Mapping of potential green city attributes in Batu District, Batu City

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Abstract. Batu District is located in Batu City defined as BWK I which is designated as central government development, modern trades and services development, tourism development, supporting services of tourism accommodation and education area. As the center of city development, the area / development that occurs in Batu District will have an impact on the increase in temperature. This research aims to identify the Batu District based on green city attributes such as green open space, green waste, green water, green transportation, green energy, green building, green planning and design, and green community that can be developed in Batu District. The method of analysis in this research are using descriptive analysis to determine the attributes of green city that can be found in Batu District. Based on the description of the seven attributes of Batu City, it is known that Batu City has 5 green city attributes that are being developed, namely Green open space of 32,317 m², Green Waste (separate waste bins and 5 garbage bank communities), Green Water (29 9 units of recharge wells, 4 communal waste water treatment plant (WWTP) and 1 individual WWTP), Green Energy (30 units of biogas) and Green Community (5 green city observers). As for the development of Green Building and Green Transportation attributes have not been done in Batu City.

1. Introduction
Green has become a new urban development model in the Americas, Asia, Europe, Australia [1]. Green city concept emerged as a refinement of the concept of garden city and the urban forest. The concept of garden city is considered less effective in dealing with increasingly complex issues of environmental issues, because the concept of green city at the beginning only emphasized on how to green the city with urban forests and city parks.

According to the Spatial Planning, the Green City is one approach to the concept of sustainable city planning, green city is also known as ecological city, which means the balance between city development and development with environmental sustainability.

Green city according to Detail City’s Spatial Planning, Batu is a city development which one of them is supported by green concept supported by structured green open space network system, efficient energy with minimal pollution, and can reduce global warming by reducing buildings with glass materials.

Green City according to the 2011 Implementation Guide of Green City Development Program (P2KH) has 8 (eight) attributes that must be fulfilled: Green Planning and Design, Green Open Space, Green Community, Green Water, Green Waste, Green Energy Green Transportation. One of the city that can be developed to the green city is Batu City, especially located in Batu District.
Batu District is located in Batu City defined as Urban Area, which is designated as central government development, modern trades and services development, tourism development, supporting services of tourism accommodation and education area, which has development goals in the form of an attractive, comfortable, and eco-friendly city tourism center as part of its comparative advantages (RDTRK Batu). As a district that is developed as a city center, Batu District is not separated from the rampant development, whether the construction of settlements, offices, and artificial tourist attractions, and these affects the carrying capacity of the environment.

The existing development issues in Sub District Batu the areas / developments of the city that have an impact on the increase in temperature, which affects the hotter temperatures. It also causes discomfort, decline in biodiversity due to land use changes caused or influenced either directly or indirectly, by conversion of forest land into agricultural areas and built areas. With the existence of these developments, the concept of environmental arrangement of Batu District leads to the efforts of green city establishment with the intention of restoring the city's microclimate to be cooler than it is today, one of the concepts that will be developed is using green transportation where green transport is one of the green city attributes (RDTRK Batu).

2. Literature Review

Green City according to [2] is a development which one of them is supported by green concept supported by structured green open space network system, efficient energy with minimal pollution, and can reduce global warming by reducing buildings with glass materials. According to [3] definition of green city is an eco-friendly city by effectively and efficiently utilizing water and energy resources, reducing waste, implementing an integrated transportation system, ensuring environmental health, synergizing natural and artificial environments based on urban planning and design in favor of sustainable development principles. A city that prioritizes the balance of the living ecosystem with the built environment so as to create comfort for the population of the city that live in it as well as for the city's visitors. In this study, green city related theories are used to identify the attributes of green cities in the Batu District, Batu City

2.1. Green City’s attributes

The green city attributes that can be used to determine the attributes of a green city according to the 2011 Implementation Guide P2KH can be seen from several attributes that have been mentioned by experts which are eight city attributes that can be regarded as green city, attributes that must be fulfilled according to [3] Development Program (P2KH) are:

- Green Open Space (Availability of Green Open Space)
- Green Waste (Waste management under the 3R Principle)
- Green Water (Effective water management)
- Green Building (Energy-efficient buildings or green buildings)
- Green Transportation (The implementation of a sustainable transport system)
- Green Planning and Design (Urban planning and design that is environmentally friendly)
- Green Energy (Efficient energy consumption)
- Green Community (Enhancement of community role as a green community)

2.2. Green Open Space (availability of Green Open Space)

Green Open Space is an increase in the quantity and quality of Green Open Space according to the characteristics of the city / district with a target of at least 30% of all urban areas as planned in the RTRW. Activities related to these attributes include the construction of green city parks, urban forests, green corridors in urban areas to increase the area of urban green space [4].

The Green Open Space is a more elongated / open-ended and / or more open-ended, plant-growing, plant-growing area [5]. Based on the Regulation of the [6], the function of green open space is also divided into two: intrinsic (main) and extrinsic (additional) functions. According to [5] About Spatial
Planning, availability of green open space are 30% of city area, 20% of private green space, and 10% of public green open space [7].

2.3. **Green Waste (waste management under the 3R Principle)**

Green waste is the application of waste and urban waste management by applying the concept of zero waste, 3R principle, i.e., reducing waste (reduce), increasing the value of waste (reuse), and developing recycling process (recycle) [4].

Green Waste or commonly called Zero Waste is an integrated waste processing so no garbage is wasted. Waste is a very crucial issue. Disposal sites are becoming increasingly difficult to find while garbage continues to be produced. The mixed waste disposal destroys and reduces the value of the material which may be utilized again. Organic materials can contaminate the materials that may still be recycled. One alternative waste management that can be the best solution is the management and processing of waste at the source in an integrated based Zero Waste (RDTR Batu).

The concept of Zero Waste essentially prevents the disposal of household garbage out of the house so that each individual must process the garbage themselves. Includes the process of reducing the volume of waste generation and handling waste as closely as possible from the source with approach through legal aspects (rules), organizational aspects (institutional), operational technical aspects, financing aspects (retribution) and aspects of active role of the community.

2.4. **Green Water (effective water management)**

Green water is the improvement of water resource utilization and management efficiency, conservation of water resources, and coverage of clean water access. Examples of the application of green water are the zero run-off concept in urban park / private green space, reuse of used water, rainwater harvesting, increased water absorption to the soil, the manufacture of surface water management systems in urban areas, and improving the quality of water-related disaster land [4].

The Green Water concept is more focused on the efficiency of water resource utilization for survival by maximizing water absorption, reducing water runoff, and water use efficiency. The application of this approach is in the form of procurement of biopori to increase water catchment area, procurement of lake as water retention, and selection of vegetation that can absorb water in large quantity so that ground water reserves can be well preserved [8].

2.5. **Green Building (energy-efficient buildings or green buildings)**

Green building is an application of building requirements with measurable performance in energy, water and other resources savings according to function and classification. The construction of a green building is a development that is both conceptually and environmentally responsible from the selection of the place to the design, materials and construction, operational, maintenance, renovation and utilization [4].

Green building is a combination of engineering designs, building materials and technologies that minimize negative impacts on the environment and human health [9,10]. This is achieved by a better site planning, design, building materials, construction, maintenance, and waste disposal.

2.6. **Green Transportation (the implementation of a sustainable transport system)**

Green Transportation is a development of sustainable transportation system, through the development of public transportation, pedestrian paths, and bicycle paths, as well as integration between modes [4].

Green Transportation is an environmental transportation device [11]. The concept of green transportation is a concept intended to make transportation modes more environmentally friendly. Green transportation is one of the eight components of green city where the development of sustainable transportation system through green transportation aims to encourage people to use the environmentally friendly public transportation. Green Transport refers to low-impact transport facilities in the environment, including non-motorized transport of walking and cycling, use of green
vehicles, carsharing, and attempting to build or protect a fuel-efficient urban transport system and space so that can create a healthy lifestyle.

Criteria for green transportation are the use of environmentally friendly fuels, green fuel types, the use of environmentally friendly technologies (Hybrid), mass transit, bicycle lane facilities, pedestrian facilities, emission levels, and Smart Transportation Management System (STMS). The variables of green transportation implementation are the use of environmentally friendly fuel, the amount of emitted emissions, the type of fuel, the use of environmentally friendly technology, mass transportation, pedestrian facilities, and bicycle lane facilities [12].

2.7. Green planning and design (urban planning and design that is environmentally friendly)

Green planning and design is an improved quality of urban spatial and urban design plans that are more adaptive to the natural physical (biophysical) environment of the region, as well as seeking adaptation and mitigation to climate change issues. Activities related to these attributes include the preparation of a green city masterplan, and the preparation of detailed plans such as the RDTR and RTBL [4].

2.8. Green energy (efficient energy consumption)

Green energy is the use of energy that efficient and environmentally friendly, such as the reduction in the use of non-renewable energy, or the use of alternative renewable energy (sunlight, water flow, geothermal, sea tides). Examples of green energy are the use of solar and/or electric power for the public street lighting [4,13].

Green energy is energy generated from environmentally friendly sources, or has little negative impact on the ecosystem of the environment. This concept evolved because of the tremendous negative impact of fossil energy use. The goal of green energy is to find alternative energy sources other than fossil energy. Energy sources that can minimize negative impacts on the environment. Already many alternative energy has been developed, ranging from the utilization of wind energy, solar, water, tides, and others. In addition to reducing the negative impact on the environment, this energy can also be used as an alternative energy for the future as a substitute for fossil energy [14].

2.9. Green community (enhancement of community role as a green community)

Green community is an active participatory enhancement of society and private institutions in the realization of a sustainable city vision. Examples of green community activities are the preparation of green community maps, the socialization of green city programs to communities, the inclusion of educational institutions through school programs and green campus [4].

Green community according to City Planning and Development Department BAPPEDA Banda Aceh is a strategy of involving various stakeholders from government, business and society in green city development. The Green Community aims to establish stakeholder participation in green city development and build communities that have environmentally-friendly characteristics and habits, including in the habit of disposing of waste and the active participation of communities in government green city programs. Green community indicators according to [3] the 2011 Green City Urban Development Program Guidelines are as community sensitivity, community initiatives, and partnerships.

3. Methodology

The method used in this research is descriptive analysis. This research gives model and concept of Batu District development with theme of green city based on criteria that suitable with existing condition of Batu District. Collecting data in this study conducted by collecting primary data by direct observation in the study area, interviews with government Batu related research such as Regional Development Planning Agency, Office of Public Works Highways and Irrigation, Public Works Department of Human Settlements and Spatial Planning, Department of Tourism, Office of the Environment, and the Batu District Office and secondary data collection from the existing literature.
The scope of the area in this study was conducted in Batu District, Batu City. The area of Batu District is 4.545.81 km² or 22.83% of the total Batu City area.

Here are the administration’s boundaries of the research area, covering:

- **West**: Malang Regency (Kabupaten Malang);
- **South**: Blitar and Malang Regency (Kabupaten Blitar dan Malang);
- **East**: Junrejo District;
- **North**: Bumiaji District

![Figure 1. Location map of research area](image)

4. **Result and Discussion**

4.1. **Profile of Green City in Batu District**

4.1.1. Green Open Space (availability of Green Open Space). *Green Open Space Under Law No. 26 of 2007 is an elongated / lane and / or clumped area whose use is more open, where crops grow, whether naturally grown, or intentionally planted*

Based on the existing condition, Batu District has green open space in the form of city park that is in the form of Batu Plaza (Alun-alun Kota Batu), Jalan Sultan Agung park, Jalan Kasiman park, Jalan Imam Bonjol park, Jalan Diran park, Jalan Gajah Mada park, and also Batu District has green open space in the form of city forest located in Oro-orO Ombo Village.
4.1.2. Green Waste (waste management under the 3R Principle).
Green Waste or commonly called Zero Waste is an integrated waste processing so no garbage is wasted. The concept of Zero Waste essentially prevents the disposal of household garbage out of the house so that each individual must process the garbage themselves. Zero waste concept consists of reduce, reuse, and recycle. In addition, green waste can be done by increasing the added value of waste by the presence or absence of creative economic programs from waste in the community, for example such as garbage bank.

Based on the existing condition, Batu District already implementing the waste management with the concept of green waste. The procurement of garbage facilities that have been equipped with the separation of waste types are along protocol roads such as Batu Plaza (Alun-alun Kota Batu), Jalan Dipenogoro, Jalan Panglima Sudirman, Jalan Gajah Mada, Jalan Brantas, Jalan Imam Bonjol, and Jalan Sultan Agung. Batu District also has five garbage bank groups which are built by Environmental Office of Batu City.

4.1.3. Green Water (effective water management).
The Green Water concept was introduced to conserve and manage the existing water, thus supporting the efforts to create a green city. Green water can be applied by maximizing water absorption, reducing water runoff, and streamlining water usage.

Based on the existing condition, Batu District in reducing water runoff that aims to control rain water to be able to seep back into the soil that is by making a recharge well. The absorption wells in Batu District are 29 units spread over several villages. The following table shows location and the number of absorption wells in Batu District.

| No. | Location of Catchment Wells | Unit |
|-----|-----------------------------|------|
| 1.  | Sisir Cemetery              | 2    |
| 2.  | SMAN 01 Batu                | 4    |
| 3.  | SDN 01 Oro-Oro Ombo         | 2    |
| 4.  | SDN 02 Oro-Oro Ombo         | 2    |
| 5.  | SDN 01 Temas                | 2    |
| 6.  | SDN 02 Temas                | 2    |
| 7.  | SDN Ngaglik 02              | 2    |
| 8.  | Lahor Agung Housing         | 4    |

4.1.4. Water Quality (evaluating the performance of water quality).
Water quality is one of the important factors that determine the quality of life in a city. Water quality must be maintained so that it is clean and safe for human consumption. Batu District has a number of water catchment areas that have been identified to protect water quality.

Table 1. Area of Green Open Space in the Batu District

| Type of Green Open Space         | Area (m²)   | Location              |
|----------------------------------|-------------|-----------------------|
| Bondas City Forest               | 22.051 m²   | Sisir Sub-district     |
| Temas City Forest                | 7.826 m²    | Temas Sub-district     |
| Jl. Sultan Agung Park            | 12.405,93 m²| Sisir Sub-district     |
| Jl. Kasiman Park                 | 630 m²      | Sisir Sub-district     |
| Jl. Imam Bonjol Park             | 317,64 m²   | Sisir Sub-district     |
| Jl. Diran Park                   | 193 m²      | Sisir Sub-district     |
| Jl. Gajah Mada Park              | 264 m²      | Sisir Sub-district     |
| Adipura Park                     | 25,8 m²     | Sisir Sub-district     |
| Batu Plaza (Alun-alun)           | 3.963,4 m²  | Sisir Sub-district     |
| Tugu Apel Park                   | 214 m²      | Sisir Sub-district     |
| Ganesha Park                     | 90,3 m²     | Sisir Sub-district     |
| Jl. Indragiri Park               | 971 m²      | Sisir Sub-district     |
| Jl. Dewi Sartika Green Path Park| 534,75 m²   | Temas Sub-district     |
| Jl. Mawar Park                   | 168 m²      | Pesanggrahan Village  |

Source: Primary survey, 2017
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| No. | Location of Catchment Wells                      | Unit |
|-----|--------------------------------------------------|------|
| 10. | SDN Pesanggrahan 02                              | 1    |
| 11. | SMPN 01 Batu                                     | 1    |
| 12. | SDN Sisir 05                                     | 1    |
| 13. | SMKN 03                                          | 1    |
| 14. | Dusun Toyomerto, Pesanggrahan Village            | 1    |
| 15. | Jl. Lahor, Pesanggrahan Village                  | 2    |
| 16. | Jl. Ngukir, Temas Sub-district                   | 2    |
| **Total** |                                              | **29** |

Source: Primary survey, 2017

In addition, Batu District has WWTP for water quality fulfillment. WWTP is a communal WWTP and medical WWTP scattered in several sub-district. The following table shows the location of WWTP in Batu District.

**Table 3. Location of WWTP in Batu District, Batu City**

| No. | Type                        | Location                        | Administrator |
|-----|-----------------------------|---------------------------------|---------------|
| 1.  | communal WWTP               | RT 05 RW 08 Pesanggrahan Village | Mr. Suropati  |
| 2.  | communal WWTP               | Sisir Sub-district RT 08 RW 11   | RW            |
| 3.  | communal WWTP               | Baranrejo, Oro-oro Ombo Village  | Oro-oro Ombo  |
|     |                             |                                 | Village        |
|     |                             |                                 | community      |
| 4.  | communal WWTP               | Pesanggrahan Village             | Pesanggrahan  |
|     |                             |                                 | Village        |
|     |                             |                                 | community      |
| 5.  | Medical WWTP                | Sisir Sub-district               | Puskesmas Sisir |

Source: Primary survey, 2017

4.1.4. Green Building (energy-efficient buildings or green buildings).
Green Building is a process of designing buildings and infrastructure in such a way as to minimize the use of building materials to reduce the negative impact on ecology. Based on the existing condition of Batu Sub District has not fulfilled the concept of green building.

**Table 4. Area of KDB and KDH in Batu District, Batu City**

| Type of Land Use          | KDB     | KDH     |
|---------------------------|---------|---------|
| House Settlement          | 60-80%  | 5-10%   |
| Commercial Facilities     | 60-80%  | 5-20%   |
| Office Facilities         | 60-70%  | 10-20%  |
| Public and Social Facilities | 70%     | 10-20%  |

Source: RDTRK Batu, 2014

4.1.5. Green Transportation (the implementation of a sustainable transport system).
According P2KH green transportation is to develop public transport that connects the service centers and settlements, a use of environmentally friendly vehicles that are intermodal, congestion reduction through the implementation of policies aimed to reduce congestion at peak hours. Based on the existing condition, Batu District already has pedestrian facility in Oro-oro Ombo Village up to Batu Plaza (Alun-alun Kota Batu). Unavailability of bike lane facility Batu District make people prefer to use private vehicles such as motorcycles and cars to reach their destination. Public transportation that can be used in Batu District is angkot. The angkot route in Batu District has been able to reach activities centers such as schools, shopping areas and city plaza. In addition, the angkot route is equipped with the presence of stops scattered in Batu District.
4.1.6. *Green Planning and Design (urban planning and design that is environmentally friendly)*. Green planning and design is the concept of urban planning that applies a green city planning approach. Implementation of green city planning approach can be seen from the existence of documents such as the existence of city planning documents.

4.1.7. *Green Energy (efficient energy consumption)*. Green energy is energy generated from sources that are environmentally friendly or have little negative impact on the ecosystem of the environment. Based on the existing condition, Batu District has not implemented the two indicators in green energy. One Batu District does not use solar energy as a replacement for street lights, and also there are no absence of a house or building with energy-efficient design by considering good lighting and ventilation that can lead to the use of lights in the day.

| Table 5. Distribution of Biogas (Livestock Waste) in Batu District, Batu City |
| No. | Location | Unit |
|-----|----------|------|
| 1. | Songgoriti Village, Songgokerto Sub-district | 1 |
| 2. | Dresel Village, Oro-or Ombo Village | 13 |
| 3. | Toyomerto Village, Pesanggrahan Village | 8 |
| 4. | Gondorejo Village, Oro-or Ombo Village | 1 |
| 5. | Tambuh Village, Songgokerto Sub-district | 1 |
| 6. | Srebet Barat Village, Pesanggrahan Village | 1 |
| Total | | 30 |

Source: Primary survey, 2017

4.1.8. *Green community (enhancement of community role as a green community)*. Green community is a strategy of involving various stakeholders from government, business and society in green city development. Based on the existing condition, Batu District has a community that is concern to the implementation of green city, the community is Ijo Royo-Royo, FKMPL (Forum Masyarakat Masyarakat Peduli Lingkungan), Alam Sejahtera, Earth Hour, Eco Ijo, and also Forum Kota Hijau (FKH). Batu District also has a program of one of the green communities, Earth Hour with activities such as distributing tree seedlings to the community, socializing green lifestyles to students in school, socialization through radio and also in Car Free Day Batu City, as well as clean action and unplug the nail on tree along with Batu City Environmental Office. But there is still no implementation of green city program in Batu District which cooperate with private / CSR.

| Table 6. Green Community di Batu District, Batu City |
| No. | Name of Green Community | Chairman | Address |
|-----|--------------------------|----------|---------|
| 1.  | Ijo Royo - Royo FKMPL (Forum Komunikasi) | Kuswardiyoko | Sisir Sub-district |
| 2.  | Masyarakat Peduli Lingkungan | Kariadi | Temas Sub-district |
| 3.  | Pamali Manggala Bala Bhakti | Mugi Wiyanto | Sidomulyo Village, Jalan Imam Bonjol Atas |
| 4.  | Earth Hour | M. Alfien Zuliansyah | no. 65 |
| 5.  | Eco Ijo | Stefan Krisna Priawan | Jl. Palem Raja 18, Sidomulyo Village |

Source: Primary survey, 2017

5. **Conclusion**
Based on the analysis result, it can be concluded that Batu District has seven green city attributes spread in seven urban villages namely green open space, green waste, green water, green transportation, green energy, green planning and design, and green community. Green city attributes
that have not been found in Batu Sub-District are green building. Each of the green city attributes that already exist in Batu District still do not meet the indicators of the 2011 Implementation Guideline for Green City Development Program (P2KH), therefore it needs an increase in every green city attribute in Batu District.

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