

Smart Sustainable Coastal Areas

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Abstract. This article is intended to explore the role urban planners in a smart and sustainable manners in coastal areas, which was inspired by previous article on smart sustainable cities five years ago. An article's focus is on exploring and mapping international publications using bibliometric analysis is the focus of this paper. It was found that there are still few publications regarding smart sustainable city planning for coastal areas which are not yet popular. In a concern of coastal areas, engineering is no more popular than environmental planning, computer science and business, while the most popular discussions about coastal areas are dominated by the fields of geography, biology, and ecology. The essential part is that integrity is required from three basic aspects: resilience, governance, and spatial concerns. Next, with developability analysis and perceptual analysis in a balanced manner, the four components (planning process, technology choices, and encouraging a competitive economy) of smartness can be well managed. In response, the promotion of sustainable coastal areas can be implemented through synergy effects, substitution effects, generation effects, and enhancement effects can promote the sustainability of coastal areas.

Keywords: *urban, planning, smart sustainable cities, coastal areas.*

1 Introduction

This article is an attempt by an urban planner in contributing to learn coastal areas, since coastal areas are strategic areas for urbanization, not only because of population growth which requires new urban space, but also historically coastal areas are centers of human activity apart from land areas, in fact often the growth of urban areas in land areas begins with the growth of coastal areas especially related to marine resources and as hubs of logistical system. Whereas coastal areas are home to some of the richest and most fragile ecosystems, such as mangroves and coral reefs, and are under high population pressure due to rapid urbanization process. Eventually, sustainability concern is highly connected to the coastal areas since it deals with the renewable efforts of governing marine resources for the future, where one of the things that is being felt now is sea level rise which is part of the global climate change phenomenon, apart from the threat of reduced or lost biodiversity in coastal areas.

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It needs to be highlighted that innovation and the use of technology in managing coastal areas do not guarantee that coastal areas will be sustainable, therefore, the important meaning of sustainability needs to be reintegrated with the presence of various innovations and the use of technology in managing coastal areas. More specifically from an urban planning perspective, not only the thematic approaches that are popular today, namely smart cities for example, can be implemented directly for coastal areas.

1.1 Background

In general, as a reflection to the current condition and the Law on coastal areas and small islands (Law No. 27/2007), regarding the concern to the coastal areas, especially in Indonesia, at least there are five issues related to coastal areas and small islands, which cannot be separated from the issues of regional autonomy, spatial planning, and development equities.

- **Biophysical Degradation of the Coastal Environment.** This refers to a decline in the quality of the coastal environment, such as degradation of corals, fish stocks and pollution.
- **External Influences and Development.** This refers to the increasing development activities in small island areas can pose a threat to environmental degradation.
- **Management integration.** This refers to the management which in the public concern related to the governance system of coastal areas and small islands tends to be sectoral, so that policies sometimes overlap with each other.
- **Vulnerability of small islands.** This refers to the small islands are vulnerable to various external influences and development activities, and require spatial planning to optimize ecological, socio-economic functions.
- **Community empowerment.** This refers to the requires very important environmental and community-based strategies to maintain the sustainability of ecosystems and marine biological resources.

Although utilizing a smart city theme would seem to make managing the five items above easier, putting it into practice is not that simple. The majority of widely read articles on smart cities were published in the early 2010s, with a focus on examples from affluent nations like the US and Europe. For example, Caragliu, Del Bo, and Nijkamp's 2011 [1] discussions on smart cities in Europe, Giffinger and Pichler-Milanovic's 2007 [2] ranking of smart cities in Europe, Hollands' 2008 [3] exploration of the specifics of smart cities, Nam and Pardo's 2011 [4] concerns about the dimensions of smart cities, Deakin and Al Waer's 2011 [5] more concerned about the process of smart cities that relates to the transformation of the urban population, and Schaffers et al.'s 2008 [6] concern about the need to promote the role of technology, particularly the internet, on smart cities.

It can be seen from this publication that the impression of a smart city is that it is a new breakthrough in managing cities, but prioritizes technology, where the role of the private sector becomes prominent in its initiation and development. On the other hand, there are also writers who have started to analyze the realm or domain of smart cities, such as Angelidou who shows that the role of the private sector, especially in terms of technology and markets, is important in the development of smart cities, which along with this, requires consideration. Policy and societal variables are the two public concern aspects that need to be taken into account [9].

In contrast to popular publications about smart cities which are mostly written by academics, popular publications about coastal areas are mostly written by international

institutions, which shows that coastal areas play an important role in human life and the sustainability of human life in the future. In this case, there are popular publications that are often referred to in discussions about coastal areas from 2017-2020, such as Sustainable Tourism and Coastal Zone Management by UNESCO in 2017 [10], integrated coastal zone management by UNDP [11], Guidelines on Blue Carbon for Sustainable Development Coastal Communities' by UNEP in 2019 [12], the concern on climate change by IPCC in 2019 [13], resilience's of coastal areas by World Bank in 2019 [13], tools for coastal areas adaptation by UNFCCC in 2019 [14], ecological networks in coastal and marine areas by IUCN in 2019 [15], the concern in developing sustainable coastal management [16], the concern to the coastal communities [17], and integrated coastal zone management by EUCC in 2020 [18].

1.2 Objective

Based on a description of the condition of specific coastal areas which have strategic value from a spatial planning perspective, because they contain natural resources and biodiversity, as well as attention to development themes that emphasize sustainability by using innovation in solving coastal areas problems, this paper has the objective of showing the role urban planner in terms of providing a comprehensive overview regarding the study of smart sustainable coastal areas. Hence, this is important in terms of urban planners responding to the development of the smart city concept as a theme for innovative urban development in the modern era which gives the impression of prioritizing the role of technology in urban and regional development. This article tends to give the impression that a smart, technology-based approach will not necessarily automatically take sustainability into account, therefore, in this modern era, sustainability should still be given top priority when choosing technologies for urban development topics..

2 Literature Review

Since this paper is more concern on analyzing trends from international publications related to smart cities, sustainability, and coastal areas, this literature section provides a general overview of key words from related international publications. The source used is lens.org. For your information, lens.org, formerly known as Patent Lens, is an online patent and scholarly literature search facility provided by Cambia, a non-profit organization based in Australia. It serves as a free and open resource for finding, analyzing, and managing patent and scholarly data from around the world. The platform offers various discovery and analytics tools, as well as access to scholarly works and patent records through its APIs and bulk data downloads. Users can search for patents using different variables, and the platform also provides access to non-patent literature and regulatory data. The Lens is available in multiple languages and is designed to be user-friendly, with no individual account registration required for access.

The discussion of smart sustainable cities are apparently more dominated by business considerations than engineering. It can be interpreted that the term sustainability in smart sustainable cities is indicated a more discussion of a description of the term smart city. Furthermore, in discussing smart sustainable cities, it also appears that sustainability considerations are greater than geographical and political science considerations. Meanwhile, for smart sustainable coastal areas, the most dominant keyword is geography. It can be understood that the discussion about coastal areas is a specific area from a geographic perspective, where in the discussion, there are keywords that emphasize natural resources and biodiversity. shown by the importance of the terms biology and ecology after the keyword geography. There are two other important keywords that represent strategic coastal

areas as development hubs because they have natural resources and biodiversity, namely business keywords, as well as computer science which is a representation of smart words for structuring coastal areas development. The next word cloud is to connect the context of smart sustainable coastal areas to the Indonesian context in the form of a search expression for smart sustainable coastal areas in Indonesia.

Just like the discussion about smart sustainable coastal areas in general, the most important keyword is geography which shows the strategic role of coastal areas both on land and sea development context. Next, because there are natural resources and biodiversity, coastal areas provide opportunities for regional development from a regional development represented by business perspective. Apart of it, it can be understood that the arrangement of strategic coastal areas for the Indonesian context is that in the development planning system in Indonesia which implements the concept of regional autonomy, there is a governance role from the national, provincial, to district and city levels, this is what gives rise to the keyword political science. There are interesting things to discuss about coastal areas in terms of smartness and sustainability for the Indonesian context, because coastal areas are also identical with the liveability of coastal settlements. In the post-pandemic era, the keyword medicine becomes very important as a requirement to develop a healthiness as an integrated part of a liveable community. Another interesting thing is the representation of the arrangement of coastal areas which must always consider an environmental perspective with the keywords including the concern of biology which indicates the importance of maintaining biodiversity as well as environmental science and environmental resource management. The next keyword that is influenced by the smart city initiative in Indonesia, which has the nuance of innovation from a technological perspective, is the emergence of the role of computer science in managing coastal areas in Indonesia, although it must be explored in depth regarding the detail contribution including its requirement of the Indonesia's coastal areas diversity.

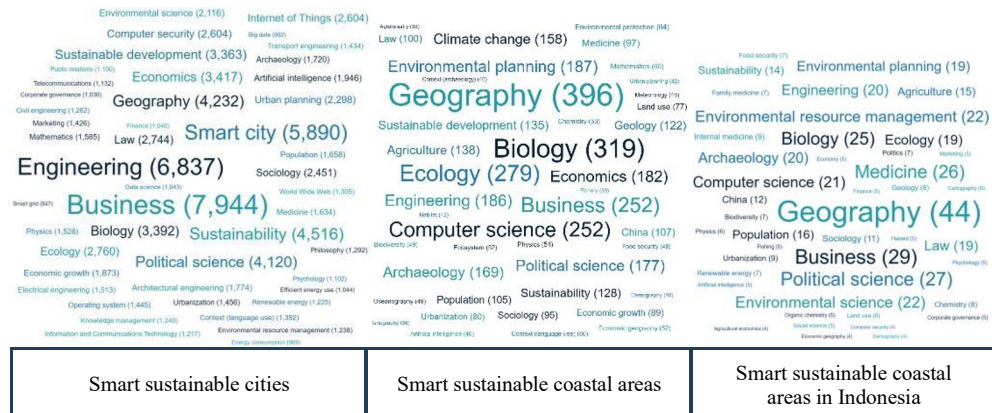


Figure 1. The Construction Keywords of Smart Sustainable Coastal Areas

There are eight layers in establishing the notion of smart cities in Indonesia, according to my earlier research from 2018 that defined smart cities with various depth [19]. This is based on the perspective of urban planners who prioritize common aims and public concerns. It also cannot be separated from the context of national development planning system. In other words, smart city is seen as a planning support system to accelerate the implementation of statutory planning stated in the national development planning system (Law No. 25/2005).

Another thing that makes the smart city concept can be used as a planning support system in the era of urban planning in the 21st century is encouraging resilience/independence based on resource potential and local characteristics with integrity since Indonesia accepts the concept of unity in diversity. In this case, integrity reflects self-image in a spatial organization and social system which can be seen from daily behavior and actions. Integrity shows consistency between words and beliefs which are reflected in daily actions. Integrity embedded in each community is the key to intelligence as a provision for development, especially in dealing with limited land (spatial concerns), self-reliance to increase economic growth and community maturity and create resilience at city and regional levels. Another important thing is that various innovations in the modern era which always strive to improve the competence of its citizens on an ongoing basis remain within the guidelines of the national development planning system (governance system).

Another note related to smart city keywords [19] based on discussions about smart cities, is the importance of considering the four main keywords that emerged from the beginning of the discussion about smart cities up to the mid-2010s, namely the population keyword which shows the basic requirements for urban development, followed by a planning process, the choice of the right technology for the study case according to the conditions of the residents, their competence and financing capabilities, and finally the choice of the smart city theme is used not only to solve various problems innovatively but also to encourage the creation of a competitive economy that is beneficial to society.

3 Methodology

This study uses bibliometric analysis which digs deeper into the bibliographic attributes of documents, such as authors, citations, collaborations, and keywords, by applying mathematical and statistical methods. The main goal of this analysis is to reveal the structure of scientific fields, understand social networks, and explore relevant themes as Fuco's and Mao's described [20] [21]. In bibliometric analysis, there are two important dimensions: the first is performance analysis, and the second is science mapping as Yu & Muñoz-Justicia, 2020 [22]. This approach opens a new window for understanding dynamics and patterns in science and research.

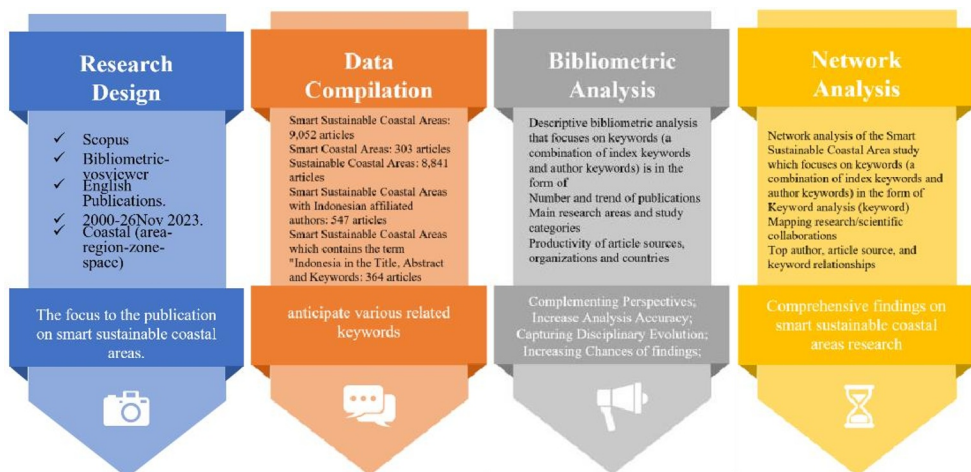


Figure 2. Methodology

The software used in this study was VOSviewer by van Eck & Waltman, 2010 [23] and Bibliometrix R-package as Aria & Cuccurullo, 2017 [24]. VOSviewer focuses on the visualization of scientific networks, enabling the creation of maps from publication data to

show relationships between authors, journals, and documents. In contrast, Bibliometrix as an R package, offers tools for comprehensive bibliometric and scientometric analysis, with particular strengths in quantitative analysis and flexibility in integration with other tools in the R ecosystem. The use of VOSviewer and Bibliometrix together allows researchers to gain a deeper understanding and comprehensive look at the structure and dynamics of scientific research, with VOSviewer providing power in visualization and network mapping, while Bibliometrix provides in-depth statistical analysis.

The data used in this paper were obtained from the Scopus database, which is one of the most popular databases for bibliometric analysis as described by Huang et al., 2020 [25] and Visser et al., 2021 [26]. Scopus was chosen here given its broad multidisciplinary coverage, which is ideal for cross-disciplinary phenomena such as smart sustainable coastal areas.

4 Overview of the Case Studies

This article is unique, because it focuses more on an in-depth analysis of the theme of smart sustainable cities based on international publications plus attributes for the Indonesian context, both in terms of keywords and author affiliation. This study explores the study landscape based on Smart Sustainable Coastal Areas (9,052 articles), Smart Coastal Areas (303 articles), as well as Sustainable Coastal Areas (8,820 articles).

These three things are done to be able to explore each study area further. Based on further analysis, there is a gap in the number of publications between publications that contain the word "smart" and publications that contain the word "sustainable". The analysis of "smart sustainable coastal areas" based on two things, these are: The study whose authors are affiliated with Indonesia, and the studies with the term "Indonesia" are in the Title, Abstract, and Keywords.

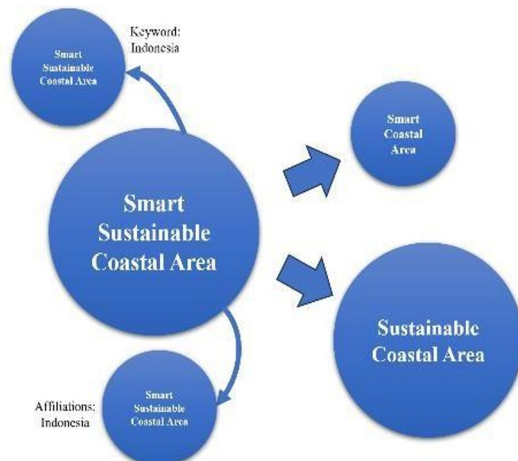


Figure 3. Overview of the Case Studies

In depth analysis of each sentence related to the discussion about smart sustainable coastal areas includes: description based on the 50 most keywords, grouping of discussions based on these keywords (co-occurrence network based on keywords), formulation of a thematic map showing knowledge hotspots (concentration of publications based on knowledge), collaboration among institutions, and ending with collaboration maps among institutions and countries.

4.1 Smart Sustainable Coastal Areas

The following is a description of the results of the analysis of publications about smart sustainable coastal areas in general:

- Description based on the 50 most keywords. This shows several important keywords, starting from coastal zone and sustainable development, followed by coastal zone management, sustainability, and ecosystem.
- Grouping of discussions based on these keywords (co-occurrence network based on keywords). There are two prominent concentrations of publications, namely those related to coastal zones and sustainable development. It is interesting that of these two

main focuses that stand out, the keyword planning is important but not many writers have discussed it.

- Formulation of a thematic map showing knowledge hotspots (concentration of publications based on knowledge). There are three main discussion themes, namely discussions with a lot of density, namely water quality, environmental monitoring, water management, seawater, and groundwater (representing niche themes). The second discussion theme with a lower density and closer to motorbike themes is the discussion about coastal zones, ecosystems, China, article, and environmental protection. The third theme that represents emerging or declining themes is a discussion of sustainable development, coastal zone management, sustainability, climate change, and decision making.
- Collaboration among institutions. It shows some prominent institutions, these are The Institute of Geographic Sciences and Natural Resource Research, University of California, and University of Washington are one of the institutions/universities with the largest number of collaborations related to research in the Smart Sustainable Coastal Areas area.

4.2 Smart Coastal Areas

The following is a description of the results of the analysis of publications about smart coastal areas in general:

- Description based on the 50 most keywords. This shows several important keywords, dominated by the keyword coastal zone, and followed by the keywords sustainable development, climate change, decision making, smart city, and risk assessment.
- Grouping of discussions based on these keywords (co-occurrence network based on keywords). There are two prominent concentrations of publications, but they tend to be dominated by the keyword coastal zone, followed by climate change. There are interesting things that emerge as keywords, namely the keyword human which is worthy of consideration when discussing coastal zones, as well as the keyword electric power transmission as a representation of the role of coastal areas in the modern era.
- Formulation of a thematic map showing knowledge hotspots (concentration of publications based on knowledge). There are many discussion themes (21 with varying intensities), but it appears that there are new discussions with relatively high intensity, including three themes, namely the theme of anticipating coastal area development in the form of erosion, flood control, residential development, and sustainable solutions, the second theme related to technological innovation such as the keywords machine learning, algorithm, NASA, ocean color, and aerosol, the third theme is related to the role of coastal areas with renewable energy innovation with the keywords power transmission network, smart grid, coastal region, wind power, and smart power grids. There are three themes that intersect with greater intensity compared to other themes, namely themes related to anticipating the development of coastal areas with a technological approach which is indicated by the keywords: disasters, articles, artificial intelligence, smartphones, and tsunamis. The second theme includes the keywords remote sensing, monitoring, internet of things, offshore oil well production, and data acquisition. The third theme includes the keywords coastal zone, sustainable development, climate change, smart city, and floods.
- Collaboration among institutions. Publications in this field are oriented towards publications from institutions in the United Kingdom which then relate to other European countries, such as Germany and Finland. The publication in the United Kingdom is close to publications in Bangladesh, and is also related to research in other countries outside Europe, such as Australia and the Philippines. The role of other institutions is institutions in the USA which are close to publications carried out in China.

4.3 Sustainable Coastal Areas

The following is a description of the results of the analysis of publications about sustainable coastal areas in general:

- Description based on the 50 most keywords. This shows several important keywords, dominated by the keyword coastal zone, and followed by the keywords sustainable development, coastal zone management, ecosystem, climate change, and sustainability. In small intensity three relevant keywords also appeared, namely decision making, environmental protection, and biodiversity.
- Grouping of discussions based on these keywords (co-occurrence network based on keywords). There are two main concentrations of publications that stand out, namely the coastal zone followed by sustainable development. The concentration with lower intensity includes discussions with the keywords coastal zone management, sustainability, ecosystem, and environmental protection.
- Formulation of a thematic map showing knowledge hotspots (concentration of publications based on knowledge). There are at least five discussion themes in the form of knowledge hotspots. New themes that approach niche themes are discussions related to water resources, especially: water quality, water management, seawater, groundwater, and groundwater resources. The themes with the highest intensity and tend to be close to motorbike themes are themes related to planning with the keywords: sustainable development, coastal zone management, sustainability, environmental protection, and decision making. There is an interesting theme with less intensity than the planning theme, but this theme is right in the middle of the relevance degree (centrality) and development degree (density), namely a discussion of the social and community side of coastal areas, with the keywords: article, human, coastal water, environmental monitoring, and seashore. Another theme with a relatively large degree of relevance is the theme of climate change with the keywords: coastal zone, ecosystem, climate change, China, and land use. Finally, there is a theme with a relatively small relevance degree and development degree, namely a discussion of coastal area cultivation with the keywords: coastal area, India, agriculture, coastal region, and rivers.
- Collaboration among institutions. Publications in this field are oriented concerning universities in several developed countries, especially the University of California, University of Washington, and University of Virginia in the United States, followed by the University of Southampton in England. There is also James Cook University from Australia, and Ocean University of China.

4.4 Smart Sustainable Coastal Areas a point of view of Indonesia

The following is a description of the results of the analysis of publications about smart sustainable coastal areas a point of view of Indonesia:

- Description based on the 50 most keywords. This shows several important keywords, dominated by the keyword sustainable development which has almost the same intensity as coastal zone. Other keywords that emerged and were interesting were: Indonesia, planning, fisheries, coastal areas, and ecosystem.
- Grouping of discussions based on these keywords (co-occurrence network based on keywords). there are several concentrations, but the main concentration is related to the keyword sustainable development, especially those discussing regional planning and conservation. The second center is Indonesian keywords which discuss a lot about coastal zone management and also local government keywords which have the potential to become a concentration of research discussion in the future. There are two other concentrations, namely related to the keywords coastal area and ecosystem.
- Formulation of a thematic map showing knowledge hotspots (concentration of publications based on knowledge). There are at least twelve discussion themes in the

form of knowledge hotspots. Some interesting themes are three themes that are starting to shift towards motorbike themes, the first is related to humans and the environment with the keywords: articles, animals, marine environment, humans, and water pollution. The second theme is related to sustainability with the keywords: Indonesia, ecosystem, coastal zone management, sustainability, and climate change. Meanwhile, the third theme with the highest density is the theme related to planning, with the keywords: sustainable development, coastal zone, planning, fisheries, and coastal area. There are other themes that approach emerging or declining themes, namely those related to the built environment with the keywords: houses, architecture, field observations, and spatial patterns.

- Collaboration among institutions. Publications in this field are oriented towards three poles, namely the poles of universities on the island of Java such as Brawijaya University, IPB University, and the University of Diponegoro. The second pole is universities outside Java which are dominated by Hasanuddin University, followed by other universities in Sulawesi such as the Islamic University of Makassar and Halu Oleo University. Meanwhile, the third pole is publications by foreign universities, such as: Utrecht University, University of Wollongong, and Pusat National University. However, there are several universities in Indonesia that follow the trend of foreign university publications, such as IPB University, Diponegoro University, Podomoro University, and the Indonesian Institute of Science.

4.5 Smart Sustainable Coastal Areas in the Context of Indonesia

The following is a description of the results of the analysis of publications about smart sustainable coastal areas in the context of Indonesia:

- Description based on the 50 most keywords. This shows several important keywords, dominated by three main keywords, namely Indonesia, sustainable development, and coastal zone. Other keywords with lower intensity include coastal zone management, sustainability, ecosystem, and planning.
- Grouping of discussions based on these keywords (co-occurrence network based on keywords). There are several concentrations, but the main concentration is related to the keyword sustainable development, especially those discussing regional planning and conservation. The second center is Indonesian keywords which discuss a lot about coastal zone management and also local government keywords which have the potential to become a concentration of research discussion in the future.
- Formulation of a thematic map showing knowledge hotspots (concentration of publications based on knowledge). There are at least twenty-six subject themes in the form of knowledge hotspots. The interesting thing that emerges is that there are four themes that overlap with each other with relatively large densities and are close to motorbike themes. The first is a theme related to Aceh with the keywords hazardous, spatial planning, and coastal protection. The second is the one that discusses sustainability with the keywords Indonesia, coastal zone, planning and management, sustainability, and mangrove. The third is the theme of sustainable development, with the keywords sustainable development, ecosystem, planning, coastal area, and climate change. Fourth is the theme about fisheries with the keywords fisheries, environmental protection, biodiversity, articles, and fish.
- Collaboration among institutions. Publications in this field are oriented regarding research conducted by universities in Japan, especially the University of Tokyo followed by Hokkaido, also followed by universities in Indonesia, especially Hasanuddin University. But some of them, Hasanuddin University, have close research ties with Cardiff University.

5 Discussions

There was a different impression when several years ago the author wrote an article about defining a smart city, where in public searches it was very closely related to key words related to technology, such as internet of things, big data, and artificial intelligence, even though the discussion about urban planning was still relatively small compared to these technology-based keywords. However, when discussing smart sustainable coastal areas in this paper, especially for the Indonesian context, the meaning of smartness is still not close to technology-based keywords, but rather from other points of view, such as natural resources, social aspects, urban planning or spatial planning, as well as governance systems (including local governance).

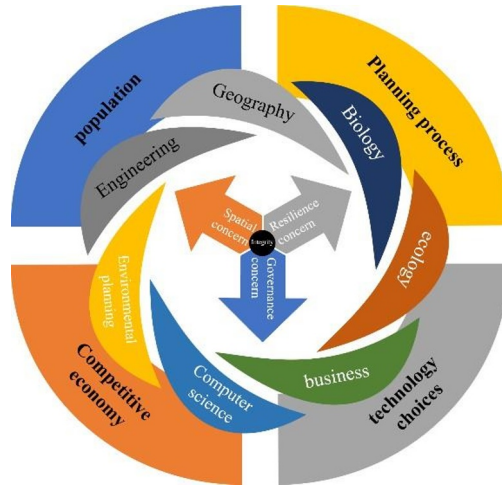


Figure 4. Construction Keywords in Smart Sustainable Coastal Areas

By considering previous research for the Indonesian context, the author concludes that the key words that can be taken to formulate smart sustainable coastal areas are: geography, engineering (as an innovative approach to solving coastal areas problems), environmental planning (a combination of environmental resource keywords management and environmental science), computer science (translating the expansion of the important role of urban planners in the digital era in understanding the philosophy of smart cities on the upstream side with smart cities on the downstream side which is very close to the development of computer science), business (translating the important role of urban planners in understanding private sector concern in the context of public sector concern in planning coastal areas), technology (translating the important role of urban planners in choosing the right technology for developing coastal areas), and finally two keywords that are closely related to ensuring the sustainability of coastal areas when the smartness approach is implemented, namely biology and ecology.

Just like the discussion about smart sustainable cities from a planning perspective that was previously published by the author [27], from an urban planning perspective, it is interesting to discuss the context of coastal areas based on three concerns, namely: business-spatial concerns, cultural-political concerns, and humane-innovation concerns. These three things are derived from the theory of land use change management from urban land use planning

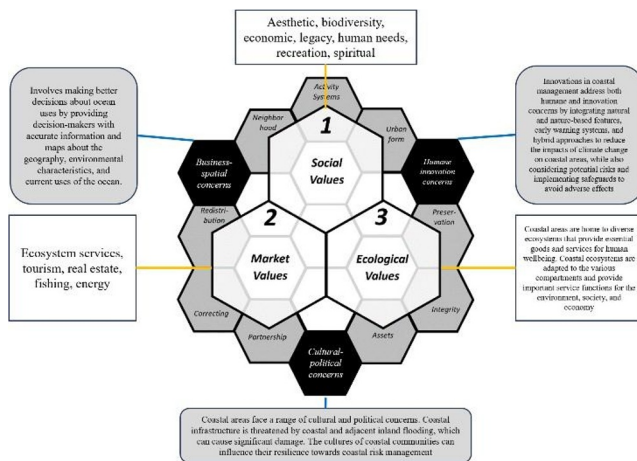


Figure 4. Enriching the Concept of Smart Sustainable Cities for the Context of Coastal Areas

1994 [28]. Based on this, important notes for coastal areas for these three concerns can be seen in figure 4.

Besides, still related to the discussion of smart sustainable cities from an urban planning perspective which was discussed previously [27], there are six notes as seen in figure 5.

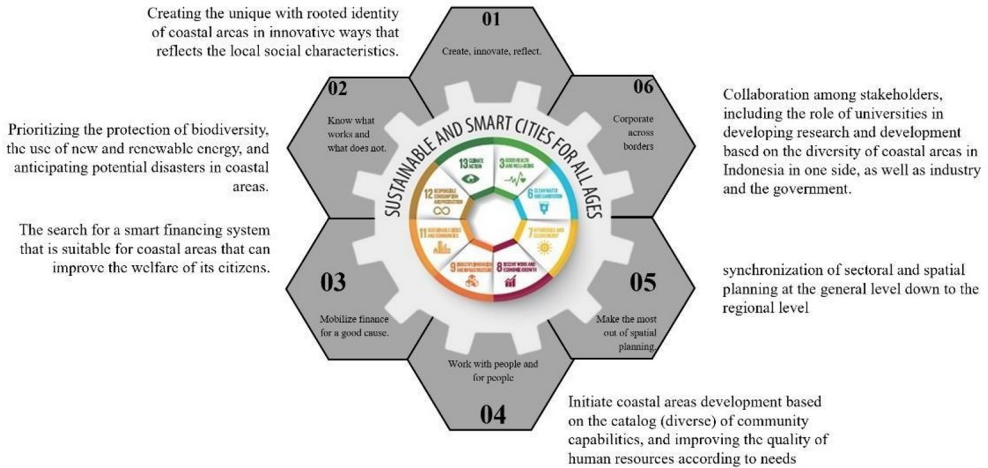


Figure 5. Notes on Coastal Areas on Sustainable and Smart Cities for All Ages

6 Conclusion and Recommendations

Sustainable coastal areas are crucial for achieving the Sustainable Development Goals (SDGs) and require a governance framework that minimizes trade-offs between SDG objectives. Coastal regions provide essential components for social and economic development, especially for less developed coastal and island states, and are subject to growing human and environmental pressures.

Theoretically, smart coastal areas typically involve the integration of various components such as citizen science, crowdsourcing, smart city concepts, and environmental monitoring. These components are tailored to address the specific challenges and opportunities characterizing coastal and waterfront communities.

The discussion on smart sustainable coastal areas is not as simple as defined based on previous general literature, but is still the main concern on sustainability, while the smart concept does not emphasize on technology but rather develops the innovation potential of coastal areas which is strongly influenced by local conditions. The smart sustainable coastal areas research theme will continue to develop and be influenced by certain institutions from certain countries that are productive in conducting research related to smart sustainable coastal areas. In this case, the implementation of coastal area policies coupled with discussion of small islands in Indonesia will be able to be better identified and analyzed to obtain policy options, plans, programs, especially in making the blue agenda a success in Indonesia. Since smart sustainable coastal areas is often linked to the sovereignty of a country, it is appropriate to include the keywords national security and resilience in defining smart sustainable cities stated by Sutriadi's previous research [19][27]. For this context, certain technologies may be developed as supports. In line with the blue agenda for Indonesia, figure 5 shows the proposal from the author in providing the concept of smart sustainable coastal areas for the Indonesian context which has considered the national blue agenda, representation of important components of smartness, and a national development planning system, starting from planning to controlling the spatial use.

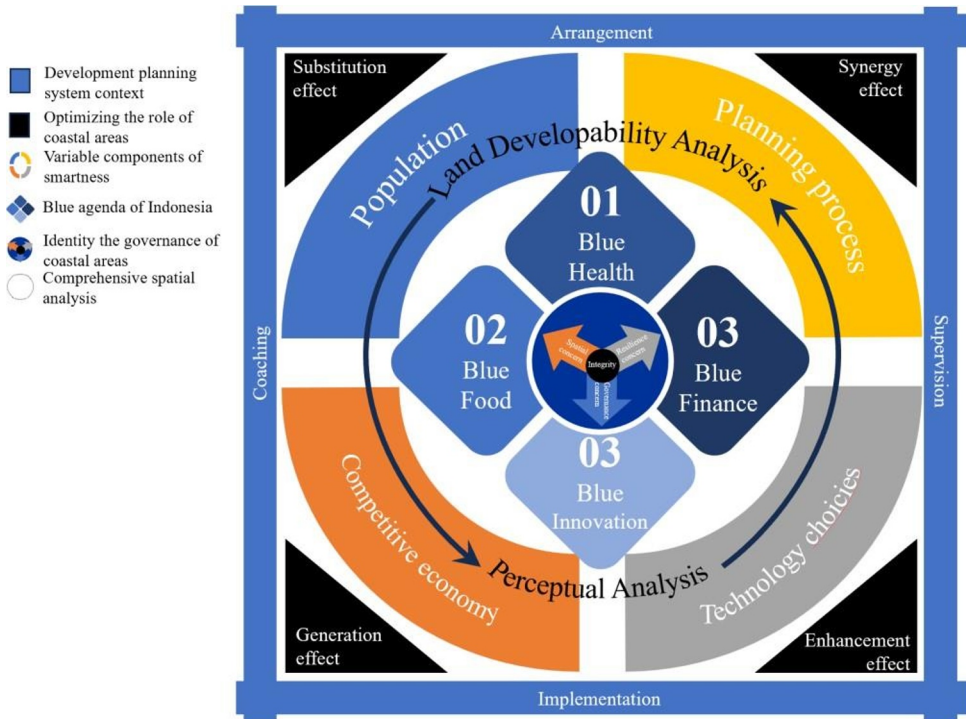


Figure 6. the Proposal in Adapting Smart Sustainable Cities for Coastal Areas in Indonesia

References

1. Caragliu, A., Del Bo, C., & Nijkamp, P. Smart cities in Europe. *Journal of Urban Technology* (2011), 18(2), 65-82.
2. Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanović, N., & Meijers, E. Smart cities: Ranking of European medium-sized cities. Vienna University of Technology, Centre of Regional Science, Vienna (2007).
3. Hollands, R. G. (2008). Will the real smart city please stand up? *City*, 12(3), 303-320.
4. Nam, T., & Pardo, T. A. (2011). Conceptualizing smart city with dimensions of technology, people, and institutions. *Proceedings of the 12th Annual International Digital Government Research Conference: Digital Government Innovation in Challenging Times*, 282-291.
5. Deakin, M., & Al Waer, H. (2011). From intelligent to smart cities. *Intelligent Buildings International*, 3(3), 140-152.
6. Schaffers, H., Komminos, N., Pallot, M., Trousse, B., Nilsson, M., & Oliveira, A. (2011). Smart cities and the future internet: Towards cooperation frameworks for open innovation. In *The Future Internet Assembly* (pp. 431-446). Springer.
7. Albino, V., Berardi, U., & Dangelico, R. M. (2015). Smart cities: Definitions, dimensions, performance, and initiatives. *Journal of Urban Technology*, 22(1), 3-21.
8. Anthopoulos, L. G. (2015). Understanding the smart city domain: A literature review. In *2015 International Conference on Smart Cities and Green ICT Systems* (pp. 1-12). IEEE.
9. Angelidou, M. (2015). Smart cities: A conjuncture of four forces. *Cities*, 47, 95-106.
10. United Nations Educational, Scientific and Cultural Organization (UNESCO). (2017). *Sustainable Tourism and Coastal Zone Management: A Toolkit for Decision-Makers*. Retrieved from <https://unesdoc.unesco.org/ark:/48223/pf0000247447>.
11. United Nations Development Programme (UNDP). (2018). *Integrated Coastal Zone Management: A Manual for Decision-Makers*. Retrieved from <https://www.undp.org/content/undp/en/home/librarypage/environment-energy/coastal-zone-management.html>
12. United Nations Environment Programme (UNEP). (2019). *Blue Carbon for Sustainable Coastal Communities: Guidelines for Policy and Practice*. Retrieved from <https://www.unenvironment.org/resources/report/blue-carbon-sustainable-coastal-communities-guidelines-policy-and-practice>
13. Intergovernmental Panel on Climate Change (IPCC). (2019). *Special Report on the Ocean and Cryosphere in a Changing Climate*. Retrieved from <https://www.ipcc.ch/srocc/>.
14. United Nations Framework Convention on Climate Change (UNFCCC). (2019). *Adaptation in Coastal Areas: A Compilation of Tools for Decision-Makers*. Retrieved from <https://unfccc.int/topics/adaptation-and-resilience/workstreams/loss-and-damage/adaptation-in-coastal-areas>
15. International Union for Conservation of Nature (IUCN). (2019). *Guidelines for Conserving Connectivity through Ecological Networks and Corridors in Coastal and Marine Areas*. Retrieved from <https://portals.iucn.org/library/sites/library/files/documents/2019-019.pdf>
16. *Coastal Zone Management Journal*. (2020). Special Issue: Sustainable Coastal Management. Retrieved from <https://www.tandfonline.com/toc/ucz20/current>
17. The Nature Conservancy. (2020). *Coastal Resilience: A Guidebook for Coastal Communities*. Retrieved from <https://www.nature.org/en-us/what-we-do/our-insights/perspectives/coastal-resilience-guidebook/>
18. Coastal & Marine Union (EUCC). (2020). *Coastal Management Guide: Integrated Coastal Zone Management*. Retrieved from https://www.eucc.net/cm/cm_guide/
19. Sutriadi, Ridwan. *Perencanaan Kota Abad 21: Inovasi dan Tujuan Pembangunan Berkelanjutan* (2018). ITB Press, Bandung.
20. Fusco, F., Marsilio, M., & Guglielmetti, C. (2020). Co-production in health policy and management: a comprehensive bibliometric review. In *BMC Health Services Research* (Vol. 20, Issue 1). Springer Science and Business Media LLC. <https://doi.org/10.1186/s12913-020-05241-2>
21. Mao, X., Guo, L., Fu, P., & Xiang, C. (2020). The status and trends of coronavirus research. In *Medicine* (Vol. 99, Issue 22, p. e20137). Ovid Technologies (Wolters Kluwer Health). <https://doi.org/10.1097/md.00000000000020137>

22. Yu, J., & Muñoz-Justicia, J. (2020). A Bibliometric Overview of Twitter-Related Studies Indexed in Web of Science. In *Future Internet* (Vol. 12, Issue 5, p. 91). MDPI AG. <https://doi.org/10.3390/fi12050091>.
23. van Eck, N. J., & Waltman, L. (2009). Software survey: VOSviewer, a computer program for bibliometric mapping. In *Scientometrics* (Vol. 84, Issue 2, pp. 523–538). Springer Science and Business Media LLC. <https://doi.org/10.1007/s11192-009-0146-3>
24. Aria, M., & Cuccurullo, C. (2017). bibliometrix : An R-tool for comprehensive science mapping analysis. In *Journal of Informetrics* (Vol. 11, Issue 4, pp. 959–975). Elsevier BV. <https://doi.org/10.1016/j.joi.2017.08.007>
25. Huang, C.-K. (Karl), Neylon, C., Brookes-Kenworthy, C., Hosking, R., Montgomery, L., Wilson, K., & Ozaygen, A. (2020). Comparison of bibliographic data sources: Implications for the robustness of university rankings. In *Quantitative Science Studies* (pp. 1–34). MIT Press - Journals. https://doi.org/10.1162/qss_a_00031
26. Visser, M., van Eck, N. J., & Waltman, L. (2021). Large-scale comparison of bibliographic data sources: Scopus, Web of Science, Dimensions, Crossref, and Microsoft Academic. In *Quantitative Science Studies* (Vol. 2, Issue 1, pp. 20–41). MIT Press - Journals. https://doi.org/10.1162/qss_a_00112
27. Sutriadi, Ridwan. Soft Infrastructure in Smart Sustainable Cities : A Literature Review. *The Journal of Indonesia Sustainable Development Planning*, 4(2), 195-215 (2023). <https://doi.org/10.46456/jisdep.v4i2.428>
28. Kaiser, E. J., Godschalk, D. R., & Chapin, F. S. (1995). *Urban land use planning* (4th ed.). University of Illinois press Urbana.
29. Janik, A., Ryszko, A., & Szafraniec, M. (2020). Scientific Landscape of Smart and Sustainable Cities Literature: A Bibliometric Analysis. In *Sustainability* (Vol. 12, Issue 3, p. 779). MDPI AG. <https://doi.org/10.3390/su12030779>