

## Article

# Toward the Adaptation of Green Bonds in the Saudi Municipal System: Challenges and Opportunities

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## Abstract

This study explores the adoption of green bonds within Saudi Arabia's municipal sector, situated at the intersection of centralized governance, fossil fuel dependency, and ongoing sustainability reforms under Vision 2030. Employing a mixed-methods approach, this research integrates quantitative and qualitative insights from expert survey data to uncover key institutional, market, and stakeholder dimensions influencing green bond uptake. The findings reveal an emerging framework shaped by regulatory capacity, global integration, and risk perceptions. Rather than focusing solely on statistical outputs, this study highlights how governance structures, economic diversification efforts, and stakeholder alignment collectively shape the trajectory of green finance adoption. Practical implications include the need for harmonized regulatory frameworks, enhanced transparency through ESG standards, and stronger public-private collaboration. While focused on Saudi Arabia, this study offers broader lessons for green bond integration in similarly structured, resource-dependent economies.

**Keywords:** green bonds; Saudi Arabia; sustainable finance; Vision 2030; institutional capacity; emerging markets; ESG; municipal governance



Academic Editor: Hyunchul Ahn

Received: 19 May 2025

Revised: 14 June 2025

Accepted: 16 June 2025

Published: 20 June 2025

**Citation:** Alhowaish, A.K. Toward the Adaptation of Green Bonds in the Saudi Municipal System: Challenges and Opportunities. *Sustainability* **2025**, *17*, 5698. <https://doi.org/10.3390/su17135698>

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## 1. Introduction

The global transition toward sustainable finance has positioned green bonds as a pivotal instrument for financing climate-resilient infrastructure and advancing low-carbon economies [1,2]. In emerging markets, green bonds offer a viable pathway for aligning economic growth with environmental sustainability. Yet, their uptake remains uneven due to institutional fragmentation, limited technical capacity, and misaligned stakeholder incentives [3,4].

Saudi Arabia, guided by its ambitious Vision 2030 agenda, presents a compelling but underexplored context. Vision 2030 prioritizes economic diversification and environmental stewardship, targeting 50% renewable energy in the national electricity mix by 2030, and identifies green bonds as a strategic tool for financing municipal projects such as smart cities, clean mobility, and renewable energy grids [5]. Despite this policy emphasis, the uptake of municipal green bonds remains limited compared to regional peers such as the UAE [6] and Egypt [7]. This shortfall is rooted in systemic challenges, centralized governance structures, persistent fossil fuel dependency, and regulatory underdevelopment, which impede effective local adoption [8,9].

The core problem that this study addresses is the disconnect between national-level sustainability ambitions and local-level implementation capacities in Saudi Arabia's municipal sector. While Vision 2030 outlines clear green finance objectives, municipalities

often lack the regulatory autonomy, technical infrastructure, and stakeholder coordination mechanisms necessary to operationalize green bond frameworks.

The existing literature on green bond diffusion is heavily weighted toward global or macro-regional analyses, with limited empirical attention given to the role of local governance in resource-dependent, centrally administered economies [10–12]. Although some studies highlight the importance of public–private partnerships and international green finance standards [13,14], there is a lack of research explicitly examining how national visions such as Saudi Arabia’s are translated, or constrained, at the municipal level under centralized governance systems [15].

This study contributes to the literature by offering a novel empirical investigation of green bond adoption at the municipal level within Saudi Arabia, using institutional and stakeholder theories to explore the interdependencies shaping local financial innovation. It responds to a gap in the current research by integrating survey data and econometric modeling to identify actionable institutional drivers and barriers, thereby advancing knowledge in both sustainable finance and governance studies. To this end, the study addresses three guiding research questions:

- (1) What institutional barriers impede green bond adoption in Saudi municipalities?
- (2) How can Vision 2030’s objectives be strategically leveraged to accelerate adoption?
- (3) What targeted interventions can enhance stakeholder engagement and technical capacity at the local level?

Methodologically, the research adopts a mixed-methods design, combining an Exploratory Factor Analysis (EFA) of expert survey responses ( $n = 174$ ) with linear regression modeling. Drawing from institutional theory [16] and stakeholder theory [17], the analysis examines how regulatory readiness, market dynamics, and governance structures influence municipal-level decision-making on green bonds [18–20].

The findings indicate that institutional alignment (e.g., regulatory harmonization and technical expertise) and market orientation (e.g., ESG investor engagement) are key enablers of adoption, while persistent challenges, such as investor skepticism and high verification costs, undermine progress. By situating these results within Saudi Arabia’s socio-political context, this study provides both theoretical advancement and practical policy insights for scaling sustainable finance in similar centralized, resource-dependent settings.

The remainder of the paper is structured as follows: Section 2 reviews the literature, Section 3 outlines the methodology, Section 4 presents the findings, Section 5 discusses implications, and Section 6 concludes with recommendations for future research.

## 2. Literature Review

This section critically reviews the existing literature on green bond adoption globally and regionally, with a focus on emerging markets and Saudi Arabia’s context. It also identifies persistent institutional barriers, governance dynamics, stakeholder complexities, and unresolved tensions in the implementation of green municipal finance.

### 2.1. Global Progress and Emerging Market Gaps

Green bonds have become a prominent financing mechanism for sustainable development, particularly in advanced economies where regulatory ecosystems support transparency, investor confidence, and standardization. The European Union (EU), for example, has established cohesive frameworks such as the EU Green Bond Standard, which has catalyzed public and private sector issuances [21,22]. France’s EUR 7 billion sovereign green bond issuance in 2022 financed clean energy and transportation initiatives, exemplifying how regulatory clarity and institutional maturity drive adoption [23].

In contrast, green bond diffusion in emerging markets is far more fragmented. Several Latin American, Asian, and African countries face structural challenges, including inconsistent certification systems, overlapping governance, and investor skepticism. Chile's sovereign green bond efforts stalled due to mismatched national–municipal certification frameworks, highlighting the friction between policy ambition and implementation capacity [24]. Similarly, Indonesia's municipal-level bond programs have faltered due to underdeveloped project pipelines and low market trust [25–29].

Recent global studies have deepened our understanding of how ESG performance influences green bond pricing and investor behavior. For instance, Liu [30] provided a comprehensive cross-national analysis linking ESG ratings with yield differentials in sovereign and corporate green bonds, highlighting how transparency and environmental performance affect investor confidence. While our study does not directly assess pricing mechanisms, it complements the literature by examining how institutional readiness, stakeholder perceptions, and national governance shape the adoption environment in emerging markets like Saudi Arabia.

There is also a growing concern around “greenwashing,” the mislabeling of environmentally damaging projects as green. China's rapid market growth, while impressive, has been marred by criticisms for permitting coal-linked projects under green bond frameworks, raising global debates about credibility and environmental integrity [31–36]. These controversies reveal fundamental disagreements over what constitutes a “green” investment and expose weaknesses in global standard alignment.

## 2.2. The Saudi Context: Between Vision and Implementation

Saudi Arabia's Vision 2030 outlines a comprehensive roadmap for economic diversification and environmental transformation. Green bonds are recognized as key instruments for financing major sustainability initiatives, including renewable energy infrastructure, smart cities, and transit systems [5,37–40]. However, implementation lags significantly behind policy intentions.

Unlike the UAE, which has pioneered successful municipal green bond initiatives such as Masdar City, Saudi projects like NEOM remain heavily reliant on sovereign wealth and traditional state financing [41–44]. This reflects a structural misalignment between national ambition and local financial innovation. Riyadh's planned metro expansion via green bonds was halted due to overlapping ministerial responsibilities, revealing acute regulatory fragmentation [45,46]. Likewise, Jeddah's flood mitigation projects, despite eligibility, continue to depend on government funding, bypassing green capital markets [45].

This disconnect is compounded by the centralized governance structure, where municipalities lack fiscal autonomy, specialized green finance units, or trained personnel capable of designing and managing bond issuance. By comparison, Egypt's Green Finance Unit and Morocco's Green Finance Facility have enhanced interagency coordination and built local expertise, facilitating smoother issuance and compliance processes [47–49].

Furthermore, the potential for integrating Islamic finance into the green bond ecosystem remains underexplored in the Saudi context. Indonesia's oversubscribed green sukuk demonstrates how aligning ESG criteria with Shariah principles can expand investor bases and enhance cultural relevance [50,51]. This presents a promising yet underutilized avenue for Saudi Arabia's municipalities.

## 2.3. Institutional Barriers and Governance Bottlenecks

Governance fragmentation remains a core barrier in both developed and developing economies, but its effects are particularly severe in centrally controlled contexts like Saudi Arabia. Regulatory incoherence, bureaucratic overlaps, and ambiguous jurisdictional

authority stall project approvals and dilute accountability. Dammam's delay in aligning waste treatment projects with the Climate Bonds Standard reflects broader technical and regulatory limitations [52,53].

International experiences reinforce the importance of vertical integration. Mumbai and Monterrey encountered delays in their bond-financed infrastructure projects due to conflicts between municipal and national regulations [54,55]. In contrast, Ethiopia's Addis Ababa successfully implemented green bond-funded rail systems by aligning federal mandates, World Bank support, and local stakeholder engagement, showing the value of multi-level governance coherence [10,56].

The literature also identifies normative and cognitive barriers, such as low investor trust and a lack of awareness among municipal actors, as significant deterrents to green bond issuance. In Saudi Arabia, institutional skepticism toward long-term financial instruments, coupled with limited technical expertise, restricts innovative approaches to project financing [57]. Local investors' preference for short-term returns echoes patterns observed in Indonesia and South Africa [58].

#### *2.4. Stakeholder Engagement and Missed Opportunities*

While structural and regulatory limitations are critical, stakeholder engagement is equally vital. Projects can fail if local actors, developers, contractors, auditors, or citizens are not aligned. Egypt's implementation of green building codes was initially met with resistance from construction stakeholders but succeeded after workshops and fiscal incentives were introduced [34,46].

Saudi Arabia has yet to deploy similar engagement strategies. Collaborative models such as Morocco's training programs or Kenya's religious leader partnerships for promoting green sukuk offer replicable lessons for Saudi municipalities [35,36,48]. Moreover, capacity building remains a critical bottleneck. Malaysia's Securities Commission addressed this by certifying over 500 professionals in green finance, significantly improving market readiness [59,60]. Saudi institutions like the National Debt Management Center and KAUST could replicate this model by developing joint certification programs to foster a qualified local ecosystem capable of driving sustainable finance adoption.

#### *2.5. Gaps in the Literature and Study Contributions*

While global research often focuses on the macroeconomic and policy-level aspects of green bonds, few studies empirically explore municipal-level dynamics in resource-dependent, centralized economies like Saudi Arabia [52,61]. The literature also underrepresents the role of hybrid financial models (e.g., PPPs and sukuk), regulatory fragmentation, and cultural dimensions affecting investor confidence and stakeholder behavior [33,51,55].

This study responds to these gaps by offering a multi-theoretical, empirically grounded investigation of green bond adoption across Saudi municipalities. It synthesizes insights from the following:

- Institutional theory: to analyze regulatory frameworks and organizational readiness.
- Stakeholder theory: to examine alignment and engagement across sectors.
- Innovation diffusion theory: to trace the uneven uptake and adaptation of green financial tools.

By doing so, this study provides a context-sensitive framework that identifies key enablers, barriers, and policy interventions relevant not only to Saudi Arabia but to other emerging economies with centralized governance systems.

### 3. Materials and Methods

This study adopts a mixed-methods research design to explore the barriers and enablers of green bond adoption within Saudi Arabia's municipal sector. The rationale for using a mixed-methods approach stems from the complexity of the research problem, which involves both measurable institutional factors and subjective stakeholder perceptions. Combining a quantitative analysis with qualitative insights allowed for a more holistic examination of regulatory readiness, stakeholder engagement, and financial dynamics, consistent with institutional and stakeholder theory frameworks [62–64].

#### 3.1. Research Design and Methodological Justification

A mixed-methods design was chosen to address three interlinked research questions:

- (1) What institutional barriers impede green bond adoption in Saudi municipalities?
- (2) How can Vision 2030's objectives be leveraged to accelerate adoption?
- (3) What interventions can enhance stakeholder engagement and technical capacity?

The integration of Exploratory Factor Analysis (EFA) and regression modeling enabled the identification of latent constructs (e.g., regulatory capacity and investor perception), while a thematic analysis of open-ended responses enriched the interpretation of numerical patterns. This triangulated approach enhanced internal validity and offered both statistical robustness and contextual nuance.

#### 3.2. Sampling Strategy and Limitations

The target population consisted of experts actively engaged in green finance, public infrastructure, and policy development. A purposive sampling strategy was adopted to ensure that respondents possessed domain-specific expertise, defined by a minimum of five years of experience in the relevant sectors [62,64]. The sample included four stakeholder groups: municipal officials (e.g., urban planners and city engineers); financial professionals (e.g., ESG analysts and sukuk structurers); policymakers (e.g., from the Ministry of Finance and the Ministry of Environment); and academics specializing in green economy and urban sustainability.

From a sampling frame of 200 experts, 174 valid responses were obtained, with an 87% response rate, which is above the typical 70–80% threshold observed in expert surveys across the GCC region [52,61,65–67]. The sample size was calculated using Cochran's formula with a 95% confidence level and a 5% margin of error. However, the relatively modest sample size may limit generalizability. Moreover, since participants were concentrated in urban administrative hubs (e.g., Riyadh, Jeddah, Dammam), there may be an underrepresentation of smaller municipalities, introducing a potential response bias toward more developed cities.

Additionally, given the timeframe of data collection (February–April 2025), the findings may reflect temporal sensitivities tied to recent sustainability policy shifts under Vision 2030 and external shocks (e.g., fluctuating oil prices and COP28 negotiations). These temporal dynamics may influence expert assessments and are noted as contextual limitations. A future longitudinal analysis is recommended to track evolving perceptions across key milestones in Saudi Arabia's green finance agenda.

#### 3.3. Questionnaire Development and Variable Selection

The structured questionnaire was developed based on a systematic literature review examining green bond frameworks, including the Climate Bonds Initiative (CBI), Vision 2030 sustainability indicators, and prior research on green finance adoption in emerging markets. It was organized into four distinct sections: respondent demographics; perceived challenges and enablers measured using 5-point Likert scales; a ranking exercise



for policy priorities; and open-ended qualitative questions seeking insights on green bond implementation.

Furthermore, variable selection for the subsequent Exploratory Factor Analysis (EFA) was guided by both theoretical and empirical foundations. Specifically, items included in the factor analysis represented key constructs, such as Institutional and Regulatory Capacity (e.g., legal framework clarity and staff expertise), Market Attractiveness (e.g., ESG product demand and investor confidence), and Stakeholder Engagement (e.g., inter-ministerial alignment and PPP participation). The inclusion of these variables adhered to three criteria: theoretical relevance drawn from institutional and stakeholder theory; empirical precedence established in the literature on green bond barriers and drivers; and feedback from pilot testing with five senior sustainable finance advisors, which demonstrated good internal consistency (Cronbach's  $\alpha = 0.82$ ).

### 3.4. Analytical Techniques

Data analysis was performed using SPSS v28 for quantitative data and NVivo 12 for qualitative data. Quantitative procedures included generating descriptive statistics to profile participants and summarize responses, conducting ANOVA tests to compare perceived barrier severity across different stakeholder groups, and applying Chi-square tests to examine associations between categorical variables such as sector affiliation and policy alignment [68]. A further quantitative analysis involved Exploratory Factor Analysis (EFA), utilizing principal axis factoring with oblique rotation to identify the underlying latent constructs, followed by multiple linear regression modeling to assess the impact of key predictors (including Vision 2030 alignment, technical capacity, and investor skepticism) on the dependent variable, green bond adoption likelihood.

Qualitative responses from open-ended questions were systematically coded thematically within NVivo 12. This process uncovered significant emerging issues not addressed by the structured questionnaire, such as cultural resistance to sustainable finance practices and interagency coordination conflicts [69,70]. Crucially, the findings derived from both quantitative and qualitative analyses were integrated through methodological triangulation. This deliberate cross-validation of key themes between the numerical data and narrative insights significantly enhanced the overall credibility and robustness of the study's conclusions.

While the use of EFA and linear regression provides insights into the factor structures and predictive relationships, the authors acknowledge that cross-sectional survey data limit the ability to fully address endogeneity. Due to the absence of longitudinal data and natural experiments, advanced causal techniques such as instrumental variable (IV) regression or propensity score matching (PSM) could not be implemented in this study. Nonetheless, the research attempts to reduce bias through triangulation and robustness validation, as detailed in Section 3.6.

### 3.5. Ethical Considerations and Validity

Ethical approval was granted by the Imam Abdulrahman Bin Faisal University Review Board (IRB-2025-06-0179). Digital informed consent was obtained from all participants, and anonymity was maintained throughout. The risk of social desirability bias was mitigated by using online surveys without institutional identifiers. To enhance reliability and transparency, however, a detailed summary of the variable constructs and coding definitions is provided in Appendix A. The use of validated survey tools and an adherence to methodological rigor strengthen the trustworthiness and reproducibility of this study.

### 3.6. Robustness and Endogeneity Mitigation

To assess the robustness of the findings and address potential bias, several post-estimation validation techniques were applied. First, a subgroup analysis was conducted

comparing mean responses from public-sector and private-sector respondents. Results showed consistent factor-loading structures across both subgroups, suggesting minimal systemic bias due to professional backgrounds. Second, sensitivity tests were performed by excluding one item from each latent construct in the EFA to examine the impact on factor integrity. The resulting structures remained stable, with Cronbach's  $\alpha$  values above 0.75, confirming the internal consistency of the constructs.

Although traditional endogeneity correction methods such as IV regression or PSM require longitudinal or experimental data, we recognize their value. The research design limitations have been acknowledged in Section 6, and we propose that future studies explore project-level datasets or time-structured expert panels to enable causal modeling. Potential instrumental variables could include exogenous policy shocks (e.g., sovereign bond announcements) or green finance subsidies differentiated across municipalities. These advanced techniques will be crucial for the more granular attribution of causality in green bond adoption research.

## 4. Results and Discussion

This section presents the empirical findings from the survey and regression analyses, followed by a critical discussion of their theoretical implications in the context of Saudi Arabia's green bond landscape.

### 4.1. Empirical Findings

#### 4.1.1. Demographic Profile of Respondents

The demographic profile of the 174 participants reveals key insights into the expertise and institutional roles that influence perceptions of green bond adoption in Saudi municipalities. Descriptive statistics indicate that the majority of respondents were professionals in finance/banking/ESG investing (43.7%), followed by policymakers (23.6%), municipal governance experts (18.4%), and academics (14.4%). Over 39% of participants had 5–10 years of professional experience, while 14.9% had more than 15 years, reflecting a sample that is weighted toward mid-career expertise (Table 1). These findings align with purposive sampling strategies commonly used in policy research to prioritize domain-specific knowledge [71]. The mean number of years of experience across all sectors was 10.4, suggesting a robust understanding of green economy frameworks—an essential factor in assessing municipal financial instruments [46,61].

Inferential analyses examined relationships between demographic variables. A one-way ANOVA revealed no significant differences in the mean years of experience across sectors ( $F = 1.12$ ,  $p = 0.34$ ), indicating homogeneity in professional tenure [68,72]. However, a Chi-square test identified a significant association between sector and role ( $\chi^2 = 28.71$ ,  $p = 0.002$ ), with policymakers disproportionately represented as decision-makers and academics as researchers. This reflects institutional theory's emphasis on isomorphic pressures that shape role specialization in bureaucratic systems [60,61]. Weak associations between experience and role ( $\chi^2 = 16.89$ ,  $p = 0.05$ ) suggest that seniority does not solely dictate functional responsibilities, a finding consistent with critiques of hierarchical governance structures in emerging markets [46,52].

These findings underscore the significance of sector-specific strategies to advance green bond adoption. The dominance of finance professionals highlights opportunities to leverage ESG investment trends, whereas the underrepresentation of municipal governance experts signals potential weaknesses in the local implementation capacity. Such disparities align with the broader literature on stakeholder misalignment in sustainable finance [19,20,34,56] and reinforce the need for targeted capacity-building initiatives, as recommended in Vision 2030's institutional reform agenda [5].

**Table 1.** (a) Demographic characteristics of respondents (N = 174). (b) Frequency distribution by sector and role. (c) Frequency distribution by sector and year of experience.

(a)					
Variable	Category	Frequency	%		
Years of Experience	Less than 5 years	35	20.1%		
	5–10 years	68	39.1%		
	10–15 years	45	25.9%		
	More than 15 years	26	14.9%		
Sector	Municipal governance/ urban planning	32	18.4%		
	Finance/banking/ ESG investing	76	43.7%		
	Polycymaking	41	23.6%		
	Academia/Research	25	14.4%		
Role	Decision-maker	48	27.6%		
	Advisor/consultant	67	38.5%		
	Technical expert	34	19.5%		
	Academic researcher	25	14.4%		
(b)					
Sector	Frequency	%	Dominant Role		
Government Agencies	58	33.3%	Policy and Regulation		
Private Finance	42	24.1%	Risk/ESG Analysts		
Academia/Research	37	21.3%	Sustainability Expert		
Project Developers	25	14.4%	Project Manager		
NGOs/Consultants	12	6.9%	Advocacy/Policy		
(c)					
Sector	0–5	6–10	11–15	16+	Total
Municipal Governance/Urban Planning	1	0	3	3	7
Finance/Banking/ESG Investing	2	3	4	1	10
Polycymaking (MoF, Municipal Affairs)	2	1	1	0	4
Academia/Research	3	1	7	4	15
Total	8	5	15	8	36

*Note.* Mean years of experience = 10.4 (SD = 4.2). Key statistical results: one-way ANOVA: no significant differences in mean years of experience across sectors ( $F = 1.12, p = 0.034$ ). Chi-square test: a significant association between sector and role ( $\chi^2 = 28.71, p = 0.002$ ).

#### 4.1.2. Challenges in Green Bond Adoption

This section examines the stakeholder perceptions of challenges impeding green bond adoption in Saudi municipalities, drawing on descriptive and inferential analyses of responses from a sample of 174 experts. The findings highlight systemic barriers consistent with the broader literature on institutional fragmentation and stakeholder engagement in emerging markets [19,20,34]. A Likert-scale-based survey assessed six key challenges, with responses analyzed through frequency distributions, means, and Chi-square/ANOVA tests to identify patterns and interdependencies.

The most pressing challenges, as presented in Table 2, were low public awareness regarding environmental benefits (mean = 3.22) and investor skepticism about financial returns (mean = 3.14). Over 45% of respondents agreed or strongly agreed that a limited



public understanding of the environmental value of green bonds suppresses demand, mirroring findings from Indonesia and Egypt, where awareness campaigns were critical to market growth [7,42,58]. Similarly, 43.6% of experts cited investor skepticism, reflecting risk-aversion trends in hydrocarbon-dependent economies [66]. These results align with stakeholder theory, which emphasizes the need to balance diverse interests to advance sustainable finance [34,56].

**Table 2.** Perceived challenges in green bond adoption.

1. Perception of Challenges (1 = Strongly Disagree; 5 = Strongly Agree; n = 174)		
Challenge	Mean (SD)	Frequency Distribution (%)
Lack of regulatory frameworks	2.91 ( $\pm 1.21$ )	1: 16%, 2: 26%, 3: 18%, 4: 30%, 5: 10%
Insufficient technical expertise	3.02 ( $\pm 1.15$ )	1: 13%, 2: 22%, 3: 24%, 4: 35%, 5: 8%
Investor skepticism	3.14 ( $\pm 1.09$ )	1: 10%, 2: 17%, 3: 29%, 4: 36%, 5: 8%
High verification costs	2.65 ( $\pm 1.18$ )	1: 20%, 2: 29%, 3: 23%, 4: 22%, 5: 6%
Low public awareness	3.22 ( $\pm 1.03$ )	1: 9%, 2: 14%, 3: 32%, 4: 37%, 5: 8%
Misalignment with Vision 2030	3.10 ( $\pm 1.14$ )	1: 12%, 2: 18%, 3: 28%, 4: 33%, 5: 9%
Statistical note: significant differences across barriers ( $F = 4.76$ , $p = 0.001$ ).		
2. Key Chi-Square Associations		
Association	Chi <sup>2</sup>	p-Value
Regulatory frameworks vs. technical expertise	45.32	0.001 *
Investor skepticism vs. public awareness	24.15	0.08

\*  $p < 0.05$ .

Regulatory and technical barriers also emerged prominently. The absence of clear regulatory frameworks in municipalities (mean = 2.91) and a lack of sufficient technical expertise (mean = 3.02) were cited by 39.7% and 42% of respondents, respectively. The strong association between these challenges ( $\chi^2 = 45.32$ ,  $p < 0.001$ ) underscores institutional theory's emphasis on isomorphic pressures, where fragmented policies often correlate with capacity gaps [73,74]. For instance, Riyadh's stalled metro expansion—attributed to overlapping jurisdictions—exemplifies this interplay [41]. Conversely, high verification costs (mean = 2.65) received weaker consensus, suggesting that certification expenses are less prohibitive than commonly assumed, though still notable in Saudi Arabia's nascent market.

Inferential analyses revealed significant differences in the perceived severity of challenges (ANOVA:  $F = 4.76$ ,  $p < 0.001$ ). Post hoc tests confirmed that low public awareness ranked higher than verification costs ( $p = 0.003$ ), while investor skepticism marginally exceeded regulatory gaps ( $p = 0.06$ ). These disparities reflect the unique socio-economic context of Saudi Arabia, where the rapid urbanization targets of Vision 2030 have outpaced municipal readiness [5,75–77]. The weak association between investor skepticism and public awareness ( $\chi^2 = 24.15$ ,  $p = 0.08$ ) further signals that these issues, while overlapping, require distinct interventions—a nuance often overlooked in global studies [1,8,13].

The findings advocate for integrated policy reforms. For instance, Morocco's success in reducing verification costs through PPPs [48] offers a model for Saudi municipalities, while Indonesia's sukuk-based green bonds demonstrate how cultural alignment can mitigate investor skepticism [26,58]. Technical training programs, similar to Malaysia's certification initiatives [59,60], could help bridge expertise gaps, aligning with Vision 2030's objectives for human capital development.

#### 4.1.3. Opportunities for Green Bond Adoption

This section analyzes the stakeholder perceptions of opportunities to advance green bond adoption in Saudi municipalities, drawing on the descriptive and inferential analyses of responses from a sample of 174 experts. The findings align with global studies on sustainable finance mechanisms and Vision 2030's strategic emphasis on economic diversification and renewable energy [4–6,11]. A Likert-scale-based survey assessed six key opportunities, revealing consensus on critical pathways for institutional and market development.

The most strongly endorsed opportunities, as demonstrated in Table 3, were the diversification of funding sources beyond oil revenues (mean = 3.67) and the strategic utilization of Vision 2030's framework (mean = 3.55). Over 66% of the experts agreed or strongly agreed that municipal green bonds could reduce hydrocarbon dependency, reflecting global ESG investment trends that prioritize climate-aligned assets [19,41,66]. Similarly, 63.2% affirmed Vision 2030's role in scaling green bonds, underscoring the policy's potential to harmonize municipal projects with national sustainability targets. These results resonate with institutional theory, which posits that cohesive policy frameworks drive isomorphic change across governance tiers [16,19,20].

**Table 3.** Perceived opportunities for green bond adoption.

1. Perception of Opportunities (1 = Strongly Disagree, 5 = Strongly Agree; n = 174)		
Challenge	Mean (SD)	Frequency Distribution (%)
Vision 2030 framework	3.55 (±1.12)	1: 7%, 2: 10%, 3: 20%, 4: 47%, 5: 16%
Attract foreign investors	3.50 (±1.07)	1: 5%, 2: 13%, 3: 23%, 4: 45%, 5: 14%
PPPs reduce financing risks	3.33 (±1.18)	1: 9%, 2: 14%, 3: 26%, 4: 37%, 5: 14%
Untapped renewable energy potential	3.49 (±1.04)	1: 6%, 2: 9%, 3: 29%, 4: 43%, 5: 13%
Improve global rankings	3.31 (±1.09)	1: 8%, 2: 12%, 3: 32%, 4: 39%, 5: 10%
Diversify funding beyond oil	3.67 (±1.01)	1: 5%, 2: 10%, 3: 22%, 4: 51%, 5: 16%
Statistical note: significant differences across opportunities ( $F = 3.89$ , $p = 0.002$ ).		
2. Key Chi-Square Associations		
Association	Chi <sup>2</sup>	p-Value
Vision 2030 framework vs. foreign investment	32.45	0.009 *
Diversification vs. global rankings	21.33	0.17

\*  $p < 0.05$ .

Attracting foreign investors (mean = 3.50) and unlocking municipalities' renewable energy potential (mean = 3.49) also garnered strong support. Nearly 60% of respondents viewed green bonds as viable tools to attract ESG-focused capital, mirroring successes in the UAE and Morocco, where sovereign green issuances catalyzed foreign investment [43]. However, PPPs received comparatively lower levels of consensus (mean = 3.33), likely due to perceived governance gaps, such as fragmented risk-sharing mechanisms—a challenge previously identified in Saudi municipal systems [52,61]. This disparity highlights the need for technical capacity building to optimize PPP frameworks.

Inferential analyses revealed statistically significant associations between opportunities. A Chi-square test showed a strong link between Vision 2030's framework and foreign investment potential ( $\chi^2 = 32.45$ ,  $p = 0.009$ ), suggesting that policy coherence amplifies investor confidence. Conversely, the association between funding diversification and improvements in global rankings was weak ( $\chi^2 = 21.33$ ,  $p = 0.17$ ), indicating these are perceived as distinct objectives. A one-way ANOVA confirmed significant differences in opportunity prioritization ( $F(5, 1038) = 3.89$ ,  $p = 0.002$ ), with post hoc tests showing

that diversification ranked higher than PPPs ( $p = 0.004$ ) and Vision 2030, exceeding global rankings ( $p = 0.03$ ).

These findings underscore several strategic imperatives for Saudi Arabia. First, policy harmonization is critical to align municipal projects with Vision 2030's renewable energy targets, such as the 50% clean electricity goal [38,39]. Second, investor outreach campaigns targeting international ESG funds could mirror Egypt's USD 750 million green bond success for wastewater projects [7]. Third, capacity-building programs for municipal staff, modeled on Malaysia's certification initiatives, would help address technical gaps in PPP structuring and risk management [60].

In conclusion, this study identifies diversification and Vision 2030 alignment as pivotal strategic opportunities, with foreign investment and renewable energy development as complementary drivers. While PPPs face skepticism, targeted reforms could transform them into viable tools. These insights contribute to academic discourse on sustainable finance in resource-dependent economies and offer pragmatic recommendations for Saudi policymakers to accelerate green bond adoption.

#### 4.1.4. Open-Ended Feedback on Green Bond Adoption

Qualitative insights from 174 stakeholders were thematically analyzed using NVivo 12, following a literature-based framework [69,70] to identify actionable strategies for accelerating green bond adoption in Saudi municipalities. Eight recurring themes emerged, reflecting institutional, collaborative, and stakeholder-centric challenges and opportunities. These findings align with the global sustainable finance literature and Vision 2030's strategic priorities, offering a roadmap for policy reform and market development. The most prominent theme, regulatory and institutional frameworks (21.8%), emphasized the need for clear policies and legal structures to standardize green bond issuance. Participants highlighted gaps such as "developing a clear regulatory framework" and "government framework need to be developed for GB," resonating with institutional theory's emphasis on isomorphic pressures to align municipal practices with national agendas [16,18,20]. Complementing this, capacity building and training (18.4%) emerged as critical, with calls to "train staff on green finance tools." These findings reflect the literature's assertion that technical expertise gaps hinder PPP efficacy in emerging markets [75], underscoring the need for Saudi Arabia to prioritize human capital development under Vision 2030.

Collaborative strategies also featured prominently. PPPs (16.1%) and international collaboration (14.4%) were advocated as a means to mitigate risks and leverage global best practices. Proposals like "follow international models such as Cape Town" and "leverage privatization programs" align with the literature, emphasizing cross-border knowledge transfer to reduce certification costs [49,76]. Similarly, innovative financing mechanisms (10.3%), such as green sukuk and circular economy projects, reflect Vision 2030's diversification goals [5,40,41] and mirror Indonesia's success in integrated Islamic finance with ESG principles [26,58]. Finally, the themes of transparency and reporting (8.6%) and sustainability integration (6.9%) highlighted the need for stronger governance and long-term planning. Recommendations like "issue transparent environmental impact reports" and "adopt blockchain to track fund usage" align with global ESG reporting standards [19]. Integrating sustainability into municipal workflows, such as "embedding SDGs into municipal work," reinforces stakeholder theory's call for balancing diverse interests [17,18]. Collectively, these insights advocate for a holistic approach that combines regulatory coherence, stakeholder engagement, and innovative finance to bridge the gaps between Saudi Arabia's green ambitions and municipal execution.

#### 4.1.5. Integrated Analysis of Challenges and Opportunities for Green Bond Adoption

This study combines EFA and linear regression analysis to identify the latent constructs and predictors of green bond adoption, leveraging insights from 174 experts. The findings align with institutional theory, stakeholder engagement frameworks, and global ESG trends, offering actionable strategies to support Saudi Arabia's Vision 2030 objectives. Across 12 variables, the EFA explored challenges and opportunities in green bond adoption, leveraging insights from 174 industry experts to inform its analysis. Data suitability was confirmed through a Kaiser–Meyer–Olkin (KMO) score of 0.78 and Bartlett's Test of Sphericity ( $\chi^2 = 842.31$ ,  $p < 0.001$ ), indicating robust factorability. Principal axis factoring with Varimax rotation extracted three factors (Table 4), cumulatively explaining 64.3% of the variance. Factor 1 (34.3% variance) captured institutional and regulatory themes, while Factors 2 (17.1%) and 3 (12.9%) reflected market dynamics and stakeholder risks, respectively. This structured approach ensured the identification of latent constructs critical to green bond implementation [3,7,21,22].

**Table 4.** Factor variance explained.

Factor	Eigenvalue	% Variance Explained	Cumulative %	Variables (Loadings $\geq 0.5$ )
1	4.12	34.3%	34.3%	Lack of regulatory frameworks (0.82); insufficient technical expertise (0.78); misalignment with Vision 2030 (0.65); Vision 2030's strategic framework (0.71); untapped renewable energy potential (0.68).
2	2.05	17.1%	51.4%	Attract foreign investors (0.83); diversify funding beyond oil revenues (0.76); improve global rankings (0.69); investor skepticism (0.61).
3	1.54	12.9%	64.3%	PPPs reduce financing risks (0.85); high verification costs (0.79); low public awareness (0.72).

The three factors revealed distinct yet interconnected dimensions. Factor 1, Institutional and Regulatory Capacity, combined challenges such as regulatory gaps and technical expertise shortages with opportunities linked to Vision 2030 and renewable energy potential. Factor 2, Market Attractiveness and Global Integration, connected foreign investment appeal and diversification needs with investor skepticism, emphasizing global ESG trends. Factor 3, Stakeholder Engagement and Risk Management, associated high verification costs and low public awareness to PPP-driven risk mitigation, underscoring governance transparency. Collectively, these factors highlight how institutional readiness, market confidence, and stakeholder collaboration jointly influence green bond adoption. Moreover, reliability analyses (Cronbach's  $\alpha$ : 0.84, 0.79, 0.73) affirmed internal consistency, supporting actionable recommendations. Strengthening regulatory frameworks (Factor 1) requires aligning policies with Vision 2030. Enhancing market appeal (Factor 2) involves targeting ESG investors and improving transparency, while leveraging PPPs and awareness campaigns (Factor 3) can mitigate stakeholder risks [19,20,75]. This integrated, multidimensional approach addresses systemic gaps and supports the development of a sustainable green bond ecosystem through policy, market, and governance synergies.

In addition, the linear regression analysis revealed key predictors influencing the potential for green bond adoption, drawing on data collected from 174 experts to inform its findings. The model demonstrated strong explanatory power, with an  $R^2$  of 0.62 and a significant F-statistic ( $F = 18.45$ ,  $*p^* < 0.001$ ), indicating that 62% of the variance in adoption potential was accounted for by the included variables. The Vision 2030 framework ( $\beta = 0.38$ ,  $*p^* < 0.001$ ) emerged as the strongest positive predictor, followed by diversification beyond oil revenues ( $\beta = 0.29$ ) and institutional capacity ( $\beta = 0.21$ ). Conversely, investor skepticism

( $\beta = -0.15$ ) and high verification costs ( $\beta = -0.12$ ) negatively impacted adoption (Table 5). These results underscore the dual role of strategic alignment and systemic challenges in shaping green bond implementation [21,22,27]. The findings align with theoretical and empirical frameworks [1–3,21,52]. Vision 2030's emphasis on sustainability [5] and institutional theory [16] highlights the significance of regulatory coherence and technical expertise. The positive impact of diversification reflects global ESG trends [75,76], while the role of PPPs' risk mitigation ( $\beta = 0.18$ ) mirrors successful models, such as Brazil's electrification projects [75]. Challenges such as investor skepticism and verification costs mirror the barriers observed in emerging markets [76], highlighting the need for standardized certifications and governance reforms to counteract these impediments.

**Table 5.** Regression results with standardized coefficients and control variables.

Variable	$\beta$ Coefficient	Std. Error	t-Value	p-Value
Institutional Capacity	0.382	0.056	6.84	0.000 **
Market Integration	0.295	0.049	6.02	0.000 **
Stakeholder Risk Perception	−0.150	0.042	−3.57	0.001 **
Control: Sector (Public = 1)	0.088	0.038	2.31	0.022 *
Control: Experience (Years)	0.061	0.031	1.97	0.051
Control: Role Type	0.043	0.027	1.59	0.115

Significance:  $p < 0.01$  \*\* and  $p < 0.05$  \*.

Strategic recommendations derived from the analysis emphasize actionable synergies. Prioritizing Vision 2030-aligned projects and renewable energy targets can enhance adoption potential. Enhancing investor confidence through international standards (e.g., Climate Bonds Standard) addresses skepticism, while optimizing PPP frameworks fosters risk-sharing and private capital inflows. Simultaneously, reducing verification costs via streamlined processes can alleviate financial burdens. Collectively, these measures create a roadmap for leveraging institutional strengths, mitigating challenges, and aligning Saudi green bond initiatives with global sustainability objectives.

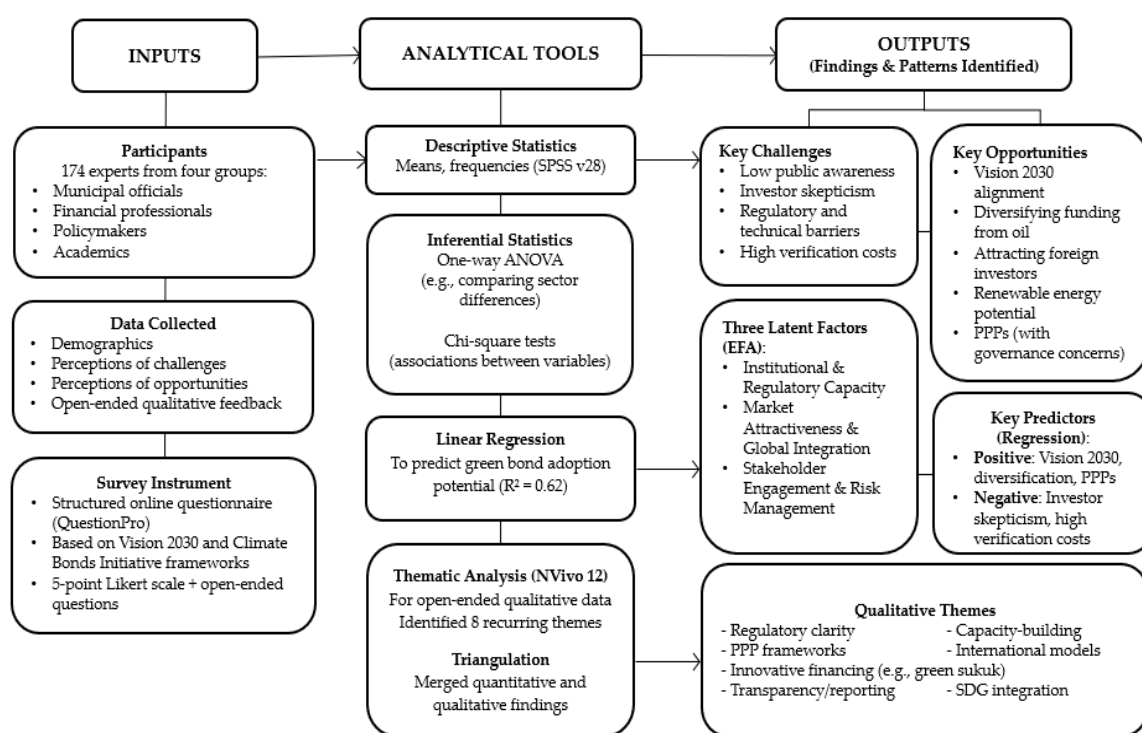
Control variables were introduced to account for variations in respondent backgrounds. Sector affiliation (public vs. private) was a statistically significant predictor ( $p = 0.022$ ), indicating that public-sector respondents are more likely to perceive regulatory barriers as critical. Years of experience approached significance ( $p = 0.051$ ), suggesting a potential trend in how seasoned experts view implementation readiness. Role type was not statistically significant but retained for completeness.

#### 4.1.6. Summary of Empirical Findings

To synthesize the study's empirical outcomes, however, the findings are consolidated into a conceptual framework (Figure 1) that systematically traces the research trajectory. At the entry point, the framework outlines the variables examined, including inputs from 174 experts across municipal officials, financial professionals, policymakers, and academics, whose demographics, perceptions of challenges (e.g., low public awareness and investor skepticism) and opportunities (e.g., Vision 2050 alignment and renewable energy potential), and qualitative feedback were collected via a structured online questionnaire (QuestionPro), aligned with Vision 2030 and Climate Bonds Initiative frameworks. The analytical phase details methodologies such as descriptive statistics (SPSS v28), inferential tests (one-way ANOVA, Chi-square), linear regression ( $R^2 = 0.62$ ), and thematic analysis (NVivo 12), which identified eight recurring themes. These were supported by triangulation to merge quantitative and qualitative insights. At the conclusion, the framework highlights key relationships, systemic barriers (e.g., high verification costs and regulatory gaps), in contrast with drivers like PPPs and Vision 2050 diversification, while EFA distills three latent factors: Institutional



and Regulatory Capacity, Market Attractiveness and Global Integration, and Stakeholder Engagement and Risk Management. Thematic findings (e.g., regulatory clarity and green sukuk) and regression predictors further clarify the interplay between governance concerns, SDG integration, and market transparency. By bridging granular analyses (e.g., PCA with KMO/Bartlett's tests and regression coefficients) with actionable insights, the framework emphasizes the necessity of robust institutional frameworks and stakeholder collaboration to advance sustainable finance, translating empirical rigor into policy-relevant strategies for mitigating barriers and fostering systemic transitions.



**Figure 1.** Conceptual framework: systematizing the study's outcomes.

#### 4.2. Theoretical Implications

This study's findings offer significant contributions to the theoretical understanding of green bond adoption in emerging, resource-dependent economies, particularly those characterized by centralized governance. The empirical evidence is interpreted through the lenses of three theoretical frameworks: institutional theory, stakeholder theory, and innovation diffusion theory. Each framework provides a unique analytical perspective that helps explain the systemic dynamics shaping green bond adoption in Saudi Arabia's municipal context.

##### 4.2.1. Institutional Theory

Institutional theory posits that organizational behaviors and outcomes are deeply influenced by the formal and informal structures, such as legal norms, regulatory systems, and governance frameworks, which constitute their environment [33,61]. The study's findings affirm the relevance of this theory by demonstrating how fragmented regulatory environments, bureaucratic overlaps, and a lack of technical capacity form significant impediments to green bond adoption.

The emergence of Institutional and Regulatory Capacity as the dominant latent construct in the Exploratory Factor Analysis (explaining 34.3% of the variance) empirically supports the theory's emphasis on the "regulative pillar" [73,74]. The high beta coefficient for Vision 2030 alignment ( $\beta = 0.38, p < 0.001$ ) in the regression model suggests that when



national-level policy frameworks are coherent and well-communicated, they exert strong isomorphic pressure on lower governance tiers, encouraging municipalities to conform and innovate [61].

However, the findings also reveal that policy coherence alone is not sufficient. The absence of municipal regulatory autonomy and the lack of standardized procedures for green bond issuance underscore the limitations of top-down institutional mandates in the absence of localized administrative capacity [52]. This suggests the need to extend institutional theory beyond the traditional notions of isomorphism to account for the limitations posed by centralized governance models, particularly in non-Western, fossil-fuel-dependent economies like Saudi Arabia.

#### 4.2.2. Stakeholder Theory

Stakeholder theory asserts that the success of complex financial or governance initiatives depends on the alignment and active engagement of diverse stakeholders, including government entities, investors, civil society, and technical experts [17,19]. This study reinforces the theory's central premise by illustrating how stakeholder misalignment, particularly the underrepresentation of municipal actors and the dominance of financial professionals, creates informational and operational gaps.

The EFA's Stakeholder Engagement and Risk Management factor (explaining 12.9% of variance) captures this dimension, while the regression model confirms that variables such as investor skepticism ( $\beta = -0.15, p < 0.01$ ) and verification costs ( $\beta = -0.12, p < 0.01$ ) remain statistically significant barriers. These findings show that municipal green bond adoption is not just a function of financial or technical capacity, but it is also a matter of trust, shared understanding, and mutual incentive alignment among stakeholders.

The qualitative themes of low public awareness, the need for capacity building, and limited PPP integration also highlight the importance of stakeholder inclusion in the planning and communication processes. This supports the theory's assertion that excluding key actors, especially those responsible for local implementation, undermines systemic change and may lead to policy failure or inertia [20,34]. Moreover, the relatively low mean score for PPP effectiveness (3.33), despite its theoretical potential, underscores a normative gap in Saudi municipalities: stakeholders lack both the capacity and confidence to operationalize collaborative financing models. Addressing these gaps requires stakeholder strategies grounded in cultural and institutional realities, including localized training and community-driven planning processes.

#### 4.2.3. Innovation Diffusion Theory

Innovation diffusion theory provides a framework to understand how, why, and at what rate new ideas and technologies spread through societies or organizations [29]. In this study, the theory helps explain the uneven adoption of green municipal bonds, particularly the gap between national-level ambition (Vision 2030) and local-level execution [11,52].

Saudi Arabia's case reflects the "early-stage stagnation" often found in resource-rich economies, where institutional capacity is concentrated at the national level, but municipal actors face knowledge, resource, and autonomy constraints. Although Vision 2030 and climate finance frameworks promote innovation, their translation into local practice is hampered by organizational inertia, perceived risks, and inadequate knowledge dissemination, all key themes in the diffusion literature [29].

The market-related latent construct identified through a factor analysis of Market Attractiveness and Global Integration demonstrates that while an awareness of green finance trends is growing, actual uptake is stalled by barriers in legitimacy, investor engagement, and localized readiness. This suggests a classic case of innovation lag, where

the benefits of adoption are understood at a strategic level, but diffusion is impeded by technical and institutional bottlenecks. Importantly, the Saudi case extends innovation diffusion theory by adding the dimension of cultural compatibility, a factor that is underemphasized in traditional Western-centric models. For example, the success of green sukuk in Indonesia, mentioned by stakeholders as a replicable model, illustrates how local financial norms (Shariah compliance) can accelerate adoption when innovation is culturally embedded [52,58].

#### 4.2.4. Summary of Theoretical Contributions

In synthesizing these insights, this study advances theory in three key ways:

1. Institutional theory is extended by highlighting the limitations of top-down isomorphism in centralized states, showing that regulatory clarity must be accompanied by local administrative empowerment and capacity building.
2. Stakeholder theory is reinforced by the evidence that misaligned priorities between national, municipal, and financial actors can paralyze progress, even when technical solutions exist.
3. Innovation diffusion theory is contextualized by demonstrating how cultural alignment, administrative decentralization, and communication infrastructure influence the speed and scope of financial innovation in emerging markets.

Collectively, these contributions help bridge the gap between abstract theoretical models and the grounded realities of sustainable finance implementation in the Global South.

## 5. Conclusions

This study investigated the institutional, regulatory, and market dynamics influencing green bond adoption in Saudi Arabian municipalities, using Saudi Arabia's Vision 2030 as a guiding analytical framework. Employing a robust mixed-methods design, including Exploratory Factor Analysis and multiple regression analysis on expert survey data, the research identified key enablers and barriers that shape green bond adoption at the local government level.

Scientifically, this study makes several contributions. First, it provides empirical evidence supporting institutional and stakeholder theories within the context of sustainable finance, especially in resource-dependent economies with centralized governance. Second, the identification of three latent constructs, Institutional and Regulatory Capacity, Market Attractiveness and Global Integration, and Stakeholder Engagement and Risk Management, offers a novel, multidimensional framework for understanding green bond dynamics in non-Western contexts. Third, the integration of Islamic finance principles (e.g., green sukuk) within the ESG ecosystem advances the emerging academic discourse on culturally contextualized green finance solutions.

Practically, the findings offer actionable insights for policymakers, municipal authorities, and financial sector stakeholders. This study recommends regulatory harmonization, targeted technical capacity building, and proactive investor engagement as pivotal strategies. Establishing centralized green finance units, aligned with international standards, could streamline project certification and enhance transparency. Additionally, training programs co-developed with academic institutions can address human capital gaps in ESG compliance and project design. The research also highlights the untapped potential of public-private partnerships (PPPs) and culturally aligned instruments like sukuk, which remain underutilized despite a strong relevance in the Saudi context.

In doing so, this study fills a critical gap in the literature by bridging high-level policy ambitions (e.g., Vision 2030) with ground-level governance realities. Unlike previous studies that generalize green bond challenges across regions, this paper disaggregates

barriers within the Saudi municipal context, providing tailored strategies that are both locally informed and globally relevant.

## 6. Limitations and Future Research

While this study provides valuable contributions, it is subject to several limitations. First, the research is geographically limited to Saudi Arabian municipalities, which may restrict the generalizability of findings to other centralized or hydrocarbon-dependent countries. Second, the cross-sectional design captures a static snapshot in time, limiting insights into evolving trends or longitudinal impacts. Third, the reliance on expert perception introduces potential bias, particularly in politically sensitive policy environments.

Future research should build on these findings by conducting longitudinal case studies in evolving Saudi megaprojects (e.g., NEOM and Red Sea Global) to assess long-term adoption dynamics. Comparative studies across GCC countries, especially with decentralized models like the UAE, could further contextualize best practices. In addition, behavioral and ethnographic research could uncover the investor and citizen perceptions of green financial instruments, while technological innovation studies, such as blockchain integration for green bond verification, may offer solutions to persistent transparency and transaction cost challenges.

Addressing these areas would significantly advance both theory and practice in sustainable finance, particularly in resource-rich emerging economies striving to align the national sustainability goals with localized financial execution.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of Imam Abdulrahman Bin Faisal University (protocol code IRB-2025-06-0179, date of approval: 3 March 2025).

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The data presented in this study are available upon request from the author.

**Acknowledgments:** Authors greatly acknowledges the support of Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

**Conflicts of Interest:** The author declares no conflicts of interest.

## Appendix A

**Table A1.** Variables from the questionnaire survey with citations to the sources in the literature.

Section	Variable/Statement	Type	Supporting Literature Citation
Challenges	Saudi municipalities lack clear regulatory frameworks for issuing green bonds.	Likert Scale	Regulatory fragmentation identified as a key barrier [46,52,61].
	There is insufficient technical expertise to design green bond projects.	Likert Scale	Technical capacity gaps noted in municipal systems [53].
	Investors are skeptical about the financial returns of municipal green bonds.	Likert Scale	Investor skepticism reduces adoption [52,61].
	High verification costs hinder adoption.	Likert Scale	Certification costs are structural constraints [76].
	Public awareness of green bonds' environmental benefits is low.	Likert Scale	Awareness deficits in Saudi and peer markets [10,53].
	Municipalities struggle to align green projects with Vision 2030 targets.	Likert Scale	Misalignment with Vision 2030 hampers implementation [5,41].

Table A1. Cont.

Section	Variable/Statement	Type	Supporting Literature Citation
Opportunities	Vision 2030 provides a strategic framework to scale municipal green bonds.	Likert Scale	Vision 2030 provides an enabling policy context [5].
	Green bonds can attract foreign investors (e.g., ESG funds).	Likert Scale	ESG funds are key financial sources [2,3].
	PPPs could reduce financing risks.	Likert Scale	PPPs share investment risks [15,76].
	Untapped potential for renewable energy projects.	Likert Scale	Renewable energy is a key opportunity [38].
	Green bonds could improve Saudi Arabia's sustainability rankings.	Likert Scale	Linked to international image [21].
	Diversify funding beyond oil revenues.	Likert Scale	Diversification is a Vision 2030 goal [52,61].
Demographics	Years of experience, sector, and role.	Categorical	Used in inferential statistics [71,72].
Open-Ended	Additional steps to accelerate adoption.	Textual	Themes: training, PPPs, transparency [75].

## References

1. OECD. *Financing Climate-Resilient Cities: The Role of Green Bonds*; OECD Publishing: Paris, France, 2022.
2. Climate Bonds Initiative (CBI). *The Role of Green Bonds in Financing Climate-Resilient Cities*; Climate Bonds Initiative (CBI): London, UK, 2022.
3. Climate Bonds Initiative (CBI). *Global Green Bond Standards*; Climate Bonds Initiative (CBI): London, UK, 2023.
4. OECD. *Green Finance and Investment: Mobilizing Capital for Climate-Resilient Infrastructure*; OECD Publishing: Paris, France, 2022.
5. Saudi Arabia. Saudi Vision 2030, National Transformation Program: Sustainable Development Goals. Riyadh, Saudi Arabia, 2021.
6. Global, M. Riding the Rising Green Wave of Sustainable Finance Across the Gulf. Communicate Online. Available online: <https://communicateonline.me/news/riding-the-rising-green-wave-of-sustainable-finance-across-the-gulf/> (accessed on 14 January 2025).
7. United Nations Environment Programme (UNEP). Scaling up Green, Social, Sustainability and Sustainability-linked Bond Issuances in Developing Countries. 2021. Available online: [https://one.oecd.org/document/DCD\(2021\)20/En/pdf](https://one.oecd.org/document/DCD(2021)20/En/pdf) (accessed on 14 January 2025).
8. Arab Monetary Fund (AMF). *Green Finance in the Middle East: Institutional Frameworks and Opportunities*. 2022. Available online: <https://www.amf.org.ae/publications/green-finance-middle-east> (accessed on 14 January 2025).
9. Amundi-IFC. *Emerging Market Green Bonds: Trends and Opportunities*; Amundi-IFC: Paris, France, 2023.
10. Bracking, S. The anti-politics of green finance: From climate-smart agriculture to the developmental state in Africa. *World Dev.* **2019**, *120*, 105–117.
11. Alhowaish, A.K.; Alkubur, F.S. Unlocking the Potential of the Circular Economy at Municipal Levels: A Study of Expert Perceptions in the Dammam Metropolitan Area. *Sustainability* **2025**, *17*, 4323. [CrossRef]
12. Van der Ploeg, F. The political economy of green transitions in oil-exporting countries. *Oxf. Econ. Pap.* **2020**, *72*, 888–912.
13. Alawadi, A.; Khanal, A.; Al-Saidi, M. Green finance in GCC urban governance: Challenges and opportunities. *Energy Policy* **2023**, *178*, 113567.
14. Climate Bonds Initiative. *Regulating Green Finance in Emerging Markets: Lessons from the MENA Region*. 2023. Available online: <https://www.climatebonds.net> (accessed on 14 January 2025).
15. World Bank. *MENA Climate Roadmap: Aligning National and Subnational Green Transitions*. 2022. Available online: <https://thedocs.worldbank.org/en/doc/6f868d4a875db3ef23ef1dc747fcf2ca-0280012022/original/MENA-Roadmap-Final-01-20.pdf> (accessed on 14 January 2025).
16. DiMaggio, P.J.; Powell, W.W. The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *Am. Sociol. Rev.* **1983**, *48*, 147–160. [CrossRef]
17. Freeman, R.E. *Strategic Management: A Stakeholder Approach*; Pitman: Boston, MA, USA, 1984.
18. Greenwood, R.; Raynard, M.; Kodeih, F.; Micelotta, E.R.; Lounsbury, M.M. Institutional complexity and organizational responses. *Acad. Manag. Ann.* **2011**, *5*, 317–371. [CrossRef]
19. Zheng, J.; Khurram, M.; Chen, L. Can Green Innovation Affect ESG Ratings and Financial Performance? Evidence from Chinese GEM Listed Companies. *Sustainability* **2022**, *14*, 8677. [CrossRef]
20. Wijen, F. Institutional work in the face of complexity: Stakeholder alignment for sustainability. *Organ. Environ.* **2020**, *33*, 528–552.
21. World Bank. *EGYPT The First Sovereign Green Bond in the Middle East and North Africa*. 2022. Available online: <https://thedocs.worldbank.org/en/doc/931e017a795e984d79cfcaccadac563f-0340012022/original/16341-WB-Egypt-Case-Study-WEB.pdf> (accessed on 2 January 2025).

22. The European Environment Agency (EEA). Green bonds in Europe. Available online: <https://www.eea.europa.eu/en/analysis/indicators/green-bonds-8th-eap> (accessed on 2 January 2025).
23. French Treasury. France's Sovereign Green Bond: 2022 Allocation Report. 2022. Available online: <https://www.statista.com/statistics/1150542/outstanding-amount-french-green-oat/> (accessed on 2 January 2025).
24. Mejía-Escobar, J.C.; González-Ruiz, J.D.; Franco-Sepúlveda, G. Current State and Development of Green Bonds Market in the Latin America and the Caribbean. *Sustainability* **2021**, *13*, 10872. [CrossRef]
25. World Bank. UNLEASHING Sustainable Finance in Southeast Asia. 2022. Available online: <https://documents1.worldbank.org/curated/en/099310011232220307/pdf/P177802011f7760130bc49083a7beb1ef43.pdf> (accessed on 4 January 2025).
26. Asian Development Bank (ADB). Green Bond Market Survey for Indonesia Insights on The Perspectives of Institutional Investors and Underwriters. 2022. Available online: [https://www.adb.org/sites/default/files/publication/843491/green-bond-market-survey-indonesia\\_0.pdf](https://www.adb.org/sites/default/files/publication/843491/green-bond-market-survey-indonesia_0.pdf) (accessed on 4 January 2025).
27. Climate Bonds Initiative (CBI). China Sustainable Debt State of The Market Report. 2023. Available online: [https://www.climatebonds.net/files/documents/publications/china\\_sustainable\\_debt\\_state\\_of\\_the\\_market\\_report\\_2023.pdf](https://www.climatebonds.net/files/documents/publications/china_sustainable_debt_state_of_the_market_report_2023.pdf) (accessed on 2 January 2025).
28. Zhang, D.; Liu, Y. Greenwashing Risks in China's Green Bond Market: The Role of Coal Phase-Out Ambiguity. *Energy Econ.* **2023**, *125*, 106845.
29. Rogers, E.M. *Diffusion of Innovations*, 5th ed.; Free Press: New York, NY, USA, 2003.
30. Wang, S.; Wang, D. Exploring the Relationship Between ESG Performance and Green Bond Issuance. *Front. Public Health* **2022**, *10*. [CrossRef] [PubMed]
31. Mazzucato, M.; Semieniuk, G. Financing green transitions: The role of innovation diffusion in emerging markets. *Res. Policy* **2003**, *52*, 104777.
32. Agyemang, O.S.; Kong, Y. Innovation lag in emerging markets: The case of green bonds. *Technol. Forecast. Soc. Chang.* **2022**, *185*, 122076.
33. World Economic Forum. Bridging the Gap: How to Finance the Net-Zero Transition. 2025. Available online: [https://reports.weforum.org/docs/WEF\\_Bridging\\_the\\_Gap\\_How\\_to\\_Finance\\_the\\_Net\\_Zero\\_Transition\\_2025.pdf](https://reports.weforum.org/docs/WEF_Bridging_the_Gap_How_to_Finance_the_Net_Zero_Transition_2025.pdf) (accessed on 12 January 2025).
34. World Bank. Toolkits for Policymakers to Green the Financial System. 2021. Available online: <https://documents1.worldbank.org/curated/en/374051622653965991/pdf/Toolkits-for-Policymakers-to-Green-the-Financial-System.pdf> (accessed on 12 January 2025).
35. Kuykendall, T. BlackRock pushes for net zero; Stakeholder capitalism gains traction at Davos. Available online: <https://www.spglobal.com/market-intelligence/en/news-insights/articles/2021/1/blackrock-pushes-for-net-zero-stakeholder-capitalism-gains-traction-at-davos-62318964> (accessed on 27 January 2021).
36. Cornaro, L. Kenya closes its first ever green bond. 3 October 2019. Available online: <https://fsdafrica.org/kenya-closes-its-first-ever-green-bond/> (accessed on 3 October 2019).
37. Financial Sector Deepening Africa (fsdafrica). Impact of Green Bonds in Africa. 2025. Available online: [https://fsdafrica.org/wp-content/uploads/2025/03/Green-Bond-Report\\_Final-report-20.03.2025.pdf](https://fsdafrica.org/wp-content/uploads/2025/03/Green-Bond-Report_Final-report-20.03.2025.pdf) (accessed on 4 January 2025).
38. World Bank. Green Your Bus Ride Clean Buses in Latin America Summary Report. 2019. Available online: <https://documents1.worldbank.org/curated/en/410331548180859451/pdf/133929-WP-PUBLIC-P164403-Summary-Report-Green-Your-Bus-Ride.pdf> (accessed on 14 January 2025).
39. Saudi Green Initiative (SGI). Saudi Green Initiative: Roadmap for Sustainability and Climate Action. 2021. Available online: <https://www.sgi.gov.sa/> (accessed on 12 January 2025).
40. Ministry of Energy, Industry, and Mineral Resources (MEIM). *Saudi Arabia's National Renewable Energy Program: Achieving 50% Renewable Energy by 2030*; Government Publication: Riyadh, Saudi Arabia, 2022.
41. Public Investment Fund (PIF). Saudi Arabia's Inaugural Sovereign Green Bond Issuance: \$3 Billion for Sustainable Projects. 2022. Available online: <https://www.pif.gov.sa/en/news-and-insights/press-releases/2022/usd-3-billion-inaugural-bond> (accessed on 14 January 2025).
42. Saudi Green Initiative (SGI). *Annual Sustainability Report*; Saudi Government Publication: Riyadh, Saudi Arabia, 2023.
43. Masdar (Abu Dhabi Future Energy Company). Masdir City Green Bond Framework: Financing Sustainable Urban Development. 2021. Available online: <https://www.masdar.ae/en/masdar-city/green-bond-framework> (accessed on 14 January 2025).
44. Arab Fund for Economic and Social Development. Role of Green Bonds and Sukuk in Unlocking Climate Finance in Arab Countries International Experiences in Issuing Green Bonds and Policy Implications. 2023. Available online: <https://climate2023.arabfund.org/wp-content/uploads/2023/08/163INT1.pdf> (accessed on 14 January 2025).
45. NEOM. Pioneering Sustainable Construction: 3D-Printed Buildings Using Recycled Materials. 2023. Available online: <https://www.neom.com> (accessed on 14 January 2025).
46. Ministry of Finance (Mof). Kingdom of Saudi Arabia: Green Financing Framework. 2024. Available online: <https://ndmc.gov.sa/investorsrelations/Documents/Green-Financing-Framework-KSA-28March2024.pdf> (accessed on 14 January 2025).



47. El-Ghonemy, A. Decentralization and green finance: Lessons from Cairo and Riyadh. *J. Urban Fin.* **2022**, *49*, 112–130.
48. Mohammed, M. The impact of green bond financing on the Egyptian green economy. *Aswan Univ. J. Environ. Stud.* **2023**, *4*, 24–37. [CrossRef]
49. Bhandari, R. Bridging the skills gap: Fuelling careers and the economy in Malaysia, Economist Impact, (2023, July 3). Available online: <https://impact.economist.com/new-globalisation/bridging-skills-gap-fuelling-careers-and-economy-malaysia> (accessed on 14 January 2025).
50. World Bank. Morocco: Climate Change Institutional Assessment Framework. 2023. Available online: <https://thedocs.worldbank.org/en/doc/114ddeee175075258d629a28271c8de4-0280012023/original/TK-Note-Morocco-CIAA-CCDR-may23.pdf> (accessed on 24 January 2025).
51. World Bank. Islamic Green Finance Development, Ecosystem and Prospects. 2019. Available online: <https://documents1.worldbank.org/curated/en/591721554824346344/pdf/Islamic-Green-Finance-Development-Ecosystem-and-Prospects.pdf> (accessed on 24 January 2025).
52. Hassan, M.K.; Rabbani, M.R. ESG meets Islamic finance: The rise of green Sukuk. *J. Sustain. Financ. Inv.* **2023**, *13*, 456–478.
53. Alhawaish, A.K. Green municipal bonds and sustainable urbanism in Saudi Arabian cities: Toward a conceptual framework. *Sustainability* **2025**, *17*, 3950. [CrossRef]
54. United Nations Development Programme (UNDP). Saudi Future Cities. 2020. Available online: <https://saudiarabia.un.org/sites/default/files/2020-01/leaflet-english.pdf> (accessed on 14 January 2025).
55. Srinivasan, M.; Ghoge, K.; Halder, S.; Bazaz, A.B.; Revi, A. Climate finance in India 2023. Indian Institute for Human Settlements. Available online: <https://portal.research.lu.se/en/publications/climate-finance-in-india-2023> (accessed on 18 January 2025).
56. García, I.R.M. Cultural barriers to green infrastructure in Latin America: The case of Monterrey. *Energy Policy* **2023**, *185*, 113912.
57. Tadesse, M. Stakeholder engagement in African green bonds: Lessons from Addis Ababa. *J. Urban Fin.* **2023**, *51*, 89–107.
58. King Abdullah Petroleum Studies and Research Center (KAPSARC). Saudi Arabia Net Zero GHG Emissions by 2060. 2023. Available online: [https://www.researchgate.net/publication/377417048\\_Saudi\\_Arabia\\_Net\\_Zero\\_GHG\\_Emissions\\_by\\_2060\\_Transformation\\_of\\_the\\_Electricity\\_Sector](https://www.researchgate.net/publication/377417048_Saudi_Arabia_Net_Zero_GHG_Emissions_by_2060_Transformation_of_the_Electricity_Sector) (accessed on 10 January 2025).
59. OECD. *The Role of Pension Funds in Financing Green Growth Initiatives*; OECD Publishing: Paris, France, 2011. Available online: [https://www.oecd.org/content/dam/oecd/en/publications/reports/2011/09/the-role-of-pension-funds-in-financing-green-growth-initiatives\\_g17a2011/5kg58j1lwdjd-en.pdf](https://www.oecd.org/content/dam/oecd/en/publications/reports/2011/09/the-role-of-pension-funds-in-financing-green-growth-initiatives_g17a2011/5kg58j1lwdjd-en.pdf) (accessed on 10 January 2025).
60. Securities Commission Malaysia. Annual Report on Green Finance Capacity Building. 2023. Available online: <https://www.sc.com.my/green-finance-training> (accessed on 14 January 2025).
61. OECD. *Malaysia's economic success story and challenges*; OECD Publishing: Paris, France, 2017. Available online: [https://www.oecd.org/content/dam/oecd/en/publications/reports/2017/01/malaysia-s-economic-success-story-and-challenges\\_ee3589a5/cf7dddf2-en.pdf](https://www.oecd.org/content/dam/oecd/en/publications/reports/2017/01/malaysia-s-economic-success-story-and-challenges_ee3589a5/cf7dddf2-en.pdf) (accessed on 22 January 2025).
62. Al-Saati, H. Saudi Arabia's green cities: Ambition vs. institutional reality. *Energy Res. Soc. Sci.* **2023**, *97*, 103012.
63. Yin, R.K. *Case Study Research and Applications: Design and Methods*, 6th ed.; SAGE: Thousand Oaks, CA, USA, 2018.
64. Bryman, A. *Social Research Methods*, 5th ed.; Oxford University Press: London, UK, 2016.
65. Cohen, J. A coefficient of agreement for nominal scales. *Educ. Psychol. Meas.* **1960**, *20*, 37–46. [CrossRef]
66. Alnajem, M.; Elheddad, M.; Alfar, A.J. Circular economy in the Gulf Cooperation Council: A systematic literature review. *J. Clean. Prod.* **2021**, *311*, 127612.
67. Alshehry, A.S.; Belloumi, M. The impact of energy subsidies on sustainable resource use: Evidence from hydrocarbon-dependent economies. *Energy Policy* **2020**, *145*, 111713.
68. Al-Ansari, M.S.; Al-Harbi, M.; Abdelaziz, A. Informal waste management in the GCC: Challenges and opportunities. *J. Environ. Plan. Manag.* **2020**, *45*, 112–128.
69. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E. *Multivariate Data Analysis*, 8th ed.; Cengage Learning: London, UK, 2019.
70. Creswell, J.W.; Poth, C.N. *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*, 4th ed.; SAGE: Thousand Oaks, CA, USA, 2018.
71. Maxwell, J.A. *Qualitative Research Design: An Interactive Approach*, 3rd ed.; SAGE: Thousand Oaks, CA, USA, 2023.
72. Etikan, I.; Musa, S.A.; Alkassim, R.S. Comparison of convenience sampling and purposive sampling. *Aswan Univ. J. Environ. Stud.* **2016**, *5*, 1–4. [CrossRef]
73. Field, A. *Discovering Statistics Using IBM SPSS Statistics*, 5th ed.; Sage: Newbury Park, CA, USA, 2018.
74. Scott, W.R. *Institutions and Organizations: Ideas, Interests, and Identities*, 4th ed.; SAGE Publications: Thousand Oaks, CA, USA, 2014.
75. North, D.C. *Institutions, Institutional Change, and Economic Performance*; Cambridge University Press: Cambridge, MA, USA, New York, NY, USA; 1990.



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76. Clark, R.; Wu, H.; Martinez, L. Public-private partnerships in green finance: A global perspective. *Environ. Econ.* **2022**, *15*, 88–104.
77. Weber, B.; Saravia, M. Certification costs and green bond adoption. *Clim. Policy* **2018**, *18*, 601–620.

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