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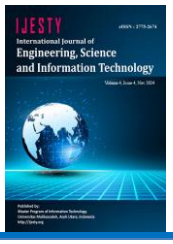

Identification of Smart Environment Readiness in Realizing Smart City Kotamobagu

Wa Nini*, Nuralfin Anripa, La Ode Alian, Muh Vikky Maulana

Universitas Dumoga Kotamobagu, Indonesia

**Corresponding author Email: ninispd@gmail.com*

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Abstract

This study aims to identify the readiness of the innovative environment in realizing an intelligent city. A descriptive qualitative approach combined data collection techniques such as in-depth interviews, observation, and documentation. Primary data were obtained directly in the field through observation and interviews with diverse respondents. Secondary data were obtained from the Kotamobagu Environmental Service and the Kotamobagu PUPR Service. Data analysis was conducted through four stages: data collection, data reduction, data display, and conclusion drawing. The study results revealed that five innovative environment indicators were adequately met: the feasibility of water channels, irrigation channels, green space planning, water and air quality, and waste management systems. One indicator, the use of environmentally friendly energy resources, was not met. The study recommends that the Kotamobagu government develop policies or programs to build renewable energy resources to support the intelligent environment and realize Kotamobagu's smart city vision.

Keywords: *Environment, Renewable Energy, Smart City, Sustainable, Urban Planning.*

1. Introduction

The fourth industrial revolution has significantly changed the architecture, infrastructure, and urban patterns that shape city public spaces. The transformation driven by information technology has led to the emergence of the brilliant city concept, which refers to a complex city system that integrates human, technological, and environmental elements [1] [2]. Moreover, smart cities have emerged as strategies to address the challenges of rapid urbanization and population growth [3]. This strategy is implemented by integrating three main aspects: Competitive (attracting investors and residents), Sustainable (social, financial, and environmental), and capital-rich (human and social) [4]. Strengthening these aspects, supported by government efforts based on community participation, will bolster the economy and improve the quality of life in society [5].

A smart city consists of six key dimensions that describe a city's ability to manage its potential and address arising issues, which include innovative economy, imaginative branding, intelligent society, smart living, innovative governance, and creative environment [6]. The intelligent economy concept, derived from the green economy, promotes economic development without causing environmental pollution [7] while focusing on innovation to increase productivity and reduce costs [4]. An intelligent economy positively impacts the welfare of society [8]. Kotamobagu City has committed to developing and planning a smart city by addressing three crucial factors: enhancing the city's economic competitiveness through trade services and investment flows, promoting sustainable urban development, and ensuring a conducive social environment and wise and environmentally friendly energy use [9].

Innovative branding emphasizes a city's image based on resource strengths to boost competitiveness. Innovative society relates to social interactions, learning ecosystems, and security levels. Smart living focuses on enabling the community to develop intelligent living practices through technology. All tasks are connected to technological devices, making them easier to complete, safer, and more cost-effective [10]. Innovative governance involves the participation of stakeholders that can enhance governance quality. This includes integrating information technology, society, policy, services, resources, and social norms to support clean and innovative local

government activities [11]. The success of intelligent governance relies on relationships between stakeholders at the regional level, with four primary issues: collaboration ability, local leadership support, alliance structure, and working under different jurisdictions [12].
The intelligent environment dimension includes enhancing Sustainability, with the city managed through environmentally friendly infrastructure and superstructures [3]. This dimension focuses on the adequacy of water channels, irrigation, green space planning, and environmentally friendly energy resources [9]. However, urban development often prioritizes economic, governance, and information technology aspects, with the environment receiving less attention. This oversight leads to problems such as floods, waste, sanitation, waste management, and access to clean water in many cities [13]. Therefore, the intelligent environment dimension is crucial to ensuring environmental Sustainability, including raising public awareness about waste control to prevent pollution [14]. Ecological education's importance for low-carbon cities was highlighted [15].
Based on the above discussion, the researcher is motivated to investigate the readiness of the intelligent environment to support the realization of a smart city in Kotamobagu. This study is critical as the environmental dimension is integral to human life globally and in urban spatial planning. Therefore, the research problem in this study is "How ready is the smart environment dimension to advance Kotamobagu's smart city?"

2. Literature Review

Innovative city initiatives have garnered significant attention due to their potential to improve urban governance, services, and Sustainability by integrating information and communication technologies (ICT). However, the literature suggests successful innovative city development requires more than technological implementation. A comprehensive approach is needed, incorporating governance, community participation, Sustainability, and social inclusion.
Effective governance structures are central to the success of innovative city initiatives. Empirical case studies are crucial in exploring the dynamics of innovative city development, particularly in understanding local contexts [16]. A systemic approach is advocated, emphasizing that addressing urban challenges requires technology and aligning governance and foresight strategies [17]. For Kotamobagu, developing a clear governance framework that involves all stakeholders, including local authorities, businesses, and citizens, will be essential for fostering collaboration and ensuring successful, intelligent city implementation.
Citizen participation is another critical aspect of smart city readiness. The importance of community involvement in shaping urban policies is highlighted, particularly in the context of climate change initiatives [18]. In the case of Kotamobagu, engaging citizens in the planning and execution of intelligent initiatives will enhance their relevance and public support. E-governance is further stressed to facilitate citizen engagement, particularly in developing countries. This approach aligns with leveraging digital platforms to promote transparent communication and inclusive decision-making [19].
Integrating technologies like the Internet of Things (IoT) is fundamental to the smart city paradigm. According to Pamudji (2023), IoT-driven environmental management systems can significantly enhance urban service delivery. Similarly, Caird and Hallett (2018) advocate for developing standardized metrics to evaluate the effectiveness of technology integration in smart cities. For Kotamobagu, adopting such technology while ensuring its compatibility with existing infrastructure will be critical in achieving smart city goals.
Sustainability is a crucial pillar of smart city development. The role of innovative city initiatives in improving urban resilience, particularly in response to crises such as the COVID-19 pandemic, is discussed. Focusing on Sustainability and resilience will be necessary for Kotamobagu, as aligning innovative city strategies with environmental and social goals will contribute to its residents' long-term success and quality of life [20].
Recent studies emphasize the importance of social inclusion in intelligent city planning. Inclusive practices ensure that all population segments benefit from intelligent initiatives. In Kotamobagu, this will involve targeting outreach efforts to ensure marginalized communities are not left behind, thus fostering social equity and cohesion [21].
By synthesizing these critical themes from the literature, it becomes clear that developing a smart city is a multifaceted endeavor beyond technological solutions. For Kotamobagu, the challenge will be to integrate these global insights into its local context, creating a smart city that is sustainable, inclusive, and responsive to its residents' needs. The following research will explore how these theoretical frameworks can inform Kotamobagu's readiness for innovative city initiatives and guide the development of tailored solutions for its urban challenges.

3. Methods

This study employed a descriptive qualitative research design, integrating various data collection techniques, including in-depth interviews, observations, and documentation. This approach gave a comprehensive understanding of the research context and enabled the gathering of rich, detailed data from multiple sources. The study involved 32 respondents from different regions within Kotamobagu, who were selected using purposive sampling. The participants were from four districts: 10 respondents from East Kotamobagu, eight from South Kotamobagu, six from West Kotamobagu, and eight from North Kotamobagu. These respondents were chosen based on their knowledge and involvement in local environmental and urban development issues, making them critical informants for the research.
Primary data were collected directly from the field through in-depth and semi-structured interviews with the 32 respondents to explore their perspectives on intelligent city readiness and other related topics. The interview guide focused on governance, infrastructure, Sustainability, and citizen participation. Data were collected through observation in critical locations in Kotamobagu to understand the current state of infrastructure and local governance practices, as well as documentation to collect relevant documents, including reports from local government agencies that were reviewed to gather secondary data. Secondary data were obtained from local authorities such as the Kotamobagu Environmental Service and Kotamobagu Public Works and Public Housing Service (PUPR).
The data analysis process was conducted in four key stages to ensure a thorough examination of the collected information. The first step is data collection, which is carried out by systematically gathering all primary and secondary data through in-depth interviews, observations, and document reviews. The data collected is then reduced by filtering irrelevant or excessive information. The focus was on identifying key themes and patterns aligned with the research objectives. The data reduction results are then organized and presented in a structured format. This step facilitated a more straightforward interpretation and allowed the researcher to represent the key findings visually. The researcher then drew conclusions, synthesized the data, and identified significant insights. This stage involved interpreting

the patterns and making connections between the findings, leading to conclusions about the intelligent city readiness in Kotamobagu. Through these four stages, the analysis provided a clear understanding of the research context and guided the study's overall findings.

4. Results and Discussion

4.1. Water Channels

Water channels are considered an environmental indicator because they serve as a solution for disposing of household or industrial waste. The condition of the water channels in Kotamobagu is shown in Table 1.

Table 1. Condition of Water Channels in Kotamobagu

No	Length of Water/Drainage Channel (Km)	Condition of Water/Drainage Channel Length in 2023 (Km)			
		Good		Not Good	
1	531,69	478,93	90,07%	52,76	9,93%

(Source: Dinas PUPR Kotamobagu 2024)

The drainage system in Kotamobagu is in good condition, as all residential areas are connected to the main drainage lines. The total length of the drainage system is 531.69 km, with 90.07% of it in good condition. The well-maintained drainage system ensures water flows smoothly to the main disposal points. Interview results revealed several issues related to the drainage system in Kotamobagu. The increasing population in Kotamobagu has led to a rise in waste and liquid waste. Improper waste management has caused silting and narrowing of drainage channels and rivers. This has resulted in drainage channels being unable to handle the water flow, causing water stagnation or flooding. There is a lack of coordination and synchronization with other infrastructure.

An example is the frequent discovery of electrical poles obstructing drainage channels and the placement of PDAM water pipes cutting through drainage systems or excavating drainage channels that damage existing infrastructure due to insufficient information. The low level of public awareness is a significant barrier. The community remains unaware of urban issues, such as household waste management. In addition to these problems, several obstacles were identified, such as the lack of funding allocated for the Kotamobagu Drainage Master Plan/Database, which is essential for more comprehensive future drainage planning. Additionally, there is insufficient budget allocation for drainage infrastructure development.

4.2. Irigation Channel

The current irrigation development has met the needs of the farming community, especially rice paddy farmers. Based on the researcher's observations, the irrigation channels have met the farmers' expectations because the irrigation of paddy fields and fishpond farmers is in line with the community's expectations. All the farmer informants stated there were no issues with the irrigation system as it reaches all the farming communities. According to interviews with the farming community and the Public Works and Spatial Planning Agency (Dinas PUPR), several irrigation issues were identified, such as weaknesses in the management of irrigation starting from the irrigation commission to the P3A; there is no irrigation cropping plan in Kotamobagu, there is a shift in the profession with fewer people becoming farmers. Many are opting for other careers, and there is a rise in the conversion of rice field land to residential yards.

The Public Works and Housing Office (Dinas PUPR) also mentioned several obstacles to irrigation infrastructure development, such as budget constraints, which affect the ability to plan, build, and maintain irrigation systems. Additionally, land conversion presents challenges, especially when land previously used for irrigation channels is repurposed for residential areas, housing, industry, or commercial development. Finally, urban development plans must consider irrigation systems to align with the broader vision and urban planning goals.

4.3. Green Spatial Planning

Green space planning is an environmental support system that makes Kotamobagu an intelligent city, and it is related to the presence of trees as a source of oxygen for humans. The green space planning in Kotamobagu is demonstrated through developing parks in various locations, as identified in Table 2.

Table 2. Kotamobagu Green Spaces

Park Classification	Total	District	Area (Ha)
Village Park	9	North Kotamobagu	2.66
	6	East Kotamobagu	5.03
Village Park	6	West Kotamobagu	4.4
Village Park	10	South Kotamobagu	7.73
City Park	4	East Kotamobagu	1.6
	2	South Kotamobagu	2.94
	1	West Kotamobagu	0.27
Total	38		24.36

(Source: Kotamobagu PUPR Office 2024)

Kotamobagu has 38 parks, which are classified into 31 subdistricts and seven city parks. Although classified as subdistrict parks, these parks are still located within the city center, providing a green atmosphere and humidity within the urban area.

4.4. Water and Air Quality Index

Water and air quality are indicators of the supporting capacity of an intelligent environment. The better the water and air quality, the better the quality of life for the city's residents. Water and air quality are correlated with how humans live in a town. Essentially, God created water and air in a sterile state that supports human life. However, human activities that neglect environmental Sustainability have led to a decline in water and air quality. Table 3 presents the water and air quality for 2022 and 2023.

Table 3. Water and Air Quality

Year	Water Quality Index	Air Quality Index
2022	44.67	91.25
2023	48.89	90.88

(Source: Kotamobagu Environment Agency Measurements 2023 and 2024)

4.5. Waste Management System

Kotamobagu's waste volume is relatively high at 20,908 tons/year or 1,742.33 tons/month. The composition of waste is diverse and still dominated by food waste. Waste from food waste is quite large at 53.5%, then paper/cardboard 11.8% and plastic 8.5%. The three composites can be processed with a reduced system. However, Kotamobagu has not yet implemented an innovative waste management system. The waste management system in Kotamobagu is as follows.

Table 4. Waste Volume

Year	Volume of Waste Entering the Landfill (Tons)
2022	20.908
2023	22.995

(Source: Kotamobagu Environmental Agency 2024)

The waste management system in Kotamobagu has implemented 3R (Reduce, Reuse, Recycle). However, based on an interview with the waste sub-sector of the Kotamobagu Environmental Agency, it was explained that the three R's system has not run optimally because the community involved in waste management activities is not sustainable. In addition, the environmental service is also still limited in the transportation fleet. This causes waste separated between wet and dry waste to be reunited when transported to the final disposal site (TPA).

4.6. Use of Environmentally Friendly Energy Resources

Environmentally friendly energy resources are the carrying capacity to support an intelligent environment. At present, efforts to transfer renewable and environmentally friendly energy resources are a priority agenda for sustainable development. Such as the transfer from vehicles with polluting fuels to electric cars. The use of plastic and paper packaging for digitalization. However, the indicators of renewable energy resources in Kotamobagu have not been identified, so the government needs to pay attention to this.

Smart City aims to provide sustainable urban development globally [12]. The environment is critical in realizing an intelligent city, particularly in Kotamobagu's efforts. Five innovative environment indicators have been well met: the feasibility of drainage systems, irrigation systems, green space planning, water and air quality, and waste management systems. One indicator that has not been met is using environmentally friendly energy resources. However, this indicator will naturally develop as Kotamobagu advances technology and intelligence in the economic and socio-cultural sectors. The drainage systems in Kotamobagu are in good condition, with 90.07% rated as good. Irrigation development has met the needs of the farming community, especially rice farmers. Thirty-eight urban parks well support green space planning. The air and water quality index is good, and the waste management system is well-established. Sustainable development is a conscious and planned effort to use and manage resources wisely for continuous development to improve quality of life. This aligns with a study that notes that the smart city, as a meeting point between economic and environmental frameworks, forms the concept of a Green Economy [22].

Environmentally friendly energy resources are essential to supporting an intelligent environment. The transition to renewable and environmentally friendly energy resources has become a priority for sustainable development. This includes shifting from pollution-based vehicles to electric vehicles and transitioning from plastic and paper packaging to digitalization. However, the indicator for renewable energy resources has not yet been identified in Kotamobagu, and therefore, the government needs to address this. Innovative environments encompass sustainability improvements, with cities managed with environmentally friendly support in superstructure and infrastructure [3]. The need for ecologically aware development is recommended [15].

Applying innovative city concepts to modern urban planning focuses on developing digital infrastructure and technology. It can also be crucial in food security and climate change adaptation. In Indonesia, climate change has significantly impacted the agricultural sector, including spice production such as nutmeg, which may decrease yield due to changing rainfall patterns and extreme temperatures [23]. Smart cities can address this threat by integrating technology to monitor weather conditions water management, and strengthen food distribution networks, thus minimizing crop failures caused by extreme weather.

Furthermore, climate change has impacted the Sustainability of food crops across Indonesia in general. Adequate technological adaptation is crucial to protecting national food security [24]. In the context of smart cities, implementing technologies like IoT sensors to monitor land and weather conditions in real time can help farmers adapt to climate change. With accurate data and predictive analysis, the government and farmers can take early preventive actions to reduce the impacts of climate change on food crop productivity and strengthen food security.

Smart cities can also play a role in preserving spices like nutmeg, which hold significant cultural and economic value in Indonesia. Climate change has been shown to threaten the Sustainability of nutmeg in Indonesia, while its medicinal benefits remain essential to local communities and the healthcare industry [25]. A smart city with a technology-based environmental monitoring system can serve as

a preservation tool for this crop, tracking favorable climate conditions and providing adaptive farming recommendations. Thus, integrating technology into intelligent cities can be a vital tool in combating climate change while strengthening local food security and preserving Indonesia's natural heritage.

The success of innovative city development, particularly in supporting the intelligent environment, depends on innovation and research as a strategy for effective governance and policy management. This can encourage the utilization of environmentally friendly energy [26]. Government organizations must be strengthened to advocate for developing environmentally friendly energy resources. Two crucial elements to enhance innovative city programs include supporting an intelligent environment: knowledge plays a vital role in developing the Smart City Model and the strategy for program development. These elements will act as an instrumental bridge, holding significant power for implementing the intelligent environment [27].

Furthermore, clarity regarding smart cities within regulatory frameworks is essential [28]. This is proven by research that shows strengthening organizational capacity and collaboration can bring about a smart city [29]. This is further reinforced by research that emphasizes strengthening government organization and governance [30]. The strategy to realize innovative urban governance in Indonesia requires an effort that the central government first supports to create policies on smart cities, including innovative urban governance, which policies for smart cities in cities across Indonesia should then follow. Secondly, strategies to implement intelligent urban governance in Indonesia must include developing technologies that support smart city implementation so that all urban services are online, using an integrated internet portal that covers all urban services [31].

5. Conclusion

Five of the six indicators of the smart environment that were analyzed have been well met: the feasibility of drainage systems, irrigation systems, green space planning, water and air quality, and waste management systems. One indicator that has not been fulfilled is using environmentally friendly energy resources. However, this indicator will naturally be developed once Kotamobagu advances technology and intelligence in the economic and socio-cultural sectors. The drainage systems in Kotamobagu are in good condition; irrigation development has met the needs of the farming community, especially rice farmers. The green space planning is good, supported by 38 urban parks. The air and water quality index is good, and the waste management system is well implemented. Therefore, the innovative environment aspect is ready to support realizing an intelligent city in Kotamobagu. This study recommends that the Kotamobagu government establish policies or programs to develop renewable energy resources as part of the innovative environmental support for the intelligent city of Kotamobagu.

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References

[1] W. O. S. J. Aswad, "Analisis Gap & Pencapaian Indikator Smart City Readiness Dalam Program Pembangunan Daerah Kabupaten Wakatobi," *Jurnal Kajian Ruang*, vol. 2, no. 2, pp. 170-192, 2022.

[2] V. Sriwulantari, E. Fatria, N. Arini, H. Alpandari, R. R. Sarapung, T. Prakoso, M. Fadli, R. P. J. Gultom, R. Alamsyah, N. D. Arianti, K. Anwar, N. Anripa, E. Sari and L. Judianto, Pemahaman Dasar tentang Lingkungan: Mengenal Sistem Ekosistem, Yayasan Literasi Sains Indonesia, 2024.

[3] H. Chourabi, T. Nam, S. Walker, J. R. Gil-Garcia, S. Mellouli, K. Nahon, T. A. Pardo and H. J. Scholl, "Understanding Smart Cities: An Integrative Framework," in *45th Hawaii International Conference on System Sciences*, Maui, 2012.

[4] N. A. C. S. B. Aishwarya, "Smart City- Far and Near Dream in Indian Context," *International Journal of Computer Applications*, vol. 174, no. 12, 2021.

[5] C. E. W. Utomo and M. Hariadi, "rategi Pembangunan Smart City dan Tantangannya bagi Masyarakat Kota," *Jurnal Strategi dan Bisnis*, vol. 4, no. 2, pp. 159-176, 2016.

[6] D. J. A. Informatika, "Guideline Masterplan Smart City Gerakan Menuju Kota Cerdas (Smart City)," Kementerian Komunikasi dan Informatika, 2021.

[7] A. R. Davies and Mullin, "Greening the economy: interrogating," *Journal of Economic Geography*, vol. 11, no. 5, p. 793–816, 2011.

[8] E. Maria, P. Marina and G. Pavel, "Global trends of «Green»economy development as a factor for improvement of economical and social prosperity," in *International Conference on Research Paradigms Transformation in Social Sciences 2014*, 2015.

[9] D. A. Bonde, E. P. Purnomo and L. Salsabila, "Analisis Kesiapan Kota Kotamobagu Dalam Mewujudkan Kotamobagu Sebagai Smart City Studi: Pemerintah Daerah Kotamobagu," *Moderat: Jurnal Ilmiah Ilmu Pemerintahan*, vol. 6, no. 1, 2020.

[10] P. D. K. Kotamobagu, "Rencana Pembangunan Jangka Menengah Daerah," tah Kabupaten Pemerintah Daerah Kota Kotamobagu, Kotamobagu, 2018.

[11] K. Paskaleva and I. Cooper, "Co-production and governance for smart city services: Learning from practice," *International Journal of Services Technology and Management*, vol. 23, no. 5/6, 2017.

[12] L. Vidiasova, P. Kachurina and F. Cronemberger, "Smart Cities Prospects from the Results of the World Practice Expert Benchmarking," *Procedia Computer Science*, vol. 119, pp. 269-277, 2017.

[13] R. Sya'rani, C. Halim, N. Anripa, A. Mahardhani and S. Hudijono, "Innovation and Challenges in Technology Environment," *Journal of Technology Global*, vol. 1, no. 2, pp. 188-195, 2024.

[14] A. F. Sa'diyah, E. P. Purnomo and A. N. Kasiwi, "Pengelolaan Sampah dalam Implementasi Smart City di Kota Bogor," *Jurnal*

Ilmu Pemerintahan Widya Praja, vol. 46, no. 1, pp. 271-279, 2020.

[15] M. N. Hudha, I. Hamidah, A. Permanasari, A. G. Abdullah, I. Rachman and T. Matsumoto, "Low Carbon Education: A Review and Bibliometric Analysis," *European Journal of Educational Research*, vol. 9, no. 1, pp. 319-329, 2020.

[16] R. Kitchin, C. Coletta, L. Evans and l. Heaphy, "Creating smart cities," in *Creating smart cities*, Routledge, 2018, pp. 1-18.

[17] J. M. F. Güell, "Urban Governance Revisited after 20 Years of Practice and Malpractice," *The Planning Review*, vol. 53, no. 2, pp. 58-59, 2017.

[18] M. Chitsa, S. Sivapalan, B. S. M. Singh and K. E. Lee, "Citizen Participation and Climate Change within an Urban Community Context: Insights for Policy Development for Bottom-Up Climate Action Engagement," *Sustainability*, vol. 14, no. 6, 2022.

[19] S. B. Lim and T. Yigitcanlar, "Participatory Governance of Smart Cities: Insights from e-Participation of Putrajaya and Petaling Jaya, Malaysia," *Smart Cities*, vol. 5, no. 1, pp. 71-89, 2022.

[20] R. D. Kusumastuti, Nurmala, J. Rouli, L. Trialdi and R. Safitri, "Improving Urban Resilience during COVID-19 Pandemic by Implementing Smart City Initiatives: A Case of Tangerang City, Indonesia," in *IOP Conference Series: Earth and Environmental Science*, Depok, 2022.

[21] J. A. Malek, S. B. Lim and T. Yigitcanlar, "Social Inclusion Indicators for Building Citizen-Centric Smart Cities: A Systematic Literature Review," *Sustainability*, vol. 13, no. 1, p. 376, 2021.

[22] B. Sergiy, L. Inna, B. Alla, L. Alexander and M. Khusainova, "Creating Urban Transportation Networks Grounded In the Principles of the Smart Port-City Paradigm," *Procedia Computer Science*, vol. 231, pp. 323-328, 2024.

[23] N. Anripa, A. Kumar, P. Maharana and A. P. Dimri, "Climate change over Indonesia and its impact on nutmeg production: An analysis under high-resolution CORDEX-CORE regional simulation framework," *International Journal of Climatology*, vol. 43, no. 10, pp. 4472-4490, 2023.

[24] G. Rusmayadi, D. R. Mulyanti and A. Z. A. Alaydrus, "Revolutionizing Agrotechnology: Meeting Global Food Demand through Sustainable and Precision Farming Innovations," *West Science Interdisciplinary Studies*, vol. 1, no. 8, 2023.

[25] N. Anripa and V. F. Lone, "Preserving Nutmeg: Historical Significance, Medicinal Benefits, and Climate Change Threats to Indonesian Nutmeg," *International Journal of Islamic and Complementary Medicine*, vol. 5, no. 2, 2024.

[26] Z. R. M. A. Kaiser, "Smart governance for smart cities and nations," *Journal of Economy and Technology*, vol. 2, pp. 216-234, 2024.

[27] F. R. Tulungen and J. R. Batmetan, "Understanding Smart Environment Strategy in Developing Countries Cities," *International Journal of Information Technology and Education (IJITE)*, vol. 1, no. 4, pp. 53-62, 2022.

[28] L. Sudirman, H. S. Disemadi and K. J. P. Manurung, "Elaborate the Superiority of Smart City in South Korea: A Study Comparison of Laws," *Justisi*, vol. 10, no. 2, 2024.

[29] F. A. Bachrian and I. B. Suryawan, "Implementasi Bandung Smart City Untuk Mewujudkan Smart Tourism Destinatio," *Jurnal Destinasi Pariwisata*, vol. 9, no. 2, pp. 458-476, 2021.

[30] S. Alawadhi, A. Aldama-Nalda, H. Chourabi, J. R. Gil-Garcia, S. Leung, S. Mellouli, T. Nam, T. A. Pardo, H. J. Scholl and S. Walker, "Building Understanding of Smart City Initiatives," in *Electronic Government*, 2012.

[31] T. Sulistyaningsih, R. A. Purnama and U. Kulsum, "Smart City Policy: Strategy and Implementation to Realize Smart Urban Governance in Indonesia," *Journal of Governance and Public Policy*, vol. 10, no. 2, 2023.