Green space planning based on biophysical and local wisdom of Luhak Agam in Lubuk Basung, Agam Regency, West Sumatra Province

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Abstract: Lubuk Basung is the capital city of this regency which is currently being developing and increasing in the population. By increasing those development activities in the city, attention to protect and anticipate the problem lead to environmental degradations is needed. Moreover, any development activities in the urban area almost creating the homogeneity in spatial development and ignored the local characteristics. One of the preventing action of these environmental problems and creating local characteristics is to conduct spatial planning for the existence of green space. In order to be able to reduce the homogeneity in creating of green space planning, integrating the local wisdom in this research is needed. The objective of the research is to understand the characteristic of existing green space, identify and analyze the green space needs, identify the value of local wisdom, and to plan the green space in Lubuk Basung city. The research consists of preparation, inventory, analysis, synthesis, and planning. The analysis was conducted to determine the green space (biophysical-based green space) toward to protected area, green space along the river corridor, and green space for urban community needs (social-based green space). It was evaluated by comparing those with the existing green space. The result of analysis was used as a reference in directing green space planning to be developed by integrating with Luhak Agam local wisdom value (cultural-based green space). The final result of this research is arranged as green space planning in Lubuk Basung City. Those green space planning consist of green spaces for protected forests, limited production forests, agricultural cultivation areas, on building areas, greenway for the river, road power line corridor, and parks.

Keywords: biophysical-based, cultural-based, green space planning, local wisdom, social-based

1. Introduction
Lubuk Basung city is the capital of Agam Regency which is in a developing condition. In the past, Agam Regency was included in the Luhak Agam (one of the three indigenous Minangkabau areas). It was recorded that population growth rate increased per year, due to an increase of development activities in this city. This needs to be considered and anticipated in order not to cause further problems such as degradation of environmental quality. One form of anticipation of this is to plan the existence of Green Space well as a form of urban spatial arrangement.

Green Space (GS) in the city are open spaces in various places in an urban area that are optimally used as a reforestation area and function both directly and indirectly for the sustainability and beauty of the environment [4]. The condition of the city of Lubuk Basung as the central government area of Agam
regency as well as the Hinterland area (the area of food staple supplies) shows the availability of green areas such as protected areas and agricultural areas but lessen of Green Spaces. Therefore, it is necessary to do the planning of Green Space in this city.

Each region has distinctive characteristics and identities that are different from other areas as well as the area of Lubuk Basung City. The life of local people who always interact with each other and with the environment produce local values of local wisdom based on customs and religion. Local wisdom is a legacy of ancestors that blend in the form of religion, culture, and customs. In its developed people to be adapted to their environment [6].

Local characteristics and local identity of Lubuk Basung can be valued as Identity and uniqueness that will enhance and strengthen the value of Lubuk Basung area. The value of local wisdom to the natural history, customs, and culture of Minangkabau born in Luhak Agam area can be expressed not only with symbols and ornaments but also with the spatial arrangement of territory. One of them is the arrangement of Green Space. In addition, the GS plan can provide a local identity that can reduce the value of homogeneity of similarity of existing green space structure in Indonesia.

The objectives of this research are: (1) to identify the characteristics and distribution of existing Green Space in Lubuk Basung, (2) to identify and analyze the needs and distribution of Green Space in Lubuk Basung, (3) to identify local wisdom of Luhak Agam community in Lubuk Basung, 4) to arranging the GS planning by integrating GS with local wisdom of Luhak Agam community in Lubuk Basung City, Capital of Agam Regency.

2. Methodology

2.1. Location, Time Equipment and Material
This research was conducted in Lubuk Basung City, the Capital of Agam Regency. The city occupied an area about 123.1 km² or 12.311 ha. The research activities begin from April to August 2016. Equipment used in site inventory include laptops, digital cameras, questionnaires as well as drawing tools and stationery. While for data processing using some software like MS Word, MS Excel, Arc GIS 9.3, and Adobe Photoshop. The materials used are satellite imagery, base map, thematic maps, biophysical data, socio-cultural data, and interview data.

2.2. Research methods
The research was conducted in five stages, namely preparation, inventory, analysis, synthesis, and Green Space planning (Figure 1). Preparation of research includes the preparation of research proposals, making detailed research activities, preparing letters and administrative supplementary documents, details and tracking of required data sources, and preparation of tools and materials for research.

Inventory consists of data collection, data processing, and checking data to the field. The primary data obtained through interviews with resource persons and direct field observation while the secondary data obtained through literature study and documents from relevant local government agencies. Data used in this study include administrative data, biophysical data, and socio-cultural data. Administrative data obtained in the form of administrative area and regulations related to green space planning. Biophysical data was obtained in the form of topographic data and slope, geology and soil, climate, natural infrastructure, city infrastructure (road and electricity network/power line), and land cover. While socio-cultural data obtained in the form of the demographic population, toponymic aspects (origin of the name of the region), aspects of custom and religion, and ethno botany (local plants and plants that interact with humans since the past until today).
The analysis was conducted descriptively and spatially. The analysis consists of GS analysis and local wisdom value analysis. The green space analysis was conducted to determine the availability of existing green space, biophysical function (protected area, local protection area, and urban green infrastructure), and green space based on per capita population needs for social space.

GS analysis was divided into 4 (four) part of the analysis that is: (1) Analysis of green space dissemination based on land cover, (2) Analysis of Protected Area based on Decree of Minister of Agriculture no. 837 / Kpts / Um / 11/1980, (3) Local Protected Area Analysis under Law no. 26 of 2007 on spatial planning and Decree of Minister of Public Works. 28 / PRT // M / 2015 on the determination of river corridor and water body border area, (4) GS analysis based on population needs to GS which is regulated by Minister of Public Works No. 05 / PRT / M / 2008 (For social space). Data of population used is based on the projected population growth in 2020.
Furthermore, the analysis of local wisdom values consists of: (1) Toponymic analysis based on place name, origin, and regional typology, (2) Analysis of custom and religion aspects based on custom institutional analysis, values, procedures, and local special provisions, and (3) Ethnobotany analysis based on community perception of some local plants.

The synthesis was performed base on Green Space evaluations. Those evaluations consist of green space for protected area, green space for river corridor and setback (buffer) of water body and infrastructure corridor, green space for community (requirement of green population per capita) and existing Green Space. Evaluation is also conducted to determine the adequacy of existing GS of 30% as a minimum requirement of urban green space based on Decree of Minister of Public Works no. 05 / PRT / M / 2008 on guidelines for the provision and utilization of green space in urban areas. The result of synthesis above is followed by creating a block plan and the formulation of planning concept.

Green Space plan was conducted by integrating block plan with local wisdom value of Luhak Agam region in Lubuk Basung capital of Agam Regency. This GS planning product will illustrate the distribution of green spaces, local wisdom elements, and the alternative plan of plant species selection.

3. Results and Discussion

3.1. Biophysical Aspects

3.1.1. Green Space of Land Cover

Based on land cover data provided by Local Development Planning Agency at Sub-National Level of Agam Regency 2010, Lubuk Basung has ten types of land cover, i.e. forest, rice field, open field, shrubs, mixed plantation, coconut plantation, oil palm plantation, moor, settlement, and body water. Lubuk Basung is dominated by forest which is 27% or 3,329.6 ha. In addition, based on the Decree of the Minister of Forestry No.35 of 2013, protected areas have been defined in Protected Forest, Production Forest, Nature Conservation Areas, and Other Use Areas. Forest Area Map in Lubuk Basung City is used by government of Agam Regency as a base of Spatial Plan in Spatial Planning of Agam Regency.

Based on data of land cover above can be known the distribution pattern of GS. The calculation results obtained that the presence of GS in the city of Lubuk Basung area is 95.23% or 12,216 ha. Green Space is in the form of Forest, Rice Field, Farm, Moor, and Open Field. The results of this calculation indicate that Lubuk Basung has fulfilled (beyond the minimum GS requirement of 30%) according to the criteria established in Government Law No. 26 of 2007.

3.1.2. Green Space of Function Protected Area

GS Analysis of Protected Areas (Decree of Minister of Agriculture No. 837 / Kpts / Um / II / 1980) was assessed based on three determinants factor, i.e. slope, soil type, and rainfall, 79.35% of the total area is a flat slope class (0-8%). Meanwhile, the type of land in the city of Lubuk Basung based on data processing obtained from Soil Research Center is dominated by Alluvial soil (94.72%) and slightly Latosol land area (5.27%). Based on the criteria for the determination of protected areas, according to their sensitivity to erosion, alluvial soils are classified as non-sensitive criteria so that no erosion is possible. While the latosol soil belongs to the category rather sensitive and the possibility of erosion is very small.

Based on rainfall data of Class II Climatology Station, Sicincin, Padang Pariaman year 2010-2015 obtained the average rainfall of 3,247 mm / year with average rainy day as much as 160 days/year. The results of interpolation of data between stations surround Lubuk Basung was obtained by the division of the region with rainfall of 23.4 (mm/day) and 22.3 (mm/day) are classified into the middle class and the area with rainfall 15.23 (mm/day) belong to the lower class.

The overall result of the above three-component analysis had been overlain for the Protected Area. The result of the analysis shows that there is no area that belongs to the protected forest area. The highest
percentage is obtained for agricultural cultivation area or another usage area with value 97.9% or area of 12,561.72 ha. Furthermore, suitable areas for production forests have a percentage of 2.06% or an area of 264.69 ha.

3.1.3. Green Corridor and Green Buffer of Water
Based on the provisions of Law no. 26 of 2007 on Spatial Arrangement Article 5 paragraph (2), natural infrastructure can be categorized into local (corridor) protected areas. Lubuk Basung City has a natural infrastructure in the form of a river that is better known by the community as batang. For smaller rivers are usually also called Banda. Based on Agam regency’s spatial plan, the required of corridor along the river flow is 15 meters along the left and right of the river. It also refers to the assumption that the river is not placed in urban areas with a depth of 3 meters to 20 meters. Meanwhile, based on The Decree of Minister of Forestry No. P.21 / menhut-II / 2011 on environmental management and monitoring of forestry activities for river border in protected areas shall be stipulated ± 100 m from the river.

3.1.4. Green Line Road Infrastructure and Power Line Corridor
Based on the regional spatial plan of Lubuk Basung (2011-2031), the information on road infrastructure and High Voltage Transmission (RPLC-150 kV) was obtained. The provisions on the Ministry of Public Works Ministerial Decree No.05 / PRT / M / 2008 state that a green road can be provided by planting between 20-30% of the Right of Way (ROW) in accordance with the road class. The city of Lubuk Basung has the main road segment consisting of the National Road (major road), Provincial Road (medium road), and District Road (small road). In green space analysis on the road obtained a green path area of 41.6 ha.

The green line of the power line is determined in the same regulation as the electric power line borderline is 64 m set from the midpoint of the power grid. In addition, there is a minimum clearance provided between the power line to the ground and other objects of 20 m from the network. Analysis of green space of the power line green corridor space obtained area of 74.7 ha.

3.2. Social Aspects

3.2.1. Green Space Based on Population Capacity Needs
Based on the provisions of Regulation of Minister of Public Works No. 05 / PRT / M / 2008 concerning the provision of green space based on the total population, can be determined the area for the park based on the projected population growth in 2020. Based on the current data obtained from the Central Bureau of Statistics Agam regency in 2014, GS for social space (Table 1).

| Nagari (Village) | Population by 2014 | Population growth rate | Projected population by 2020 | Park Area (Population *0.3m) (m²) | Allocation |
|------------------|-------------------|------------------------|-----------------------------|---------------------------------|------------|
| Lubuk Basung     | 36,347            | 1.82                   | 40,501                      | 12,150                          | Village Park |
| Geragahan        | 6,884             | -0.19                  | 6,805                       | 2,041.5                         |            |
| Kampung Pinang   | 3,684             | -0.22                  | 3,636                       | 1,090.8                         |            |
|                  | 50,942            |                        |                             | 15,282.6                        | City Park  |

Source: The result of population projection calculation using geometric method

3.2.2. Cultural Aspects (Local Wisdom)
The value of local wisdom is obtained through the interpretation of interviews of custom leaders (Datuk) in three villages (Nagari) in Lubuk Basung City. The data obtained include toponymic, custom, and
religious aspects, as well as ethnobotany which then each will be interpreted to give values on the concept of Green Space.

3.2.2.1 Toponymic
Toponymic is a term about the name of the place, its origin, meaning, use, and typology. The data obtained in each Nagari (village) has its own toponymic value. This can provide the identity of each villages with the existence of a distinctive ornament that became the origin of a Nagari.

There are plants as the source of the name of a Nagari such as Pulai Basung better known by the name of the Basung tree (Alstonia spatulata) as for the toponymic of Lubuk Basung and Areca nut (Areca catechu) as for the toponymic name of Kampung Pinang. And there is a term of agahan (term residents of the sound of the river) that describes the existence of the river (Batang antokan) in Garagahan village. This term can strengthen the existence of rivers by providing local protection areas of river border.

3.2.2.2. Custom and Religion
3.2.2.2.1. Customary Institution
Traditional institutions in Minangkabau are generally the same at every level of government. It is just special for the district in the Province of West Sumatra using the concept of territoriality with the Nagari system (village level but the boundaries determined by local customs). A Nagari will be lead by a Wali Nagari chosen based on a customary decision of Nagari (customs of a Nagari) on certain conditions. The Nagari administration will also be assisted by the secretary of the Nagari and the Civil Servant, as well as traditional leaders comprised of scholars, intellectuals and leaders of indigenous tribes in a Nagari (Also called Tungku Tigo Sajarangan-Three Custom leaders).

The Nagari district structure where the Nagari is quite clear is listed in the Minangkabau Tambo (historical literature of Minangkabau tribe). The element of the formation of a Nagari as contained in the Tambo consists of the inter-sub village boundary (Jorong) occupied by at least 4 sub-tribes of Minangkabau, there are roads, there are rice fields and fields, there are houses, there are courtyards and terrains (community gatherings), and there are graves (either in groups as custom or individual).

3.2.2.2.2. Value system
There is a foundation of custom (Minangkabau) and religion (Islam) which underlies the regulation of life in West Sumatra as a whole. In addition, there are customary systems in general (all areas of West Sumatra) and specifically (per Nagari). The value system produces the stipulation that each Nagari has different customary provisions. But still, have in common as Minangkabau custom unity. There is a characteristic of community habits both in interacting with other human beings as well as to nature.

3.2.2.2.3. Procedures
In the ordinary course of community life, there is a societal way of life closely related to the agricultural system (planting rice together-the Julo-julo community's terms, planting coconut or banana before marrying in the yard, and giving the produce to the newlyweds). That is, there is the value of the daily landscape of the people (Ordinary Landscape) in interacting with human beings as well as to nature. For example, formerly coconut and banana are required to be planted with a certain amount. Currently, the yields of these plants can be utilized by the community as the next generation. Until finally people cultivate these plants to be utilized continuously. In addition, there is also a community gathering location for religious or customs activities, customs such as traditional tribal chief election (datuk), customary marriage, and traditional art show area such as mosque courts, markets, and open fields.

3.2.2.2.4. Special provisions
Lubuk Basung area has several areas that are local special provisions namely Rimbo Larangan (Prohibited Forest) and Banda Larangan (Prohibited River). Rimbo larangan is a forest area (rimbo)
that should not be disturbed by the community or anyone. If any citizen wishing to take the wood, it must obtain permission from the Nagari apparatus. Determination of prohibited forest areas that serve as forest conservation efforts.

While the provision of Banda ban is a river flow that is kept so as not polluted from materials or objects that can destroy the biota in the river. In addition, in the provision of the community should not catch fish by using electricity and so forth. The opening time of the Banda larangan is determined by the Nagari apparatus.

3.2.2.3. Ethnobotany
Lubuk Basung is famous for its Coconut and Pinang plants (Lubuk Basung is the highest producer of Coconut and Pinang in Agam Regency). In addition, there are also plants that are often used as indigenous food and symbols for traditional ceremonial activities such as Coconut (Cocos nucifera), Fern (Pteridium aquilinum), Jackfruit (Artocarpus heterophyllus), Banana (Musa sp.), Betel (Piper betle), Areca nut (Areca catechu), and Gambir (Uncaria gambir). It can be interpreted that the need to cultivate crops that are often consumed by the community and used for such customary activities.

3.3. Synthesis

3.3.1. Evaluation
Based on the analysis of GS needs biophysically obtained GS of Protected Area, GS of River corridor Greenway of Road corridor and Greenway of Power Line. The result of the analysis is in overlay with Social Green Space (Population Needs per capita and Cultural Green Space) to get GS of Protected Area, GS of River corridor, Greenway of Road corridor, and Greenway of Power line, City Park, and Nagari (Village) Parks. The results of the biophysical and social analysis are reevaluated with existing land cover. The evaluation resulted in several GSs, namely GS of Protected Area, GS of River Corridor, GS of Forest, GS of Rice Field, Open Field GS, GS of Bushy Woodland, GS of Mixed Garden, GS of Coconut Plantation, GS of Palm Oil Plantation, Green Space of Dry land, GS at Settlement, Greenway of Road corridor, Greenway of Power line corridor, as well as City Park and Nagari park.

GS analysis based on land cover data can be seen that the existing green space has an area of 95.23% (12,216 ha) of the total area of Lubuk Basung city. This indicates that the city of Lubuk Basung has met even exceeding the minimum extent of GS area of urban areas based on Law no. 26 of 2007 covering 30% of the total area of urban areas, so there is no need to increase the proportion of green space so that this study only needs to make efforts to structuring green space.

3.3.2. Block Plan
The block plan consists of GS of protected areas, GS of river corridor, forest GS (Limited Production), GS of agricultural cultivation area, GS in the built area, GS of Urban Infrastructure, and Parks Space (Table 2). It is obtained from the generalization of GS result above.

| Land Cover           | GS Block Plan            | Area (ha) |
|----------------------|--------------------------|-----------|
| Protected Area       | Protected forest         | 256       |
| River Border         | River Border             | 1,226     |
| Forest               | Limited production forest| 175       |
| Rice Field           |                          |           |
| Mixed Garden         |                          |           |
| Coconut Garden       | Agricultural cultivation area | 7,211     |
| Palm Oil Garden      |                          |           |
| Moor                 |                          |           |
3.3.3. Concept
The concept of GS planning in Lubuk Basung City was developed based on the block plan (Table 2). The integration of the block plans with local wisdom values generates the concept of the GS development plan as presented in Table 3.

Table 3. Concept Matrix of GS Development Plans

| Green Space Block Plan                  | Integration with Local Wisdom Value                                                                 |
|----------------------------------------|-----------------------------------------------------------------------------------------------------|
| Nature reserve area*                   | There is a valuable area of Rimbo Larangan                                                         |
| Protected forest*                      |                                                                                                    |
| Limited production forest*             |                                                                                                    |
| River Corridor*                        | There is a valuable area of Banda Larangan on the river located in the cultivation area.          |
| Agricultural cultivated area           | There are ordinary landscape values for:                                                           |
|                                        | • Rice Planting Activities "Julo-julo" (the social gathering system)                                |
|                                        | • "Padi Sumpik" activity (Giving crops to newlyweds) at Kampung Pinang Nagari                       |
|                                        | There are several areas worth as Rimbo Larangan                                                     |
| Built area                             | The existence of the home yard that has several plants that are used for daily needs (Medicinal   |
|                                        | plants and spices, Coconut, Jackfruit, and Banana) already existed since the ancient time.          |
| City infrastructures*                  | Provision of typical local plant elements at several locations on the Green Line Road (e.g. on      |
|                                        | pocket garden on the street) such as Pulai Basung (Alstonia spatulata) or Areca nut (Areca catechu) |
| Park                                   | City Park: Potential for community gathering areas and local traditional art performances           |
|                                        | Nagari Parks: A fixed area that is used as a community gathering area for customary and social     |
|                                        | activities on a Nagari scale                                                                       |
|                                        | Can be given the typical local plant elements for each location                                    |

* Fixed status for RTH (not subject to change) based on (in the provisions of pre-defined rules)

3.4. Green Space Planning
Urban Planning of the City of Lubuk Basung was created to create a green space order that still pay attention to its functions ecologically, economically, aesthetically, socially, and culturally. The cultural element of local wisdom values into the identity and characteristic of GS of Lubuk Basung City. The green space plan based on the concept in Table 3 above is presented in Figure 2.
4. Conclusions and suggestions

4.1. Conclusion
1. The result of analysis and distribution of existing Green Space based on land cover is about 95.23% (12.216 ha) of the total area. The existing GS characteristics consist of forest land cover, rice field, open field, shrub land, mixed garden, coconut plantation, dryland and oil palm plantation. Based on the characteristics of this existing GS quantitatively, the city of Lubuk Basung has the GS that exceeds the minimum requirement of 30% urban Green Space,
2. Based on the analysis of the distribution of demand for green space, it could be determined the needs of Protected GS, Local (corridor) Protection GS/ Green Corridor and Green Buffer of Water, Greenway of Road corridor, Power Line Green Corridor and Social Green Space, respectively 264.69 ha, 1,226 ha, 41. 6 ha, 74.7 ha, and 3 ha,
3. Based on the interpretation of local wisdom which includes toponymic, custom, and religious analysis, and ethnobotany can be determined the green space based on customary provisions, namely Rimbo Larangan GS, Banda Larangan GS, and Cultural Green Space, as well as information of typical local plants and indigenous plants,
4. The GS planning in Lubuk Basung city can be arranged by integrating biophysical and local wisdom into each functional space namely: GS of protected forest (255.76 ha), GS of limited production forest (175.09 ha), GS of river corridor (1,226 ha) GS of agricultural cultivation area (7,211 ha), GS of open field (108 ha), greenway of road corridor (41.6 ha) and Greenway of Power line (74.7 ha)), and The Parks (City Park (1.5 ha), Lubuk Basung Nagari Park (1.2 ha), Geragahan Nagari Park (0.2 ha), and Kampung Pinang Nagari Park (0.1 ha)).

4.2. Suggestion
Green Space Planning in Lubuk Basung City, can be used as an input to the government of Agam Regency in the planning of city development.
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