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Integrated sustainability index of east Surabaya with casbee tools toward a sustainable city

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Integrated sustainability index of east Surabaya with casbee tools toward a sustainable city

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Abstract. Surabaya is a city that continues to grow from year to year. Various problems that can be identified in the city of Surabaya include population density due to immigration. Statistics show that in 2014 Surabaya's population reached 3,020,305 million with a total poverty line of 168,000 people or 5.97% of the total population. Surabaya east is one of the industrial areas in Surabaya which contributes to increasing emissions. This research is focused on the East Surabaya area with samples in Kendangsari Village, Rungkut Kidul Village and Rungkut Tengah Village. The three locations have the same character in the form of industrial estate supported by residential areas both settlements and surrounding housing. This research uses descriptive quantitative and qualitative approaches. Observations were made on several environmental aspects which were grouped into aspects of Quality (Q) and load (L). These aspects are aspects of the assessment of the Comprehensive Assessment Built Environment Efficiency - Urban Development (CASBEE-UD) index. Based on calculations it is known that the index for the East Surabaya region is (B +) Good, this index shows the quality level of the region one level below the quality of sustainable areas. The index results indicate that the region is approaching a sustainable status. Based on the results of calculations and scoring it is known that the environmental quality in this region is good at 3.5 (three points five), with a breakdown of the environmental quality index of 2.4 (two-point four), social quality index of 3.8 (three-point eight) and economic quality index of 4.4 (four-point four). However, the environmental burden received by this region is moderate, so the score obtained is 2.7 (two points seven).

1. Introduction

The concept of sustainable development is an important topic that is discussed in all parts of the world. This happens because ecosystem imbalances have spread negative impacts both qualitatively and quantitatively. The potential for urban development in general also increases the amount of human disturbance to the existing natural environment. Increasing population and technological advances have also led to a decline in human health and comfort standards due to reduced natural resources. Unsustainable cities generally also greatly contribute to global warming and climate change.

Surabaya is a city that continues to grow from year to year. The city experienced a slump as the second most populous city in Indonesia and is synonymous with city problems such as traffic jams, slums, hot dusty air, garbage and others. But in the past decade, Surabaya City has been able to improve itself so that it can become one of the best cities in ASIA through the concept of sustainable cities. This makes the city of Surabaya important to study. This study measures the level of Surabaya's sustainability using the CASBEE model which focuses on environmental, economic and social aspects. East Surabaya itself is one of the industrial areas in Surabaya City.

The concept of sustainable development has long been a concern of experts. However, the term sustainability has only emerged several decades ago, although attention to sustainability has begun since Malthus in 1798 who worried about the availability of land in England due to a rapid population explosion. A century and a half later, attention to sustainability became stronger after Meadow and his friends in 1972 published a publication entitled The Limits to Growth [1].

Over the past two decades, a lot of research has been done in several countries to produce a sustainability index measurement formula. Some indicators of sustainability index are such as the Building Research Establishment's Environmental Assessment Method (BREEAM) in the United Kingdom, Leadership in Energy and Environmental Design (LEED) in America, Green Mark (Singapore), Green Star (Australia), and Green Building Index (Malaysia). [2] Institutions that have mapped institutions in the world that have carried out assessments related to sustainable development are Criterion Planners [3].

The level of sustainability assessment is divided into several scopes; (1) city scope such as Comp Plans for Sustainable Places in America, MEP Eco-City in China, and CASBEE for City in Japan, (2) residential areas such as BREEAM Communities in the United Kingdom, BEAM Plus Hong Kong, Green Mark Singapore, and (3) scope of buildings such as the Green Building Index in Malaysia, the Green Mark for District in Singapore. Based on data from the Criterion Planner (2014) Indonesia still does not have a patented measure of sustainability, whether in the city, settlement or building. [4] Of the many sustainability index measurement tools, CASBEE tools were chosen with the argument that CASBEE is a comprehensive method of evaluating sustainable development. CASBEE uses data in the form of numbers and not numbers so as to produce values that indicate the comprehensive performance of an environment.

CASBEE for City itself is a measuring tool that was first developed by the Institute for Building Environment & Energy Conservation in Japan. After the adoption of the Aalborg Charter in Denmark in 1994, the Japan Sustainability Building Consortium (JSBC) decided to develop a new assessment tool for the city. [5] "CASBEE for Cities" is a comprehensive assessment system to evaluate the environmental performance of cities using a triple-bottom-line approach that is the environment, society, and economy. CASBEE City calculates Environmental Load (L) in the city and Evaluates Quality (Q) through several measurement aspects. One of them is the area measurement for the CASBEE UD model is shown at Figure 1.
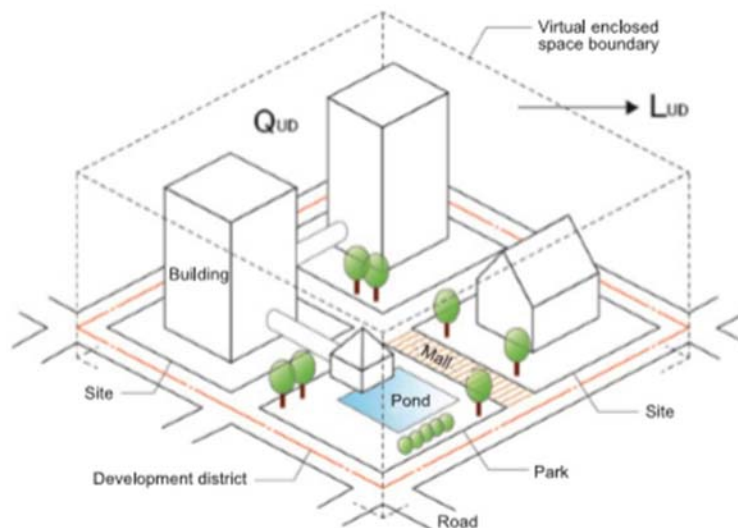

Figure 1. Overview of Area Measurement.

2. Methods

This research uses descriptive quantitative and qualitative approaches. Observations were made on several environmental aspects which were grouped into aspects of Quality (Q) and load (L). These aspects are aspects of the assessment of the Comprehensive Assessment Built Environment Efficiency-Urban Development (CASBEE-UD) index. This research is interdisciplinary research that uses qualitative and quantitative variables in the data processing with assessment in Table 1.

Table 1. The assessment items in casbee tools

Major Item	Middle Item	Small Item	Minor Item	
1. Environment	1.1 Resource	1.1.1 Water Resource	1.1.1.1 Waterworks	
			1.1.1.2 Sewerage	
		1.1.2 Resources Recycling	1.1.2.1 Construction	
			1.1.2.2 Operation	
	1.2 Nature (greenery and biodiversity)	1.2.1 Greenery	1.2.1.1 Ground greening	
			1.2.1.2 Building top greening	
		1.2.2 Biodiversity	1.2.2.1 Preservation	
			1.2.2.2 Regeneration and creation	
	1.3 Artifact Building	1.3.1 Environmentally considerate buildings		
2. Society	2.1 Impartiality/ Fairness	2.1.1 Compliance Observation of applicable laws and regulation and verification		
		2.1.2 Area Management Cooperation with and promotion of local community		
	2.2 Security / Safety	2.2.1 Disaster Prevention	2.2.1.1 Basis disaster prevention performance	
			2.2.1.2 Disaster response ability	
		2.2.2 Trafic Safety Execution of separating pedestrian vehicles		
		2.2.3 Crime prevention Security measure		
	2.3 Amenity	2.3.1 Convenience / welfare	2.3.1.1.1 Accessibility to facilities and services	
		2.3.1.2 Health and welfare, education Accessibility to facilities and service		
		2.3.2 Culture	2.3.2.1 History and culture	
			2.3.2.2 View	
3. Economy	3.1 Traffic/Urban structure	3.1.1 Trafic	3.1.1.1 Development of traffic facilities	
			3.1.1.2 Logistic and Management	
		3.1.2 Urban structure	3.1.2.1 Consistency with and complementing upper level plan	
			3.1.2.2 Land Use	
	3.2 Growth Potential	3.2.1 Population	3.1.2.1 Consistency with and complementing upper level plan	
			3.2.1.2 Staying population	
		3.2.2 Economic Development	3.2.2.1 Revitalization activity	
	3.3 Efficiency / Rationality	3.3.1 Information system	3.3.1.1 Information service performance	
			33.1.2 Block management	
		3.3.2 Energy system	3.3.2.1 Possibility to make demand/ supply system smart	
			3.3.2.2 Updatability and expandability	

3. Result and discussion

3.1. Areas Overview
The areas that became the sample of the study were Kendangsari Urban Village, Rungkut Kidul Urban Village and Central Rungkut Urban Village. The three regions have the same character, which is an industrial estate that is supported by residential areas both settlements and housing.

First, The Kendangsari area is located in the Trenggilis Mejoyo District and has an area of 1.32 km^2. In the Kendangsari area, industrial companies are dominated by industries engaged in chemicals, printing, food, cigarettes and warehousing including PT Rentokil Initial Indonesia, PT Bayer Indonesia, PT Indonesia Multi-Color Printing, PT Citra Nutrindo Langgeng, PT Karyadibya Mahardika and Gudang Hartono Electronic. Second, the Rungkut Kidul area is located in the area of Rungkut District which has an area of 1.37 km^2. In the area of Rungkut Kidul, industrial companies are dominated by industries engaged in chemicals, food and warehousing including PT. SC Johnson Manufacturing, PT. Karya Mas Makmur, PT. Smart Tbk Refinery Surabaya, and PT. Spindle Unit 1. The Central Rungkut region is within the area of Gunung Anyar District and has an area of 0.93 km^2. Rungkut Tengah Urban Area is dominated by industries engaged in the fields of cigarettes, electronics and mass media including PT Hanjaya Mandala Sampoerna Tbk, PT Polytron, and Surya Daily.

3.2. CASBEE Items Identification
An explanation of the environmental, social and economic aspects of this section will explain based on the parameters specified in the CASBEE assessment which are Q1-Environment, Q2-Society, and Q3-Economic.

3.2.1. Q1 Environment

a. Resource

Water Resources: The water resources comes from wells and wells drill. In some areas, communities also use Municipal waterworks for the supply of clean water. There is no water treatment system from rainwater and gray water.

Waste Management: No efforts were found to manage more rainwater resources or groundwater resources. Rainwater runoff flows directly to the city sewers.

Source of Recycling: Data in the field shows that buildings in the sample location are dominated by permanent buildings and walled buildings. A small portion of the building is non-permanent and has no tile floor covering. Solid waste management in the form of recycling is still minimal and is only applied in a small portion of the area.

b. Nature

Greenery: The level of reforestation is still in the range according to the urban greening policy which is 20% -30%. Efforts to increase the ratio of green open space is done in the form of greening the roof of the building by 15% -20%. Greening efforts have been done vertically but still a small part.

Biodiversity: The potential of existing natural resources in the form of Surabaya tributaries that have been designed to be canals. The landform is relatively flat and flat.

Regeneration and Creation: Green corridors and green networks are quite good, but no conservation efforts have been found for native species in the sample location.

c. Artifact (Building)

Environmentally consideration building: As mentioned before, this research is the first research that assesses the sustainability of Jodipan through CASBEE tools, so there is no single building evaluated with CASBEE.

3.2.2. Q2 Society

a. Impartiality /Fairness
Compliance: In the area, the condition of settlements where housing is not habitable is still found. This condition has been responded by the city government and is in the process of submitting a process for rehabilitation.
Area Management: There is a community of citizens who care about environmentally friendly activities.
b. Security and Safety: There are no integrated plans and management related to disaster prevention, especially floods. There is no map of flood spots. Flood management efforts are still carried out conventionally such as mutual cooperation, community service work.
Traffic Safety: There are decent pedestrian facilities in the industry.
Crime Prevention: Security efforts are carried out by patrol every day/night, supported by emergency communication access in the form of a command center (112). Supporting efforts are applied to good and even environmental lighting. Not yet found CCTV Spot.
c. Amenity
Convenience/welfare: Distance to district facilities and services such as medical and health/welfare facilities (hospitals/clinics, child welfare institutions), educational facilities (kindergartens, primary schools and junior high schools) and cultural facilities (libraries, museums, sports facilities) is around 800-1 km and can be reached in less than 30 minutes.
Culture: There is no specific cultural conservation effort in the area.

3.2.3. Q3 Economy

a. Trafic and Urban Structure
Traffic: The Road System in the area shows good quality, this is supported by the transportation network and can be reached by residents at a distance of less than 500 m.
Urban Structure: Generally, the area has been in accordance with the allotment of land use stipulated by the Surabaya City Spatial Plan. The process of utilizing the area is still in accordance with the direction of the development of the Surabaya city plan.

b. Growth Potential
Population: The planned population or actual population is equivalent or Equivalent or only slightly increased compared to the past.
Economic Development: In the aspect of industrial estates, there are company organizations, cooperative promotions and sales, local products, business area management schemes integrated with the residents.

c. Efficiency/Rationality
Information System: In this area, communication access is adequate, CATV is introduced, security is guaranteed for network monitoring, internet connectivity is quite high in line with the efforts of the city of Surabaya as a smart city and promoting the E-Government system. This is also supported by block management that regulates or manages water demand and supply management, medical information, public service information, traffic management.
Energy System: There is a renewable technology applied, namely solar panels.

3.3. CASBEE Assessment
An assessment conducted based on observation, interviews and water testing. This assessment considers three aspects, i.e., Q1 (environmental quality), Q2 (social condition of society) and Q3 (Economic condition), are described in Figure 2.

Based on calculations it is known that the index for the East Surabaya region is (B +) Good, this index shows the level of regional quality one level below the quality of sustainable areas. The index results indicate that the region is approaching a sustainable status. Based on the results of calculations and scoring it is known that the environmental quality in this region is good at 3.5 (three points five), with a detailed environmental quality index of 2.4 (two-point four), social quality index of 3.8 (three-point eight)) and economic quality index of 4.4 (four-point four). However, the environmental burden received by this region is moderate, so the score obtained is 2.7 (two points seven). This is mainly sourced from residential areas.
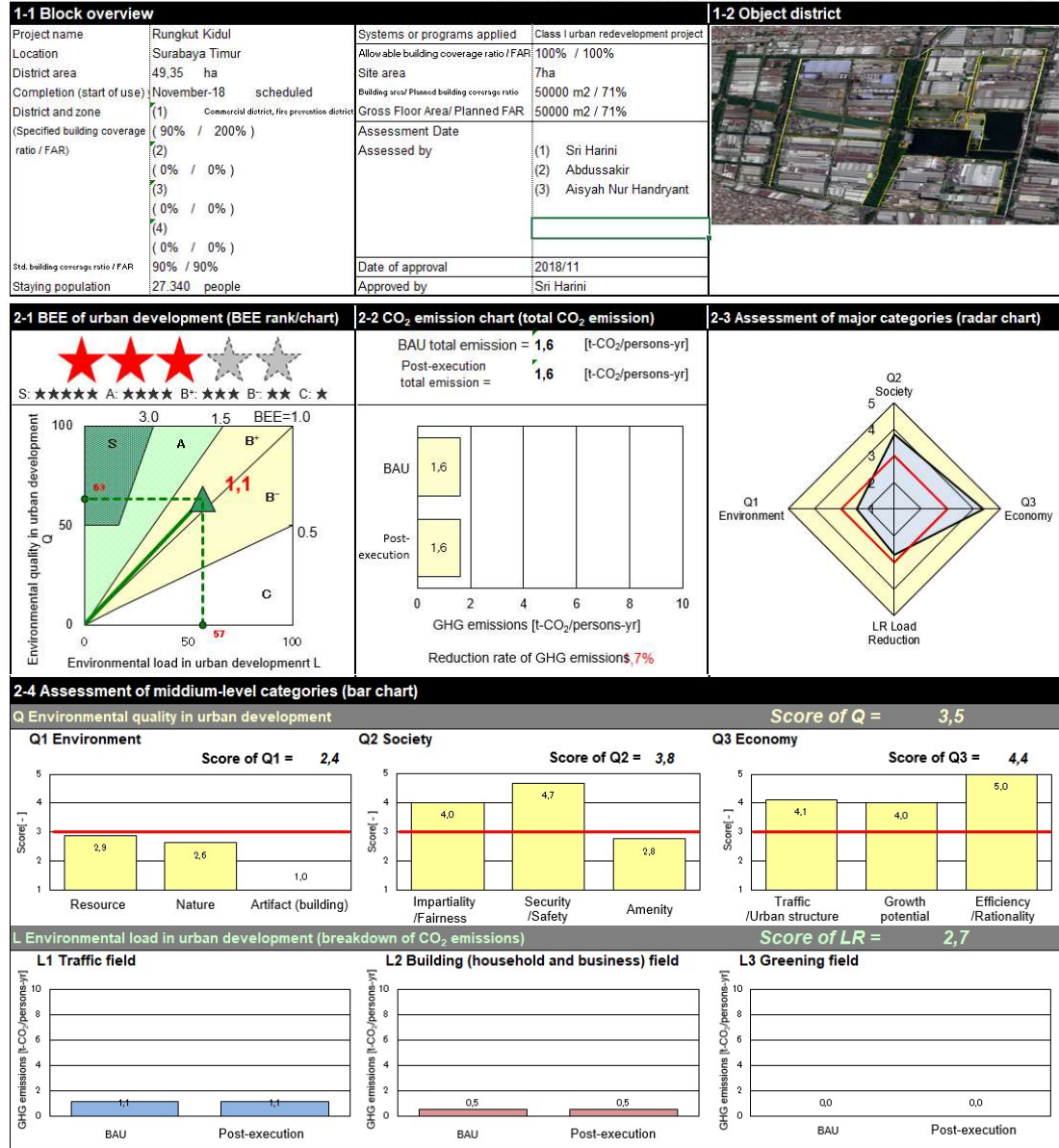

Figure 2. Casbee Asessment.

Environmental aspects as major items are divided into middle items, namely resources, nature and artefacts (building). The results of the assessment of environmental aspects will be explained in Table 2. Based on the assessment that has been carried out, it is known that the total value of environmental quality in this region is 2.4. This score is below the standardized average value. The lowest value is in the artefact (building) item which shows the lack of environmentally friendly application in buildings in the observation area.

Table 2. The environmental quality assessment score results

Middle Item	Small Item	Minor Item	Parameter Score	Score	
				Weighting Coefficient	Score
1.1 Resource	1.1.1 Water Resource	1.1.1.1 Waterworks	1.1.1.1.1 Rain water utilization	4.0	0.125
			1.1.1.1.2 Treated water	4.0	0.125
		1.1.1.2 Sewerage	1.1.1.2.1 Reduction of sewage discharge amount		
			1.1.1.2.2 Reduction of sewerage discharge amount	1.0	0.125
			3.0 0,125 -		
			N.A 0.0		
	1.1.2 Resources Recycling	1.1.2.1 Construction	1.1.2.1.1 Wood material		
			1.1.2.1.2 Recycled material		
		1.1.2.2 Operation	1.1.2.2.1 Garbage separation	2.0	0.125
			1.1.2.2.2. In-area resource circulation	3.0	0.125
1.2 Nature (greenery and biodiversity)	1.2.1 Greenery	1.2.1.1 Ground greening	1.2.1.1.1 Greening ratio		
		1.2.1.2 Building top greening	1.2.1.2.1 Rooftop greening	1.0	0.125
			1.2.1.2.2 Wall greening	5.0	0.125
	1.2.2 Biodiversity	1.2.2.1 Preservation	1.2.2.1.1 Natural resources	3.0	0.250
			1.2.2.1.2 Landform	2.0	0.125
		1.2.2.2 Regeneration and creation	1.2.2.2.1 Patch (planar) quality	1.0	0.063
			1.0 Habitats space of species	0.063 0.125	
			1.0 Consideration for regionality		
			1.2.2.2.2 Corridor (network) quality	1.0	0.063
1.3 Artifact Building	1.3.1 Environmentally considerate buildings			1.0	1.000

The second aspect in the CASBEE index assessment is the society aspect. The results of the assessment of the aspects of society will be explained in Table 3. Based on the assessment that has been done, it is known that the total value of the quality of society in this region is 3.8. This score is high and is above the standardized average value. The two minor items in the middle item have an above average value: impartiality / fairness with a score of 4.0 and security and safety with a score of 4.7. The score was obtained from the high knowledge, sensitivity and awareness of the community to contribute to protecting the environment. But in the items of convenience it is still below the standard standard of 2.8, one of which is due to the distance of community service facilities with settlements and the lack of conservation efforts in the historic area at the observation site.

Table 3. The society quality assessment score results.

Middle Item	Small Item	Minor Item	Parameter Score	Score	
				Weighting Coefficient	Score
2.1 Impartiality/ Fairness	2.1.1 Compliance Observation of applicable laws and regulation and verification			5.0	0.333
	2.1.2 Area Management Cooperation with and promotion of local community			2.0	0.250
2.2 Security / Safety	2.2.1 Disaster Prevention	2.2.1.1 Basis disaster prevention performance	2.2.1.1.1 Understanding of hazard map	1.0	0.083
		2.2.1.2 Disaster response ability	2.2.1.2.1 Disaster prevention vacant space and evaluation route	5.0	0.083
			2.2.1.2.2 Continuity of business and life in the block	5.0	0.083
	2.2.2 Trafic Safety Execution of separating pedestrian vehicles			5.0	0.083
	2.2.3 Crime prevention Security measure			5.0	0.333
2.3 Amenity	2.3.1 Convenience / welfare	2.3.1.1 Convenience	2.3.1.1.1 Accessibility to facilities and services	5.0	0.333
		2.3.1.2 Health and welfare, education Accessibility to facilities and service		2.0	0.250
		1.0	Distance to medical and health/ welfare facility (hospital/clinic that deals with daily medical treatment needs, elderly welfare facility, etc)	2.0	0.083
		1.0	Distance to educational facilities (kindergarten, elementary school, and junior high school)	2.0	0.083
		5.0	Distance to culture facilities (library, museum, sport facilities, etc)	5.0	0.083
	2.3.2 Culture	2.3.2.1 History and culture	2.3.2.1.1 Inheritance of history and culture, and creation of culture (creativity)	1.0	0.250
		2.3.2.2 View	2.3.2.2.1 Consideration formation townscape and landscape in the district	5.0	0.125
			2.3.2.2.2 Harmonization with the periphery	5.0	0.125

Finally, the third aspect of the CASBEE index assessment is the economic aspect. The results of the economic aspects are outlined in Table 4. Based on the previous assessment, the total economic value of this area is 4.4. This score is high and above average standardized values. The overall three minor items in the middle items are above average namely traffic / urban structure with a score of 4.1 growth potential with a score of 4.0 and efficiency / rationality of 5.0. The whole aspect of economy in the

parameters of the casbee at the observation site is high score for example in Development of traffic facilitiesc and Rationalization, cooperative delivery etc. of logistic (including carrying out waste material). Another high-scoring parameter is the fulfillment with and utilization of urban infrastructure in the area of observation and Flexibility and usability of information environment of the area.

Table 4. The economy quality assessment score results.

Middle Item	Small Item	Minor Item	Parameter Score	Score	
				Weighting Coefficient	Score
3.1 Traffic / Urban structure	3.1.1 Trafic	3.1.1.1 Development of traffic facilities	3.1.1.1.1 The development level of roads, parking lots, bicycle parking area, etc	5.0	0.125
			3.1.1.1.2 Usability of public transportation	1.0	0.125
		3.1.1.2 Logistic and Management	3.1.1.2.1 Rationalization, cooperative delivery etc. of logistic (including carrying out waste material)	5.0	0.250
	3.1.2 Urban structure	3.1.2.1 Consistency with and complementing upper level plan	3.1.2.1.1 Consistency with and utilization of urban infrastructure	5.0	0.250
		3.1.2.2 Land Use	3.1.2.2.1 Utilization level standard floor area ration	3.0	0.125
			3.1.2.2.1 Handling of brown field site	4.0	0.125
3.2 Growth Potential	3.2.1 Population	3.2.1.1 Inhabitant population	3.2.1.1.1 Planned population of accrual population (for assessment of existing state)	3.0	0.250
		3.2.1.2 Staying population	3.2.1.2.1 Average number of person staying in each building type	3.0	0.250
	3.2.2 Economic Development	3.2.2.1 Revitalization activity	3.2.2.1.1 Effort for economic revitalization programme	N.A.	-
3.3 Efficiency / Rationality	3.3.1 Information system	3.3.1.1 Information service performance	3.3.1.1.1 Flexibility and usability of information environment of the block	5.0	0.500
		33.1.2 Block management	3.3.1.2.1 Block infrastructure system management utilizing ICT	5.0	0.250
	3.3.2 Energy system	3.3.2.1 Possibility to make demand/ supply system smart	3.3.2.1.1 Flexibility to change in energy demand and price	5.0	0.250
		3.3.2.2 Updatability and expandability	3.3.2.2.1 Medium- and long-term ease of update and expansion for the whole block	5.0	0.250

4. Conclusion
One of the environmental measurements of sustainable areas is by using the CASBEE Model. This model is able to read in an area by applying 3 main bases, namely environmental, social and economic. In the case of East Surabaya urban area studies, this model shows a 3-star score which means the region

has GOOD conditions. This is of course, a special note because the urban area of East Surabaya is dominated by industrial estates. That way this area can be said to have a value of sustainability. The efforts of the Surabaya City Government to move towards a sustainable city seem to have been quite successful. Furthermore, it also needs to be calculated in other urban areas so that Surabaya City is indeed worthy of a Sustainable City.

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