concept in Kampung Braga.

Evaluation Criteria of Compact City	Evaluation Result of Kampung Braga
Compactness	• Kampung Braga meets the criteria of compactness due to its affordable distance both within the village area and to various city's main facilities which are still less than 1.5 Km away. • Although the composition of the ideal open space is lacking, Kampung Braga can still be a compact area where the existing outdoor spaces, including the streets in front of the house, become a flexible space where social interaction of its residents takes place and creates an active frontage. • Kampung Braga is a compact area with its local commercial units called <i>warung</i>, which support the daily need of its residents, as well as support the economic sustainability of the kampung itself.
Density	• Kampung Braga is a settlement area with high density so that brings various impacts, such as creating some dark and narrow parts where not an ideal environment to live, lack of public open spaces for social interaction, and the potential for fire hazards that can quickly spread. • If it is seen from the perspective of compact city, the density of Kampung Braga can be potential, namely the formation of community cohesiveness because of the strong social ties among its citizens.
Mixed land use	• Kampung Braga is a compact area with its mixed land use. Overall, the area is dominated by the commercial function on its block perimeter and residential on its center. • Within its dense settlement area has been mixed of land use of residential and local commercial, such as one building has living space on its upper floor and informal commercial on the ground floor such as <i>warung</i>, <i>warteg</i>, etc. • The existence of this mixed function supports the sustainability of life and the development of Kampung Braga in the middle of the city.

Sustainable transportation	• From this criteria's point of view, Kampung Braga is a compact area, where most of its residents have the feeling of comfortable and safe doing their daily activities within kampung area with only on foot. • Kampung Braga is a compact area due to its very strategic location, where city's main facilities are located within affordable distance in 1 to 1.5 Km away, and it is traversed by Bandung's public transportation routes.
Green structure	• Kampung Braga has none ideal area for green and public open space. However, it is indicated that the behavior of residents needs to be encouraged in terms of using the remaining land within kampung as gardens or parks that are useful for common purposes. • There still can be found the potential abandoned vacant land within kampung that can be used by residents as green spaces or spaces for social activities.
Intensification	• Kampung Braga is a very attractive area for many people from Bandung and also newcomers, due to its strategic location in the middle of the city with easy access to the city's main facilities. • The intensification of density in Kampung Braga has the potential to increase its economic sustainability.

2. From the perspective of circular city, in Kampung Braga has already existed circular economy activities by its residents based on its three principles and 9R strategy. Nevertheless, those activities haven't done with basic knowledge and awareness regarding the benefits and impacts of circular economy for their life and urban environment sustainability.

7 Propositions

By looking at the findings in this study, it is important to follow up on further input and discussion. Below are the propositions from the author:

1. With the many potentials of Kampung Braga, in term of its existence as a compact area and the circular behavior of its residents but without awareness and correct knowledge of its benefits and contributions to personal life and urban environment, various kinds of support as well as from the government is urgently needed to encourage this existing potential to become a contribution to the sustainable development the city of Bandung.
2. Further studies and discussion from researchers regarding Kampung Braga need to be encouraged and then the results need to be campaigned to the residents to build their awareness of their potentials based on the correct knowledge.
3. Cooperation is needed from all residents in terms of improving the quality of the environment in Kampung Braga.

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