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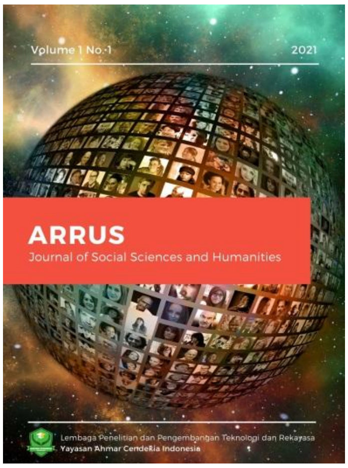

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RESEARCH ARTICLE

Digital Green Finance for Sustainable Urban Development

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Abstract: The fast-paced urbanization process and the increased demand for sustainable infrastructure development due to climate changes and the degradation of the environment have raised interest in the emergence of sustainable financial technologies for urban areas. There is a lot of scientific literature available on the subject of green finance and smart cities; however, very little research has been done on the intersection of all these aspects combined – digital financial technologies, ESG investments, environment sustainability indicators, and artificial intelligence – to create a sustainable urban development evaluation framework. This study focuses on the creation of an Intelligent Decision Support System based on Digital Green Finance and its influence on Sustainable Urban Development using quantitative methodology. Mainly, this means using indicators such as green investments' portion in the total sum of investments in a city, ESG financing index, volume of transactions, amount of carbon financing, fintech for sustainable urban development, Green Open Spaces accessibility, urban vegetation index, CO2 emission reduction, urban livability index, and economic resilience. Combining all these factors with SAW-based algorithm and Artificial Intelligence prediction using the Random Forest method enables researchers to assess sustainability rankings and the level of smartness of cities using the developed system. As a result, it is possible to conclude that cities with higher green investment allocation and better ESG financing and digital green transaction volumes are more sustainable. Specifically, Gamma City received the highest ranking, followed by Omega and Alpha Cities.

Keywords: Digital Green Finance, Sustainable Urban Development, Smart City, ESG Investment, Artificial Intelligence, Decision Support System.

1. Introduction

Urban spaces have become essential in the pursuit of sustainable development because urbanization brings together population, economy, infrastructure demands, energy use, and environmental impact. As urbanization increases, more demands are placed on cities for housing, transport, telecommunications, and utilities, but there is also increased urbanization-related land-use change, carbon footprint, urban heat islands, air pollution, species extinction, water stress, and unequal access to green space. In recent years, there has been a realization within smart city research that sustainability cannot be achieved through technological advancement alone, but instead depends on sustainable urban governance that combines environmental sustainability, social sustainability, finance, and evaluation(Bashir et al., 2025).

Climate change makes it more necessary than ever before to undertake sustainable urban redevelopment projects. Climate change has increased the vulnerability of cities to such dangers as the aggravation of heat stresses, flood risk, energy consumption, and public health issues in relation to urban density. The degradation of the urban environment in turn leads

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to the degradation of ecological infrastructure systems that include such things as green spaces, urban vegetation, drainage infrastructure, wetlands, and biologically diverse areas. Sustainable urban development involves not only improving physical infrastructure but also setting up systems for financing a range of other initiatives as well(Leal Filho et al., 2026; Maleki et al., 2026).

The concept of green finance plays a central role within the current setting because of its capacity to redirect capital into eco-friendly investments. Instruments like green bonds, environmentally sustainable investments, carbon finance, sustainability-linked loans, and climate funds play a key part in reducing carbon emissions and improving the ecological condition within cities. According to recent studies on the subject, green finance, when coupled with digital economic development, has the potential to reduce carbon intensity by boosting energy efficiency, promoting eco-innovation, and facilitating better capital allocation(Jin et al., 2025). Additionally, digital finance has proved to promote eco-innovation by relaxing capital constraints(X. Li et al., 2022).

With the development of financial technology, the scope of green finance has expanded to encompass digital green finance. Digital green finance is an innovative combination of financial technology, environmental information, ESG analysis, blockchain technology, digital payment, carbon accounting, and AI risk assessment to improve sustainability investments' effectiveness and transparency. In sustainable urban development, digital green finance facilitates sustainable investments through the association of finance flows and environment metrics, including reduced carbon footprint, vegetated areas, air quality, energy consumption, and availability of green spaces. A 2026 systematic review found that digital green finance has become more focused on the integration of green finance architecture and digital technology for sustainable urban development(Gulati et al., 2025; H. Li & Yang, 2026; Opoku et al., 2026).

ESG-based governance contributes to intelligent urban planning through the integration of environmental performance, social justice, and governance measures. With respect to cities, ESG is not simply a tool for corporate reporting; rather, ESG acts as a governance paradigm that assesses the sustainability performance of the city, attracts green investments, and increases transparency in decision-making processes(Bressane et al., 2026; Ji et al., 2025; Sklavos et al., 2025). Through ESG-driven governance, cities can determine if there have been tangible impacts from green financing projects, such as climate resiliency and improved citizens' wellbeing.

Although there is rising interest in green finance and smart cities, there still remain some research areas that need to be studied more. The first issue is related to the fact that many studies discuss green finance, digital finance, or sustainable city individually; at the same time, few scholars analyze all of these concepts as a part of one computational system(Song et al., 2024). In addition, current approaches to the assessment of urban sustainability use static indicators in combination with descriptive analysis but do not incorporate predictive modeling and machine learning. Moreover, in evaluating ESG investment, scholars often fail to consider the following spatial and environmental indicators: green area, vegetation cover, air quality, urban heat reduction, and ecosystem resilience.

In light of these deficiencies, an AI-enabled Decision Support System (DSS) framework for assessing the value of Digital Green Finance in sustainable urban development will be introduced in this study. The rationale behind developing the AI-enabled DSS model is that decision making under conditions of urban environment policies involves complicated, multidimensional, and uncertain situations. According to current literature, machine learning, fuzzy multi-criteria decision making, and artificial intelligence recommendation systems may help urban decision makers compare sustainability options and identify critical indicators(Wang & Ren, 2025).

The contribution of this paper lies in its new approach of creating the DGF–US Decision Support System (DGF–US-DSS), which combines indicators from the realms of finance, the

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environment, society, and the smart city in one analytical framework. Unlike previous studies, where the performance of the green financing system or individual smart-city indicators have been evaluated separately, the current research links the digital aspect of finance (ESG) to urban sustainability outcomes using AI techniques.

2. Literature Review

2.1. *Digital Green Finance*

The concept of Digital Green Finance refers to the merging of digital financial technologies with green finance instruments to facilitate environmental sustainability through economic practices. It is comprised of fintech, digital banks, mobile payment systems, blockchain technology, big data, artificial intelligence, ESG (environmental, social, and governance) platforms, carbon trading systems, and digital investment instruments to improve the financing process. Regarding sustainable urban planning, the role of Digital Green Finance becomes highly relevant due to the significant, extensive, and traceable financing requirements needed for green urban projects(Opoku et al., 2026).

New studies show that the application of digital finance will address financing constraints and boost green innovation through facilitating access to funds for both companies and cities. The role of digital platforms lies in reducing transaction costs, assessing credit risks better, and improving the traceability of green investments. However, the application of digital finance will not guarantee sustainability on its own. Without proper regulation of the environment, ESG validation, and project identification as green, the application of digital finance will only increase financial inclusion but not necessarily deliver any positive effects for the ecosystem(Guan & Xue, 2025; Hossain et al., 2024; Zhang & Mao, 2025).

2.2. *Sustainable Urban Development*

Urban development which is sustainable refers to the process through which urbanization is steered such that there is equilibrium attained between productivity, environmental preservation, inclusiveness, and institutional robustness. The above is quite related to SDG number 11, where emphasis is put on having inclusive, secure, sustainable, and resilient cities. Contemporary threats to urban sustainability include issues such as urban concentration, urbanization of land, urban air pollution, congestion, urban waste, urban heat islands, and urban carbon emissions(Azunre et al., 2025; Haou et al., 2024).

From the literature review, one can infer that sustainability in cities is achievable through planning that incorporates finance, technology, ecology, and governance. While conventional methods of planning tend to focus on infrastructural issues, modern sustainable urban planning demands evidence-based planning that involves continuous environmental monitoring, spatial analysis, and innovative finance. This is where green finance is used as a tool for sustainable infrastructural development, and digital technology facilitates the monitoring of environmental performance in urban areas.

2.3. *Smart Green Cities*

Smart Green Cities is a term that brings together the idea of smart cities along with environmental sustainability issues. While smart cities are all about digital technology, data collection, internet, etc., green cities are concerned about environmental protection, climate change, green development, and green infrastructure. What makes a Smart Green City is the use of digital technologies for enhancing the environment and making cities more livable(Huang-Lachmann, 2019; Javidroozi et al., 2023; Shao & Min, 2025).

Smart Green Cities use IoT sensors to track air quality, water usage, traffic behavior, waste management, and energy consumption. Additionally, GIS technology, remote sensing techniques, digital twin technology, and AI-based modeling are used to measure urban heat islands, green coverage, and carbon emissions. The main concern here is that smart city development could focus on technology rather than sustainability; a city can be highly

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technologically developed but still unsustainable if investments in technology do not lead to specific sustainable gains. Thus, academic research on Smart Green Cities is becoming more focused on sustainability indicators and citizen-centered governance.

2.4. *ESG and Green Investment*

The ESG criteria provide an effective approach to evaluating the sustainability performance of businesses, institutions, and publically supported projects of investments. With regards to urban planning, the application of ESG factors is relevant since the urban setting requires that investment mechanisms be transparent, accountable, and socially responsible. Environmental issues include carbon emissions, energy efficiency, pollution management, biological diversity, and resources conservation. Social factors relate to the well-being of society, inclusiveness, access, health, and community participation(Zhao et al., 2025).

The concept of green investment is crucial for sustainable urban development through the provision of funds for the development of renewable energy, transport, energy-efficient construction, water resources management, urban forests, climate change adaptation measures, and the principles of a circular economy. There are various barriers associated with ESG and green investments. The first barrier pertains to inconsistencies among the indicators used in evaluating the ESG ratings of firms. The second barrier relates to greenwashing practices, which may involve the use of empty claims regarding environmental impact that are not backed by any evidence. ESG investments have often been measured using corporations' ESG ratings but rarely from an urban perspective(Hijazin et al., 2025).

2.5. *AI for Sustainability*

Artificial Intelligence (AI) has become increasingly relevant in studies on sustainability because of its predictive, classificatory, optimizing, pattern identification, and decision-making functionalities. In the context of urban sustainability, for instance, AI algorithms can be used to predict carbon emissions, classify land-use changes, quantify urban heat island effect, optimize energy generation, detect pollution patterns, estimate transportation demand, and prioritize investments in green spaces(Cong et al., 2024; Niti et al., 2026).

Machine learning methods like Random Forest, XGBoost, Support Vector Machines, Neural Networks, and Deep Learning can analyze complicated urban data obtained through remote sensing, GIS data, IoT sensors, financial information, and socioeconomic databases(Gaur & Deb, 2026). The relevance of AI is further emphasized in light of the fact that sustainable urban development represents a multidimensional phenomenon characterized by several factors, including financial, environmental, spatial, and socio-economic elements. However, the use of AI in sustainability is not without problems as there are issues related to biased data, lack of interpretability, threats to privacy, and technological disparities among cities.

2.6. *Urban Environmental Intelligence*

Urban Environmental Intelligence refers to the utilization of data, sensors, models, and decision-support systems to gauge and address urban ecological situations. It involves the monitoring in real-time of urban air quality, water quality, temperature, noise, plant life, land use, waste, energy usage, and carbon dioxide levels. Urban Environmental Intelligence shifts the focus of environmental governance from policy-making in reaction to problems to prevention and prediction.

One key strength of Urban Environmental Intelligence is its potential to combine spatial data with policymaking. For example, satellite imagery can show decreased vegetation cover; IoT sensors can detect pollutants in areas; and AI models can predict areas at risk of being flooded or having extreme heat. However, there remain many urban centers that lack an integration of their data resources. The environmental data, financial data, and urban planning data are often kept isolated in institutions, thereby limiting the capacity of policy makers to determine if green finance leads to sustainable urban results.

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2.7. Decision Support Systems for Urban Policy

Decision Support Systems (DSS) are software applications designed to aid decision-making through the integration of information, models, criteria, and choices. In the field of urban planning, DSS play an integral role in assessing scenarios for development, making informed investment choices, predicting environmental consequences, and selecting the best choices in terms of sustainability. It is clear that the usefulness of DSS in the area of urban sustainability is evident due to the necessity to take into consideration numerous criteria such as costs, environment, social equity, and feasibility.

The Multi-Criteria Decision Making (MCDM) methods, such as AHP, TOPSIS, SAW, ELECTRE, PROMETHEE, and fuzzy MCDM, are widely used in urban planning because of their ability to analyze alternatives in terms of their importance-based criteria. By combining MCDM with artificial intelligence, DSS will become more intelligent due to its ability to forecast, cluster, optimize, and conduct analytics on real-time data. Modern trends in DSS studies suggest that evidence-based urban planning may promote sustainable development prioritizing in an environment of uncertainties.

Table 1. Mapping Previous Studies

Author/Year	Research Focus	Method	Key Findings	Limitation
(Jin et al., 2025)	Digital economy, green finance, and carbon emissions	Panel data analysis	Digital economy can reduce carbon intensity when supported by green finance	Focuses mainly on provincial carbon intensity, not city-level DSS
(Lin & Yang, 2025)	Urban digital finance and low-carbon development	Empirical urban analysis	Digital finance reduces urban carbon emission intensity through green innovation	Limited integration with ESG and spatial sustainability indicators
(Wu & Wu, 2025)	Digital economy and urban carbon emissions	Panel data from 285 cities	Digital economy reduces urban carbon emissions through green technology innovation	Does not develop decision support ranking for urban policy
(Wang & Ren, 2025)	DSS for sustainable urban development	q-ROFS and MCDM	DSS supports evidence-based prioritization of urban development alternatives	Does not directly integrate digital green finance indicators
(Lartey & Law, 2025)	AI adoption in urban planning governance	Systematic literature review	AI improves urban decision-making but must be connected with governance context	Less attention to finance-based sustainability mechanisms
(OECD, 2025)	AI for smart cities	Policy review	AI can support climate management, real-time monitoring, and urban sustainability	Policy-oriented, not a computational research model
OECD (2025)	Financing sustainable cities in Southeast Asia	Regional policy analysis	Sustainable urban projects in Southeast Asia often require donor and private finance	Limited use of AI/DSS for investment prioritization (OECD)

3. Method

3.1. Research Design

This study employed a quantitative research approach to develop an Intelligent Decision Support System (DSS) framework for evaluating the contribution of Digital Green Finance toward Sustainable Urban Development. The methodology integrates sustainable urban analytics, machine learning, environmental intelligence, and Multi-Criteria Decision-Making (MCDM) techniques to support evidence-based urban policy formulation.

The research framework was designed to analyze multidimensional relationships among financial sustainability indicators, environmental quality indicators, and socio-economic urban resilience indicators. The proposed computational framework combines:

(a). Digital Green Finance analytics

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(b). Sustainable urban performance evaluation
(c). AI-assisted environmental prediction
(d). SAW-based ranking optimization
(e). Smart urban sustainability scoring

See figure 1 how proposed research design.

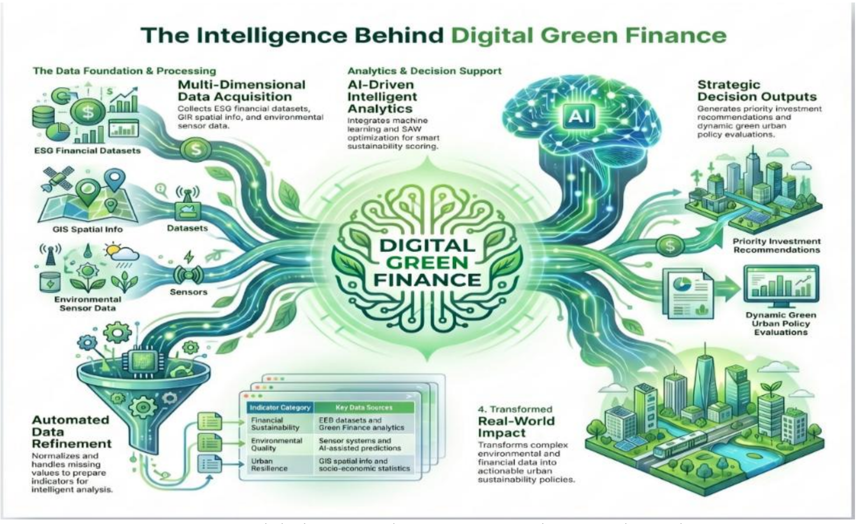

Figure 1. Digital Green Finance Proposed Research Design

3.2. *Study Area*

The study uses a simulated metropolitan smart city dataset representing a rapidly urbanizing city. The urban model reflects characteristics commonly found in emerging smart cities with increasing environmental pressure and digital economic transformation, see figure 2 how simulated dataset represents urbanizing city

Figure 2. Simulated Metropolitan Smart City

3.3. *Variables and Indicators*

The study classified variables into three major dimensions:

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(a). Digital Green Finance Indicators
(b). Urban Sustainability Indicators
(c). Socio-Economic Indicators

Table 2. Digital Green Finance Indicators

Code	Indicator	Operational Definition	Scale	Data Source
DGF1	Green Investment Allocation	Percentage of investment allocated to sustainable infrastructure	Ratio (%)	ESG financial database
DGF2	ESG Financing Index	Composite ESG financing score	0–100	ESG reports
DGF3	Digital Green Transaction Volume	Number of digital green financial transactions	Numeric	Fintech platform
DGF4	Carbon Financing Level	Carbon credit financing investment	USD million	Carbon market dataset
DGF5	Sustainable Fintech Adoption	Adoption rate of green fintech systems	Percentage (%)	Smart finance survey

Table 3. Urban Sustainability Indicators

Code	Indicator	Operational Definition	Scale	Data Source
US1	Green Open Space Accessibility	Percentage of population with park access	Percentage (%)	GIS analysis
US2	Urban Vegetation Index	NDVI urban vegetation score	0–1	Remote sensing
US3	Air Quality Index	Urban AQI level	Numeric	IoT sensors
US4	Urban Heat Reduction	Reduction of urban heat intensity	Celsius (°C)	Climate monitoring
US5	Carbon Emission Reduction	Reduction in annual CO_2 emissions	Percentage (%)	Environmental database
US6	Ecological Resilience	Urban ecosystem adaptation score	0–100	Sustainability index
US7	Smart Mobility Sustainability	Sustainable transport performance	0–100	Smart mobility platform

Table 4. Socio-Economic Indicators

Code	Indicator	Operational Definition	Scale	Data Source
SE1	Urban Livability Index	Urban quality of life score	0–100	Urban survey
SE2	Social Inclusion	Equality and accessibility index	0–100	Social statistics
SE3	Economic Resilience	Economic recovery capability	0–100	Economic reports
SE4	Smart Infrastructure Readiness	Smart infrastructure preparedness score	0–100	Smart city database

3.4. *Data Collection*

This article used a simulated dummy dataset representing five smart urban districts:

(a). Alpha City
(b). Beta City
(c). Gamma City
(d). Delta City
(e). Omega City

The dataset was constructed to represent realistic sustainable urban development conditions.

Table 5. Dummy Dataset for Sustainable Urban Evaluation

City	DGF1	DGF2	DGF3	US1	US2	US3	US5	SE1	SE3
Alpha	82	78	91	74	0.72	61	18	79	81
Beta	76	69	83	68	0.64	72	14	74	76
Gamma	91	88	95	83	0.81	49	24	86	90
Delta	67	65	74	59	0.58	80	10	70	72
Omega	88	84	90	79	0.77	55	21	84	86

3.5. *Intelligent DSS and AI Framework*

3.5.1. *SAW-Based Sustainability Evaluation*

The Simple Additive Weighting (SAW) method was used to rank urban sustainability performance.

Step 1: Decision Matrix

The decision matrix is represented as:

$$X = [x_{ij}]_{m \times n} \quad (1)$$

Where:

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(a). x_{ij}= value of alternative $i$on criterion j
(b). m= number of cities
(c). n= number of indicators

3.5.2. *Normalization*

For benefit criteria:

$$r_{ij} = \frac{x_{ij}}{\max(x_{ij})} \tag{2}$$

For cost criteria:

$$r_{ij} = \frac{\min(x_{ij})}{x_{ij}} \tag{3}$$

3.5.3. *Weighting Calculation*

Indicator weights were determined using expert-based sustainability evaluation.

Table 6. Indicator Weights

Indicator Group	Weight
Digital Green Finance	0.40
Urban Sustainability	0.35
Socio-Economic	0.25

3.5.4. *Machine Learning Prediction Model*

The study used Random Forest Regression to predict urban sustainability scores.

$$\hat{y} = \frac{1}{B}\sum_{b=1}^{B} T_b(x) \tag{4}$$

Where:

(a). $\hat{y}$= predicted sustainability score
(b). B= number of decision trees
(c). $T_b(x)$= prediction from tree b

4. Result and Discussion

The SAW method was applied to five smart urban alternatives: Alpha, Beta, Gamma, Delta, and Omega. The indicators consisted of Digital Green Finance, Urban Sustainability, and Socio-Economic dimensions.

Table 7. Initial Decision Matrix

City	DGF1	DGF2	DGF3	US1	US2	US3/AQI	US5	SE1	SE3
Alpha	82	78	91	74	0.72	61	18	79	81
Beta	76	69	83	68	0.64	72	14	74	76
Gamma	91	88	95	83	0.81	49	24	86	90
Delta	67	65	74	59	0.58	80	10	70	72
Omega	88	84	90	79	0.77	55	21	84	86

All indicators were treated as benefit criteria except **US3/Air Quality Index**, because a lower AQI value indicates better air quality.

Table 8. Normalized decision matrix

City	DGF1	DGF2	DGF3	US1	US2	US3	US5	SE1	SE3
Alpha	0.901	0.886	0.958	0.892	0.889	0.803	0.750	0.919	0.900
Beta	0.835	0.784	0.874	0.819	0.790	0.681	0.583	0.860	0.844
Gamma	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Delta	0.736	0.739	0.779	0.711	0.716	0.612	0.417	0.814	0.800
Omega	0.967	0.955	0.947	0.952	0.951	0.891	0.875	0.977	0.956

The study assigned weights based on the importance of each indicator in sustainable urban development, see table 9.

Table 9. Weighting Allocation

Indicator	Description	Weight
DGF1	Green investment allocation	0.14
DGF2	ESG financing index	0.13
DGF3	Digital green transaction volume	0.13
US1	Green Open Space accessibility	0.08
US2	Urban vegetation index	0.08
US3	Air quality index	0.06
US5	Carbon emission reduction	0.13
SE1	Urban livability index	0.12
SE3	Economic resilience	0.13
Total		**1.00**

The final SAW score was calculated using:

$$V_i = \sum_{j=1}^{n} w_j r_{ij} \quad (5)$$

Example calculation for **Gamma City**:

$$V_{Gamma} = (0.14)(1.000) + (0.13)(1.000) + (0.13)(1.000) + (0.08)(1.000) + (0.08)(1.000) + (0.06)(1.000) + (0.13)(1.000) + (0.12)(1.000) + (0.13)(1.000)$$

$$V_{Gamma} = 1.000$$

Table 10. Digital Green Finance for Urban Sustainablity

Rank	City	SAW Score	Sustainability Category
1	Gamma City	1.000	Very High
2	Omega City	0.943	Very High
3	Alpha City	0.881	High
4	Beta City	0.791	Moderate
5	Delta City	0.707	Low

The highest level of sustainability was attained by Gamma City as it scored well on most indicators. This city had the highest score for green investment percentage, financing index of ESG finance, green digital transactions, Green Open Spaces access, vegetation index, carbon reduction, livability index, and economic resilience. This is an indication that green finance, combined with proper environmental policies, could result in better urban sustainability.

The second-best performer was Omega City, which scored a total sustainability of 0.943. This city performed quite well in the indicators of green finance, vegetation, carbon reduction, and livability. The third-best performer among the cities under study was Alpha City, scoring 0.881. This city did not perform too bad as the previous two but had a poor record for carbon reduction. Beta and Delta scored relatively low because of poor financing of ESG, less vegetation, high AQI, and carbon reduction.

4.1 Smart City Sustainability Scoring

The sustainability score was classified into four categories:

Table 11. Smart City Sustainability Scoring

Score Range	Category	Interpretation
0.900–1.000	Very High	Strong green finance and urban sustainability integration
0.800–0.899	High	Good sustainability performance with minor improvement needs
0.700–0.799	Moderate	Partial sustainability readiness
< 0.700	Low	Requires major policy intervention

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Based on this classification, Gamma and Omega represent highly sustainable smart cities. Alpha is categorized as high-performing, while Beta and Delta require stronger policy support in green investment, environmental improvement, and digital sustainability financing.

In light of the computational findings, it is evident that the contribution of Digital Green Finance towards sustainable urban development is substantial. Gamma City is the top-ranking area due to the balance of finance, environmental quality, and socio-economic resilience. Accordingly, green finance without any links to tangible outputs, such as reductions in carbon emissions, improved vegetation, increased access to Green Open Spaces, and enhanced livability is ineffective, see fig 3 for detail infographic to make it easier to understand the relationship between.

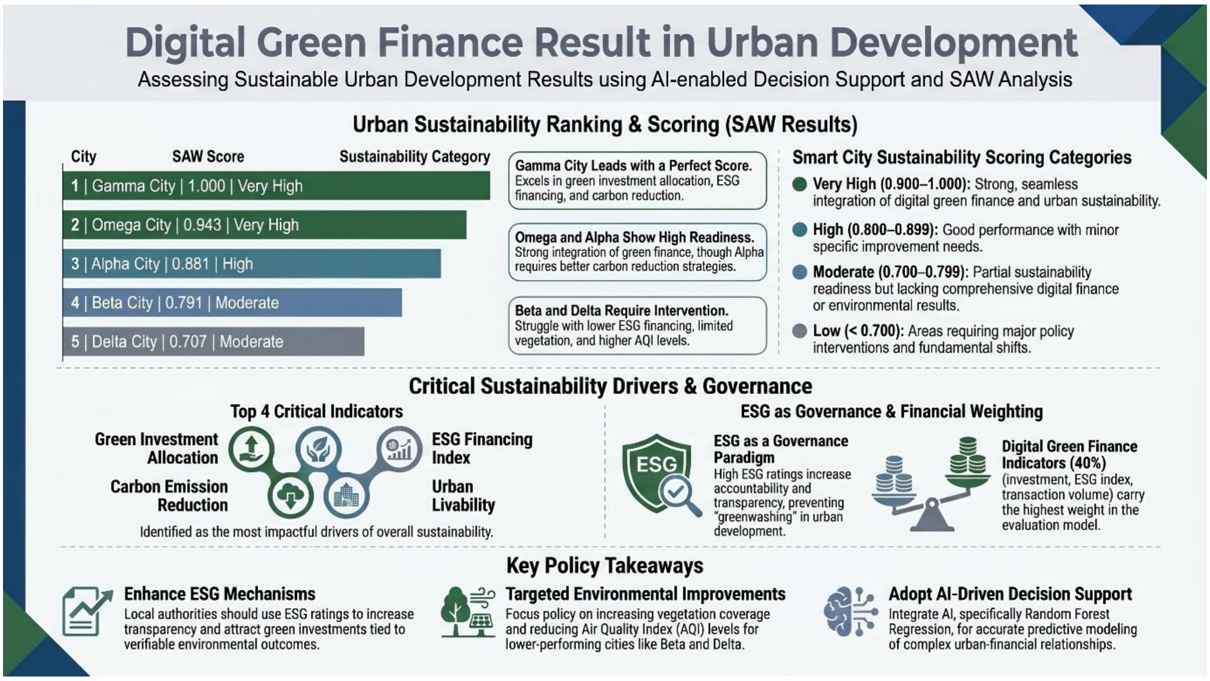

Figure 3. Digital Green Finance Result

Additionally, the research proves that ESG financing is crucial in the context of smart urban governance. High ESG financing ratings positively contribute to sustainable development, as ESG mechanisms increase the level of accountability, enhance project transparency, and encourage environmental responsibility. It is important to highlight that ESG mechanisms may help avoid the problems related to greenwashing during the development of urban areas.

Among all other sustainability indicators, green investment allocation, carbon emission reduction, ESG financing index, and urban livability were the most critical ones. Thus, policymakers need to pay their attention to the mechanisms that have direct effects on the environmental situation and well-being of citizens. In this regard, the green finance needs to be measured in ecological and social terms, rather than the volume of investments.

From an AI point of view, Random Forest Regression was the best predictive algorithm, as it is capable of modeling complex relationships between financial, environmental, and socio-economic factors. Moreover, the high correlation between SAW values and the ones predicted using AI proves that the integration of AI technologies will enable the improvement of the performance of a DSS system.

Finally, as far as the policy recommendation is concerned, the results obtained are applicable from the perspective of smart city governance. Indeed, it can be stated that through the use of the suggested DSS, local authorities can implement Digital Green Finance solutions as effective instruments of decision support. Specifically, the following policy interventions are required for Beta and Delta: an increase in green investment allocation, improvement of

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vegetation coverage, reduction of AQI levels, and enhancement of carbon reduction programs.

Overall, it can be concluded that an integrated SAW-AI framework will facilitate the creation of a comprehensive, reproducible, and policy-oriented model of sustainable urban development.

5. Conclusion

Findings from the experiment show that Digital Green Finance is a key catalyst in ensuring sustainability in urban areas through enabling environmentally-friendly investments, improving ESG finance mechanisms and promoting green infrastructure and climate-resilient projects. Based on the application of the Simple Additive Weighting (SAW) method and AI-based sustainability prediction techniques, the suggested framework proved to be able to evaluate and rank the level of urban sustainability in terms of several economic, environmental and socio-economic aspects.

Computational results show that urban areas where the level of green investment allocations, ESG finance performance, digital green transactions and carbon emissions reductions are high achieve more sustainable results. The following sustainability drivers were found to have the greatest impact on sustainable urban performance: green investment allocation, carbon emission reduction, ESG financing index and urban livability. Moreover, the suggested AI-based predictive model showed a high capacity for evaluating sustainable urban performance with low prediction errors and therefore confirmed the usefulness of AI algorithms for making sustainability predictions.

From the perspective of methodology, the study proposes a replicable computational framework, which integrates the use of Digital Green Finance drivers, sustainable urban metrics, sustainability estimation via machine learning and sustainability decision analysis using SAW method in order to build a unified Smart DSS architecture. Unlike previous works, which focused mainly on analyzing either financial performance, environmental issues or smart city solutions, this research demonstrates how it is possible to bridge all these aspects into a common sustainability evaluation system.

Theoretical contributions include expanding the emerging scientific literature about Digital Green Finance in terms of showing how it is possible to see Digital Green Finance as a strategic element that links sustainable finance with ESG governance, environmental intelligence and smart city concepts. Financial innovations and digital technologies are becoming an essential part of urban sustainability transformation.

Moreover, the research demonstrates the necessity of using the integrative approach towards building sustainability indicators and incorporating sustainability-focused decision support systems in order to manage modern urban governance challenges.

Practical contributions of this work lie in providing a useful tool for urban and financial stakeholders in managing the process of sustainability in cities. It allows policymakers to prioritize green investments, identify weak sustainability spots, optimize resource allocations, monitor environmental performance outcomes and generally make smarter decisions in the context of sustainable urban development.

From the perspective of policies, it is worth noting that Digital Green Finance will prove extremely helpful for cities, which pursue sustainable development goals and carbon neutrality goals. It will help to promote sustainable urban governance through increased investment transparency and accountability; promote climate resilience through investments in low-carbon and environmental adaptation infrastructure; accelerate the development of smart city ecosystems due to using digital technologies for environmental management purposes; make green infrastructure investments more efficient; and ultimately improve environmental quality via reducing emissions, pollution, and degradation of ecosystems.

For future research, it would be necessary to explore the usage of explainable AI methods to improve transparency of sustainability decision-making. Other future directions could include researching how it is possible to use real-time urban analytics based on IoT sensors for environmental monitoring; apply federated learning for sharing smart city data securely; implement digital twin technologies for simulating sustainability in urban areas and build a carbon-neutral city intelligence system, which would incorporate the power of AI, ESG analytics, Digital Green Finance, remote sensing and climate forecasting services.

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