Factors affecting green banking technology adoption in Bangladesh

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Abstract

Green banking technology is a strategic instrument for promoting green finance and climate resilience in developing economies, particularly Bangladesh. This study examines the adoption of green banking technology in Bangladesh using an extended UTAUT model. It examines the main elements that affect consumer intention, such as system quality, bank reputation, customer awareness, performance and effort expectations, and individual innovativeness. PLS-SEM, or partial least squares-structural equation modeling, was used to analyze a survey with 475 respondents. The results show that while customer awareness, personal innovativeness, and bank reputation have a considerable impact on consumer intention, performance expectancy and effort expectancy have no significant effect. Actual usage behavior is highly predicted by behavioral intention. This study provides practical insights for financial institutions and governments looking to ensure the adoption of green banking as a means of achieving climate mitigation through digital transformation by coordinating its findings with Sustainable Development Goal 13 (Climate Action).

Keywords Green banking technology, Structural equation modeling, UTAUT model, Bangladeshi financial institutions, Customers' intention

1 Introduction

The expansion of human civilization and globalization has a constant effect on global environmental problems (pollution, overpopulation, deforestation, ozone depletion, waste disposal, loss of biodiversity, etc.). The unsustainable usage of natural resources is one of the prime reasons. The usage of energy by industries generates a massive amount of CO_2 and other gases related to greenhouse gases are released into the atmosphere [1, 2]. Consequently, to encourage practices of environmentally and socially responsible economy, the green banking technology progress promotes the initiatives of environmentally friendly marketing and investments of ESG [3–5]. According to [6], e-banking has an optimistic impact on mitigating climate change. It minimizes carbon dioxide emissions by reducing the usage of paper, promoting eco-friendly transactions, and so on.

As digitization and ecology became recognized as worldwide challenges, financial institutions—particularly those in the banking industry—were under pressure to adopt a green strategy [7]. Economic sustainability is thought to be fueled by the banking industry. It is an important consumer financier and has a significant role in economic growth [8, 9]. By integrating green ideas into their lending and investing procedures, directing users' focus toward environmental management, and implementing the appropriate green technologies, banks can help preserve the environment [10]. Therefore, the greening and digitization of the financial sector are crucial to a nation's sustainability. As a result, the idea of green banking, a banking philosophy founded on environmental sustainability principles, was created [11]. It entails combining structural technological advancements into banking operations and encouraging financial services that are paperless [12]. That is, green banking has progressively gained traction in promoting environmentally friendly practices with a clear vision of future sustainability through operational and technology advancements as well as shifting customer preferences. Since it not only ensures greening but also makes it easier for banks to improve the quality of their assets and their financial performance, this idea benefits banks, consumers, and economies alike. Many emerging nations have yet to embrace this novel worldview, though [13, 14].

In the 21st century, Bangladesh is recognized as a dominant player with immense investment and economic growth that also maximizes the intensity of change of climate [15]. Bangladesh is dealing with severe environmental degradation issues, including sea level rise, an increase in natural disasters, mass deforestation, and air and water pollution, which have a direct impact on the country's agricultural sector, population health, and economic stability. Bangladesh is regarded as one of the most vulnerable countries to climate change. The overpopulated nation is also faced with the problem of overpopulation and poor waste disposal, which makes its environmental impact even more severe [16]. These issues require urgent and efficient measures to adopt green banking technology (GBT). GBT is significant to Bangladesh to address its urgent environmental concerns and incorporate financial judgments [17]. This includes banks encouraging green financing of environmentally friendly projects, curtailing their environmental impact, enhancing customer knowledge, and promoting eco-friendly digital transactions that produce fewer carbon emissions. This has been benefited by the Bangladesh Bank, especially its 2011 Green Banking Guidelines and later efforts such as green project refinance schemes and the Sustainable Finance Policy (2020–2021), which has a Green Taxonomy and an agenda of sustainability ratings and reporting by financial institutions [18]. All these are steps to spur sustainable development and environmental protection in BD.

By scrutinizing the private commercial banks of Bangladesh, Chen et al. [19] portrayed a positive effect of the banks' employees, daily operations, and diverse climate strategies on green financing that leads to the effective environmental performance of a bank. Hence, green finance has experienced a 65% increase annually, expanding to USD 227.78 million in the first quarter of 2023 from USD 138.63 million in the January-February quarter of 2022. In addition, a 40% increase in sustainable finance is identified for promoting loans in eco-friendly businesses and industries [20]. GBT could be instrumental in mitigating environmental problems and promoting eco-friendly progress in this country. The possible emergence of GBT is in the adoption to execute paperless transactions, accelerate digital banking operations, and allocate financial resources to the

environmentally sustainable functions. Customers consuming the benefits of GBT can help to mitigate the carbon footprint by dealing with banks less physically, using less paper (e.g., e-statements rather than paper ones), and investing more in investments associated with environmentally friendly products provided by banks [17]. In the case of green financial instruments, green bonds are in the very initial stage, but the most usual instrument consumed by the general population in Bangladesh is mainly green loans and financing of multiple green projects, and the most popular source of financing is through the refinance schemes of the Bangladesh Bank. For example, solar residence system financing has been greatly embraced, especially in distant locations. By the completion of Q3 2023, the amount of green finance of banks was USD 295.78 million, and sustainable finance of banks was USD 2,651.55 million [21]. Although these numbers are a sign of prosperity, the percentage of green finance in integrated bank improvements still needs to grow to achieve the goals of the Bangladesh Bank of at least 5% of green finance and 20% of sustainable finance of total term loan disbursement, which means that there is still ample opportunity to emerge and involve more customers [22].

The destruction of nature's wealth, the use of non-renewable electricity, and the escalation of greenhouse gases are considered primary challenges that require immediate action. With the growth of economic development and global population, the demand for natural resources has increased to an unprecedented level [2, 23]. As sustainability becomes the prime concern for a country like Bangladesh, various research has been conducted to explore the challenges of green banking. In the study of [24], the UTAUT method is implemented to examine the acceptance of sustainable technology among consumers. Some challenges are identified, such as user knowledge, a proactive mindset, brand equity of banks, and platform reliability. Numerous investigations have been conducted on green banking, environmental sustainability, and user adoption. Nevertheless, there is a lack of comprehensive studies integrating GBT adoption with behavioral and technological acceptance models in Bangladesh. Hence, the study aims to execute a thorough analysis of the customer intention behind the acceptance of GBT by leveraging a UTAUT-driven mixed-method framework. Performance expectancy, effort expectancy, user awareness, personal innovativeness, system quality, bank reputation, and consumer intention are some of the characteristics that are studied in order to achieve the research's goal.

GBT plays an imperative role in enhancing environmental quality and addressing the climate-related challenges. Through the incorporation of environmentally friendly processes into business strategies, financial institutions with GBT policies can become an essential factor of sustainable economic development, environmental protection, and a sustainable future [25–27]. Our motivation behind the query is based on the analysis of consumer intention to adopt GBT. *Firstly*, a noteworthy increase in natural phenomena (rising sea level, deforestation, and pollution) in a vulnerable country like Bangladesh has caught the attention of policymakers, which stimulates alignment of the financial sector with sustainability goals and addressing the nation's vulnerability. Lu et al. [28] state that severe ecological degradation has been acknowledged in the coastal zone due to environmental degradation. To mitigate the impact of environmental degradation, coordinated effort is required to increase long-term investment and sustainable landscape-scale investment along with the reformation of fiscal and monetary policy as well as centralized reporting [29–31]. *Secondly*, low user knowledge and adoption of GBT are

the outcomes of being unaware of paperless banking, digital transactions, and financing for sustainable initiatives. Here, Hasan et al. [32] reveal a significant influence of eco-friendly mental effort expectation, perceived social expectations, and cognitive stance on bankers' GBT usage behavior. Another study, by Taneja and Ali [14], considered trust, environmental consciousness, and perceived behavioral outcome as the prime factors of customer behavioral influence. This research examines the influence of customer awareness, personal innovativeness, and behavior toward GBT by conducting empirical research on the reshaping of consumer attitudes within the banking sector. *Thirdly*, this research will assist financial organizations in aligning their operations with sustainable practices by analyzing many criteria, including performance expectation, effort expectancy, and others. The financial sector in Bangladesh holds significant capacity to drive eco-friendly growth by funding green initiatives and fostering sustainable banking activities. According to Rahman et al. [33], through funding sustainable initiatives and promoting effective banking and investment, a sustainable financial strategy has a prominent impact on the fulfillment of SDG goals. *Finally*, the study will help academicians, policymakers, and regulators by providing efficient recommendations for overcoming the challenges; for example, lack of government support, security concerns, and inadequate infrastructure hinder progress.

GBT is the environmentally sustainable transactional practice to minimize environmental risk and promote ecological well-being in the financial sector by encompassing a range of steps such as financing green projects, implementing energy-efficient banking operations, and raising environmental awareness among stakeholders [34, 35].

After going through the previous literature, we found that previous studies focused on green investment, green policy, and sustainable innovation [4], and pressure from customers, competitors, and the community [10]. Iqbal et al. [36] sought to better understand customers' environmental consciousness, attitudes, and behaviors around green banking by including more factors into the UTAUT framework. This would provide crucial information on consumers' approval of ecologically sustainable methods. However, previous literature has not explored extended UTAUT to comprehend the driving forces behind Bangladesh's embrace of green banking. Nevertheless, despite the role of GBT being increasingly vital, recent research in Bangladesh has mainly concerned the internal greening of the banks in terms of their operations and activities, the financial performance of green finance, or the general policy environment [37–47]. Although certain studies address customer satisfaction or overall awareness [48], the overall factors affecting the customer adoption of green banking technologies (GBT) in Bangladesh, especially an extended UTAUT framework, are under-researched [49–59]. So, our paper adds to the body of literature by applying an expanded UTAUT model to analyze Bangladesh's adoption of green banking. It examines the additional elements that affect consumer intention, such as system quality, bank reputation, customer awareness, performance and effort expectations, and individual innovativeness.

The research answered the following questions:

- What are the key determinants in the adoption of green banking by customers in Bangladesh?
- To what extent does system quality and bank reputation affect customers' intention to use green banking?

- To what extent does customer awareness and personal innovativeness affect customers' intention to use green banking?

This research offers several important contributions to the existing literature through integration theory, factors of GBT adoption, the banking sector, and sustainability within the Bangladesh context. Firstly, this research uses empirical analysis on the basis of primary data in the context of Bangladesh of GBT adoption, which is one of the most rigorous research studies conducted in Bangladesh, since hardly any studies have been conducted in this region. Secondly, this study applies UTAUT-driven theory by considering performance expectancy (PE), effort expectancy (EE), behavioral intention (BI), and use behavior (UB) as factors of the UTAUT theory, which fills out the existing gap in perceiving the way users make decisions regarding GBT acceptance from a Bangladeshi perspective. Thirdly, this article extended the UTAUT theory by incorporating several factors, including customer awareness (AWA), personal innovativeness (PI), system quality (SQ), and bank reputation (BR) as the predictors of the consumer behavioral intention towards GBT users. Fourthly, another theoretical contribution is that the impact of behavioral intention is determined by the use behavior, which extends the UTAUT theory framework, and it offers new insights to the literature within the GBT adoption context, not only in Bangladesh but also all over the world. Fifthly, this query provides an extensive overview of user decision-making strategies since this research evaluates not only technological factors but also behavioral variables in the GBT adoption. Based on the results of the predictors, including PI and AWA, they have a favorable impact on GBT adoption and suggest that customers might be stimulated by extending the GBT in academia and society. Sixthly, this paper offers significant insights for both financial institutions and policymakers to foster GBT acceptance within the nation. Since this research concluded with the significant effect of AWA and BR on BI of GBT users, it stresses the banks to motivate the consumers regarding the use of GBT through increasing service quality and trust. Governments and policymakers can organize training and webinars, invest in R&D on GBT, and provide incentives and rewards for both financial institutions and consumers who already practice this sustainable idea. Seventhly, beyond technology and behavioral dimensions, this research emphasizes how to achieve SDG 13 (climate action) by using GBT. This paper also contributes to developing countries like Bangladesh to accomplish the sustainable development goals. It also affirms the technological adoption related to sustainability in the green banking sector to enhance the activities of the banking industry to build a cashless society at the earliest convenience in this current scenario and perspective of Bangladesh. This research highlights the way banks play a significant role in driving the development of Bangladesh towards achieving these targets through investing in eco-friendly projects. Finally, this investigation analyzed the dataset by utilizing PLS-SEM, which refines the perception of GBT adoption in developing economies.

2 Theoretical underpinnings, existing research, and hypotheses development

2.1 Theoretical underpinnings

This section provides the empirical foundation and theoretical analysis necessary to identify the effect of several factors on the customer's behavioral intention (BI) behind the use of GBT. The UTAUT theory is one of the popular theories used to determine BI towards adopting any system or technology. For example, Sharma [60] examined

blockchain application in supply chain by using UTAUT theory, Sarfaraz [61] used this theory in mobile banking, Venkatesh [62] applied it in AI tools application, Cabrera-Sánchez and Villarejo-Ramos [63] utilized it in big data analytics adoption, Nysveen and Pedersen [64] employed it in RFID technology, Alhalafi and Veeraraghavan [65] integrated it with cybersecurity, Balakrishnan et al. [66] leveraged it in AI chatbot, and so on. Few research has expanded the model to sustainability-driven financial innovations, despite the fact that these studies show how versatile UTAUT is. In order to investigate GBT adoption as a calculated reaction to environmental degradation, the current study integrates UTAUT within a climate-conscious framework. This study supports SDG 13, which highlights the role of financial technology in promoting climate adaptation through tying BI to sustainable investment decisions through digital financial services.

2.2 Performance expectancy (PE), effort expectancy (EE), and customer behavioral intention (BI)

Performance expectancy (PE) is the degree to which people think that utilizing technology will make them more productive and successful at reaching their objectives. Users' perception of the technology's ease of use is known as effort expectancy (EE). Both these factors are the constructs of UTAUT and have been extensively applied to explain BI across several areas [67], including GBT adoption. In the GBT perspective, PE and EE are not only predictors of technological acceptance but also behavioral indicators of climate-conscious financial engagement. The implementation of GBT promotes carbon-conscious banking services, energy-saving banking activities, and paper-free exchanges, all of which directly support SDG 13 [13]. In order to create digital banking networks that promote a sustainable environment, it is crucial to comprehend how PE and EE affect BI.

Numerous drivers contribute significantly to the effect within the acceptance of the GBT domain. For example, from the regression analysis, Shafique and Khan [68] highlight that among the factors of BI to adopt the banking practices, the contribution of EE and PE is higher on the attitude of the consumer. The challenges of the acceptance of GBT are explored in this study [24]. An analysis of 332 banks in the UAE about the challenges of the use of green banking solutions, Bouteraa et al. [24] reveals six challenges, for instance, AWA, PI, and BR. For GBT proliferation in the mainstream market, drivers such as PE, EE, and emotional as well as social values have a noteworthy impact, while the collective culture has an irrelevant impact [67]. Another study, by [69], highlights a substantial relationship between PE and EE to strengthen BI toward the enhancement of green banking practices. Iqbal et al. [36] elaborated on the mediating role of green banking practices between bank policy and sustainable finance. Moreover, the study recognizes a moderating role not only between employees' green value and green awareness but also between green banking activities and green financing. The mediating and moderating impact of GBT is portrayed in [70, 71], and [72]. According to Deb et al. [73], green investment improves the banks' environmental performance in Bangladesh. According to Deb et al. [74], environmental management accounting is crucial for improving both financial and environmental performance. Notwithstanding these realizations, there is still a deficiency of empirical studies investigating how PE and EE affect BI in Bangladesh's sustainable banking environment. Closing this gap is essential to expediting the achievement of SDG 13 and developing climate-sensitive banking

services. Drawing upon prior literature and conceptual reasoning, the following hypotheses are advanced:

H1 *PE significantly affects customers' intentions.*

H2 *EE significantly affects customers' intentions.*

2.3 Customer awareness (AWA), personal innovativeness (PI), and customer behavioral intention (BI)

Personal innovativeness (PI) refers to the level of user's willingness and tendency to adopt any system or technology. When individuals find any benefits of the products, they start to adopt the system that enhances the behavioural intention of the users. On the other hand, customer awareness implies that customers already know about using any systems or technology. Positive customer awareness increases the adoption of GBT [3, 75]. By lowering utilization of resources and operating expenses in comparison to traditional banking systems, sustainable banking includes a range of financial products and services intended to save the environment and advance social well-being. Through facilitating environmentally friendly transactions, cutting down on paper use, and promoting ecologically conscious banking practices, GBT is a climate-conscious invention that directly promotes SDG 13 [14].

Bouteraa et al. [76] explore the 8 determinants of green banking, which are categorized into five segments. Among segments, the individual dimension consists of personal innovativeness, awareness, and personal benefits. Here, the most influential determinant among these factors is customer awareness. However, the study [77] identifies personal innovativeness and trust as the most impactful drivers towards the acceptance of GBT. In addition, financial literacy hinders the mobilization of green savings to some extent. An inverse finding has been explored in the study. According to Afridi et al. [78], the level of environmental consciousness and attitude of consumers detect the degree of embracing GBT. According to Malik and Singh [79], technological literacy plays a moderating role while PE and EE are directly connected to the stronger positive emotion that contributes a significant effect in terms of adoption. Along with increasing the perceived symbolic value of adoption of sustainable banking, Hasudungan& Saragih [80] highlight a positive association between PI and purchase intention. The result coincides with [3]. In the context of Bangladesh, sustainable innovativeness as well as policies regarding green banking and green investment have an optimistic impact on the acceptance of the GBT [81–85]. The in-depth scrutiny of the theoretical study reveals a lack of studies about the relationship between AWA or PI and customer BI towards the adoption of sustainable banking rather than conventional banking in Bangladesh. Hence, the following hypotheses have been developed to reveal the nature of the relationship:

H3 *AWA significantly affects customers' intention.*

H4 *PI significantly affects customers' intentions.*

2.4 System quality (SQ) and customer behavioral intention

System quality (SQ) describes a technical system's overall performance, agility, and dependability. SQ includes ecological usefulness as well as technological efficiency in

the context of GBT, such as facilitating paper-free transactions, cutting down on energy use, and assisting environmentally conscious financial processes. These characteristics reduce the environmental impact of banking services, which directly supports SDG 13 [24]. Among the determinants of technological adoption, such as trust, perceived value, economic efficiency, convenience, etc., there is a trivial impact of security risk on the BI of the users that has been explored by Saif et al. [86]. Bouteraa et al. [24] highlight a positive impact of SQ on the acceptance of GBT. Furthermore, an analysis of the determinants of GB acceptance detects that the threat of good SQ influences the BI to adopt green banking solutions [87]. Existing literature is not enriched with empirical studies about the impact of SQ on the customer BI of Bangladesh. To address the gap, we develop the following hypotheses:

H5 *SQ has a significant effect on customers' intention.*

2.5 Bank reputation (BR) and customer intention
In the context of GBT, bank reputation (BR) is especially important in determining client trust, loyalty, and BI. Green banking techniques are adopted more readily when an institution has a well-established, sustainability-focused image that communicates environmental responsibility and increases institutional legitimacy. The "green image" serves as a facilitator between consumer opinion and green banking practices in this sense [88, 89]. Correspondingly, a significant influence of BR over the use of green banking solutions has been explored in [24]. For mitigating between digital payment systems and sustainable organizational performance, Hidayat-ur-Rehman & Hossain [90] evaluate the mediating role between sustainable financing and competitiveness. The study discloses the direct and significant influences of technological adoption, which enhances the effectiveness of sustainable banking operations. The higher investment in green projects increases the BR [91, 92]. From the analysis of prior literature, we recognize a gap that exists in understanding the nature of the association between BR and customer BI in terms of adoption of GBT [88–90, 93–95]. Therefore, we develop the following hypotheses to bridge the chasm in the context of Bangladesh:

H6 *BR significantly affects customers' intention.*

2.6 Behavioral intention (BI) and use behavior
Research suggests a significant association between various GBT factors and consumer behavioral intentions. Jain et al. [96] found that attitude enhances the customers' BI towards green banking initiatives. Shafique and Khan [68] found that perceived usefulness and perceived ease of use are key factors of consumers' attitude toward GBT use. Furthermore, their study, along with [97], indicates that PE and EE are strong drivers of BI, positively affecting the use of GBT. Jamal [98] explored bankers' BI to adopt GBT, suggesting that these intentions motivate faster implementation of green practices compared to conventional banking. However, Malik and Singh [79] emphasize the effect of personality traits, in addition to BI, in actual GBT adoption. Specifically, they highlight the importance of agreeableness, conscientiousness, and extraversion in translating intention into use. In spite of these revelations, nothing is known about the relationship between BI and real GBT usage, especially in light of Bangladesh's changing

banking landscape. This difference is crucial since the practical effect of green finance on reducing emissions is determined by the shift from intention to usage. Adoption of GBT reduces greenhouse gases, encourages ecologically conscious financial behavior, and decreases paper-intensive transactions, all of which directly support SDG 13 [20]. Designing productive measures that promote environmentally conscious financial systems requires a comprehension of the behavioral dynamics behind GBT usage. To empirically examine this relationship, the study puts forward the following hypothesis:

H7 *Intention significantly affects green banking technology use behavior.*

3 Methodology

This study uses a quantitative research methodology, which is appropriate for methodically and impartially analyzing the relationships between variables. Numerical data was gathered through quantitative research, facilitating statistical analysis and hypothesis testing that improves the validity and generalizability of results [24]. Studies aiming to measure constructs, establish causal relationships, and examine patterns across sizable datasets will find it especially helpful [13]. Additionally, by ensuring a systematic and repeatable methodology, a quantitative approach reduces researcher bias and improves the validity of findings [68]. Because this method uses statistical techniques like Structural Equation Modeling (SEM), which allow the analysis of complex interactions between latent variables, it is helpful for evaluating theoretical models [86, 99]. The goals of this study are best served by the quantitative technique as it can support theoretical generalizations and offer empirical proof [87].

3.1 Research design and method

The descriptive cross-sectional research design used in the present research is suitable for examining the relationships between factors at a certain moment in time. A descriptive approach is ideal when examining perceptions and actions in real-world contexts because it allows for a complete understanding of patterns, features, and relationships without altering research variables [85]. This approach provides a thorough overview of the phenomenon under study by methodically gathering data from a sample population in order to spot patterns and correlations [100]. Research that seeks to evaluate attitudes, behaviors, or factors influencing decision-making at a particular point in time is best served by a cross-sectional design [90]. Because it is practical and economical for gathering large amounts of data, it is frequently utilized in survey-based research and allows researchers to effectively analyze the responses of a wide range of participants. The descriptive cross-sectional technique is ideally suited for the goals of this study since it can produce statistically significant insights without necessitating long-term follow-up [39].

3.2 Population, sampling, and sample size

The study's target population consists of GBT service consumers from Bangladesh. In order to guarantee that the sample is representative of a group that is aware of GBT adoption, the GBT user population was chosen from among those who had actively utilized these services in the preceding six months. In studies when time or resources limit access to a more randomized sample, data from GBT users was collected using a

convenience sampling approach. This method is less precise than probability sampling, but it nonetheless ensures valuable data gathering and yields meaningful conclusions about user opinions and behavior [100]. Convenience sampling was chosen because respondents were easily accessible through social media sites, which are heavily populated by GBT users. The data collecting phase, which took place between November 2024 and January 2025, yielded 496 replies. After a careful inspection, 21 invalid and unreliable replies were eliminated from the dataset, resulting in a final sample size of 475 valid responses, which were judged appropriate for SEM analysis [66]. Additionally, a sample size of 398 is suitable for quantitative research, which is what this study is, according Krejcie and Morgan [101]. According to Siddiqi et al. [100], 300 samples in total are sufficient for SEM analysis.

3.3 Measures

Table 1 shows the measurement scales at a glance in this study. The items are somewhat modified based on research objectives. This study uses a 5-point Likert scale to measure all items. Three constructs, like PE, EE, and BI, are from an existing study [24], and the first two constructs have 4 items, and 3 items are in BI. AWA is another independent variable, evidenced by [24] having 5 items. PI sources [24], SQ [24]; [23], and BR [24] have 4, 6, and 5 items, respectively. All the variables above are used to determine their

Table 1 Measurement scales

Construct	Items	Source
Performance Expectancy (PE)	PE1: In my everyday life, I find GBT to be helpful. PE2: By using GBT, I have a better chance of accomplishing my goals. PE3: I get things done faster when I use GBT. PE4: My productivity is increased when I use GB.	[24]
Effort Expectancy (EE)	EE1: I have no trouble understanding how to operate GBT. EE2: I have an easy-to-understand relationship with GBT. EE3: I observe GBT easy to use. EE4: Learning how to use GBT is simple for me.	[24]
Customer Awareness (CA)	AWA1: I understand that GBT exists AWA2: I understand the idea of GBT AWA3: I understand its goal AWA4: I understand the advantages of utilizing GBT AWA5: Overall, I'm knowledgeable much concerning GBT	[24]
Personal Innovativeness (PI)	PI1: When I learn regarding new technology, I try to find chances to test it out. PI2: Among my friends, I typically explore new information technology first. PI3: I generally have no problem experimenting with new information technology. PI4: I enjoy trying out novel information technologies.	[24]
System Quality (SQ)	SQ1: GBT has a comprehensive design SQ2: GBT has a fast transaction processing time SQ3: GBT is reliable SQ4: GBT can be used at any time SQ5: GBT has good functionality relevant to my transaction SQ6: GBT keeps error-free transactions	[23, 29]
Bank Reputation (BR)	BR1: This bank has a reputation for honoring its commitments to clients. BR2: In the financial sector, this bank is well-regarded. BR3: Customers have a favorable opinion of this bank. BR4: The public is aware of the bank. BR5: This bank has a good reputation for consumer transactions.	[24]
Behavioural Intention (BI)	BI1: In the future, I plan to keep utilizing GB. BI2: I'll make an effort to include GB into my everyday activities. BI3: I intend to keep making frequent use of GB.	[24]
Use Behaviour (UB)	UB1: I have been using GBT regularly. UB2: I have been using GBT for my daily banking needs. UB3: I have been using GBT over the past six months	[102]

impact on consumer intention. Finally, UB [102] holds 3 items, which are our dependent variable, and this research looks at the impact of consumer intention on UB.

3.4 Analysis approach

By extending the UTAUT theory and its invaluable items (Fig. 1), the Partial Least Squares-Structural Equation Modelling (PLS-SEM) software (SmartPLS 4.1.0.2) is used to examine the green consumers' BI towards green banking solutions adoption. Researchers can assess measurement models and structural routes more successfully by using SEM [99]. Because the study used a structural model with several dependent variables, latent constructs derived from multi-item indicator variables, and several structural model stages and levels of constructs, SmartPLS software was utilized. Strict limitations on the multivariate normality of data and sample sizes are necessary for CB-SEM, which usually leads to skewed test statistics, unacceptable solutions, and issues with model identification. Therefore, we employ PLS-SEM instead of CB-SEM [103].

4 Results and findings

4.1 Common method bias (CMB)

Initially, Harman's single-factor test was utilized in this study. To perform Harman's single-factor test, all studied indicators are included in an unrotated exploratory factor analysis (EFA), and CMB is considered problematic if the first factor explains more than 50% of the variance in indicators [103]. In Table 1, the first factor explains 36.95% of the variance in indicators. Therefore, this study confirms no common method bias. Later, the full collinearity test [71] was applied in this study to detect the common method bias. The variation inflation factor (VIF) of every link must be below 5 [99]. The structural model's lateral and vertical relationships were analyzed. In Table 2, all the VIF values are lower than 5. This research ensured that the dataset followed a normal distribution.

4.2 Overview of participants

Table 4 depicts the respondents' demographic information. Five types of demographic variables, including gender, age, educational level, occupation, and perception about GB, are used in this research. Most respondents in this study are male (56.20%). 59.8% of participants' ages are 18–39. Almost 55.6% of participants have a bachelor's degree, and 28.8% are academician by profession. 100% of respondents hold GBT experience.
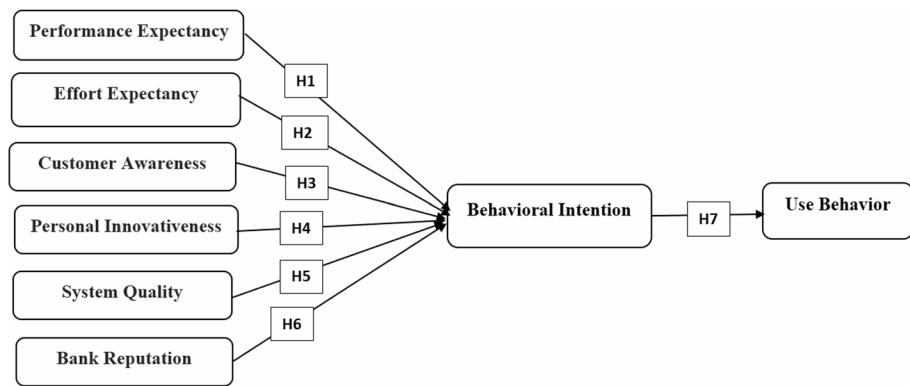

Fig. 1 Research model

Table 2 Results of Harman's single factor test

Total variance explained						
Component	**Initial eigenvalues**			**Extraction sums of squared loadings**		
	Total	**% of variance**	**Cumulative %**	**Total**	**% of variance**	**Cumulative %**
1	8.13	36.95	36.95	8.13	36.95	36.95
2	2.76	12.53	49.48			
3	1.95	8.86	58.34			
4	1.37	6.22	64.56			
5	1.27	5.75	70.32			
6	0.81	3.69	74.00			
7	0.69	3.14	77.14			
8	0.61	2.79	79.93			
9	0.56	2.55	82.48			
10	0.49	2.23	84.71			
11	0.43	1.97	86.68			
12	0.42	1.89	88.57			
13	0.37	1.66	90.23			
14	0.34	1.55	91.78			
15	0.34	1.53	93.30			
16	0.32	1.43	94.74			
17	0.26	1.18	95.91			
18	0.22	1.00	96.92			
19	0.19	0.86	97.78			
20	0.19	0.84	98.62			
21	0.16	0.72	99.34			
22	0.15	0.66	100.00			
Extraction method: principal component analysis.						

Table 3 Variation inflation factor (VIF)

	AWA	BI	BR	EE	PE	PI	SQ	UB
AWA		1.95						
BI								1.00
BR		1.47						
EE		2.44						
PE		2.77						
PI		1.21						
SQ		1.51						
UB								

4.3 Descriptive statistics and normality test

The research's descriptive analysis, which is depicted in Table 5, involved analyzing several statistical measures related to the latent variables, including mean and standard deviation. With a score of 4.74 and a standard deviation of 0.49, the results showed that bank reputation produced the highest mean value. On the contrary, among the constructs analyzed, personal innovativeness and system quality had the lowest mean scores (4.29), with a standard value of 0.55 and 0.49 for a set of variables. Table 5 also demonstrates the results of normality test. For normal data distribution, Kline [104] suggested that the value of skewness should be +/- 3 and +/- 10 for kurtosis. In the table, all the values are within the acceptable range. Thus, there is a normal assumption of data.

Table 4 Participants' demographic characteristics

	Frequency	Percent
Gender		
Male	267	56.2
Female	208	43.8
Total	475	100
Age		
Young (18–39 years old)	284	59.8
Old (40 years old and above)	191	40.2
Total	475	100
Educational level		
Bachelor	264	55.6
Masters	132	27.8
Professional certificate	62	13.1
Others	17	3.6
Total	475	100
Occupation		
Student	76	16.0
Merchant/Businessman	61	12.8
Manager/Executive	84	17.7
Professional, e.g. lawyer, doctor, engineer	97	20.4
Academician	137	28.8
Others	20	4.2
Total	475	100
Have you any idea about green banking technology?		
Yes	475	100
No	0	0

Table 5 Descriptive statistics and results of normality test

Constructs	N	Mean	Std. deviation	Skewness	Kurtosis	Normality assumed
Performance Expectancy (PE)	475	4.55	0.59	−1.29	0.77	Yes
Effort Expectancy (EE)	475	4.59	0.54	−1.34	1.16	Yes
Customer Awareness (AWA)	475	4.65	0.54	−1.65	1.85	Yes
Personal Innovativeness (PI)	475	4.29	0.55	−0.30	−0.27	Yes
System Quality (SQ)	475	4.29	0.49	−0.20	0.00	Yes
Bank Reputation (BR)	475	4.74	0.49	−2.14	3.93	Yes
Behavioral Intention (BI)	475	4.63	0.52	−1.11	0.14	Yes
Use Behavior (UB)	475	4.61	0.50	−1.37	1.56	Yes
Valid N (listwise)	475					

4.4 Testing of hypotheses using PLS-SEM

The PLS-SEM analysis is conducted by following two stages. Hair et al. [99] suggested that the PLS-SEM independently examines the connection between measurement and structural model through ordinary least squares regression. This query applied Smart-PLS 4 (Version 4.0.9.2).

4.4.1 Assessing measurement model

Evaluating the measurement model is essential for testing both reliability and validity. Hair et al. [99] suggested four aspects of each model construct in evaluating the reflective measurement model. They include indicator loadings (size and significance), construct reliability, convergent validity (CV), and discriminant validity.

4.4.1.1 *Internal consistency (IC) and convergent validity (CV)* Convergent validity is measured using average variance extracted (AVE) and outer loadings, whereas internal consistency (IC) is evaluated using composite reliability (CR). The dependability of a set of indicators assessed by the CR is displayed in Table 6. Hair et al. [99] argued that the CR value of 0.708 falls within a satisfactory level, but they suggest a higher threshold, including 0.8 or 0.9. Due to low outer loadings value, Items PE3, EE3, EE4, AWA3, PI4, SQ2, SQ3, SQ4, SQ5, BR4, BR5, and BI1 are excluded from the study. Accordingly, all the item codes are renamed. In Table 6, all constructs CR value exceeds the recommended value, which means good IC.CV is measured by using both outer loadings and AVE, respectively. Hair et al. [99] proposed that item reliability is acceptable when loading values surpass 0.708, that highlights the factors that describe above 50% of the variance of the indicator. All items hold outer loadings that exceed 0.708, that is shown in Table 6. According to Ringle et al. [105], the CV depends upon AVE values. The values should be above 0.50 to ensure the CV. Table 6 depicts that all AVE values are between 0.70 and 0.90, which exceeds the limit of 0.50. Hence, this research makes sure there is no any CV issue (Fig. 2).

4.4.1.2 *Discriminant validity (DV)* The DV is the last stage for assessing the reflective measurement model. "DV refers to a construct that is unique than any other constructs within the structural model" [99]. The DV is measured through "Fornell-Larcker Ctiter" and "Heterotrait-Monotrait ratio (HTMT)" (see Table 7). According to Fornell and Larcker [106], if the square root of the AVE for each concept is greater than other correlation values between the constructs, it may be used to evaluate discriminant validity. In this analysis, the square root of AVE for the diagonal values of each construct was discovered to be greater than its off-diagonal values. Correct discriminant validity is ensured by the estimated value of AVE, which is higher than the correlations between the

Table 6 Test of IC and CV

Constructs	Items	Loadings	Composite reliability (CR)	Average variance extracted (AVE)
PE	PE1	0.82	0.92	0.79
	PE2	0.94		
	PE3	0.87		
EE	EE1	0.87	0.82	0.70
	EE2	0.80		
AWA	AWA1	0.89	0.92	0.75
	AWA2	0.88		
	AWA3	0.83		
	AWA4	0.85		
PI	PI1	0.82	0.91	0.77
	PI2	0.94		
	PI3	0.87		
SQ	SQ1	0.81	0.83	0.71
	SQ2	0.87		
BR	BR1	0.89	0.92	0.78
	BR2	0.86		
	BR3	0.91		
BI	BI1	0.95	0.95	0.90
	BI2	0.95		
UB	UB1	0.88	0.89	0.73
	UB2	0.80		
	UB3	0.88		
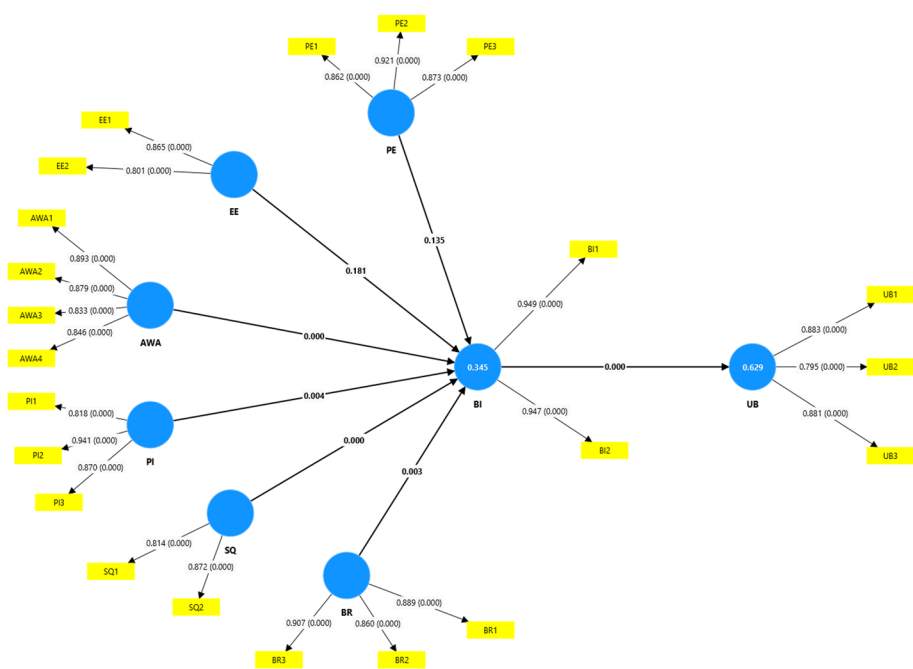
Fig. 2 Measurement Model of the Framework

Table 7 Results of Fornell–Larcker criter

	AWA	BI	BR	EE	PE	PI	SQ	UB
AWA	0.86							
BI	0.44	0.95						
BR	0.49	0.39	0.89					
EE	0.59	0.38	0.46	0.83				
PE	0.58	0.37	0.45	0.74	0.89			
PI	0.36	0.06	0.27	0.17	0.14	0.88		
SQ	0.38	0.47	0.37	0.42	0.54	0.24	0.84	
UB	0.37	0.79	0.39	0.31	0.34	0.01	0.42	0.85

Table 8 Results of HTMT

	AWA	BI	BR	EE	PE	PI	SQ	UB
AWA								
BI	0.50							
BR	0.56	0.45						
EE	0.81	0.53	0.65					
PE	0.67	0.42	0.52	0.89				
PI	0.41	0.06	0.31	0.24	0.17			
SQ	0.52	0.64	0.51	0.70	0.75	0.34		
UB	0.43	0.89	0.46	0.46	0.40	0.06	0.59	

diagonal constructs and the other off-diagonal constructs (Table 7). Consequently, the analysis finds that the measurement model used in this study meets both convergent and discriminant validity criteria.

Hair et al. [99] also argued that the value of HTMT must be below 0.90. Table 8 confirms that all of the HTMT values are lower than 0.90, which is ultimately within the acceptable range. Hence, all the variables ensure DV.

Table 9 Results of coefficient of determination (R^2) and predictive relevance (Q^2)

Construct	*R*-square	*R*-square adjusted	Q^2 predict	RMSE	MAE
Use behavior (UB)	0.63	0.63	0.27	0.86	0.65
Behavioral intention (BI)	0.35	0.34	0.32	0.83	0.64

Table 10 Results of model fitness

	Saturated model	Estimated model
SRMR	0.06	0.06
d_ULS	0.85	0.91
d_G	0.56	0.57
Chi-square	1642.51	1657.44
NFI	0.75	0.75

4.5 Coefficient of determination (R^2) and predictive relevance (Q^2)

The predictive accuracy is evaluated by R^2, which shows the impact of exogenous and endogenous factors. Hair et al. [99] argued that the coefficient of R^2 varies between 0 and 1. Thus, 0 means no effect while 1 refers to a perfect one. The R^2 value of 0.26 indicates substantial predictive accuracy, 0.13 represents moderate accuracy, and 0.02 means weak accuracy [107]. Both the endogenous variable in Table 9 has an R^2 value greater than 0.26. Holding such a level of value represents the model's substantial degree of predictive accuracy. The Q square is used to examine the quality of the path model. Q^2 measures the model of predictive relevance (PR) through examining its capacity to replicate observed values. PLSpredict uses the value of Q^2. When $Q^2 > 0$, the PR of the path model is acceptable [99]. While $Q^2 < 0$, it refers to the lack of predictive relevance. In Table 9, Q^2 values of the BI and UB measure are greater than zero. Therefore, the model exists in PR.

4.6 Model fitness

As recommended in [108, 109], the standardised root mean square residual (SRMR) was used to evaluate the created model's approximate fit. According to Henseler et al. [110], a fit is deemed satisfactory if the SRMR is less than 0.08. An appropriate SRMR of 0.06 was determined for this investigation. The model's approximate fit was also assessed using the Bentler–Bonett normed fit index (NFI) [108]. According to Singh [111], an acceptable NFI should fall between 0.6 and 0.9. The model is considered to be a satisfactory match because the NFI calculated for this study was 0.75 and fell inside the specified threshold (Table 10).

4.7 Importance-performance map analysis (IPMA)

Ringle et al. [112] stated that standard PLS-SEM research offers insights into the relative contribution of components in explaining other constructs within the structural model. They also argued that the importance-performance map analysis (IPMA) is impactful for the outcomes of PLS-SEM. The IPMA also takes into account the performance of every variable. Importance and performance are two dimensions to reach judgments. They are crucial for managerial actions. Table 11 indicates that SQ has a substantial impact since it targets the behavior intention (BI). In particular, the BI performance increases by 0.36 with the increase of one unit in the performance of SQ. This improvement ultimately measures the SQ impact on total BI. Additionally, SQ plays a vital role in positioning as

Table 11 IPMA results full data set

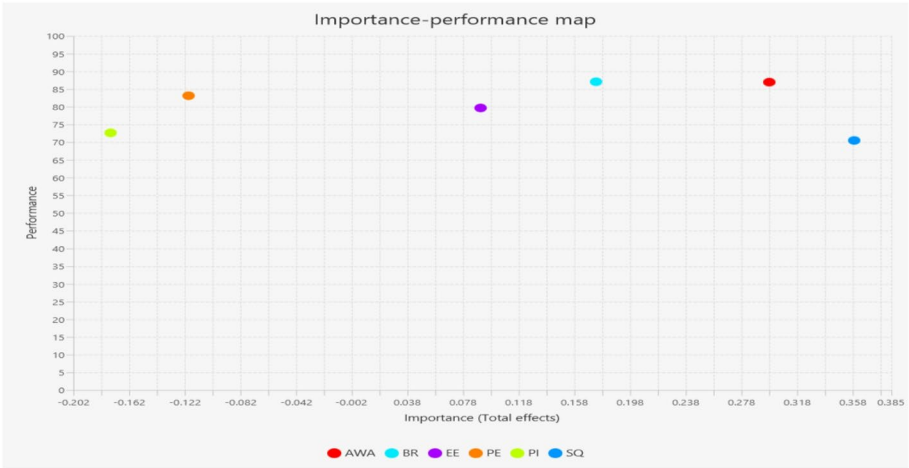| Behaviour intention		
Latent variable	Total effect (importance)	Index value (performance)
PE	−0.12	83.12
EE	0.09	79.66
AWA	0.30	86.95
PI	−0.18	72.62
SQ	0.36	70.47
BR	0.17	87.07

Fig. 3 Importance-performance map

Table 12 Results of path coefficient (direct effect)

Hypothesis	Path	Original sample (O)	Sample mean (M)	Standard deviation	T Statistics	P values	Decision
H_1	PE ->BI	−0.12	−0.11	0.08	1.49	0.14	Not Supported
H_2	EE ->BI	0.09	0.09	0.07	1.34	0.18	Not Supported
H_3	AWA ->BI	0.30	0.29	0.07	4.43	0.00	Supported
H_4	PI ->BI	0.18	0.16	0.06	2.90	0.00	Supported
H_5	SQ ->BI	0.36	0.35	0.05	7.34	0.00	Supported
H_6	BR ->BI	0.17	0.17	0.06	2.95	0.00	Supported
H_7	BI ->UB	0.79	0.79	0.02	34.08	0.00	Supported

a fundamental element of this construct that is related to managerial actions. Due to the relatively low performance of PI, there is sufficient scope for improvement. Figure 3 also confirms the importance-performance analysis.

4.8 Path co-efficient (hypothesis testing)

The bootstrapping techniques were applied in evaluating the path value of the construct. The coefficient of path coefficient ranges from − 1 to + 1. The stronger absolute values result in a stronger predictive relationship between the constructs. Hair et al. [113] stated that significance is achieved when T-statistic value surpasses 1.96 for a two-tailed test and the *P* value must be lower than 0.05. Table 12 shows that the t-values of the hypotheses (H_1, H_2) are less than the threshold value. Therefore, both hypotheses were

rejected. On the other hand, the *p* value of the other hypotheses is less than 0.05. More specifically, the estimated data verify that customer awareness has significant positive effects on behavioral intention (t-value 4.43; *p* value 0.00) (H3). This result provides similar empirical evidence in favor of hypotheses H4, H5, H6 and H7, where all the hypotheses have higher recommended t-values and *p* values. However, H1 and H2 were rejected. More specifically, performance expectancy does not have significant and positive effect on behavioral intention (t-value 1.49 and *p* value 0.14). Similarly, effort expectancy and behavioral intention are not significantly correlated (t-value 1.34 and *p* value 0.18).

5 Discussion

To solve the issues brought on by climate change and promote environmental sustainability, GBT is essential. Financial institutions with GBT policies may play a significant role in promoting sustainable economic growth, environmental preservation, and a sustainable future by integrating eco-friendly procedures into their business plans. Using UTAUT, the study improves policymakers' and scholars' comprehension of the myriad technological, societal, and individual aspects that impact the adoption of GBT. The study develops 7 hypotheses, of which five are significant and positive.

Firstly, PE and EE do not have positive and significant effects on BI. The reasons could be that customers are not aware of how green baking can increase the accuracy of their performance. Additionally, in developing countries like Bangladesh, because of a lack of education and technological know-how, they may not understand how green baking can be easier to use for them. On the other hand, customers who are already used to using green banking services may not differentiate between traditional banking and green banking. Therefore, they may think green banking is not adding additional benefits. The result contradicts the previous literature, which employed the UTAUT model. So, the result paves the way for future researchers that users' context and demographic characteristics can moderate the intention in the UTAUT model. Shafique and Khan [68] demonstrate how perceived utility and perceived ease of use are more important predictors of attitude toward usage, which is a key component of behavioral intent to adopt GBT practices, together with EE and PE. Another inconsistent result found by Ahmad et al. [29], indicated a substantial influence of PE and EE on consumers' intentions and actions toward GBT practices. Moreover, Majeed & Rasheed [67] concluded that the most important variables propelling the growth of GBT are enabling conditions and PE, which are followed by emotional and conditional values, SE, and EE. Because of time-saving features, effective financial management, and increased productivity and usefulness, customers may think that utilizing GBT services will enhance their overall performance. Buyers may believe that obtaining green loans with advantageous conditions will enable them to invest in environmentally sustainable goods like solar panels, hybrid or electric cars. The accessibility of the necessary technical tools or infrastructure, including internet connections, digital literacy, and legal aid. The presence of niche branches devoted only to sustainable banking initiatives [41, 114].

Secondly, the result of our analysis indicates that the influence of AWA and PI on BI is significant and positive. The result is consistent with the finding by Ellahi et al. [115] who demonstrated that consumers are open to adopting the changes brought forth by the banks' green effort. In the chosen sample, education seems to significantly increase awareness of GBT. This may be because of the lack of knowledge among the clients.

There may also be geographic, demographic, and cultural differences between the respondents. Verkijika [116] asserted that customers' attitudes and level of environmental consciousness indicate how often they use GBT. Mehta and Handriana [72] claimed that whereas performance expectations and effort expectancy are directly related to the stronger positive feeling that is crucial for adoption, technical literacy has a mitigating influence. The reason for this positive impact of PI can be that consumers are willing to be involved in the innovation of GBT, or they have no opportunity to take part in the innovation process. These direct effects certainly generate consumer consciousness and awareness about the prevention of climate change and mitigation of climate risks. These constructs directly impacted the SDG 13: climate action as consumers are conserving and preserving atmosphere through the implications of green banking technologies usage. Previous studies done by Hasudungan and Saragih [80] showed similar findings, such as that purchase intention and personal inventiveness are positively correlated. The outcome also aligns with Sharma et al. [3].

Thirdly, SQ has a positive and significant relationship with BI, with a p value of less than 0.05 and it is consistent with the previous literature. Consequently, it also leads to secure the sustainable development goal 13 (climate action). To mitigate and minimize the risk and adverse effects of climate change and various natural disasters, adoption of green banking technology is a crying need for an emerging country like Bangladesh. According to Bouteraa et al. [24], system quality has a favorable effect on the uptake of GBT. The more consumers can do their transactions and find the process of transactions with GBT more willing they are to adopt GBT practices leads to achieve SDG 13. However, according to Saif et al. [86], security risk has a negligible effect on consumers' behavioral intentions among the factors that influence the adoption of technology, such as perceived value, trust, economic efficiency, and convenience.

Fourthly, BR has a positive and significant impact on BI. Similarly to the findings, Bouteraa et al. [24] have investigated the substantial impact of bank reputation on the adoption of GB technologies. According to Kıymalıoğlu [71], the association between compatibility and future intention to utilize mobile banking services is partially mediated by attitudes about utilizing them. The efficiency of sustainable banking operations is improved by the direct and substantial effects of technology adoption, according to Hidayat-ur-Rehman and Hossain [90]. Besides, it diminishes the adverse effects and risks of climate change like disasters and contributes to enhance climate action so that atmospheric discipline and prosperity maintenance are being monitored by the researchers.

Finally, BI has a positive and significant impact on UB which is consistent with the study done by Jamal et al. [98], the behavioral intention of bankers to embrace GBT, encourages them to do so more quickly than traditional banking methods. To secure the goal 13: climate action), the significance of personality and behavioral intention in adopting GBT is emphasized by Malik and Singh [79]. It also connects the technological innovation and adoption associated with sustainability in green banking sector to emerge to build cashless society and less carbon emissions atmosphere at earliest convenience in this contemporary situation of Bangladesh. Conscientiousness, extraversion, and agreeableness are necessary for converting an individual's goal into practical application.

6 Implications

6.1 Theoretical implications

The study's empirical results significantly advance a more sophisticated scholarly understanding of consumers' willingness to embrace GBT. The key contribution in this study is the extended UTAUT model, where sustainability is aligned with the banking sector. The integration of personal innovation, awareness, system quality, and bank reputation has added to the main elements of the UTAUT model that give an insightful view of the psychological and environmental consciousness of customers. Additionally, it has been shown how system quality and bank reputation can be a strength for the banks to increase trust among the customers. Thus, the theoretical framework blends sustainable awareness and organizational credibility. It has increased the UTAUT model's applicability and precision in describing the development of GBT in Bangladesh, a recently developing economic environment. This improves a thorough comprehension of GBT adoption patterns. The model's high degree of variance explanation shows how well the UTAUT framework worked in this study. The study's model has considerable predictive power, according to the PLS prediction analysis, which is a larger theoretical contribution. This indicates that the model can produce testable predictions for different types of technology adoption and effectively predict answers from respondents outside the sample. By employing analytical techniques, PLS-SEM, this work methodologically enhances the body of existing research on GBT. The net impacts of the new factors and the UTAUT variables on GBT adoption were demonstrated by the PLS-SEM results. The subsequent findings demonstrated that when combined with other variables, certain variables that were not significant in the PLS-SEM analysis might encourage the use of GBT. The study greatly influences customers' behavioral intention and subsequent usage behavior towards GBT in Bangladesh by identifying and analyzing their green values (awareness and innovativeness).

6.2 Practical implications

In addition to its theoretical contributions, the current work has applications for practitioners and legislators. There were few empirical studies on GBT practices in Bangladesh, but what was discovered offers important insights for developing and implementing policies in other nations. The study can serve as a useful guide for creating efficient GBT policies that aim to maximize the advantages for banks, the national economy, and mass consumers while also achieving sustainability, given that it has examined and discussed how different individual, technological, organizational, and environmental factors affect the plans of customers to adopt GBT. The study offers a model by integrating PE, EE, AWA, PI, SQ, BR, BI, and UB for practitioners by better describing the real problems faced by their clients and the difficulties in implementing green banking technological services.

The study finds a positive impact of customer awareness on behavioural intention. It means that customer awareness regarding GBT adoption is one of the critical factors. Financial institutions and regulators should work for the enhancement of customers awareness. The majority of the people in Bangladesh use smartphones and have different social media accounts. In this case, the banks and regulators must initiate an online-based campaign on GBT benefits by publishing their content on Facebook, YouTube, LinkedIn, and other social media platforms. Apart from social media, they could raise

customer awareness by organizing workshops. Moreover, they could collaborate with NGOs and universities to include GBT-related information. If the students get any benefits from their texts, they can practically launch this environmental technology, which ultimately motivates them to work as ambassadors in their society. The governing body could also mandate green banking disclosures in bank communication, including monthly statements and apps. Additionally, they could offer tax waivers to those customers who are actually utilizing GBT services.

Personal innovativeness has a positive impact on BI. This effect describes that innovative users are early adopters. As a result, they can influence others to adopt GBT. Financial institutions can include new features, such as innovator loyalty programs, in the mobile banking apps. The innovator loyalty programs can be incorporated with tiered reward systems such as bronze, silver, gold, and platinum and green pioneer badges. In the case of tiered reward systems, tech-savvy users can achieve points by making eco-friendly transactions. The more transactions they make, the more points they will achieve, and this strategy helps them to use this system for a longer period of time, which ultimately helps to protect the environment. Green pioneer badges are a kind of social recognition for the users. Financial institutions can award digital badges to the customers in their mobile apps for each green transaction. When users share this kind of recognized base, they can motivate others to practice green transactions. The government can launch a fund for Hackathon (tech events) for green banking innovation since Hackathon has the capacity to fast-track innovation in GBT.

System quality is positively correlated with behavioral intention, which implies that customers prioritize trustworthy, fast, and continuous functionality in GBT systems. In this regard, financial companies must finance the next-gen infrastructure through ensuring quantum-resistant encryption for all sustainable financial transactions. Apart from this, banks can use edge computing for the purpose of decreasing latency in the countryside. While regulators should mandate service level agreements for GBT systems for the objective of upholding service reliability and saving users interests. Moreover, they must develop a self-reliant GBT certification authority that will annually audit banks performance. Lastly, the study shows a significant relationship between BR and BI. It refers to the fact that user trust and perceived environmental loyalty positively advance GBT adoption. For the enhancement of bank reputation, banks can enhance transparency level through impact reporting. This transparency plays a significant role in building trust and improving collaboration with green banking efforts. Financial institutions can introduce real-time "Green Impact" dashboards that show branch-level environmental indexes, and these dashboards allow users and stakeholders to observe tangible results of green practices. On the other hand, regulatory bodies could enforce guidelines requiring financial institutions to accentuate their GBT usage rates in all marketing materials that would help users to take environmentally friendly decisions.

6.3 Contribution to the SDG 13: climate action

Beyond theoretical and practical implications, this research also paves the way for achieving SDG 13. To accomplish SDG 13, it is necessary to put strong sustainability practices into action. Banks help achieve this by making sure the projects they finance result in real climate benefits. The plan not only reduces the effects of climate change but also helps the financial sector support and promote environmental action. For instance,

green stocks are an example of how investments in environmentally friendly companies can support SDG 13 by providing funds for companies that invent new ways to reduce carbon emissions and by helping organizations switch to more sustainable practices [32, 117]. The investment is good for the environment and also motivates companies to find sustainable solutions. Sustainable buildings and transport systems help lower pollution and improve city life. In addition, strict adherence to sustainability standards supports the achievement of SDG 13. Banks make sure that their supported projects contribute to the environment and encourage people to care more about it. Mittal et al. [118] explain that this approach stresses the value of including sustainability in banking to educate and involve customers in using green financial products. Mohamed [119] also points out that promoting informed financial habits is necessary for creating positive results in society and stresses the wider social impact of sustainable banking.

7 Conclusion and future research directions

With sustainability becoming a top priority for a nation like Bangladesh, a lot of research has been done to examine the difficulties associated with GBT. The paper aims to explore the factors that impact BI's adoption of green banking solutions. This study uses an extended UTAUT model. It utilized the key factors influencing customer behavioral intention, including PE, EE, AWA, PI, SQ, and BR. A survey of 475 respondents was analyzed using the PLS-SEM. Findings indicate that PE and EE have no significant impact on customer BI, while AWA, PI, and BR have a substantial effect on consumer BI. BI strongly predicts actual usage behavior. This study also assists emerging countries like Bangladesh to achieve the sustainable development goals. It also concurs the technological adoption associated with sustainability in green banking sector to emerge to build cashless society at earliest convenience in this contemporary situation of Bangladesh. Through highlighting organizational and interpersonal aspects that encourage the implementation of ecologically conscious banking practices, these findings directly support SDG 13. GBT promotes ecologically sustainable growth in developing countries by enabling electronic financial transactions, decreasing paper-intensive procedures, and promoting environmental-conscious purchasing decisions. The findings highlight the significance of raising consumer knowledge, encouraging new ideas, and establishing reputational trust in order to hasten the acceptance of GBT by banks and governments. This study offers practical recommendations for combining technology and climate adaptation tactics in the framework of Bangladesh's shift to a paperless and environmentally friendly economy. In order to facilitate wider adoption of the 2030 Agenda in the banking industry, future research may examine the relationship between online banking and sustainability in greater detail.

  Nevertheless, there may be limitations that future scholars can follow to go further. However, there can be limitations that later researchers can adhere to advance. Firstly, the empirical study was likely unable to establish causality due to the convenience sample survey design. These links can thus be verified in later research by using a cross-sectional or longitudinal study design. To provide a more comprehensive understanding of the factors impacting competitive advantage in higher education, research may also use a range of approaches, such as mixed methods that combine quantitative and qualitative techniques. Secondly, due to the problem of heterogeneity across GBT services, one research study cannot address all these difficulties at once; it did not include green

banking products, such as green bonds, green credit cards, or green loans. Therefore, our study suggests that additional GB product kinds that are crucial to achieving sustainability might be the subject of future research. Thirdly, the study is based on the Bangladesh context; future studies should look at other contextual factors that were left out of our analysis, such as the nature of the organization, the kinds of service providers, and geographical differences. Finally, we did not take any mediator and/or moderator for our study, though these could more insight to the existing literature. However, it paves the way for the future researchers to include moderators like users demographic characteristics such as age, gender, and income as these can moderate the adoption intension and the relationship between the dependent and dependent variable.

Declarations

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