

Establishing the Smart City through the Implementation of Smart Environment

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This paper aims to look at the difficulty in creating a smart city through the smart environment approach. The smart environment is one of the dimensions of smart cities to develop a sustainable city in line with environmental management. Cirebon City's inability to receive the Indonesian Green City-Adipura Award eventually led the government to decide to incorporate the smart city by using the smart environment framework. By using a descriptive qualitative research approach, this research seeks a solution by acquiring a profound understanding of environmental management and the community's views on the environment in this area. The result indicates that there is a discrepancy that renders the management of the environment inadequate, and it gives a new perception that the idea of smart environment might bring improvements in the proper management of the environment.

Key words: *Environmental management, Smart city, mart environment, Indonesia.*

Introduction

The environment is a crucial aspect of urban development and governance. Most of the time, however, the government would depart from environmental issues and concentrate only on the development of the city itself, which in turn contributes to unsustainable development in the region (Trundle, Barth, and Mcevoy, 2019). From an environmental point of view, the effectiveness of such an operation is calculated not only by rapid economic growth and equity gain, but also by the preservation of the environment in which development takes place (Hardoy, Gencer, and Winograd, 2019). Poor environmental management destroys development resources (Tyagi, Garg, & Paudel, 2014). The factors of the development concerned are land availability, access to clean water, decent air quality, etc. (Ifeakachuku, 2014). Then, as a result, the environment is becoming a dangerous and uninhabitable

location, since both development and human life are endangered by environmental destruction.

Geerling (2007), argues that environmental management should build an effort to understand human-environmental interaction that can be clarified through two approaches — egocentrism and ecocentrism. Kopnina and Washington (2017), argue that the method of egocentrism and ecocentrism can identify between human and environmental hegemony. The antidote to egocentrism is based upon different individual preferences. This strategy is based on the needs of people, which concentrate on what behaviours are appropriate for them (Alagoz & Akman, 2016). Egocentrism claims that what is ideal for individuals is also good for the community, where the acts of each citizen are meant to pursue personal goals and promote themselves (Molina-Motos, 2019). Meanwhile, Miklos (2014), asserts that the solution to ecocentrism stresses the interdependent biotic and abiotic dimensions so that duties and roles are not only restricted to living things but also the whole environmental setting (Miklós, 2014).

The two approaches have a specific inclination, and the difference between the two strategies can also be defined at the same time through the inadequate environmental management situation in Cirebon City (Kopnina et al., 2017; Miklós, 2014). In 2012, Cirebon City won the *Adipura* award due to its capability to maintain the city environment, especially in the environment that was the place of education and public space (Jaksi, 2016). However, the city did not receive the award again in the *Adipura* assessment in 2014 and 2016, because the score obtained was inadequate. Several variables affected the loss, some of which are issues with poorly managed landfills, polluted rivers and many unmanaged public facilities that reflect incompetent management of the environment (Yogiswatin, 2014).

Environmental issues in Cirebon City-Indonesia show disparity in resource management and collective involvement in the protection of resources. In response to a lack of environmental protection, the government has decided to adopt the concept of a smart city for city management. Therefore, referring to the Decree of the Minister of Communication and Information Number 265/2017, concerning Submission of the Movement to the 100 Smart City Assessment Selection, Cirebon City officially participated as one of the 25 cities participating in the program (Sri, 2017). The adaptation process dashed, as evidenced by the establishment of the Smart City Master Plan of Cirebon (SCMPC) document, which was created as a development planning map. The report clearly explains about various work programs from each dimension of the smart city. Each aspect has a work program that focuses on the desired goals and objectives.

This research focuses on measuring the smart environment that incorporates the SCMPC. Besides, the use of the smart environmental concept and programs in the city also aims to

identify the gap in environmental management. Furthermore, the smart environment can provide changes by analysing its implementation process; whether it is successfully implemented in environmental management.

Literature Review

Context of Study: Efforts to Realise Sustainable Environmental Management

Environmental degradation can be a problem for urban social and economic development (Asaju & Arome, 2015). Chopra (2016), believes that environmental degradation can even threaten human life. Thus, it becomes a priority in national development in several countries in the world (Chopra, 2016). Di, Varriale, and Trujillo (2019), argued the effective management of the environment could be accomplished utilising regulatory and organisational ties (Di et al., 2019).

It means that damage to the environment may have a detrimental effect on development, and it is a shared responsibility for its completion. The presence of ecological damage would delay development as it is a fundamental aspect that incorporates resources of life such as water, soil and air (Astuti, Parenta, Paddu, & Hasanuddin, 2014). The contaminated urban environment would inevitably cause many problems, such as difficulty obtaining clean water and polluted air attributable to car contamination, or residual combustion (emissions) that may interfere with breathing (Oliveira, 2019; Union & All, 2019). The government should pay close attention to the maintenance of the environment so that the city's development is sustainable and the environment does not disrupt certain occurrences.

The discussion on the polemic of waste management can be explored through the theory of waste management based on governance presented by Kirkman and Voulvoulis (2017), who explain four indicators to review the success of the waste management program in a city: involvement; collaboration; participation and innovation; and information and communication. The involvement consists of various parties. The collaboration generates advances in communication and innovative solutions. The transition must be socialised among all parties and carried out with exemplary communication and coordination (Purnomo, Anand, & Choi, 2018), which makes the waste management in the city useful (Kirkman & Voulvoulis, 2017).

Therefore, the smart environment is a concept that aims to be efficient and practical in maintaining environments. This idea is closely related to the sustainability concept, since its influence offers the opportunity for a community to enhance its environmental management. This concept may create better environmental management through collaboration between the government, the community and interested parties, in which case it refers to private or social

organisations involved in the field of environmental enhancement. Therefore, this research provides new ideas and information about the application of the smart environment concept in Cirebon City, based on the gap between the planned theory and the implementation.

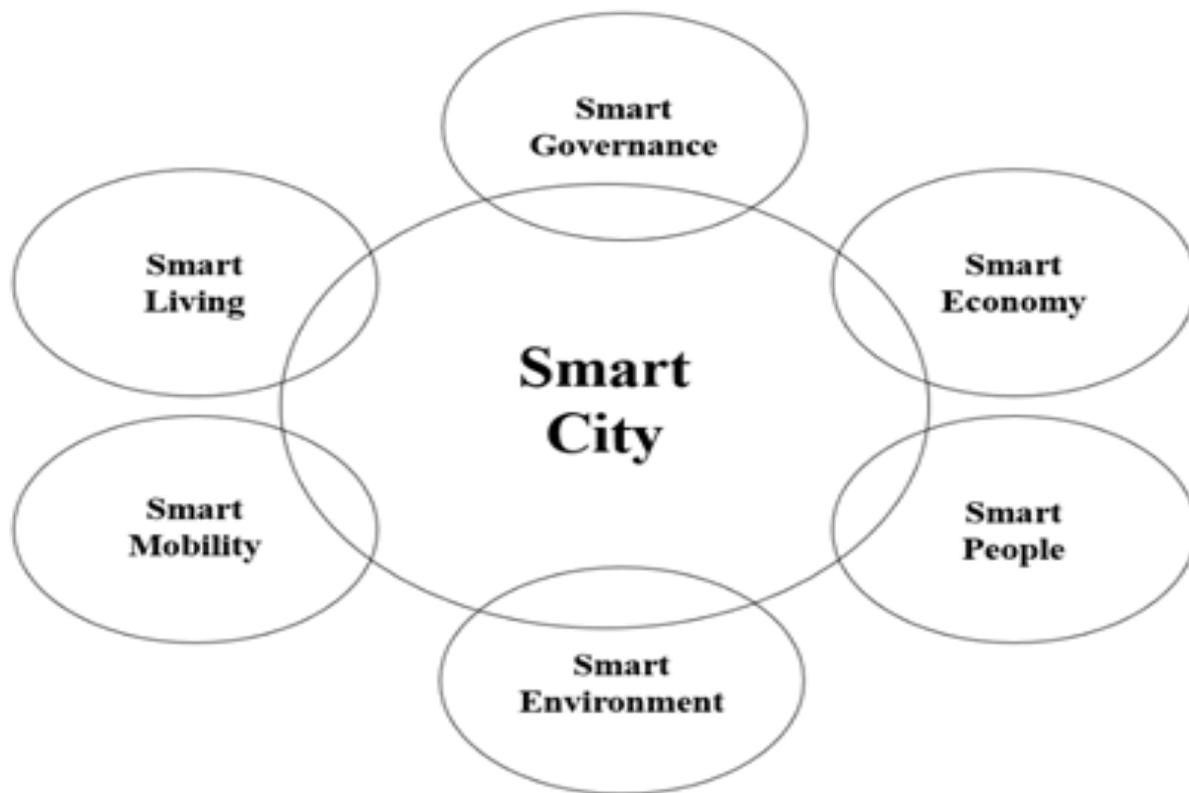
Sustainable Development Goals

Sustainable development is an idea of how to develop the economy and preserve the environment and social conditions in the city for the benefit of present and future generations (Campagnolo, Eboli, Farnia, & Carraro, 2018). In their implementation, SDGs have three basic principles as references (Nurmandi & Purnomo, 2011). Firstly, commitment to justice and fairness, where priority should be given to the world's least developed communities and decisions should take into account future generations' rights. Second, as a long-term goal that emphasises precautionary principles, where there is a severe threat or something that cannot be prevented, the lack of knowledge should not be used as an excuse for delaying cost-effective measures to prevent environmental degradation. Third, sustainable development integrates and understands, while acting in the complex interrelationships that exist between the environment, economy, and society. Environment, economic development, and social justice are the three main pillars of sustainable development (Morton et al., 2017). Moreover, the incapability of the government and private sectors has to lead the community itself to become the main pillar in the implementation of the sustainability of resources and environment (Purnomo & Hubacek, 2010).

Smart City Concept

The smart city concept employs the use of intelligent computing technology to integrate essential components of city infrastructure and services, such as city administration, education, health, public safety, real estate, transportation, and other city needs, where the overall use must be done intelligently, interconnected, and efficiently (Govada, Spruijt, & Rodgers, 2017). A smart city is defined as a city that builds up human resources, social capital and modern telecommunications infrastructure as one resource (Information and Communication Technology), achieving sustainable economic growth and high quality of life, with smart management of resources through community-based governance (Meijer & Bolívar, 2016). In the process, this study divided the smart city into six parts/types—smart mobility, smart economy, smart environment, smart people, smart living, and smart governance. The following Figure 1 is the illustration of smart city dimensions:

Figure 1. Illustration of Smart City Dimensions



Source: Trindade et.al, 2017

A *smart economy* dimension combines innovation, entrepreneurship, self-branding, competitiveness and competition (Slawomira, 2016). *Smart people* are a dimension that relates not only to the level of community education but also to how social interactions occur within the community that will lead to smart communities, and these are continuously performed to support their creativity, thinking skills and social skills (A. Khalid, 2016).

Smart governance can be seen in the cooperation between the government and the community-run, it aims to realise clean, honest, fair, democratic governance, and better quality and quantity of public services (Razaghi & Finger, 2018). It includes such factors as political participation, quality of service, and public administration (Bolívar & Meijer, 2016). Fourth, *smart mobility* usually can be measured by how transportation and community mobility perform in a city (Noy & Givoni, 2018), or availability of information and communication technology and environmentally friendly urban transport systems, local and international accessibility as an indicator of smart mobility (Tomaszewska & Florea, 2018).

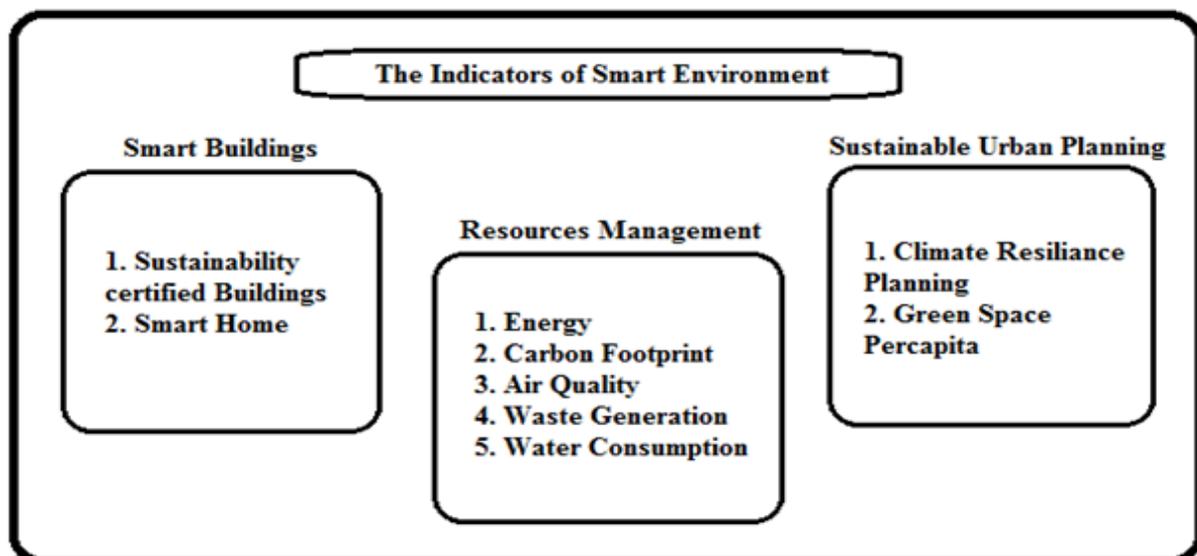
The *smart environment* deals with natural environmental protection issues. It specialises in creating smart environments, including sustainability and better resource management. The last dimension is *smart living* that is related to the quality of life aspects of urban

communities. It has conditions, criteria, and goals for the process of managing the quality of life and intellectual culture (Hayati et al., 2017). Not all dimensions of the smart city should be applied and developed. The implementation can focus on one or several of them, depending on the potential and character of the city.

Smart Environment

The smart environment dimension plays an essential role in improving the environment in Cirebon. The steps in implementing the smart environment have several indicators or benchmarks to ensure the success or the standard of how the concept is applied. Based on the table above, this dimension divides the steps into two, specifically through the working area (area sector) and the predetermined indicators per regional sector. The regional sector is divided into three parts, namely, intellectual development, resource management, and sustainable urban planning. The following Figure 2 is the description of the regional sector and indicators in the smart environment:

Figure 2. Illustration of Smart Environment Indicators



Source: Alibegovi & Villa, 2018

There are two approaches in smart development, smart home approaches and sustainability toward development (Alibegovi & Villa, 2018). This smart home approach is a concept which seeks to demonstrate how technology products can be implemented to help people conduct their daily activities easier (Yang, Lee, & Lee, 2018). In turn, the smart planning field also discusses building qualifications concerning the need for sustainability. In this indicator of Environmental Impact Assessment-EIA (*Analisis Dampak Lingkungan/ AMDAL*) is a tool for maintaining requirements for buildings that are healthy and environmentally

friendly or vice versa (Hidup et al., 2011). The assessment is a structured research tool used to quantify environmental impact through preparing project activities aimed at ensuring the presence of environmental impact problems which need to be evaluated in the early stages of project planning and design as a decision-maker (Muda, 2016).

Air quality is an environmental aspect which needs to be measured. As mentioned by Hernandez (2019), air quality is also an essential element in implementing the intelligent concept of the environment, even though it is a necessary component of every single thing on earth, for person, animal and plant alike (Hernandez et al., 2019). Poor air quality may affect the human respiratory system and therefore, can cause several diseases in the airways (Mannucci & Franchini, 2017).

The quality and amounts of clean water consumption are other necessary aspects which also maintain human existence. This element is essential, considering that there are several cases of fresh water crises in several regions of Indonesia. Khalifa (2018), states that the clean water problem has forced many people to drink water polluted with hazardous chemicals that will affect their health (Khalifa, 2018). Therefore, air and water are important natural elements in the concept of a smart environment, since human life could take place and be sustainable through these two components (Hunter, Macdonald, & Carter, 2010).

Research Methodology

This research applied a descriptive qualitative method. A descriptive qualitative approach is a technique of meeting several humans, an object, a unit of condition, a system of discussion or events (Cropley, 2019). This study provides information about the application of the smart environment concept that explains how people perceive changes in environmental governance with the thoughts they produce. Data collection was carried out through documentation, observation, and interviews. The researchers interviewed around 25 key people, from all departments responsible for the implementation of the smart environment program (Environmental Office (*Dinas Lingkungan Hidup/DLH*); Communication, Information, and Statistics Office (*Dinas Komunikasi, Informasi, dan Statistik/DKIS*); Public Works and Spatial Planning Office (*Dinas Pekerjaan Umum dan Penataan Ruang/DPUPR*); Transportation Office (*Dinas Perhubungan/DISHUB*); Social Affairs Office, Women's Empowerment and Child Protection Office (*Dinas Sosial, Pemberdayaan Perempuan, dan Perlindungan Anak/DSPPA*)). The researchers also conducted direct discussions and documentation in several corners of the city that were the object/discussion in this study.

This study aimed to cover many areas of the region, such as wide-open spaces, landfills, industrial parks, and several other locations relevant to environmental management in Cirebon City, so that the research took three months to complete. This research involved



many parties responsible for environmental management in Cirebon City, such as the Environmental Officer and the Transportation Division. Interviews with several stakeholders provided details on developing the idea of a smart environment. This research provides not only information relevant to the implementation of the definition, but also information that exposes the reality and sources of inadequate environmental management.

Result and Discussions

Implementation of the Smart Environment Concept According to the Smart City Masterplan in Cirebon City

The term implementation refers to an essential instrument in a government that implies a dynamic process, where the executor of policy carries out an activity, and the results are following the goals or objectives of the policy itself (Corchhn, 2015). The implementation theory ascertains that the application of the smart environment concept in Cirebon is an attempt to get the desired results, particularly a change in the better quality of environmental management; a dynamic process carried out by the government to realise the application of the smart environment concept. The three programs were designed according to the needs and environmental conditions. Table 1 is the description of the three main smart environmental programs:

Table 1: Smart Environment Programs in Cirebon City

Main Program	Sub Programs	Interviewees
Important Ecosystem Protection Program and Critical Land Restoration	<ol style="list-style-type: none"> 1. Management of urban green space (UGS) in Cirebon City 2. Protection and conservation of natural resources in Cirebon City 3. Restoration of coastal ecosystems 4. Management and development of a drainage system in Cirebon City 	<ol style="list-style-type: none"> 1. Public Works and Spatial Planning Office, 2. Environmental Office, 3. Social Affairs, Women's Empowerment and Child Protection Office
Management Program of Waste and Garbage	<ol style="list-style-type: none"> 1. Development of solid waste management performance in Cirebon City 2. Control of pollution and environmental damage in Cirebon City 3. Application of community-based environmental management in Cirebon City 	<ol style="list-style-type: none"> 1. Communication, Information, and Statistics Office, 2. Environmental Office, 3. Public Works and Spatial Planning Office, 4. Social Affairs, Women's Empowerment and Child Protection Office
Energy Saving Program	<ol style="list-style-type: none"> 1. Efforts to save energy consumed by people of Cirebon City 	<ol style="list-style-type: none"> 1. Transportation Office, 2. Public Works and Spatial Planning Office

Source: Document of the Smart City Masterplan in Cirebon City

Furthermore, the discussion begins with identifying the main programs and sub-programs to find out explicitly whether the implementation of the smart environment concept has run according to the plan as follows.

Important Ecosystem Protection Program and Critical Land Restoration

Ecosystem protection is an integrated effort to preserve environmental functions that include the policy of structuring, utilisation, development, maintenance, restoration of supervision, and control of the environment to create a sustainable ecosystem (Martín-lópez et al., 2019). Following this statement, ecosystem protection is the main program of the intelligent environment in Cirebon City. Environmental Damage Control and Recovery personnel stated

that to support this program, several sub-programs were held, with descriptions and results of the research as follows:

1) Management of Urban Green Space (UGS) in Cirebon City

Urban Green Spaces (UGS) for the city areas is an essential aspect in ecosystem services, because it can promote physical activity, psychological well-being, and public health of the city dwellers (Brontowiyono, 2016). Unfortunately, the existence of UGS in Cirebon is only limited to regulation. The city has an area of 3,900.8 hectares, with residential land use of 1,298.91 hectares or 33.30 per cent of the total area of the city (Lestari, Fatimah, & Barus, 2017). The use of land for settlement eventually cut off the UGS land due to the difficulties of the government in claiming that the area is UGS. However, there are still several problems at the implementation stage, such as land acquisition efforts that will take up a lot of costs. At the same time, the owned financial capacity is limited and has to be allocated for other development purposes as well.

2) Protection and Conservation of Natural Resources in Cirebon City

Conservation of natural resources is the management of natural resources that are used wisely to ensure the continuity of inventory while at the same time maintaining and improving the quality of diversity and value (Evely et al., 2012). The launched natural resource conservation program is at the discretion of the government to protect natural resources. When considering these issues, the Environmental Office in Cirebon City took several steps in carrying out the protection and conservation of natural resources. In this program, an emissions test is carried out to obtain quality data from water, air, and soil. The test is conducted periodically, which is twice a year.

3) Restoration of Coastal Ecosystems

Repair is the process of assisting the recovery of an ecosystem (Inácio & Umgieser, 2019). Coastal restoration is an aspect that must be considered by the Cirebon City Government as this city is on the coastal shore. Unfortunately, the management and recovery of coastal ecosystems in this city turned out to be inadequate due to the inability of the government and the responsible institutions to solve the waste problem around the coast.

4) Management and Development of the Cirebon City Drainage System

A drainage system is a central part of a residential area. Valipour (2012), mentions that a drainage system is a series of activities that form water drainage efforts, both surface water (run-off), and underground water from an area or region (Valipour, 2012). The drainage management system in the city is not portrayed, since there is no data collection on the drainage system and network that are currently being built in Cirebon City, which usually coincides with the restoration and construction of roads.

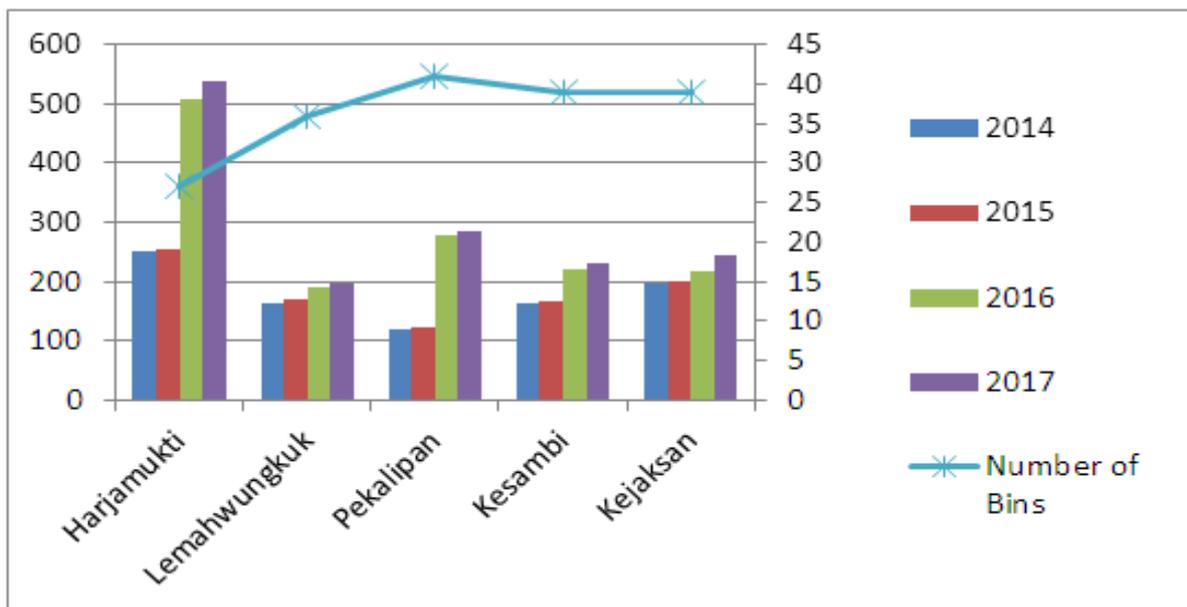
Management Program of Waste and Garbage

Waste is the remnants of material undergoing treatments, either because the central part has been taken, or because of processing, or because there are no benefits based on an economic point of view, that can cause environmental pollution or interference with the environment. Improper waste management can cause environmental pollution (Tonini, Federica, & Fruergaard, 2018). Therefore, this program received special attention from the government. This program consists of three sub-programs that become supporters, namely:

1) Development of solid waste management performance in Cirebon City

The waste management system, especially for urban areas, must be implemented appropriately and systematically. There are several reasons why waste management in Cirebon has not run optimally, such as management techniques that are not innovative, no additional land for landfills, and weak drainage system. The following data and Figure 3 are the results of research related to the inequality of the volume of waste with the number of landfills. There is an imbalance between the volume of waste that continues to grow each year.

Figure 3. Graph of Waste Inequality in Cirebon City



Therefore, through this program, the Environmental Office of Cirebon City finally decided to manage waste by finding new land for landfills. It also maximises its role and synergy by becoming a coordinator and synergising with scavengers. The scope of the coordination with janitors in waste management only covers certain areas, such as landfills, lay stalls, and around the area of the Environmental Office.

2) Control of pollution and environmental damage in Cirebon City

Environmental damage is the deterioration of the environment through depletion of resources such as air, water, and soil, the destruction of ecosystems and the extinction of wildlife (Tyagi et al., 2014). This program is a preventative effort from the city to reduce the level of pollution and environmental damage. The real action of this program is to tighten the implementation and supervision of the environmental impact. The Environmental Office applies the procedure through the effort of environmental management and monitoring as a condition for obtaining environmental permit documents for each business stakeholder.

3) Application of community-based environmental management in Cirebon City

Community-based natural resources management is one of the approaches to manage natural resources by placing the knowledge and environmental awareness of the local community as a management basis (Lawson, Gordon, Mensah, & Atipoe, 2015). It is a program to increase community participation in managing the environment. By introducing four strategies that support community-based environmental management are guaranteeing access to resources for groups and individuals and fair distribution; enhancing the exchange of information, expertise, and technology; increasing participation in conservation and development; and maintaining the environment by community actions.

Tabulation of Smart Environment Implementation in Cirebon City

Findings from the collected data is summarised in the form of tabulation. This tabulation presents an analysis of the application of the smart environment concept, particularly regarding its success or failure. It also describes the cause of failure. This tabulation provides an understanding of the extent to which this concept can be applied (table 2).

Table 2: Tabulation of Smart Environment Program in Cirebon City

Main Program	Sub Programs	Status	Information	Smart Environment Indicators
Important Ecosystem Protection Program and Critical Land Restoration	Management of urban green space (UGS) in Cirebon City	Failed	Limited government fund causes bidding difficulties.	Smart Buildings, Resources Management, and Sustainable Urban Planning
	Protection and conservation of natural resources in Cirebon City	Successful	Monitoring and evaluation were enough through assessing <i>Emission Testing</i> run effectively.	

	Restoration of coastal ecosystems	Failed	Weak governance and lack of community awareness.	
	Management and development of a drainage system in Cirebon City	Failed	Poor coordination of structuring or preparation of the drainage blueprint.	
Management Program of Waste and Garbage	Development of solid waste management performance in Cirebon City	Failed	<ul style="list-style-type: none"> a. Limited room for the government to carry out innovative management techniques b. The absence of additional land for landfills c. Poor coordination 	Resources Management
	Control of pollution and environmental damage in Cirebon City	Successful	Enhanced Environmental Impacts Assessment (EIA) and emphasised city development instrument	
	Application of community-based environmental management in Cirebon City	Successful	Four strategic communities supporting program in maintaining environment was implemented well	
Energy Saving Program	Efforts to save energy consumed by people of Cirebon City	Successful	Power saving program was delivered well	Resources Management and Sustainable Urban Planning

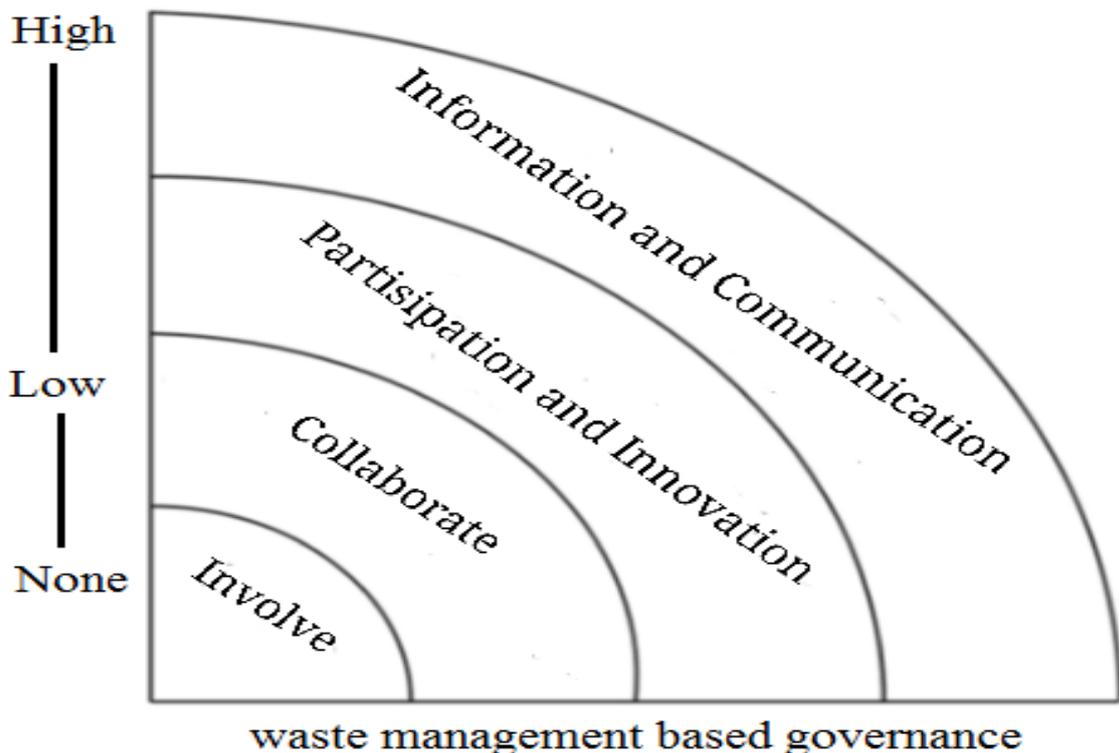
This tabulation shows that the three main smart environment programs designed by Cirebon City have met the indicators set out in this study, namely, smart buildings, resources management, and sustainable urban planning. Four programs were successfully implemented, and the rest were not. Those that have been successfully implemented are old programs that

are reformulated into the smart environment concept, while others are still in the planning stage in formulating strategies and instruments.

Discussion

In this section, the discussion continues by explaining the analysis of the application of the smart environment program in Cirebon City. The discussion begins with examining the causes of the success and failure of several programs implemented, in which a gap emerges through the discussion. The gap is a guide, offering new insights to improve the application of the smart environment. This identification and analysis also provides information on which parts must be changed, fixed, and advanced to maximise the implementation of the concept. The tabulation shows the success and failure of the programs, including the information. Four programs are successful, and four others have failed. The causes of this condition could be explained through the theory of government-based waste management delivered by Kirkman (2017), as illustrated in the following Figure 4:

Figure 4. The Practices of Waste Management in Cirebon City



Source: Kirkman, 2017

Involvement is the primary key to the success of waste management, according to this theory. Araujo (2012), also argues that public participation is a way to ensure that citizens have a direct voice in public decisions. The government should invite many parties or encourage

advocacy with many parties that produce input, both in the form of records of needs or demands (Araujo et al., 2012). The government excludes many parties, either from society or community organisations engaged in the environment. The lack of involvement makes the *collaboration* hampered. Collaboration is an effort to involve non-government stakeholders in a formal, consensus-oriented, collective decision-making process, that aims to build and implement public policies and manage programs or public assets (Cradock-henry, Greenhalgh, Brown, & Sinner, 2017). As the executor, the government has limitations both in terms of human resources and funds. Therefore, there should be effective cooperation from various parties to actualise environmental management. The success of the previous or pre-existing programs, which were carried out only by a few institutions, proved that the government ignored aspects of engagement and cooperation.

Furthermore, *aspects of participation* do not work on environmental management in the city, which is an obstacle. Ideally, participation is an action to take part in implementing a policy for a common goal (Bernauer & Betzold, 2012). The participation of the community proves that the program has been know and supported, where people are interested in taking part in it. However, the community show no interest in participating in the program. The failure of coastal restoration programs evidenced this, because it was polluted by garbage from society. However, the aspect of innovation has begun to grow even though it is still in the preparation phase, namely in a community-based environmental management program with several strategies designed by the government to provide environmental literacy and education to society.

The last indicator is the *aspect of information and communication*, known as program socialisation and coordination in program implementation. Policy socialisation is a form of notification of information related to policies or decisions that have been determined to the public so that they know and want to participate in it. Socialisation can also be described as a form of soft diplomacy in implementing policies. It is a government obligation but a right for the community (M. A. Khalid & Said, 2016). The government is good enough at providing socialisation in the form of an energy-saving movement. However, poor coordination happens between the agencies, which then makes the green open spaces in Cirebon City limited due to poor coordination between the Environmental Office and Public Works and Spatial Planning Office related to land acquisition and maintenance.

It could be understood that the smart environment program launched by Cirebon City has fulfilled all the established smart environment indicators. The program may be considered perfect, but many problems need to be adjusted at the level of implementation. The program implementations are hampered due to several factors. The first factor is community participation. Community participation in Cirebon City in maintaining and managing the environment is still meagre. The second factor is the communication pattern between the



government and the bureaucratic pathway. The third factor is the limited funds, and the last is the absence of strict sanctions for those who commit pollution and environmental damage.

Conclusion

The following conclusions have been drawn from previous discussions on the application of the smart environment concept in Cirebon City. First, the Masterplan Program made by the Cirebon City Government has fulfilled all smart environment indicators and is comprehensive, as it raises strategic environmental issues. Waste management and the existence of green open spaces had been considered as solutions to the unresolved environmental problems. They are preparatory activities to welcome the election of *Adipura* in the following years so that Cirebon City can rise and regain the award.

Across the implementation point, though, many issues need to be solved by the government and the society collectively, because protecting the environment is a shared responsibility. Some problems, such as low community participation, limited operational funds, the lack of clarity of inter-office duties, including the complicated communication between the government and bureaucratic, and less assertive sanctions, must be followed up to optimise the application of the program. If the government can achieve this, Cirebon City can declare itself as a sovereign city for its environmental management, and it can support other aspects of development.

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