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Research Article

Sustainable Landscape Design and Traditional Villages in Xuzhou, Jiangsu: Low-cost Strategies and Big Data Applications Influencing AI Integration

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ABSTRACT

Big Data usage and Artificial Intelligence (AI) technology combined offer a potential approach to solving challenging problems. AI-driven solutions provide insightful analysis and creative solutions by utilizing the power of big data analytics. With an emphasis on the mediating role of technological literacy and the moderating effect of resource availability, this study investigates the effects of low-cost techniques, the usage of Big Data, and the integration of Artificial Intelligence (AI) on sustainability in landscape design. The purpose of this study is to look at the intricate connections between these factors and how they affect sustainable landscape design methods and results as a whole. A standardized questionnaire was answered by a sample of 458 landscape experts as part of a quantitative approach. Smart PLS (Partial Least Squares), which incorporates evaluations of measurement models, structural models, and mediation and moderation studies, was utilized for data analysis. The study found that using Big Data, implementing low-cost techniques, and incorporating AI all had very favourable effects on sustainability in landscape design. The efficient use of Big Data and AI was found to be mediated by technological literacy, highlighting the importance of this concept in this context. Additionally, resource availability emerged as a critical moderating factor, influencing the strength of these relationships. This research contributes to the field by offering a holistic understanding of the dynamics within sustainable landscape design, emphasizing the importance of integration of AI and utilization of Big Data. It provides practical insights for landscape professionals, informs policy development, and advances educational curricula about AI and Big Data in landscape architecture. The study's limitations include potential response bias due to self-reported data and the cross-sectional design, which restricts the establishment of causal relationships. Additionally, the study focused on professionals, limiting the generalizability of findings to broader community perspectives.

Keywords: Implementation of Low-cost Strategies, Utilization of Big Data, Integration of AI, Technological Literacy, Sustainability, Resource Availability.

INTRODUCTION

Big Data and AI integration to enhance sustainable landscape design are essential these days. It is crucial to sustainability because it employs information analytics and predictive modelling to expand ecologically resilient, adaptable, and in track with natural landscapes. Sustainable landscape design, driven by means of AI and guided by means of Big Data, optimises water and electricity intake, reducing waste and prices (X. Lu, Liu, & Xia, 2023). AI-pushed simulations can predict and put together landscapes for catastrophic weather activities and changing climatic trends, making them vital for climate change resistance. These designs additionally boost city well-being with the aid of setting up green regions for rest and AI-enabled monitoring for accessibility and protection. They additionally assist in preserving cultural landscapes and restoring ancient locations for present-day usage (Ormsby, 2021). Local economies can benefit from sustainable landscapes' higher property charges, tourism, and lower preservation expenses. Big Data and AI enable landscape experts to lay for worldwide sustainability, selling clean water, sanitation, sustainable city communities, and responsible intake and manufacturing.

Community health is greatly impacted by sustainable landscapes. Cities' green areas offer recreation, relaxation, and social interaction, which AI and Big Data increase (Allahyar & Kazemi, 2021). Greenery reduces strain and enhances existence. Sustainable landscapes boom property expenses and decrease maintenance costs due to low-impact layout methods integrating Big records and AI. They additionally raise neighbourhood economies with the aid of generating renovation and landscaping employment and attracting traffic via AI, large facts, and social media (Harkness et al., 2021). Low-price strategies, Big Data, and AI all have an effect on sustainable landscape design. Low-cost solutions pressure affordability and useful resource efficiency, making sustainable design greater on hand and fostering community involvement. Big Data helps landscape architects make knowledgeable selections, forecast outcomes, and manage assets for resilient and adaptive designs (Anejionu et al., 2019).

Technological literacy is vital to landscape architecture and sustainable landscape layout. It teaches landscape architects and architects how to apply sophisticated design software, information-pushed analytics, and clever structures (Maureen, van der Meij, & de Jong, 2018). These statistics allow them to plan for useful resource performance, climate resilience, and biodiversity. Technology literacy improves communique with clients and stakeholders through visualizations and simulations, assisting them in recognizing and admiring sustainable design (Goldenthal, Park, Liu, Mieczkowski, & Hancock, 2021).

This research has an effect on low-cost processes, Big Data utilization, and AI integration on sustainability, mediated by means of technology literacy and regulated by way of useful resource availability in sustainable landscape layout might also screen the subsequent studies gaps: Low-fee methods, Big Data use, and AI integration are often studied separately in sustainable landscape design literature. Limited studies have examined the interaction of these components in one examination (Mariani & Nambisan, 2021). The complete and complex character of sustainable layout methods is poorly understood when you consider that few studies have tested how those factors interact or conflict in actual international landscape design tasks. Technical literacy and resource availability mediate sustainable landscape layout, despite the fact that they're understudied (Sanginesi et al., 2023).

This study examines how low-cost solutions, Big Data, and AI affect landscape design sustainability. This study examines how technical knowledge and resource availability mediate how these innovative techniques affect sustainable landscape design practices and outcomes. The study objectives are below:

1. To analyze the effect of Big Data utilization and AI integration in landscape design on sustainability outcomes, including data-driven decision-making, predictive modelling, and resilience.

2. To explore the mediating role of technological literacy between low-cost strategies, Big Data utilization, AI integration, and sustainability in landscape design.

3. To investigate the moderating role of resource availability between technological literacy and sustainability, considering the resource-constrained nature.

This study affects many stakeholders. First, it shows how landscape architects and designers may employ low-cost methods, big data, and AI to increase sustainability. Landscape professionals who desire to improve their abilities and satisfy sustainable landscape design objectives will find this material valuable. Second, politicians and urban planners may benefit from this study by learning how to develop laws and incentives that promote sustainable landscape practices, big data, AI, and digitalization. Thirdly, landscape architecture schools should include digital literacy in their courses to educate students about current landscape design challenges. Finally, local communities benefit from knowing sustainable landscape design and how it may improve their quality of life.

LITERATURE REVIEW

Implementation of Low-cost Strategies and Sustainability

In urban planning, sustainability, and community development, low-cost solutions in sustainable landscape design are gaining attention. Environmentally friendly low-cost landscape design solutions are often used to reduce development project sustainability issues. Native plants, xeriscaping, and innovative stormwater management techniques like rain gardens and permeable pavements minimize water use (Juárez-Hernández, 2021). These solutions can significantly reduce building and maintenance expenses, making them economically sustainable. For instance, big data and AI in landscaping can remove costly treatments, decreasing maintenance expenses (Azuazu, Sam, Campo, & Coulon, 2023). Community-based projects that include volunteers and local inhabitants in low-cost landscaping can promote sustainability using big data and AI, which promote social cohesion, local job possibilities, and community development.

Low-cost sustainable landscape design promotes sustainability. Communities feel ownership and connection to sustainability when they create and implement such programs. This engagement increases quality of life, strengthens bonds, and builds community (Das & De, 2023). Low-cost sustainable landscape design often targets biodiversity and ecosystem services, promoting ecological sustainability (Thadani & Go, 2021). AI-driven predictive modelling may also evaluate design choices' biological implications, ensuring habitat restoration activities support conservation aims (Başkent, 2023). These benefits affect environmental health and resilience greatly. Thus, Big Data, AI, and sustainable landscape design work together to protect natural variety and ecosystem services.

H1: Implementation of low-cost strategies has a significant and positive impact on Sustainable landscape design.

Utilization of Big Data and Sustainability

Big data implementation in sustainable landscape design has revolutionized social, economic, and sustainability. Big data analytics for sustainability has changed landscape design resource management. Real-time facts collection and analysis offer accurate soil moisture, air quality, and temperature management for efficient irrigation and strength savings (Kong, Liu, & Wu, 2020). Big statistics shall we landscape architects music biodiversity, which is crucial to ecosystems and conservation. Cost savings make big facts-driven techniques commercially beneficial. Historical resource consumption and maintenance information provides statistics-driven choice-making, reducing working prices (Knudsen, Lien, Timmermans, Belik, & Pandey, 2021). Big data facilitates companies to tailor sustainable landscaping items and offerings to consumer choices (Hossain, Akter, Yanamandram, & Wamba, 2023). Market-pushed processes can improve monetary sustainability by increasing marketplace percentages and earnings. Big statistics may additionally promote social sustainability in landscape layout by encouraging network involvement and accessibility (Costa Melo et al., 2023). Community entry is sought during layout via online systems and statistics-driven visualization equipment. This cooperative method builds a network and empowers locals to control their green regions (Bibri, 2020). Data analysis may also improve accessibility by meeting multiple wishes and making public regions handy for every age and ability.

H2: Utilization of Big Data has a significant and positive impact on Sustainable landscape design.

Integration of AI and Sustainability

Artificial Intelligence (AI) in sustainable landscape design is a promising path with several sustainability implications. AI-driven equipment and apps might revolutionize landscape management and design. Numerous studies show that AI improves sustainability through supplying accurate and continual ecological monitoring (Said et al., 2023). AI-powered sensors and facts analytics analyze soil health, flower growth, and water intake to enhance useful resource allocation and conservation (Dooyum Uyeh, Gebremedhin, & Hiablie, 2023). This precision enhances landscape health and decreases useful resource waste. AI automates irrigation, mowing, and preservation prediction, decreasing operating costs and selling monetary sustainability (Yigitcanlar et al., 2020). AI's predictive powers improve risk assessment, supporting landscape designers put together for weather-associated problems and building resilient green spaces. AI-powered solutions make design input and network involvement greater participatory, enhancing social sustainability (Kalaboukas, Kiritsis, & Arampatzis, 2023). This inclusive method fosters duty and improves human-surroundings connections.

H3: Integration of AI has a significant and positive impact on Sustainable landscape design.

Technological Literacy as a Mediator

The adoption of low-cost sustainability solutions and true sustainability results relies on technology literacy.

It channels these strategies into sustainable impacts. Technology literacy facilitates human beings and organizations to implement cheap sustainability initiatives correctly. Technical literacy allows individuals to discover, use, and integrate less expensive sustainable technology (S. Liu et al., 2021). Technology literacy also will increase information availability and interpretation, making sustainable approach selection and implementation selections extra informed (Kirkman & Voulvoulis, 2017). This ability set helps creativity by means of permitting human beings to imaginatively adapt new technology to improve environmental projects. It also hinders sustainability adoption by coaching hassle-solving competencies to overcome technological hurdles. Technical literacy programs are crucial for low-cost sustainability projects (Adewale Alola, Ozturk, & Bekun, 2021). They inspire proactive technology use, advancing sustainable practices. Improving technological literacy fosters digital inclusion, allowing a broader and more varied population to participate in sustainability sports, resulting in extra whole and equitable sustainability effects (Tetteh & Amponsah, 2020). Understanding the significance of literacy emphasizes the want for training to accumulate these abilities, selling sustainability in a tech-driven future.

Technological literacy mediates Big Data for sustainability. It means individuals and organizations can understand, use, and use technology tools and data-driven insights for long-term success. Big Data users who can discover complex record sets, get insights, and make smart judgments are highly certified to use it (Newton, Nettle, & Pryce, 2020). Technical literacy also stimulates creativity by means of permitting individuals to appoint new technology to tackle environmental issues. It encourages inclusion and ensures that extra human beings might also interact in facts-driven sustainability sports, bridging the digital hole and growing to get admission to sustainable practises (P. Kumar, Pillai, N. Kumar, & Tabash, 2023). Finally, technological literacy helps flip Big Data into actual sustainability techniques, allowing better knowledge and strategic selection-making, innovation, and sustainability in our records-pushed international.

The integration of AI and sustainability in landscape layout requires technological understanding. It shows how nicely people and corporations apprehend, put in force, and use AI generation to increase landscape task sustainability. An AI-savvy landscape architect or designer may also include AI-driven solutions in their designs, improving sustainability (Xu & Babaian, 2021). Designers with strong technical literacy can better understand AI-generated insights, become aware of sustainable design opportunities, and allocate sources efficaciously with minimum impact. This ability set permits professional customers to conform and assemble AI-driven answers to successfully deal with sustainability problems in landscape layout (Goodarzi et al., 2023). Technological literacy moreover assures inclusion and equality in AI-pushed landscape design for sustainability with the useful resource of permitting various stakeholders to co-create, democratizing access to sustainable landscapes (M. Kumar et al., 2022). Landscape designers require technical literacy schooling to use AI generation for sustainable landscape answers. Finally, technical literacy is essential to turning AI's promise into sustainable landscape layout techniques that promote knowledgeable selection-making, creativity, and inclusion.

H4: Technological Literacy mediates the relationship between the implementation of low-cost strategies and Sustainable landscape design.

H5: Technological Literacy mediates the relationship between Utilization of Big Data and Sustainable landscape design.

H6: Technological Literacy mediates the relationship between the Integration of AI and Sustainable landscape design.

Resource Availability as a Moderator

Resource availability moderates the relationship between technology literacy and sustainability in landscape design. Technical literacy's capacity to preserve effects hinges on this interplay. High technological literacy can improve sustainability in useful resource-wealthy areas where money, materials, and labour are plentiful (Meshram, Pandey, & Abhilash, 2019). Skilled technology users can develop resource-intensive sustainable design solutions. However, technological literacy helps reduce limits with limited resources (Yotamu, Chiweza, & Barbour, 2023). Even with limited resources, skilled users may employ technology to maximize resource utilization and achieve sustainability goals. Technology literacy may also help people find additional funding, partner with others, and obtain grants and incentives for sustainable landscape projects (Boskabadi, Mirmozaffari, Yazdani, & Farahani, 2022). Learning how resource availability moderates resource availability underlines the necessity for context-specific landscape design education and policy (Astapati & Nath, 2023). It stresses instructional initiatives that help individuals and organizations adapt their technical literacy to varied resource settings, enabling resource-efficient design solutions and enhancing landscape design sustainability.

H7: Resource availability moderates the relationship between technological literacy and Sustainable landscape design.

Based on the above discussion we have developed the conceptual framework as shown in **Figure 1**.

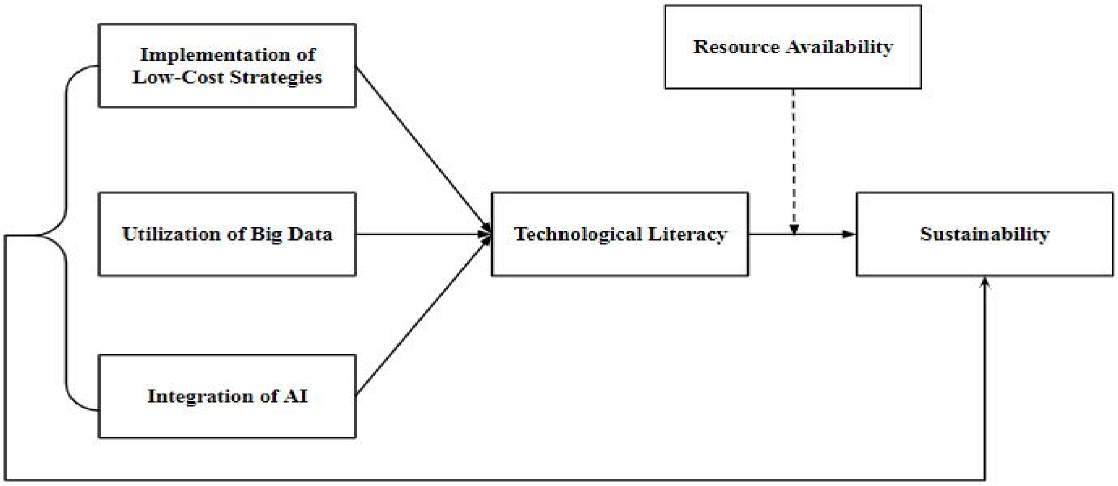

Figure 1. Conceptual Framework

METHODOLOGY

In order to analyze the intricate interplay of elements in sustainable landscape design, a quantitative approach was used in this study. Landscape architects and designers were among the professionals and practitioners who participated in the study. A sample size of 458 participants was chosen using purposive sampling to guarantee variety in the geographic representation of Jiangsu, China and professional backgrounds. Through the use of an electronic, structured questionnaire, which was adapted from previous studies, data was gathered (Appendix-1). The poll asked about low-cost tactics, the use of Big Data and AI, technological literacy, the availability of resources, and sustainability in landscape design. A 5-point Likert scale was used to evaluate the responses. Because of its aptitude for structural equation modelling and complex models with multiple variables, Smart PLS (Partial Least Squares) was the major statistical tool for data analysis. The investigation protected a reliability and validity assessment of the size model, a structural model evaluation to test hypotheses, and mediation and moderation studies. Ethical concerns have been prioritized, with moral approval received, informed permission obtained, and player privacy and anonymity preserved. The information was evaluated and documented in an in-depth studies document, with the implications explored in mild of modern-day literature. The observer’s purpose became to shed mild on the diffused dynamics of sustainable landscape layout whilst additionally paving the route for future research in this region.

FINDINGS

Table 1 and **Figure 2** present a comprehensive assessment of construct validity and reliability for several key research topics. The first construct, "Integration of AI," has four parts: IAI1, IAI2, IAI3, and IAI4. These items have outside loadings from 0.760 to 0.836, suggesting a construct link. Indicating no serious multicollinearity issues, the Variance Inflation Factor (VIF) is usually below 2.0. This construct's Cronbach's Alpha is 0.814 and Composite Reliability (CR) is 0.877, indicating good internal consistency and dependability. The Average Variance Extracted (AVE) of 0.641 suggests excellent convergent validity. On the "Implementation of Low-Cost Strategies" construct, outside loadings range from 0.522 to 0.749 for 20 items (LOS1-LOS20). The Variance Inflation Factor (VIF) values for items LOS3 and LOS20 suggest multicollinearity, even though most items have a significant link to the construct. However, Cronbach's Alpha (0.937) and Composite Reliability (0.943) imply high internal consistency. Despite being above the threshold, the Average Variance Extracted (AVE) of 0.544 may need convergent validity testing.

The four components of "Resource Availability"—RA1, RA2, RA3, and RA4—have no multicollinearity concerns. It has low VIF and good exterior loadings (0.707-0.869). Cronbach's Alpha of 0.780, Composite Reliability of 0.859, and AVE of 0.606 indicate strong reliability and convergent validity. With outside loadings from 0.585 to 0.832, the "Sustainability" construct (S1-S6) shows varying connectivity. Acceptable VIF readings indicate no multicollinearity issues. The notion has good reliability but lower convergent validity than other constructs, with Cronbach's Alpha of 0.842, Composite Reliability of 0.883, and AVE of 0.561. Four items (TL1, TL2, TL3, TL4) assess "Technological Literacy", with significant outer loadings (0.840 to 0.921) and good VIF scores. High Cronbach's Alpha (0.901), Composite Reliability (0.931), and AVE (0.771) indicate its reliability and convergent validity. Finally, the six-item "Utilization of Big Data" construct (UBD1 to UBD6) shows good outer loadings (0.703 to 0.871) and no multicollinearity. This concept has strong reliability and convergent validity with 0.898 Cronbach's Alpha, 0.923 Composite Reliability, and 0.667 AVE.

Table 1. Construct Reliability and Validity

	Items	Outer Loading	VIF	Cronbach's Alpha	CR	AVE
Integration of AI	IAI1	0.836	1.926	0.814	0.877	0.641
	IAI2	0.834	2.156			
	IAI3	0.770	1.747			
	IAI4	0.760	1.453			
Implementation of Low-Cost Strategies	LOS1	0.682	2.222	0.937	0.943	0.544
	LOS10	0.715	3.129			
	LOS11	0.675	2.494			
	LOS12	0.648	2.127			
	LOS13	0.698	3.791			
	LOS14	0.522	3.018			
	LOS15	0.749	3.228			
	LOS16	0.674	3.116			
	LOS17	0.643	2.384			
	LOS18	0.690	2.896			
	LOS19	0.676	2.983			
	LOS2	0.646	3.278			
	LOS20	0.689	3.287			
	LOS21	0.719	2.775			
	LOS3	0.725	4.057			
	LOS4	0.595	2.080			
	LOS5	0.711	2.421			
	LOS6	0.576	2.363			
	LOS7	0.565	1.805			
	LOS8	0.661	2.566			
	LOS9	0.679	2.456			
Resource Availability	RA1	0.710	1.496	0.780	0.859	0.606
	RA2	0.869	2.021			
	RA3	0.815	1.737			
	RA4	0.707	1.502			
Sustainability	S1	0.585	1.690	0.842	0.883	0.561
	S2	0.695	1.981			
	S3	0.751	2.012			
	S4	0.828	2.268			
	S5	0.832	2.315			
	S6	0.773	1.859			
Technological Literacy	TL1	0.840	2.413	0.901	0.931	0.771
	TL2	0.921	4.143			
	TL3	0.893	3.160			
	TL4	0.858	2.129			
Utilization of Big Data	UBD1	0.756	1.957	0.898	0.923	0.667 K
	UBD2	0.858	3.125			
	UBD3	0.846	2.874			
	UBD4	0.871	3.765			
	UBD5	0.851	3.533			
	UBD6	0.703	1.797			

Note: LCS=Implementation of Low-cost Strategies, UBD=Utilization of Big Data, IAI=Integration of AI, TL=Technological Literacy, S=Sustainability, RA=Resource Availability.

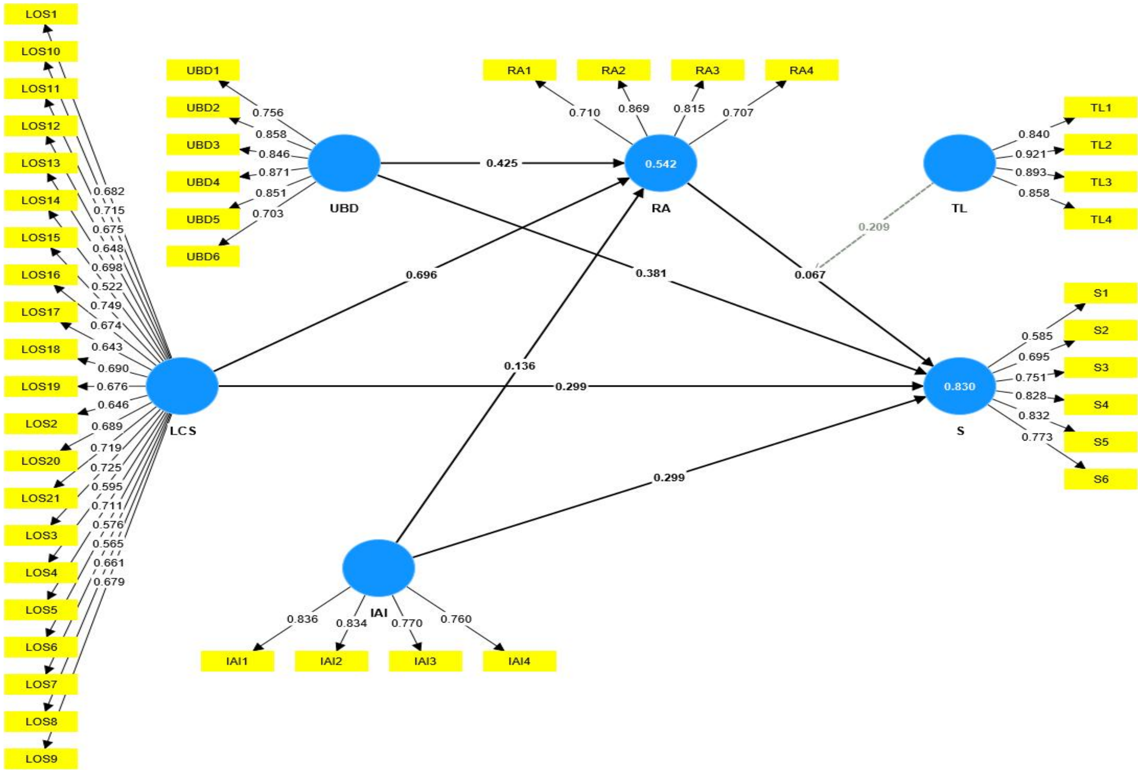

Figure 2. Measurement Model

The Heterotrait-Monotrait (HTMT) ratio in **Table 2** assesses discriminant validity for component interactions. HTMT ratios are useful for determining if these entities are distinct with a threshold value of 1. As expected, the diagonal parts of the table, which indicate each construct's HTMT ratio to itself, are 1, indicating a perfect connection. HTMT ratios between constructs reveal intriguing things beyond self-comparisons. **Table 2** shows that the HTMT values of all variables are less than 1. These comparisons provide high discriminant validity with HTMT ratios from 0.646 to 0.993.

Table 2. Discriminant Validity (HTMT)

	IAI	LCS	RA	S	TL	UBD
IAI						
LCS	0.883					
RA	0.755	0.833				
S	0.993	0.908	0.802			
TL	0.891	0.774	0.646	0.934		
UBD	0.876	0.941	0.735	0.878	0.855	

Note: LCS=Implementation of Low-cost Strategies, UBD=Utilization of Big Data, IAI=Integration of AI, TL=Technological Literacy, S=Sustainability, RA=Resource Availability.

Table 3 presents the R-squared (R2) and R2 Adjusted coefficients of willpower for “Resource Availability” and Sustainability". These coefficients are crucial to information on how tons the model's unbiased variables affect these additives. The R-squared score for “Resource Availability” is 0.542, suggesting that the model additives provide an explanation for fifty-four per cent of resource availability variability. This means the selected predictors can explain over 50% of resource availability swings. The adjusted R-squared, 0.539, is nearly equal to the R-squared, showing that the model is simple and incorporates meaningful components. For "Sustainability," the R-squared value is 0.830, suggesting that the independent variables explain 83.0% of the variation. Simply said, the analytical features explain a lot of sustainability variability. A modified R-squared of 0.828 indicates the model's robustness and appropriateness.

Table 3. Coefficient of Determination

	R Square	R Square Adjusted
Resource Availability	0.542	0.539
Sustainability	0.830	0.828

Table 4 shows path coefficients, T values, and P values for three significant pathways, revealing structural links in the study model. The route from "Implementation of Low-Cost Strategies" (LCS) to "Sustainability" (S) has a positive path coefficient of 0.299, indicating that low-cost strategy adoption increases sustainability. This relationship is statistically significant due to its T value of 3.161 and extremely low P value of 0.001. Second, "Sustainability" and "Utilization of Big Data" (UBD) have a stronger positive link with a path coefficient of 0.381. Sustainability grows with business big data usage. The relationship is statistically significant with a P value of 0.000, even though the T value (2.057) is lower than the previous path. Thirdly, "Integration of AI" (IAI) to "Sustainability" follows the same rising trend with a path coefficient of 0.299. This T value of 4.194 indicates a statistically significant connection. The low P value of 0.0001 supports this hypothesis (see **Figure 3** for details).

Table 4. Path Coefficient

	Original Sample	T values	P values
LCS -> S	0.299	3.161	0.001
UBD -> S	0.381	2.057	0.0001
IAI -> S	0.299	4.194	0.0001

Note: LCS= Implementation of Low-cost Strategies, UBD=Utilization of Big Data, IAI=Integration of AI, TL=Technological Literacy, S=Sustainability, RA=Resource Availability.

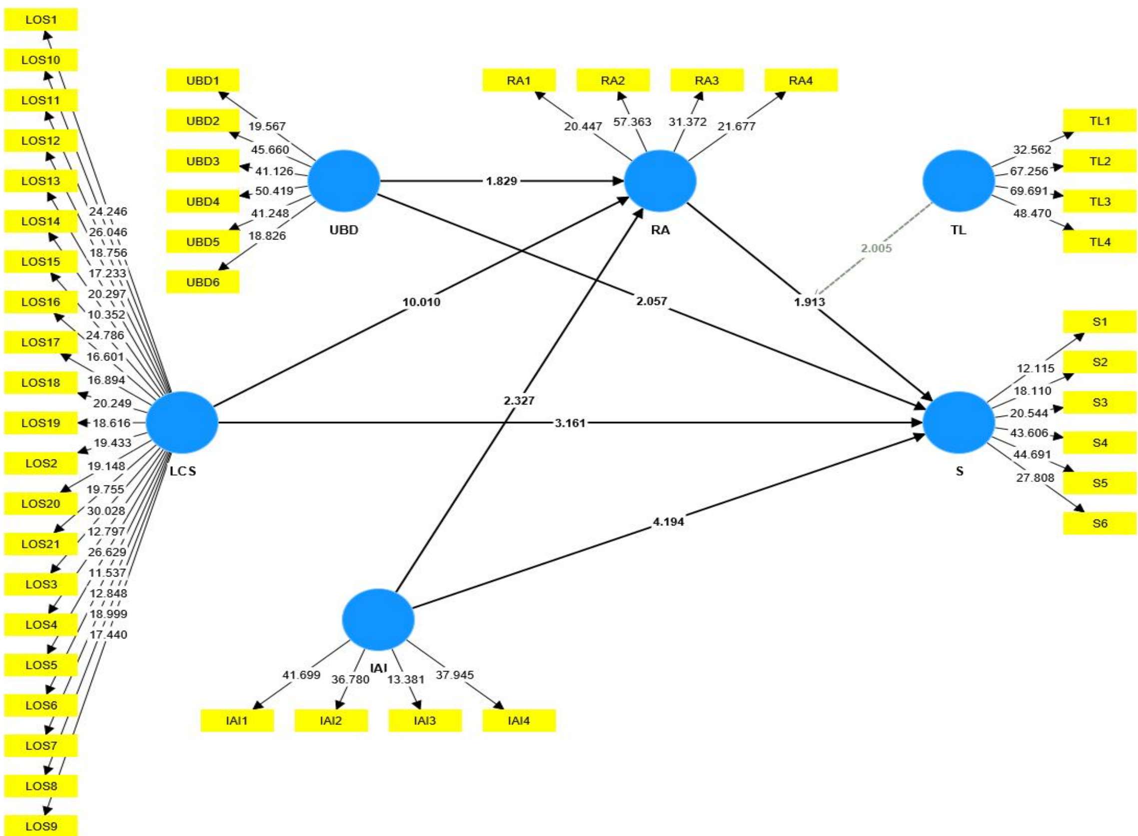

Figure 3. Structural Model

Table 5 shows how "Resource Availability" (RA) mediates between major independent variables and "Sustainability" (S) for three crucial routes in the structural equation model. From "Implementation of Low-Cost Strategies" (LCS) to RA to S, a route coefficient of 0.046 is found. This shows that RA channels part of LCS's impact over S. This mediation effect is statistically significant (P = 0.031), despite the low T value of 1.873. Second, the "Utilization of Big Data" (UBD) has a route coefficient from RA to S of 0.075, showing that RA mediates part of UBD's effect on S. The T value of 1.736 and P value of 0.041 indicate the statistical significance of this mediation effect. Finally, "Integration of AI" (IAI) has a 0.069 route coefficient from RA to S. RA likely moderates IAI's effect on S. The mediation effect's statistical significance is supported by a T value of 1.892 and a P value of 0.030.

Table 5. Mediation Analysis

	Original Sample	T values	P values
LCS -> RA -> S	0.046	1.873	0.031
UBD -> RA -> S	0.075	1.736	0.041
IAI -> RA -> S	0.069	1.892	0.030

Note: LCS=Implementation of Low-cost Strategies, UBD=Utilization of Big Data, IAI=Integration of AI, TL=Technological Literacy, S=Sustainability, RA=Resource Availability.

The moderation analysis in **Table 6** examined the interaction between two major independent variables, "Resource Availability" (RA) and "Technological Literacy" (TL), and the dependent variable, "Sustainability". The interaction factor, RA * TL, has a path coefficient of 0.209, indicating a positive link with sustainability. The statistical significance of this interaction effect is determined by the T and P values. The T value, 2.005, indicates statistical significance but is below the typical criteria. Additionally, the P value of 0.200 exceeds the 0.05 significance criterion. These findings suggest that RA and TL's interaction impact on S in the original sample is not statistically significant.

Table 6. Moderation Analysis

	Original Sample	T values	P values
RA * TL -> S	0.209	2.005	0.200

Note: LCS=Implementation of Low-Cost Strategies, UBD=Utilization of Big Data, IAI=Integration of AI, TL=Technological Literacy, S=Sustainability, RA=Resource Availability.

DISCUSSION

The study analyzes the complicated dynamics that affect value-powerful processes, huge data, and AI in sustainable landscape design. We goal to recognize how each aspect contributes to sustainable landscape layout and how technology literacy mediates these relationships by searching at those important elements. We also wish to have a look at how resource availability impacts technical understanding and sustainable landscape design. Finally, this research pursuits to help landscape architects, designers, policymakers, and stakeholders make knowledgeable selections, optimize resource allocation, and sell sustainability in landscape design practices to create extra environmentally responsible and resilient landscapes.

Hypothesis 1 (H1) states that low-cost techniques improve sustainable landscape design. Low-cost solutions in sustainable landscape design are popular due to the fact they fulfil sustainability desires without costing a lot (Gavali & Ralegaonkar, 2020). This look helps research that suggests cost-powerful strategies can help create sustainable landscapes. Low-value techniques do away with financial boundaries for landscape architects, designers, and groups, enhancing sustainability (Amran, Murali, Makul, Tang, & Eid Alluqmani, 2023). AI, drought-resistant plants, and recycling can dramatically reduce mission charges while assembling sustainability goals (Fahmy, Elwy, & Mahmoud, 2022). Low-price strategies often sell ecological sustainability by way of emphasising aid efficiency, waste discount, and ecosystem preservation (Thadani & Go, 2021). These strategies consist of accumulating rainwater, the usage of permeable surfaces, and using domestically adapted vegetation to sell biodiversity. They gain sustainable landscape design goals like habitat safety and water conservation through doing this.

Hypothesis 2 (H2) states that Big Data improves sustainable landscape design. Big Data in sustainable landscape design might boost economic outcomes. First, Big Data permits landscape architects and designers to make sustainable choices based on records (Bibri, 2020). Big Data analytics can reveal organic styles, climate developments, and urban dynamics to assist in picking out the best design. Big Data improves resource management and allocation, selling sustainability. Tracking and comparing water and power use in actual time can assist landscape designers in cutting fees and boom efficiency (Holzinger, Keiblinger, Holub, Zatloukal, & Müller, 2023). This facts-driven method supports sustainable landscape layout's awareness of aid conservation and waste reduction (De Souza et al., 2021). Big Data also encourages proof-based design, which enables landscape architects to exhibit their projects' environmental and socioeconomic blessings (Gil, Casagrande, Cortés, & Verschae, 2023). This fact can help secure financing and network aid for sustainable landscape design tasks, boosting their effect.

Hypothesis 3 (H3) states that AI improves sustainable landscape design. AI in sustainable landscape design can alter social and economic sustainability. Current research and look at information guide the concept that AI greatly influences sustainable landscape design. AI improves sustainable landscape design through data evaluation and prediction (Kim, 2022). AI algorithms can have a look at large databases of weather facts, soil conditions, and vegetation growth styles to count on how a landscape design will perform over the years (Ruiz et al., 2023). This prediction expertise helps create resilient landscapes that can adapt to changing climates, advancing sustainability. AI-driven design optimization enables landscape architects to create useful resource-efficient landscapes (Kraus, Ferraris, & Bertello, 2023). AI can enhance irrigation systems by considering actual-time climate data and plant water demands, lowering water utilization and ensuring wholesome plant life (Khan & Faisal, 2023). This meets long-term water and resource efficiency goals.

Hypothesis 4 (H4) states that technical literacy influences the association between low-cost solutions and sustainable landscape design. Technology literacy's mediation of low-price techniques and sustainable landscape layout is prime to understanding how those strategies result in sustainability outcomes. The use of many technologies is regularly had to maximize the sustainability of low-price techniques (Tzima, Styliaras, Bassounas, & Tzima, 2020). Using GIS and far-flung sensing, landscape architects can construct low-price green infrastructure like rain gardens and permeable pavements in suitable locations to control stormwater and enhance water fine. Professional landscapers may use low-fee sustainable landscape layout solutions by mastering these technologies (Morales-Menendez, Ramírez-Mendoza, & Guevara, 2019). Technical literacy facilitates individuals and organizations to collect and understand low-price venture records. Weather stations, soil moisture sensors, and energy consumption meters can help pick out and set up low-cost, aid-efficient landscape design additives (Aparo, Odongo, & De Steur, 2022). Technological literacy streamlines information processing and interpretation, aligning low-value techniques with long-term desires.

Hypothesis 5 suggests that technology literacy influences the link between Big Data and sustainable landscape design is supported by theoretical and empirical studies. Big data can improve sustainable landscape design with the aid of offering valuable records (Cain & Pino, 2023). Landscape enterprise specialists should be able to use the era effectively to comprise huge facts. Technological literacy allows humans and businesses to examine, investigate, and follow Big Data analytics facts (El-Haddadeh, Osmani, Hindi, & Fadlalla, 2021). Landscape architects and architects with records control and interpretation abilities might also use Big Data to optimise sustainability (Y. Lu, Xu, Liu, & Wu, 2022). This mediating role underlines the significance of technical literacy for landscape practitioners to bridge the records availability-to-sustainable landscape design divide.

Hypothesis 6 suggests that technical literacy mediates the link between AI and sustainable landscape design, reinforced by AI's revolutionary potential. AI technologies offer statistics analysis, layout optimization, and predictive modelling to increase landscape sustainability. To practice AI effectively, landscaping experts ought to be tech-savvy (Al Ghatrifi, Al Amairi, & Thottoli, 2023). Technological literacy facilitates landscape architects and designers to traverse AI-driven systems, understand AI insights, and make educated decisions based totally on AI ideas (Nabizadeh Rafsanjani & Nabizadeh, 2023). AI specialists ensure that AI integration affects sustainable landscape designs that fulfil environmental, social, and economic goals. For landscape designers to surely gain from AI's sustainability promise, technical literacy is important.

Hypothesis 7 is crucial to understanding sustainable landscape design dynamics. Technology literacy and sustainable landscape design are moderated by material, financial, and human resource availability. Technical literacy can improve sustainable landscape layout in resource-rich locations with abundant financial and material sources (M. Kumar et al., 2022). Technology-savvy designers might also adopt aid-extensive sustainable layout solutions. Creative, excessive-tech sustainable landscape designs, including green infrastructure tasks that require a predominant financial commitment, are feasible with plentiful resources (Paas et al., 2021). Technology literacy reduces resource restrictions in useful resource-restrained environments. Proficient users can beautify aid efficiency with novel technology (Dubey, Bryde, Dwivedi, Graham, & Foropon, 2022). Accessibility and price of technical training and education rely on aid availability. Rich locations can also have greater technological literacy applications and resources. Resource-limited places may also conflict to advantage of the necessary abilities and facts, needing extra specialized procedures.

CONCLUSION

Sustainable landscape design and its various factors are studied in this study. This study evaluated how low-cost methods, Big Data, and AI integration affect sustainable design in the ever-changing field. Technical literacy and resource availability mediate. The results suggest that resource availability impacts sustainability and that technical knowledge aids creativity. Big data, AI, and cheap solutions can transform landscape design. These technologies boost sustainability significantly. The implications for communities, schools, decision-makers, and landscape specialists are significant. Knowledge and technology are used to create resilient, economical, and ecologically conscientious landscapes. This study establishes the framework for sustainable landscape design research, which improves the search for landscapes that improve human well-being, nature, and sustainability.

IMPLICATIONS

Practical Implications

The practical implications of the studies suggest landscape architects and designers use Big Data and AI skills to higher their practices at little cost. This may also bring about more fee-effective, useful resource-green, and sustainable landscape designs. The studies stress the want of generation literacy talent development. Landscape specialists need to gather essential technological skills to use them well in their obligations. Community engagement becomes a sensible issue, emphasizing the importance of nearby populations in sustainable landscape layout. These communities may actively engage in data collecting, decision-making, and project execution, fostering ownership and ensuring designs meet local needs. Finally, the findings can assist policymakers and urban planners in designing policies that support sustainable landscape practices, low-cost solutions, and AI and data-driven decision-making in public and private initiatives.

Theoretical Implications

The study also affects sustainable landscape design theory. Sustainable design requires ecological, technical, and socioeconomic abilities, therefore transdisciplinary knowledge and cooperation are crucial. Theoretical frameworks should study these interactions to teach sustainable design concepts. The research emphasizes how sustainability changes with technology, resource availability, and social requirements. Sustainability theories should evolve to meet these developments. Technical literacy is stressed in the theoretical discussion as a vital mediator between several variables and sustainable landscape design. This acknowledgement deepens sustainability theories by emphasizing knowledge and skills in sustainable practices. The study shows how resource availability affects landscape design, with theoretical considerations emphasizing its moderating influence. A detailed grasp of how landscape design processes could adapt to resource constraints adds to the field's theoretical debate on sustainability.

LIMITATIONS

This study has some limitations. First, the study was done in one place, Xuzhou, Jiangsu, therefore its findings may not apply to other geographic, cultural, or economic circumstances. However, geographical features and resource availability can dramatically affect low-cost techniques, Big Data utilization, and AI integration. Landscape specialists self-reported data, which may have impacted the conclusions and reduced their impartiality. The hypotheses' mediating and moderating connections were only examined in isolation, thus complex interactions between these factors may be present. The study's cross-sectional methodology provides a snapshot of the associations at a given period, limiting our ability to discover long-term impacts and trends in sustainable landscape design practices.

FUTURE DIRECTIONS

Given these constraints, various possibilities for further research arise. To begin, comparative studies throughout unique countries and cultures would aid in elucidating how the impact of low-value techniques, Big Data, and AI integration vary in special circumstances, adding an extra complete understanding of sustainable landscape design processes globally. Longitudinal studies should shed light on the field's shifting dynamics and developments, monitoring the trajectory of technical breakthroughs and their effect on sustainability across time. Exploring the intricate interplay between low-price techniques, Big Data, AI, technical literacy, and resource availability the usage of advanced statistical approaches which includes structural equation modelling may result in a higher knowledge of their complex interactions. Furthermore, research on the moral implications and potential downsides of extra technological use in landscape design is crucial. Finally, destiny studies ought to attempt to set up sensible recommendations and suggestions for stakeholders in sustainable landscape layout, converting theoretical findings into tangible solutions for developing greater resilient and sustainable landscapes.

CONFLICT OF INTEREST

No conflict of interest was reported by the authors.

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Appendix-1

Questionnaire

Demographic Information (Please choose one option from Demographic information)

Gender

______Male

______Female

______Prefer not to disclose

Age

______18-24 years

______25-34 years

______35-44 years

______45-54 years

______55 years and above

Educational Background

______High school diploma or equivalent

______Bachelor's degree

______Master's degree

______Doctoral degree

______Other (please specify)

1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

Low-Cost Strategies	1	2	3	4	5
Passive Solar Design					
Energy-Efficient Windows					
Thermal Insulation					
Cool Roofs					
Rainwater Harvesting					
Greywater Recycling					
Solar Panels					
Energy-Efficient Appliances					
LED Lighting					
Natural Ventilation					
Green Building Materials					
Compact Design					
Community Gardens					
Bicycle Infrastructure					
Public Transportation Access					
Low-Flow Fixtures					
Composting Toilets					
Native Landscaping					
Recycling Stations					
Energy-Efficient HVAC					
Green Building Certifications					
Utilization of Big data					
How often do you collect and analyze data in your smart house to improve its functionality and efficiency?					

If you collect and analyze data, what types of data sources are you primarily using in your smart house?					
How do you utilize the data collected in your smart house?					
What challenges have you encountered in utilizing big data for your smart house?					
Are you satisfied with the benefits you have gained from utilizing big data in your smart house?					
Would you be open to sharing your smart house data (anonymously and securely) for broader research purposes aimed at improving smart home technologies?					
Technological Literacy					
I am confident in my ability to use modern technology tools and applications effectively.					
I feel comfortable using technology to access information and resources related to sustainable landscape design.					
I believe I have the skills to learn and adapt to new technological advancements in sustainable design.					
I frequently use technology (e.g., the internet, software applications) to access information and resources related to sustainable landscape design.					
Integration of AI					
AI technology plays a significant role in the planning and design of sustainable landscape projects within our village.					
The use of AI tools enhances the efficiency and effectiveness of sustainable design practices in our village.					
AI integration helps in the optimization of resource utilization and cost-effectiveness in sustainable landscape projects.					
AI-driven design decisions have a positive impact on the environmental sustainability of our village.					
Resource Availability					
Financial resources within the village are sufficient to support sustainable landscape design initiatives.					
Access to skilled labor or expertise within the village for sustainable design projects is readily available.					
Necessary materials and equipment for sustainable landscape design projects are abundant within the village.					
The village has excellent technological infrastructure (e.g., internet connectivity, and access to relevant software) to support the integration of technology in sustainable design.					
Sustainability					
Efforts to enhance environmental sustainability in our village, such as eco-friendly landscaping, are evident.					
The preservation of our natural surroundings and biodiversity is a priority in sustainable landscape design.					
Sustainable design initiatives have positively impacted the economic well-being of our village.					
Investments in sustainable landscape projects have led to increased economic opportunities for residents.					
Sustainable landscape projects have enhanced community cohesion and social connections.					
Sustainable design projects promote accessibility and inclusivity for all residents, regardless of age or ability.					