Development of Smart Sustainable City Conceptual Design for Indonesia's New Capital City

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Abstract

Development of new city needs comprehensive planning to answer urbanization challenges, such as environmental crises and socio-economic crises. The natural trait of human activities is destroying nature and a city is the most significant place of human activities. Sustainable approaches are important to ensure future's ability to fulfill their needs by regulating today's consumption sustainably. Smart city applications are more than just technology, rather smart city is a way to achieve better city services and offer highest quality of urban life. Therefore, technological usage to achieve sustainability is key for the sustainable smart city concept. This research aims to develop conceptual design based on sustainable smart city concept for Indonesia's New Capital. Conceptual design is developed with urban planning knowledge based on the result of site analysis and case study from other country city's development which later are validated by expert. The result of this research is conceptual design that show spatial and usage form with the application of sustainable smart city concept for the construction of Indonesia's new capital.

Keywords
Spatial Analysis, Smart Sustainable City, Indonesia's New Capital City; Smart City; Conceptual Design

1. Introduction
The Indonesian's government has announced the relocation of the nation's capital city from Jakarta to East Kalimantan Province. The newly relocated city, which later named Nusantara, is planned to relocate administrative function of the capital city, while Jakarta remains as the center of economic function. The National Development Planning Agency or Bappenas stated that the relocation is done because of the highly concentrated population in Java Island which is around 56,54% (Bappenas 2019). This disproportionate distribution of population concentration may impact towards further inequality of national economic contribution, with Java accounts for 58,49% of national GDP. With relocation taken place, the government hopes to decentralize economic and population concentration into more equitable condition.

As a new city development, the new capital city or IKN is affected by the growth of urbanization rate on a global scale and its impact to the environment and society. UN estimated with the current rate of urbanization around 6,5 billion people will live in urban areas by 2050 (Streitz 2015). With such high rate of urbanization, cities are facing environmental and socio-economic crisis, for example climate change, ecosystem damage, socio-economic disparity, and regional inequality all of which are mainly caused by high population growth with high consumption of natural resources (Yigitcanlar et al. 2019). Major advancement of information and communication technology makes many planner and government wants to utilize its technological capability to face environmental and socio-economic crises. Here the smart city concept can be explained as the utilization of infrastructure network to increase economic and political efficiency also promote social, cultural, and urban development. Nowadays, Smart city have become a global movement which promises better ability to utilize city's natural resources more efficiently, make public transport more attractive, and provide data for planner and decision maker to allocate resources effectively (Yigitcanlar et al. 2019).

Through application of smart city concept, city development is guided towards sustainable city, which is a concept that focuses on technical result from effective urban transformation from in accordance with sustainability impact. Only by combining both concepts, where the application of information and communication technology for the goals of sustainability, the concept smart sustainable city can be realized (Yigitcanlar et al. 2019). City is where the most significant human activity take place, with mainly the nature of human activity is destructive towards nature (Yigitcanlar and Kamruzzaman 2015). To resolve this problem, city development must adhere to the principle of sustainable development, which is the development that meet the current need without impacting future generation to fulfill their needs mainly in three inter-related dimensions; economic, environment, and social (Bocchini et al. 2014; Keeble 1988).

1.1 Objectives

Based on the need of comprehensive planning for the relocation of the new capital city, especially on the area of city planning with the concept of smart and sustainable city, research related the subject matter is still relatively scarce. Although the development concept has seen an increase in attention, the specific implementation on IKN still need to be explored. Therefore, this research aims to develop planning model based on sustainable smart city conceptual design for the development of IKN. The model will provide information on how the implementation of development concept can be utilized on conceptual level, opening further opportunity to future research.

2. Literature Review

According to the newly published IKN law, the new capital city IKN area is divided into structured regional hierarchy, governmental core area (KIPP) with 6.671 ha, IKN area with 56.180 ha, and IKN expansion area with 199.962 ha. Combined, the total designated area for IKN is around 256.142 ha of land area and 68.189 ha of water area which reach into the sea from the coastline. The relocation of the capital city from java is hoped to change Java-centric national development into an Indonesia-centric one (PUPR 2020). The greenfield developed city is applying three basic principle for development, forest city, sponge city, and smart city according to the masterplan from the IKN law.

Planning in general is the process of organizing the sequence of certain action to achieve the desired goal (Hall and Tewdwr-Jones 2019). In the context of urban planning, conventionally, planning consists of spatial or geographical component which main goal is to provide spatial structure from certain activity or land use that substantially better if done without planning. Spatial arrangement can be defined as spaces in a region that have been arrange and chosen as a location for a program, economic activity, and development that already or will be done (Adisasmita 2014). Through that definition, regional spatial planning is important in development planning economically. Urban areas are developed area which already have urban structure as centralized residential area with high density, also an adequate public facility. The main function of city consists of residential facility that enough for its citizen, provide enough jobs for the livelihood of its resident, effective and efficient public transportation system, and leisurely or recreational activity for the people (Adisasmita 2014).

Land development usually consist of a few steps into the final plan. According to (Dewberry 2012) although the process are ordered as sequential steps, in planning stage almost never follows straight path into solution. Processes can be done simultaneously across different steps to ensure the availability of relevant information. The planning processes start with development site assessment, which is providing understanding and information about the characteristic of the developmental area and the neighboring area. Site assessment is carried out to empower planner to have a full understanding related to the potential and limitation of the area. The next step is conceptual design to determine basic framework which represented the distribution, organization, and composition of development program. The conceptual design have to consider the potential and limitation of the development area identified in site assessment stage (Dewberry 2012).

Planning also need to consider smart city concept in accordance to the masterplan of the city. Currently, there are no widely accepted general definition of the smart city concept because interpretation may varied according to context (Sharifi 2019). Existing definition tend to focus on different aspects with majority focus on the role of technology. Basically, the goal of smart city is to offer its citizen highest quality of urban life (Axelsson and Granath 2018; Kummitha and Crutzen 2017). Therefore, mere implementation of technology is not enough to make a city become a smart city. A city needs to invest on the growth of human capital, social, and environmental aspect to develop sustainably (Ismagilova et al. 2019; Yigitcanlar et al. 2019). Lara (2016) argued that a smart city must be systematically promote welfare for all member of its city, and flexible enough to become a better place to live, work, and play proactively and sustainably. Based on these definition, (Kummitha and Crutzen 2017) explain a literature approach to explain smart city into technology driven and human driven methods. Therefore, to sum up different definition, according to (Ismagilova et al. 2019) smart city can be defined as the use of information technology in a smart way integrated into interactive infrastructure to provide modern and innovative services for its citizen, impact the quality of life, and manage resources more efficiently.

3. Methods

To develop conceptual design based on smart sustainable city concept, this paper use literature study and case study and benchmarking methods. The concept of smart sustainable city is explored through the relationship between smart city and sustainable city as well as the characteristics of smart city. City planning methods are also identified, mainly on-site analysis for conceptual design generation. Information related to new capital city development are identified to be used as case study. Using relevant information from the goals of the project, this paper generates preferred design criteria as sustainability indicator based on previous literature. Then, alternative designs are developed based on other capital city development as benchmark for land use composition. Alternative designs are reviewed by using ArcGIS, a Geographic Information System (GIS) software, to evaluate based on previously defined indicator using multi-criteria elevation methods. The resulting evaluation are then used to determine the preferred design by using paired comparison technique. Further analysis is then taken to develop initial cost estimation based on each land use and needs. Expert validation from government body and appropriate stakeholder provides feedback from the result of this paper.

4. Data Collection

In the design process, firstly, the condition of the site of development need to be analyzed and studied (Dewberry 2012). Data collected for this paper are in Penajam Paser Utara Regency, East Kalimantan Province, Indonesia with study area shown in Figure 1. Topographical information related to the site is an important factor to make decision for land planning, by providing basic information of landform such as elevation, slope, and land aspect graphically (LaGro Jr. 2008). This paper uses digital elevation modelling (DEM) data retrieved from national DEM registry DEMNAS from Badan Informasi Geospasial (BIG). Using ArcMap software, DEM are compiled and projected with coordinate system of WGS 1984 UTM Zone 50S based on the location of the site. The site analysis is carried out in the study area based on the relocation plan of new capital city.

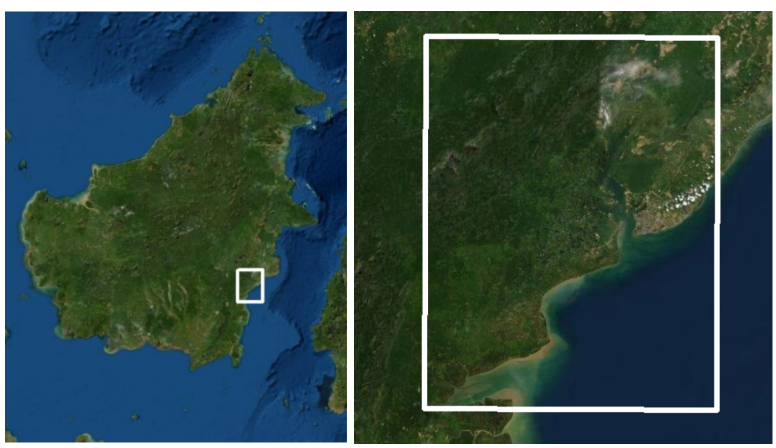

Figure 1. Study area

From elevation map, the development site has elevation range from -27 m to 1234 m from sea level. The map showed a high difference in elevation between coastal areas towards more hilly central area as shown in Figure 2. With high difference in elevation, the intensity of inclination of slope in the region is a important factor for measuring suitability for development, such as roads, buildings, and other structure (LaGro Jr. 2008). Land use map also generated by using data from BIG for Penajam Paser Utara Regency.

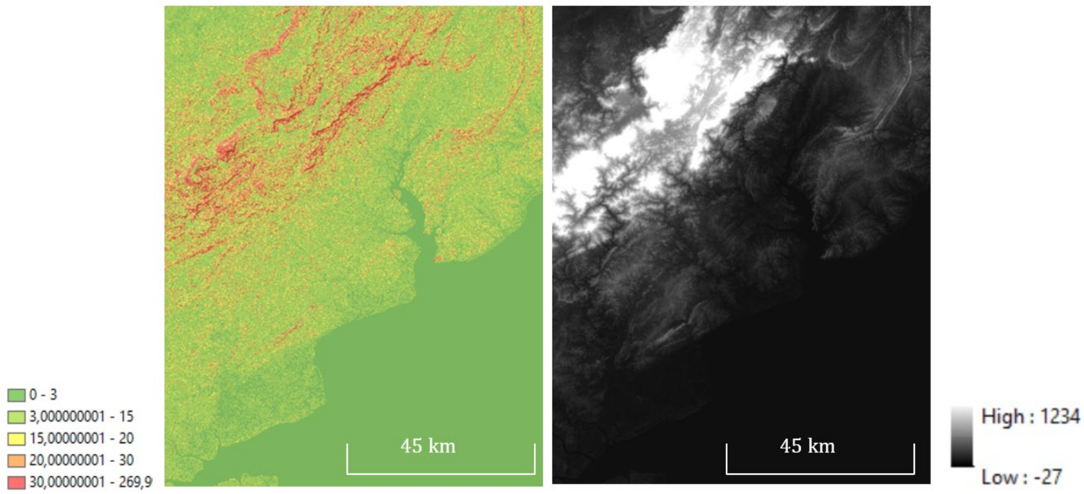

Figure 2. Land slope and elevation map

Majority of the land usage are for agricultural, forest, and residential which can be seen in Figure 3. Main agriculture usage is for oil palm plantation which account for 49.689 ha from 62.041 ha of total agricultural land use (Dinas Perkebunan Provinsi Kalimantan Timur, 2020). Natural disaster risk index provided by National Agency for Disaster Relief (BNPB) measures the risk and impact of natural disaster in the area, among other earthquake, flooding, and forest fire. Mitigating risk by avoiding or significantly reducing development in high risk area is crucial in planning stage (LaGro Jr. 2008). By considering these maps, development area for National Capital City Area (K-IKN) is determined with total area of 40.000 ha in accordance with the plan in Figure 4.

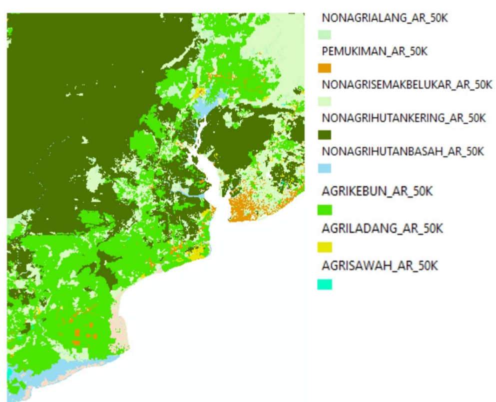

Figure 3. Land use map

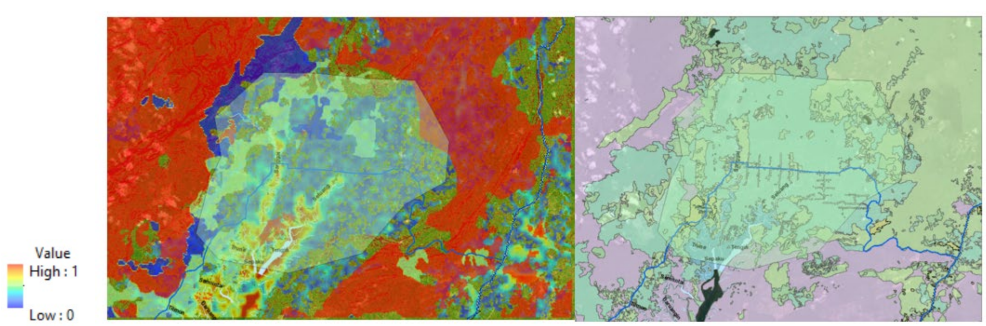

Figure 4. Natural disaster risk map and development area

5. Results and Discussion

5.1 Land Use Allocation

To determine the composition of land use, this paper uses benchmarking methods with cities that possess desired characteristic for implementation in IKN, namely the city of Canberra, Putrajaya, and Sejong. All three of those capital cities are developed with masterplan from the ground up, meaning a fully planned city (Leem et al. 2019; Suprayitno et al. 2020). From each land use allocation, this paper develops three land use composition alternatives by combining land use allocation with a varied weight of influence (see Table 1). Spatial distributions for these alternatives are developed conceptually to show location, shape, and development pattern based on benchmarking reference.

Table 1. Land use alternative composition

	Land Use	(1) Canberra	(2) Putrajaya	(3) Sejong	Alternative 1 (Avg 1,2,&3)	Alternative 2 (Avg 1&2)	Alternative 3 (Avg 1&3)
1.	Green Open Space	82,86%	37,60%	52,00%	57,49%	60,23%	67,43%
2.	Residential	6,64%	25,50%	22,00%	18,05%	16,07%	14,32%
3.	Infrastructure	4,42%	18,80%	14,00%	12,41%	11,61%	9,21%
4.	Commercial	0,99%	2,90%	3,00%	2,30%	1,95%	2,00%
5.	Recreation and Culture Facility	4,06%	0,20%	2,00%	2,09%	2,13%	3,03%
6.	Community Facility	0,00%	9,70%	4,00%	4,57%	4,85%	2,00%
7.	Governemental Facility	0,88%	5,30%	2,00%	2,73%	3,09%	1,44%
8.	Industry	0,16%	0,00%	1,00%	0,39%	0,08%	0,58%
	Total	**100,00%**	**100,00%**	**100,00%**	**100,00%**	**100,00%**	**100,00%**

5.2 Alternative Design Development

Land suitability is defined as the fitness or compatibility of land area with certain specific usage (LaGro Jr. 2008). Indicators are utilized to measure the level of land suitability with component from site analysis such as land slope, natural disaster risk, and accessibility. Land suitability is measured through multi criteria evaluation in Figure 5 which is a spatial analysis from the indicators defined with each weight of influence. Multi criteria evaluation focuses on land allocation to each attribute that needed for the function, in this case the attribute are the indicators being used (Eastman 2005). The result of this analysis, alternative 2 have highest suitability score with 82,9%, followed by alternative 3 with 82,4%, and lastly alternative 1 with the lowest score of 77%. Generally, all three of the alternatives have high score of suitability because the conceptual placement for each alternative area already considering the indicator used in the analysis.

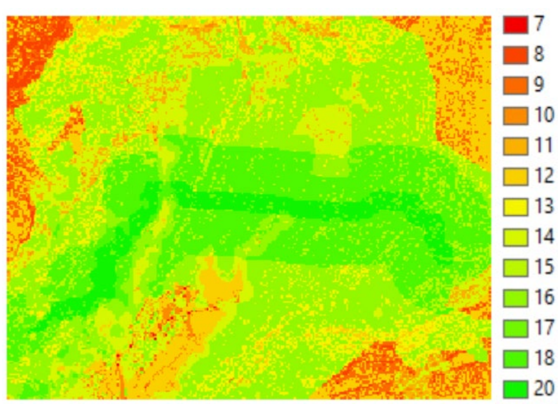

Figure 5. Multi Criteria Evaluation

Beside land suitability to determine the preferred design alternative, this paper uses sustainability aspect into consideration in the form of a few indicators divided into four categories, suitability, environment, infrastructure, and socio-economy. By calculating each indicator based on the attributes of the design alternative, the result can be seen in Table 2.

Table 2. Sustainability Indicator

Code	**Indicator**	**Unit**	**Source**		**Alternative Evaluation**		
					1	**2**	**3**
A.a.	Land Suitability	%	Pourebrahim (2011)		77,4%	82,9%	82,4%
B.a.	Green Open Space	km^2/Total Area	Samara (2015); Shen (2011);		57,5%	60,2%	67,4%
B.b.	Reforestation	km^2/Total Area	Samara (2015); Andrea (2020)		69,9%	61,1%	50,7%
C.a.	Urban Land Take	km^2/Total Area	Andrea (2020); Shen (2011)		18,2%	26,8%	36,7%
D.a.	Residential Supply	m^2/Population	Murray et al. (2018)		48,12	42,85	38,18
D.b	Workplace Supply	km^2/Total Area	Alberti (1996)		2,68%	2,21%	3,61%
D.c.	Leisure Supply	km^2/Total Area	Alberti (1996)		2,09%	4,85%	2,00%
D.d.	Population Density	Population/km^2	Shen (2011)		88,21	94,29	115,14

(Alberti, 1996; Andrea et al., 2020; Murray et al., 2018; Pourebrahim et al., 2011; Samara et al., 2015; Shen et al., 2011)

The evaluation result for each indicator is used as the basis for determining the final alternative which have the highest value of sustainability. Pairwise comparison methods utilized to compare each indicator based on expert judgement resulting in respective weight for indicators. The weights resulted from the comparison shown in Table 3 are subjective in nature, therefore the resulting alternative are directly influenced by the product of expert judgement used for this paper. Previous evaluation score for each indicator is compared between the alternative and allocated comparative score in terms of importance difference in three factor, major, moderate, or minor difference. Based on this weight, indicator comparison score for each alternative are multiplied by respective value of the weight, resulting in normalized value of indicator score for each alternative. The sum of all indicator score are ranked to determine the highest value of sustainability in decision matrix (see Table 4), therefore the most preferred design alternative for K-IKN development is set to be alternative 3.

Table 3. Indicator Comparison using Pairwise Comparisons

								Indicator Comparisons		
	B.a	B.b	C.a.	D.a.	D.b.	D.c.	D.d.	**Description**	**Score**	**Percentage**
A.a	A.a 2	A.a 3	A.a 1	A.a 1	A.a 1	A.a 2	A.a. 1	A.a Land Suitability	11	25,00%
	B.a	B.a 1	B.a 2	D.a 2	D.b 1	B.a 2	D.d. 2	B.a Green Open Space	5	11,36%
		B.b	C.a 1	D.a 2	D.b 1	B.b. 1	D.d. 2	B.b Reforestation	1	2,27%
			C.a.	D.a 2	D.b 1	D.c 1	D.d 2	C.a Urban Land Take	1	2,27%
				D.a.	D.a 1	D.a 2	D.d 1	D.a Residential Supply	9	20,45%
					D.b.	D.b 2	D.d 1	D.b Workplace Supply	5	11,36%
						D.c.	D.d 3	D.c Leisure Supply	1	2,27%
							D.d.	D.d Population Density	11	25,00%
								Total	**44**	**100,00%**

Factor	
1	Minor
2	Moderate
3	Major

Table 4. Decision Matrix based on evaluation

Indicator	A.a	B.a	B.b	C.a.	D.a.	D.b.	D.c.	D.d.	Total	Rank
Weighted Score	25,00%	11,36%	2,27%	2,27%	20,45%	11,36%	2,27%	25,00%		
Alternative										
Alternative 1	0,00%	0,00%	75,00%	83,33%	75,00%	50,00%	33,33%	0,00%	25,38%	3
Alternative 2	60,00%	25,00%	25,00%	16,67%	25,00%	0,00%	66,67%	25,00%	31,67%	2
Alternative 3	40,00%	75,00%	0,00%	0,00%	0,00%	50,00%	0,00%	75,00%	42,95%	1

5.2 Benchmarking Comparison

Based on the benchmarking process, all three benchmark cities have allocated green open space as the largest usage of land. This is relevant with the development concept of IKN which prioritize sustainability aspect, which one of the components is environmental sustainability. In terms of residential allocation, all three cities also designate residential area as the next largest usage beside green open space. Industrial allocation, on the other hand, almost nonexistent on three benchmark cities. This provide information relating the characteristic of the city, what type of capital city, and what kind of function designated to be supported in those cities. Comparison of each city and the alternative generated provided in Figure 6.

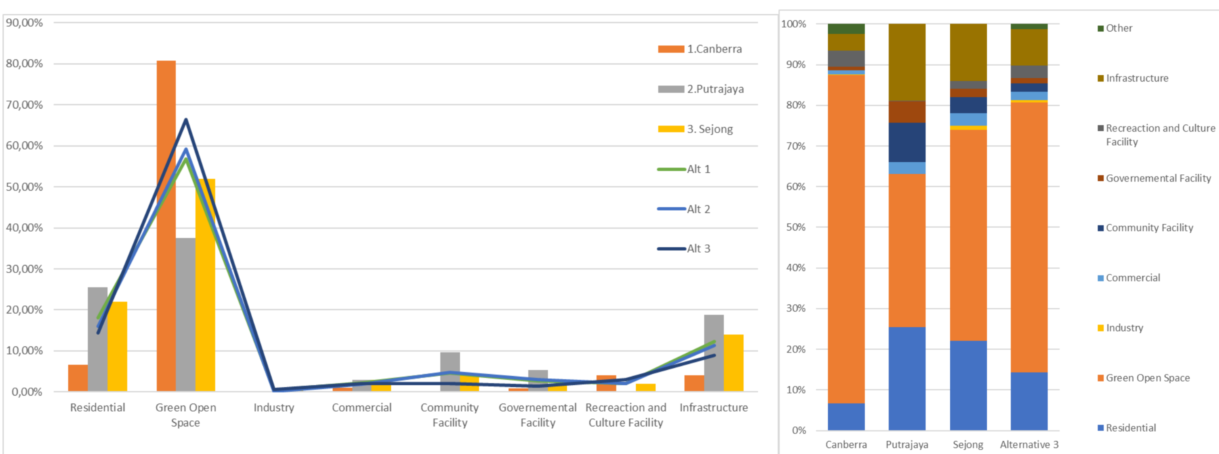

Figure 6. Comparisons of land use

5.3 Proposed Improvements

Based on the result, further improvement can be made, especially in terms of cost estimation and conceptual design. Currently there is ongoing research around the topic of conceptual design for the development of IKN. Cost estimation will be important as the basis of evaluation for the feasibility of the applied concepts according to the model. Estimation can be sourced from related or similar projects as benchmark to develop a mockup estimation which can be further developed into life cycle cost analysis to address the sustainability of the project financial aspects. The main challenges face today is the availability of reliable data to be molded into the conceptual design, especially in smart city technology aspects. With the current development of knowledge, the concept is still being explored and technology will keep moving forward. Latest technological improvement in the realm of smart city technology then can be explored and evaluated in the context of IKN conceptual design to determine how the concept of smart sustainable city can become a reality.

5.4 Validation

Expert judgement is integral to the method used for measuring the difference of varied indicators using paired comparison technique. The experts also give validation for the method and result of this paper. Experts contribution for this paper comes from relevant stakeholder that have relevant expertise with the topics of planning and IKN which is from the governmental agency for planning, specifically IKN secretariat team at National Planning Agency (Bappenas) and the head of Jakarta's Regional Planning Agency (Bappeda Jakata). Both experts have direct experience related with the planning of IKN or capital city in Indonesia that can provide insightful takes on the issues of smart sustainable city planning in this paper. Structured interview is used as the methods for expert validation. From the expert opinion there are a few notes that can be fixed in future research, regarding other planning context and information, such as transportation, financial, relocation scheme, and regulation. The main takeaway from the validation are the component used for this paper are sufficient, but can be improved by reducing the scope of planning, using more robust estimation technique, including more detailed information such as geographical information, and using performance indicator to design the application of certain concepts.

6. Conclusion

This paper has provided basic information regarding the conceptual design development processes based on the concept of the city and situation of the development site. Benchmarking methods used also provided relevant information on how other city function and how it can be applied in IKN by reviewing the suitability and other sustainability factor to the design alternative. The result shown the composition of land use plan for IKN conceptual design and open ways for future research to fill the gap for other planning related question. To conclude, this paper has completed a conceptual design for the development of IKN based on the concept smart sustainable city through GIS-based site analysis and sustainability evaluation.

References

Adisasmita, R., *Ekonomi Tata Ruang Wilayah*, 1st edition. Graha Ilmu. 2014.

Alberti, M. Measuring urban sustainability. In Environmental Impact Assessment Review, vol. 16, Issues 4–6, pp. 381–424, 1996.

Andrea, L., Gallego, A. C., & Lopez-chao, V. Indicators Framework for Sustainable Urban Design, pp. 1–18, 2020.

Axelsson, K., & Granath, M., Stakeholders' stake and relation to smartness in smart city development: Insights from a Swedish city planning project. *Government Information Quarterly*, vol 35, no. 4, pp. 693–702, 2018.

Bappenas., Dampak Ekonomi dan Skema Pembiayaan Pemindahan Ibu Kota Negara. *Report*, pp. 1–24, 2019.

Bocchini, P., Frangopol, D. M., Ummenhofer, T., & Zinke, T., Resilience and Sustainability of Civil Infrastructure: Toward a Unified Approach. *Journal of Infrastructure Systems*, 20(2), 04014004, 2014.

Dewberry., *Land Development Handbook (S. O. Dewberry (ed.)),* 3rd edition. McGraw-Hill Education, 2012.

Eastman, J. R., *Multi-criteria evaluation and GIS. In Geographical Information Systems: Principles, Techniques, Management and Applications*, 2nd Edition, pp. 493–502, 2005.

Hall, P., & Tewdwr-Jones, M., *Urban and regional planning. In Urban and Regional Planning*. Routledge, 2019.

Ismagilova, E., Hughes, L., Dwivedi, Y. K., & Raman, K. R., Smart cities: Advances in research—An information systems perspective. *International Journal of Information Management*, vol. 47, pp. 88–100, 2019.

Keeble, B. R., The Brundtland Report: "Our Common Future." *Medicine and War*, vol. 4, no. 1, pp. 17–25, 1988.

Kummitha, R. K. R., & Crutzen, N., How do we understand smart cities? An evolutionary perspective. *Cities*, vol. 67(May), 43–52, 2017.

Leem, Y., Han, H., & Lee, S. H., Sejong smart city: On the road to be a city of the future. *Lecture Notes in Geoinformation and Cartography*, pp. 17–33, 2019.

LaGro Jr., J. A., *Site Analysis*, 2nd edition. John Wiley & Sons, Inc. 2008.

PUPR., Rancangan Renstra PUPR 2020 - 2024. *Report*, 2020.

Sharifi, A., A critical review of selected smart city assessment tools and indicator sets. *Journal of Cleaner Production*, vol. 233, pp. 1269–1283, 2019.

Streitz, N., Citizen-centered design for human and sociable hybrid cities. *Proceedingsof the 3rd International Biannual Conference*, pp. 17–20, September 2015, 2015.

Suprayitno, H., Muluk, A., & Sunarharum, T. M., Preliminary Overview of Three Purpose-Built Capital Spatial Plans Related to Indonesian Capital Relocation Plan. vol. 2(September), pp. 161–185, 2020.

Yigitcanlar, T., & Kamruzzaman, M., Planning, development and management of sustainable cities: A commentary from the guest editors. *Sustainability (Switzerland),* vol. 7, no. 11, pp. 14677–14688. 2015.

Yigitcanlar, T., Kamruzzaman, M., Foth, M., Sabatini-Marques, J., da Costa, E., & Ioppolo, G., Can cities become smart without being sustainable? A systematic review of the literature. *Sustainable Cities and Society*, vol. 45(November 2018), pp. 348–365, 2019.

Murray, A., Skene, K., Haynes, K., Smol, M., Kulczycka, J., Avdiushchenko, A., Organisation for Economic Co-operation and Development, Blomsma, F., Brennan, G., PBL, N. E. A. A., Minson, A. J., Santagata, R., Zucaro, A., Viglia, S., Ripa, M., Tian, X., Ulgiati, S., MacArthur, E., Stahel, W. R., … European Commission. *Indicators for Sustainable Cities. In-depth Report 12*. Produced for European Commission DG Environment by the Science Communication Unit, UWE, Bristol. In European Commission DG Environment, 2018.

Pourebrahim, S., Hadipour, M., & Bin Mokhtar, M., Integration of spatial suitability analysis for land use planning in coastal areas; case of Kuala Langat District, Selangor, Malaysia. *Landscape and Urban Planning*, vol. 101(1), pp. 84–97, 2011.

Shen, L., Ochoa, J. J., Shah, M. N., & Zhang, X. The application of urban sustainability indicators e A comparison between various practices. *Habitat International*, vol. 35(1), pp. 17–29, 2011.

Samara, F., Tampekis, S., Sakellariou, S., & Christopoulou, O., Sustainable indicators for land use planning evaluation: The case of a small Greek island. *Fresenius Environmental Bulletin*, vol. 24(2A), pp. 652–655, 2015.

Biography

Rafly Muzady obtained his Bachelor's Degree in Civil Engineering with specialization in construction management from University of Indonesia in 2021. He joined Center for Sustainable Infrastructure Development research group in 2020 as a junior researcher. Currently, he is a master's student in Infrastructure Management from the department of civil engineering at University of Indonesia.

Prof. Mohammed Ali Berawi is a professor in the department of civil engineering, faculty of engineering, Universitas Indonesia and has extensive research experience in value engineering/value management and innovation in the context of infrastructure, construction, and manufacturing industries. Before joining the Faculty of Engineering at the University of Indonesia in 2008, Prof. Berawi was appointed senior lecturer at the Faculty of the Built Environment and Director of the Value Management Centre at the University of Malaya (2006-2008) and a lecturer in the School of Technology at Oxford Brookes University in the United Kingdom (2003-2006). He was a scholar in the Department of Civil Engineering and Environment, University of Washington, USA (2017), and and since 2019, Prof. Berawi has been appointed as Professor in the Graduate School of Industrial Economics, Peter the Great St. Petersburg Polytechnic University, Russia. Prof. Berawi's work on value engineering/value management, knowledge and quality management, engineering design, and innovation has led to various publications in books, international journals, conferences, and consultancy proceedings. He was selected as the most outstanding lecturer/researcher at the University of Indonesia (2009) and was a finalist for the UK Alumni Award (2008) and Toray Science and Technology Award (2014). His research leadership is reflected through his election as Editor-in-Chief of Value World, the journal of the Society of American Value Engineers (SAVE International) (2008-2014) and as Editor-inChiefforthe scopusindexed journal,International Journal of Technology (IJTech). Prof.Berawi has been involved in many national and international research collaborations and consultancies. He has been listed by Webometrics as one of the Top Scientists in Indonesia (2015-2017), Top 500 Indonesian Best Researchers by Ministry of Research and Technology of the Republic of Indonesia (2020), World's top 2% scientist by Standford University (2021) and his biography featured in the 24th edition of Who's Who in the World. Prof. Berawi served as Lead Advisor to the Republic of Indonesia's Ministry of Transportation (MOT) in 2012, Director of the Directorate of Research and Community Services (DRPM) at the Universitas Indonesia (2015), and Chairman of Standing Committee on Infrastructure Strategic Policies for Indonesia Chamber of Commerce (2017). He currently serves as Executive Director of the Center for Sustainable Infrastructure Development (CSID) Universitas Indonesia, and Director of ASEAN University Network for Sustainable City and Urban Development (AUN-SCUD).