Developing framework for assessing city sustainability

Case Study: the City of Bandar Lampung and

the City of Metro, the Province of Lampung

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**Abstract.** All High population growth in urban areas requires improvements in many aspects especially infrastructure. However, these needs of improvements are often not fulfilled. As a result various problems that would ultimately affect the city to sustain emerge. To overcome the problems, it is important to develop a comprehensive and integrated policies and strategies framework that enable a city to meet the demand of improvement and sustainability. The very first stage of developing a city development framework is to understand the current condition of city’s infrastructure performance and sustainability. Triple Bottom Line (TBL) sustainability of people, planet and profit is one method that widely applied to assess performance and sustainability. It is the main objective of this paper to develop indicator framework of a sustainable city based on TBL principles. The stages of developing the framework consists of defining the criteria and indicators of sustainable city then developing the TBL framework of city’s infrastructure performance and sustainability. The level of sustainability is measured by using a weighted-score method. Subsequently, the framework developed was tested to two cities in the Province of Lampung. The results showed that the City of Metro was better than the City of Bandar Lampung in term of performance and sustainability.

Keywords: *city infrastructure, in-depth interview method, purposive sampling technique, sustainability, TBL criteria, TBL indicators.*

1. Introduction

High population growth in city areas has implications for the improvement of the community infrastructure needs. Marvin and Slater [1] stated that the relationship between cities and infrastructure is now emerging as a key city policy issue. Many relevant aspects and actors involved in city infrastructure development and planning and it required a comprehensive and integrated policy to be sustainable [1, 2, 3, 4]. A variety of strategies, policies, plans and programs of action for the development of an integrated and sustainable infrastructure in urban areas have been prepared, however the development of urban infrastructure still faces unresolved issues [5]. Since infrastructure development does not only affect the aspect of economic, but also social and environmental aspects. Those three are the main dimensions of sustainable development. Hence, it is important to determine the measuring instrument to identify the ability to build sustainable infrastructure based on those three sustainability aspects.

Previous studies from 2000-2013 [6-23] on sustainable infrastructure reflected the need to design and manage engineering systems by the environment, social and economics consideration. The study include: municipal water system sustainability criteria, sustainable transportation, drinking water system, waste water systems, rainwater systems, green infrastructure and solid waste. Based on these studies it is known that there has been no research on criteria and indicators for integrated and sustainable infrastructure for a city, the research only mentioned one particular area of infrastructure. Therefore, the main objective of this paper is to develop indicator framework of a sustainable city based on TBL principles with specific objectives such as: firstly, to define criteria and indicators of sustainable infrastructure development of city; and secondly, to develop a TBL framework to measure city’s performance and sustainability. To see the workability of the framework, it was tested to assess the level of performance and sustainability of city's infrastructure of the City of Bandar Lampung and the City of Metro.

1. Research method

The scope of city infrastructure research is restricted to a basic network infrastructure that influence city development, namely: transportation, water systems (drinking water, storm water, waste water), green open spaces and solid waste. This study has taken a case study of the City of Bandarlampung and the City of Metro in the Province of Lampung Province, Indonesia. The City of Bandar Lampung represents a major city and the City of Metro represent a town in Indonesia. The data used were primary and secondary data. The primary data was obtained directly from the resources or experts whereas the secondary data was obtained from statistical reports related to the observed objects such as demographic, environmental, economic, social and documents related to the cities’ planning.

The survey method applied to gather information and knowledge of the stakeholders and experts were using *in-depth interview method* to predetermined samples that selected intentionally or *purposive sampling*. The sampling units or respondents in a *purposive sampling* method are selected based on certain consideration, characteristics or criteria. For this research, the selection of experts to serve as respondents were based the assumptions that someone was: (1) having sufficient experience for the research field; (2) having position, reputation and credibility as stakeholders; and (3) willing to be a respondent and can be met for an interview. The number of stakeholders interviewed was 11 people consisted of academics, governments, professionals and NGO.

Sustainability citeria and incators for different infrastructure systems from various research from 2000-2013 [6-23] was summarized. Based on these research the indicators of city’s infrastructure performance and sustainability framework for this study were developed. The study employed 5 criteria that can be further break down into 50 indicators as can be seen on Table 1.

The method of assessment applied to this study was scoring and weighting method. A set of criteria and indicators selected from literature review were used as parameters in determining city sustainable infrastructure development. Index of sustainable infrastructure development was achieved by assessing the indicators based on objective data and expert perceptions. Thus, indicators were scored and weighted in two stages. Firstly, the set of indicators were scored and weighted by experts through in-depth interview; and secondly, it was scored and weighted through secondary data assessment indicators. The weights applied to each criteria was different according to its importance to sustainability. Whereas, the scores applied were range of values from 1 to 4. The structure of scoring and weighting can be seen on Table 2 and the index of sustainability can be seen on Table 3. ​​

Table 1. Criteria and indicators of sustainable infrastructure



Tabel 2. Formulation of assessment of city’ performance and sustainability



Table 3. Sustainability index and status

|  |  |
| --- | --- |
| Index | Category |
| < 97 | Poor (not sustainable) |
| 97 - 192 | Less (less sustainable) |
| 193 - 288 | Fair (fairly sustainable) |
| 289 - 384 | Good (Sustainable) |

1. Result and Discussion
	1. Infrastructure performance and sustainability status of the City of Bandar Lampung and

 the City of Metro

The Table 4 shows the assessment results of infrastructure performance and sustainability status of the City of Bandar Lampung and the City of Metro. The result shows that the total weighted score of sustainability index for the City of Bandar Lampung is 130,4. This value demonstrates the status of infrastructure development sustainability of this city is quite critical. Almost all indicators were of low value. The low value of environmental indicators index is due to environmental problems commonly caused by population growth pressure and urbanisation; the low social sustainability index is closely related to environmental problems and other problems; the low value of technology index is caused by inadequate infrastructure facilities and technology; and the low value on governance index is generate by weak law enforcement and inadequate development planning, lack of leadership, community participation, budget and resources, and political conditions. On the other hand, economics sustainability index is better than other sustainability indexes. Since the city infrastructure facilities are quiete good, it generate, among other things sufficient local government revenue (*pendapatan asl*i daerah or PAD) and investments.

The Table 4 also shows the total weighted score of sustainability index of The City of Metro. The value demonstrates the status of infrastructure development sustainability of this city is fairly sustainable. However, the results shows there are weak and robust indicator values in each criteria with no particular criteria is robust. To boost the sustainable infrastructure development, the government now implementing the Green City development program (*Program Pengembangan Kota Hijau* or P2KH).

**Table 4**. Assessment results on performance and sustainability of

infrastructure development of the City of Bandar Lampung and the City of Metro



* 1. Efforts on improving sustainability status of city infratstructure

The status of the sustainable infrastructure development criteria can be increased in the future through sustainable infrastructure planning. Sustainable urban infrastructure planning is part of infrastructure development process that takes into account the balance between sustainable development criteria of economic, social and environmental as well as choice of technology and good governance. The influential indicators to increase the sustainability status of the City of Bandar Lampung and the City of Metro were based on stakeholders’ perspectives and based on *Rencana Pembangunan Jangka Menengah Daerah* or RPJMD (Mid-Term Local Development Planning) documents. RPJMD is the reference of development in a Spatial Plan.

The RPJMD of the City of Bandar Lampung Year 2010 – 2015 includes the 5 criteria of sustainable development, namely: environmental, social, economic, technology and good governance. However, it only contains 28 out of 50 indicators of sustainable infrastructure development. Similarly, the RPJMD of the City of Metro Year 2010 – 2015 includes the 5 criteria of sustainable development and contains 23 out of 50 indicators of sustainable infrastructure development. Based on this evaluation, there are additional indicators that should be included in future RPJMD to increase the sustainability infrastructure development status of the cities. On the other hand, there are also indicators that exist in RPJMD but with low value. Therefore, efforts should be focused on indicators that need to be optimized.

* 1. Guidelines of Sustainable Infrastructure Development Policy of the City of Bandar Lampung and

 the City of Metro

Based on the previous evaluation, guideline for development policy should be rectified. The followings are the proposed revision on policy guideline for priority in sustainable infrastructure development for both cities:

1. local economic growth that pay attention to the micro economics infrastructure needs,
2. integrated infrastructure planning,
3. effective and efficient use of improved infrastructure budget,
4. equal distribution of available water resources and implementation of 5R principle to increase fresh water quantity;
5. public participation through agreement and information transparency,
6. urban infrastructure management based on local community culture,
7. air quality improvement through public transportation system, regular vehicle emission test, eco-friendly energy, green industry and eco-friendly waste management, and
8. built environment in-line with city spatial planning requirement of at least 30% of green open space, efficient use of city spatial, and conservation areas.
9. Conclusion and suggestion

Based on previous discussion, it can be concluded from the study that:

1. The TBL framework of city’s performance and sustanaibility that was developed based on literature review contains 5 criteria and 47 indicators.
2. The framework was successfully assess the performance and sustainability status of two cities in the Province of Lampung. The level of infrastructure development of the City of Bandar Lampung is less sustainability. With index value of 38.05%, the existing infrastructure is in need of improvements to be regarded as sustainable.
3. Results shows the 8-most influential indicators in sustainable infrastructure development of a city are: (i) local economics growth, (ii) infrastructure planning, (iii) infrastructure budgeting, (iv) availability of clean water system, (v) public participation, (vi) public behaviour/culture toward infrastructure facilities, (vii) air quality, and (viii) built environment usage.

Based on the conclusion, it is suggested to:

1. Extend the study to other cities in Indonesia since the influential indicators might be different according to characters and problems of a particular city,
2. It is suggested to expand the study by implementing dynamic model to accommodate the estimation of urban infrastructure sustainability as well as to engineer a policy model of urban sustainable infrastructure development.
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