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Infrastructure Impact and Sustainability: The Case of Public Sanitation Facility in Indonesia

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Abstract
Recently, the focus of infrastructure has been not only on its physical output *per se* but also on its impact on sustainability. This study aims to introduce an infrastructure framework based on Epstein and Buhovac's model to better understand the step-by-step process of the creation of infrastructure sustainability for wastewater treatment facility in Indonesia. The study employs a qualitative approach using a qualitative data set from interviews, observations and a survey. We focused on the case study analysis of a wastewater treatment facility in Yogyakarta Province, Indonesia. Through this framework, stakeholders' participation was found to play an important role, thus enabling the sustainability of the infrastructure project in the future. This active participation is the result of a set of impacts-social, economic, and environmental-that have been created by the wastewater treatment facility in their community. We provide a theory-of-change diagram to explain this process.
Keywords: Infrastructure sustainability, Impact, Sanitation facility, Indonesia

1. Introduction

For decades, infrastructure has been the main focus of most governments across the globe. They believe that infrastructure is one of the most important pillars in the economic development of a country. For instance, governments build transportation facilities, such as highways, seaports, airports, and railways, to create a free flow of resources which can enhance their country's economic growth. People and goods are easily and rapidly moved from one place to other places without any significant barriers. Thus, new economic centers will emerge in rural areas, creating new employment opportunities for the people. Evidence shows that a country with good infrastructure will have more competitive advantages than one deficient in infrastructure. However, the rapid growth of infrastructure development is not without potential problems. Some countries, such as Sri Lanka, are now in difficult situations due to their inability to repay foreign debt as a result of this massive infrastructure development (Limaye, 2017). Most of Sri Lanka's infrastructure plan is financed by foreign debt funding, especially from China.

As infrastructure is a long-term investment, a country should be clear at the very beginning about its development benefit or impact. Improper planning and evaluation on how infrastructure is going to provide a positive change to stakeholders could cause disruptive conditions not only at the country level but also at the local level. Previous studies in the literature have shown that these phenomena could be driven by the 'iron triangle' approach to infrastructure development (Toor and Ogunlana, 2010, Atkinson, 1999). The 'iron triangle' approach is used to label infrastructure development which is focused on time, cost, and quality *per se*, without sufficient attention given to environmental, cultural, and economic aspects. The 'iron triangle' approach focuses on how to deliver the output, that is, the infrastructure facility, without any concern for how this facility could impact on stakeholders. Hence, this lack of attention to stakeholders' interests makes the infrastructure facility both useless and unsustainable. Therefore, researchers argue that discussing the infrastructure's sustainability is important as the way to link an infrastructure facility's physical output and its broader range of impact (Sierra et al., 2015, Whitton et al., 2015, Amiril et al., 2014).

Prior works in the literature provide a wide spectrum of definitions related to the impact on infrastructure sustainability. For instance, the United Nations (UN) Economic and Social Commission for Asia and the Pacific (ESCAP) (ESCAP, 2006) defines sustainable infrastructure as infrastructure in harmony with the continuation of sustainability in the economy and environment by designing and maintaining buildings, structures, and other facilities with an eye towards resource conservation over the life of the infrastructure. The National Research Council (2009) has referred to infrastructure sustainability as a lifeline system that enables the needs of current and future generations to be met in ways that are cost-effective, physically resilient, socially equitable, and environmentally viable. Furthermore, Meng *et al.* (2015) argued that infrastructure sustainability is one of the most important factors in project success. Infrastructure sustainability aims to provide a sustained and effective system for urban economic, social, and ecological development throughout the entire life cycle of the

infrastructure project. Therefore, it is clear that those developing sustainable infrastructure should be aware of its social, environmental, and economic impact as an integrated part of infrastructure effectiveness. Most of these impacts are related to stakeholders, whether direct or indirect; thus, it is important to understand how impacts could be created from an infrastructure project to achieve this objective. An infrastructure project with good impacts means that the infrastructure achieves the desired sustainability performance.

Prior studies in the literature have revealed that infrastructure's sustainability performance is a project that provides a set of societal, economic, and environmental impacts for stakeholders (Amiril et al., 2014). This succeeds in transforming the physical delivery of an infrastructure project into a social change that creates social impact on stakeholders, and especially on beneficiaries. Moreover, Amiril *et al.* (2014) established four categories for sustainability performance: environment, economic, social, and engineering/resource utilization, in addition to project administration. The environment aspect consists of project performance in areas such as minimization of pollution and environmental impacts; compliance with waste management standards; minimization of carbon footprints and energy use; protection of water quality; and protection of native and aquatic wildlife. Economic aspects include being fit for purpose and of high quality; minimization of maintenance and operation costs; minimization of risk; and on-time completion. Social performance aspects relate to the protection of cultural heritage; savings in travel time and vehicle operating costs; safety in construction; open and transparent community involvement; and promotion of interagency collaboration. Engineering/resource utilization performance is reflected in the enhancement of the infrastructure's life span; achievement of project objectives; savings in maintenance costs; and long-lasting and high-quality products. Lastly, performance in infrastructure project administration could be seen through on-time completion, no disputes, and achievement of the client's objectives.

The infrastructure project should include sustainability factors as the drivers for achieving sustainability performance. Joumard and Nicolas (2010) stated that the advantage of these sustainability factors is to provide data for managing the construction project (evaluation, performance, control). Thus, users need to understand the assumptions, perspectives, and limitations when using sustainability factors (Litman, 2007). For instance, the New South Wales (NSW) Transport Division focuses on factors in the three spheres of sustainability, namely, environmental, societal, and economic. The use of these spheres emphasizes that sustainability is central to the planning, development, and delivery of a transport infrastructure project. Sustainability factors under the environment category consist of greenhouse gas (GHG) emissions, water, pollution control, noise management, resource management, waste management, materials consumption and biodiversity. The societal factor category comprises stakeholder relationships, communities and public acceptance, and heritage conservation, while corporate sustainability is under the economic factor category. Researchers have argued that these factors play a central role in sustainability performance. Infrastructure project operators should include these factors in project management to ensure that all aspects of sustainability have been well considered. Amiril *et al.* (2014) proposed a nexus model between sustainability factors and sustainability performance. They argued that sustainability factor components influence sustainability performance in infrastructure projects, and that both these concepts have attracted major attention from other researchers. Sierra *et al*. (2016) studied the relationship between sustainability factors/criteria and the infrastructure life cycle. They found that several social sustainability criteria were significantly correlated to specific stages of the infrastructure life cycle, with their study focusing on finding the social sustainability factors that were relevant to each stage. For instance, they found that stakeholder participation is an important element during the planning stage. On the other hand, Meng *et al.* (2015) revealed that sustainability performance is related to leadership, as represented by project management. In their study in China, they discovered that leadership dimensions—intellectual dimensions (IQ), managerial dimensions (MQ), and emotional and social dimensions (EQ)—positively influenced infrastructure sustainability.

In this context, most prior studies in the literature appear to have discussed how sustainability performance could be achieved through a complex interaction between sustainability factors and other factors, such as leadership and the infrastructure life cycle. Studies are still lacking on combining all these factors into a single framework to better understand the overall process of infrastructure sustainability. Therefore, this study aims to collect all the missing puzzle pieces into one comprehensive model. Specifically, the current study attempts to answer this question: how can infrastructure sustainability be created by conducting a sustainability framework analysis? In terms of a framework, this study specifically addresses one critical issue, that is, gaining an understanding of the role of stakeholders in this complex mechanism as stakeholders are the ultimate beneficiary to whom these impacts are dedicated. A clearer perspective is needed on how stakeholders could participate and contribute to this process which would enable the creation of a continuous improvement mechanism along with infrastructure sustainability. In doing so, we adopt Epstein and Buhovac's (2014) sustainability model to gain an understanding of the whole process of sustainability creation**.** In their book, Epstein and Buhovac (2014) proposed a model of sustainability which explains the inter-correlations between sustainability elements at the corporate level. In the current study, their model was slightly modified to ensure compatibility with infrastructure sustainability as the main point. We discuss this framework in more detail in the following section.

Indonesia provides the background to and context of this study as, under President Joko Widodo's administration, infrastructure is the main sector of Indonesia's economic development. During the President's five-year presidency, Indonesia has needed more than 5,000 *triliun* (*tn*) (trillion) Indonesian rupiah (IDR) (US$362bn) to build highways, seaports, railways, airports, and dams to generate economic growth across the country. President Joko Widodo initiated a strategic program, namely, "Development from the Outer Line", clearly indicating that the infrastructure development should not only focus on the island of Java but also on the outer islands and borders. Thus, highway and railway projects are being undertaken in Papua, Borneo, and Sulawesi. In terms of the maritime issue, President Joko Widodo has launched a 'sea toll' program which relates to the cruise lanes that connect the main seaport in Java with the other islands. This program aims to boost the economy by providing better access for commodities to reach Java as well as reducing price variability between the islands. However, these ambitious infrastructure projects are not without risk. In only a 2.5 year-period (2014–2017), Indonesian debt has increased by IDR1,062*tn* (US$77bn) (Jefriando, 2017). Thus, the Indonesian government must ensure that all its infrastructure projects will provide a positive impact, which is the reason why this study becomes relevant.

2. Literature Review

2.1 Impact

As previously mentioned, infrastructure sustainability is concerned with how to deliver the different aspects of impact to stakeholders, and especially social, environmental, and economic impacts. A sustainable infrastructure project is recognized as having good sustainability performance if it can create impacts on all three aspects. Therefore, our discussion in this section is focused on how impact is created and the role of the infrastructure project in this process.

Basically, impact can be created through a systematic approach that starts by defining a mission statement through to measuring the impact. Whether positive or negative, impact is a significant change in the society that will change people's quality of life (Epstein and Yuthas, **2014**). It all begins with a social investor's clear mission statement about what kinds of problem they will address and how the specific problem will be addressed, or what kind of action or intervention they will apply. The impact is more abstract than the output and/or outcome and is mostly experienced in the long term, but this is what people are really seeking. In terms of infrastructure, the government invests its money with one expectation, that the benefit created for society by this infrastructure will be greater than its costs. Thus, the government has to ensure that its value for the money invested is really worthwhile for the public. In this sense, researchers have developed the concept of a theory of change (TOC) to explain the linkage between the desired goal, actions, and desired impacts (Epstein and Yuthas, **2014**). The theory of change is concerned with which actions or interventions will create the desired change.

Figure 1 depicts how the theory works, according to Epstein and Yuthas (2014):

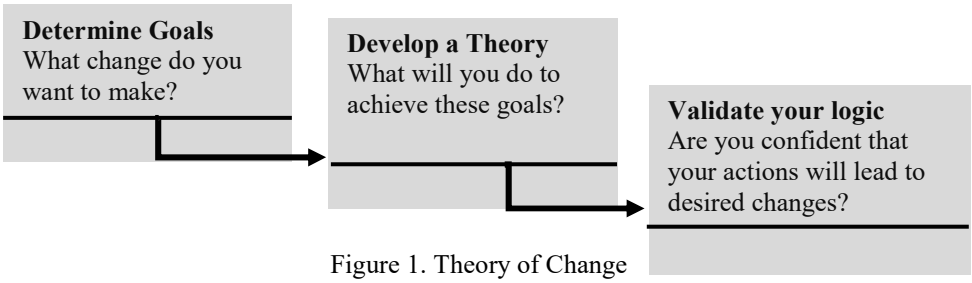

Figure 1. Theory of Change

In the first stage, the impact goal is determined. The organization should have the ability to articulate its mission about what change will be created. This should be clear in the mission statement, providing guidance to the organization for evaluating its effectiveness. In many cases, organizations have failed to clearly articulate their goals and have only focused on their output (goods or services). For instance, when a highway and roads were built on Indonesia's remote islands, the government declared that this would open new and faster access to certain locations. This statement is more from an output-oriented perspective than from an impact-oriented perspective. The government could elaborate more relevant impact goals, such as providing access to new locations to improve people's quality of life in remote areas. The impact-mindset perspective could drive the government to think in the longer term with a clearer objective.

The second stage is developing a theory. This means determining which activities or interventions are needed to achieve the goal. According to the social impact literature, the organization has a number of intervention options that can be used to create an impact (Epstein and Yuthas, **2014**). In this stage, the organization should decide which activity or intervention it should select from these alternatives. Figure 2 shows various intervention alternatives:

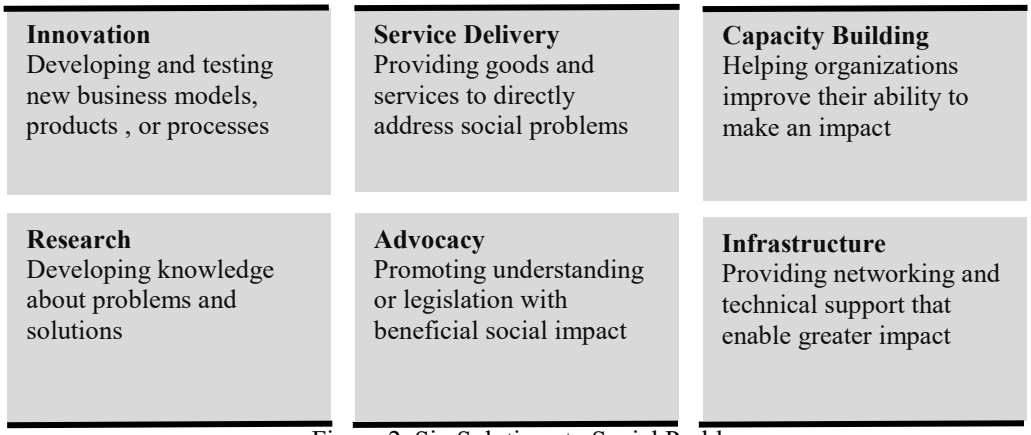

Figure 2. Six Solutions to Social Problems

In this context, infrastructure is one option for overcoming social problems by providing networking and technical support that enable a greater impact. The government can support people, an industry, or a sector through its investment; thus, stakeholders can leverage their potential to improve their performance. One good example is government investment to establish a national broadband backbone which is an essential breakthrough for the digital industry to achieve higher performance level. The government should realize its role as the facilitator for stakeholders by optimizing all resources to create a greater impact. In terms of the TOC approach, the organization could choose from all possible solution options and review how the specific selected option is linked to the desired goal.

The third stage is validating the logic behind the choice. Once the TOC has been decided, the organization should validate it which can be done in several ways. Firstly, it could assign individuals with trained judgment and experience in the field to confirm the theorized relationships. Hence, the organization could refer to the work of peers on the same problem to examine their successes and failures. Alternatively, academic, trade, and government publications could be relevant sources of evidence for TOC validation. Last, but not least, the organization should check the TOC with stakeholders, and especially beneficiaries, to gather their feedback. This might be a time-consuming process, but it is worthwhile, providing guidance for the organization on what they are doing and why it matters.

From the above explanation, it is clear that the most important element in the process of impact creation is effective participation between stakeholders and the organization to ensure that the intervention will be effective in attaining the desired impact. Moreover, the validation process infers a sense of stakeholder involvement; thus, the organization can receive positive feedback to improve the intervention process. Essentially, impact creation is a loop process which enables the organization to revise its sustainability system based on stakeholder feedback to achieve better sustainability performance. Infrastructure sustainability is more than a linear relationship model between infrastructure factors and infrastructure performance: a mechanism for feedback from stakeholders could improve infrastructure factors which, in turn, will improve sustainability performance. The next section further discusses how this framework is organized.

2.1 Epstein and Buhovac's Sustainability Framework

Epstein and Buhovac's (2014) sustainability framework was initially developed for the corporate sector for developing corporate sustainability in their operations. However, we think that, with a little modification especially for the long-term corporate financial performance element, this framework's main idea is also applicable to other non-profit organizations, especially public sector institutions. Therefore, we employ this framework to explain how sustainability and impact are correlated in the infrastructure context. Basically, this framework consists of four main elements: input, process, output, and outcome. As shown in Figure 3, Epstein and Buhovac's (2014) framework starts from input, as the main resources and factors need to be considered to perform as a sustainable organization. This is then followed by a process which comprises leadership and sustainability systems, programs, and actions which basically form the intervention offered by the organization. The third element is output comprising sustainability performance and stakeholder reactions. The fourth and last element is the outcome which represents the impact that the organization is willing to achieve.

The first element is input which comprises all the resources required to implement the intervention, with these analyzed in both the internal and external contexts. The resources can be in the form of human resources, financial resources, and material assets. Human resources refer to all personnel involved in the project who dedicate their knowledge, ability, and skill. Furthermore, an intervention should have a clear mission, vision, and objective as part of the internal context analysis. Input also means the external environment that could possibly affect the intervention process. This includes any government regulations, whether at the level of central or local

governments. It is important to comply with these regulations as, in many countries, this compliance could be vital for project success. The second element relates to the process which consists of two main elements: leadership and sustainability systems. Leadership, in this context, is the project management (operator) with all its capabilities to manage this infrastructure project. Meng *et al.* (2015) identified the three dimensions of these capabilities as IQ, MQ, and EQ. They found that these capabilities significantly influenced the infrastructure's sustainability. Leadership also means that project management should have a strong commitment to delivering the sustainable project with real impact for the stakeholders. Therefore, leaders should consider all relevant resources to support the intervention and utilize these resources to achieve higher sustainability performance. Another element in the process phase is the sustainability strategy, structure, and systems. Project governance needs a compatible organization chart which identifies those responsible for implementing the sustainability strategy in the organization. A sustainable system is a type of support system to the project management, providing the elements of product costing, capital budgeting, information system, and performance evaluation.

The third phase of the framework is output which consists of two elements, namely, sustainability performance and stakeholder reactions. According to Epstein and Buhovac (2014), "[s]ustainability performance is the social, environmental, and economic performance of a company and relates to the objectives that are important to the internal and external stakeholders of the organization" (p. 65). Ugwu and Haupt (2007) identified several infrastructure sustainability performance benefits, such as better decision making; minimization of wastage; efficient project delivery; avoidance of delays; and minimization of constructability-related problems (rework, claims, etc.). Lim (2009) revealed several project sustainability performance benefits for road projects, such as minimization of pollution and environmental impacts; community/public acceptance; being fit for purpose and of high quality; minimization of maintenance and operation costs; minimization of risk; on-time completion; protection of cultural heritage; and safety in construction.

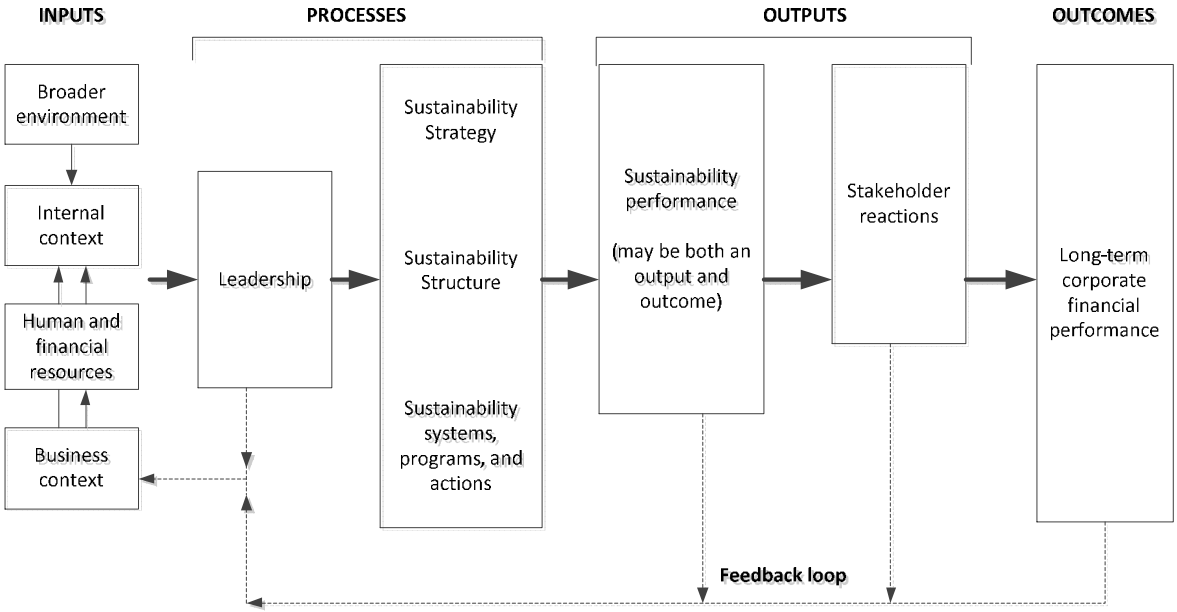

Figure 3. Epstein and Buhovac's Sustainability Framework

Sustainability performance can be achieved if the organization has a better understanding of its relevant stakeholders and its own objectives. Social and environmental performance are, in most cases, less tangible than economic performance. One important issue in this framework is that sustainability performance can be classified as an intermediate output and a final outcome. As a final outcome, the infrastructure project succeeds in delivering the outcome to stakeholders which contributes to improving their quality of life. On the other hand, when sustainability performance is an intermediate output, further action is still needed to achieve the impact required by stakeholders. Hence, sustainability performance needs the next element, that is, stakeholder reaction. Sustainability performance is converted into impact through stakeholder reaction. The mindset of involving stakeholders' interests in daily operations should be present within the organization. The organization must communicate transparently to both internal and external stakeholders and implement the proper mechanisms to listen to their specific concerns through broad stakeholder identification (Epstein and Buhovac 2014). Stakeholders are the driver for program success; thus, understanding their expectations will bring advantages to the organization. For instance, beneficiaries of an infrastructure facility provide this advantage through their caring behavior in maintaining the facility so it can provide them with long-term impact. When they experience a positive change through this facility, they will show a strong commitment to taking care of and maintaining this

facility for a longer period. Therefore, stakeholder reactions determine the project's ability to create the required impacts.

The fourth phase is the project outcome which can be short term or long term. For the private sector, the ultimate outcome is corporate financial performance but, for social and public investment, the outcome could be more varied. The spectrum could be broader, ranging from social to economic aspects, depending on program objectives. For instance, in the case of sanitation infrastructure, the main desired impact would be related to health impacts, such as a healthier family and community. Moreover, healthier people could create other impacts, such as economic (e.g. less absence from the workplace) and social (more frequent social meetings). As shown in the framework, a feedback process extends from sustainability performance through stakeholder reactions to outcome. This forms the most important aspect of the sustainability framework (Epstein and Buhovac 2014). Sustainability performance, stakeholder reactions, and the outcome must all be reported and used to modify future sustainability strategy formulation and implementation (Epstein and Buhovac 2014). This enables potential learning by the organization from appropriate significant information in its implementation of sustainability actions. Feedback mechanisms and continuous learning are important parts of any learning organization and in the implementation of systems to improve corporate sustainability. Managers must constantly use feedback to challenge their assumptions about the viability of various decisions and their long-term implications for the company, society, the environment, and the economy (Epstein and Buhovac 2014). This study uses this sustainability framework to answer the research questions based on a case study in Indonesia, as discussed next in the research methods section.

3. Research Methods

This research employed several methods to collect qualitative data, including a case study in Bantul Regency, Yogyakarta Province, Indonesia. This regency has an outstanding achievement in sanitation facilities having the highest number of community-based wastewater (or sewage) treatment facilities (in *Bahasa: Instalasi Pengolahan Air Limbah Berbasis Komunitas [IPAL]*) across Indonesia, hence, its selection as the site for the case study. These sewage treatment facilities are a program of the Ministry of Public Works and People's Housing which provides sewage treatment facilities in villages. These facilities were funded by Asian Development Bank (ADB) between 2012 and 2015. Basically, each facility provides access to the community sewage treatment plant for around 75 houses in villages. The regency, through its Public Works Unit (PWU), is responsible for initiating this program together with the community. As this is a community-based program, the community was involved starting from the planning stage, through construction, and then to maintenance. In other words, stakeholders' participation and involvement were high in each stage of the infrastructure life cycle. Therefore, it is interesting to explore how this type of program could be sustainable through impact creation. Through employing Epstein and Buhovac's [12] sustainability framework, we conducted interviews with 136 beneficiary households, as well as with local government officers, community leaders, and the project facilitator. The objective of the interviews was to identify the input and process elements from this *IPAL* project, as well as the outcomes. Hence, we undertook a 'golden thread' approach by developing a logic model of outcomes based on interviews and observations. A golden thread is a technique of analysis that we used to select only significant outcomes for inclusion in our analysis. This logic model was then confirmed through a large-scale survey of 2,358 beneficiary households across Bantul Regency to obtain a benchmark model for impact creation across the regency.

4. Results and Discussion

This study is specifically focused on one community-based sewage treatment facility as an example of the infrastructure facility (*IPAL*). The objective of this facility is to provide sewage treatment access for houses in a small community (around 75–100 house connections). The *IPAL* program is one of the government initiatives for improving people's quality of life, especially in terms of their rights to good public sanitation. It is part of the "100-0-100" ("One Hundred-Zero-One Hundred") program which aims to provide 100% access to clean water; 0% slum areas; and 100% access to basic sanitation, in accordance with the Sustainable Development Goals (SDGs). In addition to central government funding, this *IPAL* program has been funded by an international agency, the Asian Development Bank (ADB). For the purpose of this study, we focused on ADB's *IPAL* initiative, namely, the Communal Sewage Treatment Facility in Bantul Regency, Yogyakarta Province, Indonesia.

The Communal Sewage Treatment Facility has a unique characteristic which differs from the regular projects. The case project is based on community initiatives throughout its construction process starting from planning, though construction, and to maintenance stages. In this way, the community is actively involved and empowered and, as a result, community members have a sense of belonging which is a key factor in achieving sustainability. This element is very important in the sustainability cycle as stakeholder reactions will determine the success of the facility, as well as the requirements for infrastructure sustainability. Each element of the

sustainability framework, based on the *IPAL* project, is discussed in the following sections.

4.1. Infrastructure Sustainability Creation

4.1.1. Input

As shown in Figure 3, four types of input are received in the sustainability framework, that is, broader environment, internal context, human and financial resources, and business context. During our observations in the *IPAL* project, we experienced different forms of output. This was not only the project invesment fund, but also in the form of time, effort, and goods. We discovered that people (beneficiaries), as stakeholders of the project, were highly engaged in the planning and construction process. The human and financial resources elements relate to several personnel who are dedicated to the achievement of sustainability. These personnel are trained to perform sustainability activities in the project, and, in our case study, are the community. In the planning stage, people received an intensive briefing from the Public Works Unit (PWU) of the local government (i.e. Bantul Regency) about their basic knowledge of the sewage treatment facility. Field facilitators assisted people during the planning and construction stages, as well as ensuring the quality of construction. The case project was successful in employing several dedicated people so these people were also project beneficiaries. These people knew what was best for them; they knew what could fulfil their need; and they were involved in this project. This method of community involvement is crucial to the sustainable performance creation mechanism. This unique characteristic of the project ensured that the facility and its features were really the approriate intervention for the people's problem from the very beginning of the project. The people's views were counted, with appreciation shown during the process, thus ensuring that the project had a clear mission and objective as the manifestation of the internal context element of input.

4.1.2. Process

In terms of process, two essential parts, namely, leadership and the sustainability structure, are discussed. According to our observations, this community-based sewage treatment facility had a unique characteristic being based on community participation. This program utilized a local community group, *Kelompok Swadaya Mandiri* (*KSM*) (Local Community Group) to communicate and work together with a single main objective, that is, poverty elleviation. The *KSM* was established as part of the "Urban Poverty Alleviation" program initiated by the Ministry of National Planning, Ministry of Public Works and Ministry of Public Housing. This is a bottom-up mechanism through which local people have greater autonomy during the planning stage and find the best way to realize the project. In terms of leadership, sustainability performance needs a committed leader who can be dedicated to delivering the best results with a good impact. This can be realized if the leader truly understands stakeholders' needs. In our case, as this project uses a bottom-up approach, the leadership of this project is derived from the local people. Initially, the head of *KSM* was the person responsible for managing the construction process. The head of *KSM* was a local person who would also be a future beneficiary of the program . A series of meetings, both formal and informal, was held with local people to discuss the program's benefits; the technical aspects of the sewage treatment facility; budget preparation; and the construction schedule. The local leader was very committed to project accomplishment through a participative approach with all the local people. All the people were highly involved in the construction committtee, with collective decision making used to ensure that effective decisions would be made and executed.

4.1.3. Outputs

According to Epstein and Buhovac (2014), sustainability performance is the social, environmental, and economic performance of a company and relates to objectives that are important to both internal and external stakeholders of the organization. Figure 4 shows impact creation starting from output through to impact. In terms of impact, this sewage treatment facility has different outcomes: these were six months; middle term is between 6 and 12 months; while long term is more than one year. As previously mentioned, in our interviews, local people reported that they were experiencing significant changes in their quality of life through this facility. They reported better social conditions, a good quality environment, improved family finances, and good healthy habits. Our finding confirms findings reported in the prior literature that a sustainable infrastructure facility should cover multiple aspects of sustainability criteria, such as economic, environmental and social aspects (Sierra et al., 2015). We discovered that, through a participative mechanism which involves stakeholders' views from the early stage of the project, all these aspects of sustainability performance can be achieved. A sustainable infrastructure facility is not only concerned with technical benefits but, as pointed out by researchers, it needs to cover all the sustainability factors, such as the economic, environmental, and social aspects.

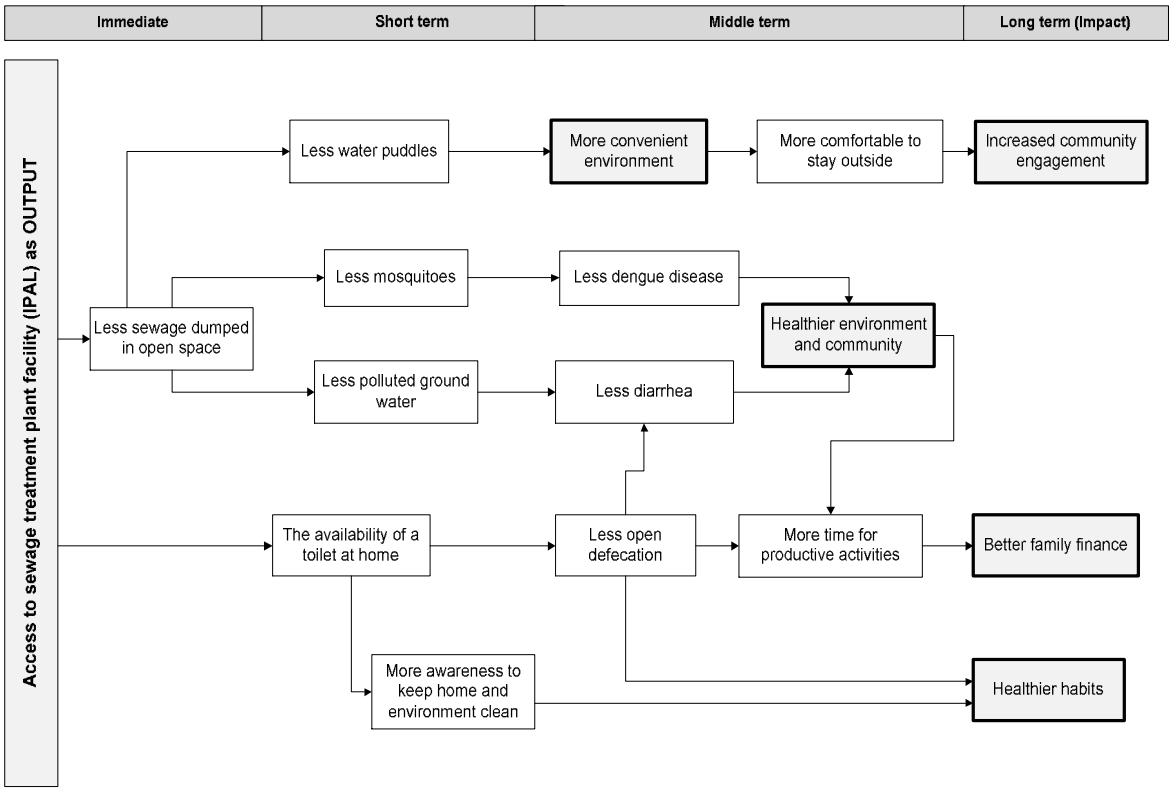

Figure 4. Impact Map

Five main impacts were discovered from this sewage treatment facility: socially (more convenient environment and increased community engagement); environmentally (healthier environment and community); economically (better family finance); and health (healthier habits). Each of these four impacts is a result of golden thread logic analysis which represents the flow of outcomes in Figure 4. We confirmed our interview results by conducting a large-scale survey of 2,358 connected households across Bantul Regency, Yogyakarta Province, to obtain several outcomes depicted in Figure 4. According to Figure 4, we find that wastewater treatment facility improves community engagement for the local people as the result of more convenient surrounding for people to move from one place to other places and interact to neighbors. This activity was more difficult in the past, before the sewerage is operating, due to a high number of water puddles which come from the habit to dump wastewater in the open space. Thus, people were more reluctant to stay outside and choose to stay at home. In terms of health aspect, we discover that local people are healthier than before as the result of less dengue and diarrhea diseases. The incidence of dengue disease in the community has been decreased to the lower level after the sewerage operated. The similar impact also happens for diarrhea disease. Local people were used to drink a highly polluted groundwater due to the condition that their water wells were closed to septic tanks. Moreover, the diarrhea incidents were relatively high due to the high number of open-defecation amongst local people. They did not have a proper toilet in their homes, so they were highly depending on the latrine or river. And, this caused a detrimental environment problem for the community. Sewage treatment facility has enabled people to have their own toilets in their homes which are connected to the communal septic tank. Local people now have more time for more productive activities such as going to farm or creating handicrafts as in the past they were wasting time to go to the river to open-defecate. Thus, wastewater treatment facility brings economic impact as well. For the last impact, we find that local people have healthier habits as they spend more time to take care of the toilet at home and the connection pipeline to the septic tank. We also find that they are more actively involved in local community work especially which are related to the cleanliness of the environment. Thus, overall we discover positive impact from this facility for the community.

4.1.4. Project Sustainability

After discussion of the impact and outcome creation process, in this section, we refer to this paper's main argument that a sustainable infrastructure facility is the facility that can address all stakeholders' interests, including the economic, social, and environmental benefits, and empower them during the construction process. Stakeholders, and especially beneficiaries, should participate in formulating the objectives of the infrastructure facility. According to Epstein and Buhovac (2014), stakeholders are the driver for program success [in achieving sustainability]; thus, understanding their expectations will bring advantages to the organization. Our study reveals that sewage treatment facilities, which have been operating for more than 3–5 years, have created

significant impacts on the community and one reason is stakeholders' participation. Stakeholders' involvement is the key to infrastructure sustainability as stakeholders are the ultimate users of the infrastructure itself. Therefore, their reaction is the key to converting infrastructure outcomes into impact (Epstein and Buhovac 2014). Moreover, in our case study, in the location of every sewage treatment facility, the local community has established a Maintenance and Beneficiary Group (*in Bahasa: Kelompok Pemanfaat dan Pemelihara*) which is responsible for facility maintenance during its operation. Through the actions of each community, this project has shown one of the characteristics of infrastructure sustainability, as stated by the National Research Council (2009). This characteristic is that infrastructure sustainability is a lifeline system that enables the needs of current and future generations to be met through ways that are cost-effective, physically resilient, socially equitable, and environmentally viable. Finally, the argument of the current study supports Amiril *et al.* (2014) who stated that sustainable infrastructure performance is a project that provides a set of societal, economic, and environmental impacts for stakeholders.

5. Conclusions

This paper begins with the idea that sustainable infrastructure comes with the significant contribution of stakeholders. Many of the definitions of infrastructure sustainability place stakeholders' interests as the center of attention. A sustainable facility is a facility that addresses stakeholders' views and provides benefits from multiple aspects, not only addressing technical issues, but also broader aspects: socially, economically, and environmentally. Only by ensuring that this set of aspects is fulfilled can the benefits of the facility last for the next generation. Thus, designing a good program in the planning stage is important, but executing an effective program that can deliver real impact for beneficiaries is more important. The sewage treatment facility (*IPAL*) in our study shows that a high-impact program starts from a step-by-step mechanism, that is, input-process-output-outcome as a sequential process. More importantly, the active participation of stakeholders throughout this process is the key factor to creating a sustainable facility's impact. As we have explained through this study, creating a sustainable facility is a comprehensive system which can be explained with a comprehensive framework.

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