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Towards More Green Buildings in Tanzania: Knowledge of Stakeholders on Green Building Design Features, Triggers and Pathways for Uptake

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Abstract: Green Building Practices (GBPs) are gaining prominence in many countries around the world. However, in many developing countries, Tanzania inclusive, little progress has been made in achieving its implementation. The current study sought to examine the factors attributable to low uptake, focusing on an appraisal of the stakeholders' knowledge of GB design features, triggers, and the pathways for uptake. The study was conducted in Dar es Salaam City in Tanzania, involving different stakeholders sampled from the construction industry, including architects, engineers, quantity surveyors, and property managers. Valid data were collected through 412 questionnaires. The study revealed a general consensus among the respondents that GBs are environmentally friendly and cost effective. However, it appeared that the ranking score of GB design features according to the respondents did not correlate with their ranking in existing GB rating systems. It was concluded that there exist misconceptions among the constructions industry stakeholders regarding what green building practices entail and the essential requirements for their implementation. Therefore, the study recommends pragmatic educational trainings to stakeholders in the construction sector of Tanzania on GBPs. Mandatory legislation of green building codes and regulations is also suggested as a potential pathway for enhancing GB practices in Tanzania.

Keywords: green building practices; sustainability; Tanzania; architecture/construction; energy

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1. Introduction

The Sustainable Development Goal SDG 11, titled "Sustainable cities and communities", requires the development of inclusive, secure, and resilient cities with zero net emissions [1]. This has become essential since 55% of the world's population live in cities, and the number is projected to rise to 85% by 2100 [2]. Omisore [3] observed that more than 50% of SDGs are linked directly to environmental sustainability, and that African countries require the most attention as they are the most vulnerable. Green Buildings (GBs) are essential for achieving Sustainable Development Goals; they help mitigate and reduce adverse climate change, increase the use of renewable energy [4], encourage the development of eco-cities [5] and reduce environmental impacts arising from planning, construction and operations in the construction industry [6,7]. Wen et al. [8] proposed a realistic mapping tool using GBRS to scientifically quantify and intuitively demonstrate GB's contribution to the SDGs. The tool revealed that SDGs 3, 7, 11, and 12, namely Good Health and Well-being, Affordable and Clean Energy, Sustainable Cities and Communities, and Responsible Consumption and Production, are strongly supported by GBRS. Among these, SDG 12 exhibited the greatest benefits. Goubran et al. [9] illustrated how three GBRS, namely LEED, BOMA BEST, and GRESB, contribute to SDGs 3, 7, 11, and 12. In Jordan, Alawneh et al. [10] observed that implementing water and energy efficiency measures in green buildings plays a significant role in achieving SDGs. However, achieving the above SDGs requires environmental awareness and sensitivity on the part of the stakeholders, which can promote the green building movement in developing countries.

The "Green Building" concept has been defined by the EPA [11] as "the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. Green building is also known as a 'high performance' building" [12]. Green building certifications examine buildings in areas including indoor environmental quality, energy efficiency, water use, and materials choices and offer points or ratings depending on the sustainability level attained [13]. The well-known standards used across the globe include: BREEAM-UK, LEED-USA, Green Star-Australia, Green Mark-Singapore, CASBEE-Japan, DGNB-Green Star SA-South Africa, and Excellence in Design for Greater Efficiencies (EDGE) [14,15].

Green Building Rating Systems (GBRS) encourage stakeholders to design and develop green buildings that reduce environmental effects and energy usage. Early adopters in Africa, such as South Africa [16] and Egypt, have attained uptake achievements of the GBRS and have consequently adapted their own rating systems, such as Green Star SA (adapted from Green Star Australia) and Green Pyramid Rating System (GPRS) (adapted from LEED), respectively. However, the main observation underlying this paper is that GBP uptake in Tanzania has remained too low. Likewise, there is no indication that the status could change for the better. The uncertainty on the prevailing state of affairs regarding GBP uptake prompted us to conduct a study aimed at critically examining the knowledge held by stakeholders in the construction sector of Tanzania regarding GBP uptake, design features and their importance, barriers, and the way forward.

1.1. Barriers and Drivers of Green Building Uptake in Africa

Despite the apparent benefits of green buildings in the built environment in Africa, only fifteen out of fifty-four recognized countries have a green building council [17]. Regardless of whether the council is considered as established or emergent, the decision to adopt a green building council improves an uptake [18,19]. However, in these countries, it is still challenging to uncover concrete evidence of concerted uptake of GBP. Dadzoe et al. [20] and Anzagira et al. [18] identified a lack of awareness as one of the limiting factors hindering the uptake of GB in Sub-Saharan Africa. Other impediments include but are not limited to inadequate training and education, existing policy/regulation, implementation capability, higher initial costs of green construction practices and materials [16,18,21–24], lack of integration of local culture, traditional construction methods [18,19,25], and challenges related to design and construction implementation of green building processes [19,22,24]. Inferring from the cited literature, low GBP uptake seems to be a crosscutting feature prevailing in most African countries. Considering the significance of GBP in energy saving and environmental sustainability of buildings especially in the global South, low intake presents a challenge that must be more vigorously addressed. The study was therefore inspired by a scholarly desire to examine the knowledge levels held by stakeholders in the construction industry in Tanzania on the aspect of GBRS, the factors linked to uptake and the interventions required.

1.2. Architectural Trends and Status of Green Buildings in Tanzania

Urban Tanzania's architectural patterns show little attention for sustainable construction. Marwa [26] examined architectural trends from 2002 to 2013 and discovered that buildings employ a lot of glass glazing on the façade, and they overlook sustainable design and construction. The author asserted that few buildings in Dar es Salaam are sensitive to a hot, humid climate and encouraged sustainable design and construction. Nkini et al. [27] also conducted a study in Dar Es Salaam that compared traditional office buildings constructed between 1970 and 2000 and modern office buildings constructed between 1999 and 2016. The findings revealed that traditional office buildings, which incorporated a greater number of climate-responsive design elements, exhibited lower energy consumption compared to modern office buildings.

Tanzania is among the few developing countries that are trying to achieve progress in green building practices and development. The Tanzania Green Building Council (TZGBC), a Non-Governmental Organization, was established in 2014 with a view to promoting awareness of green building design and construction through conferences and to propel the green building movement through influencing policy, building codes, regulatory bodies, and the community at large [28]. Nkini et al. [29] studied two office buildings that had obtained certification under separate green building rating systems. The historical projection of progressions in green buildings constructions can be observed as follows. The first is the National Housing Cooperation (NHC) Kambarage Building (GK), a government-owned building, which was certified by BCA Green Mark in 2014. The second one is the Luminary building (GL), a privately-owned office building certified by LEED-V4.1 BD +C; Core and Shell from the USA. This is the first LEED gold certified building in Tanzania, recognized in 2016 under the categories of shell and core. The Citibank Tanzania Serengeti building conducted LEED interior design and construction certification process for floors 0, 2, and 3 and became the first LEED ID+C Commercial interiors in Tanzania. The private Hotel Verde Zanzibar which received a 5 Star Rating South African Excellence, accredited in March 2019, is the first Green Hotel as Built certified by Green Star South Africa; the hotel uses numerous green technologies to encourage sustainable tourism [30].

There are no clear government policies and regulations mandating the application of GBP practices in building development in Tanzania. The construction industry policy of 2003 was the first to acknowledge that there are a number of activities in the construction industry that are not environmentally green/sustainable, and that there is a lack of awareness and technological know-how regarding the green building practices, but the policy lacks a clear definition of GB and it has hardly been enforced, especially insofar as three pillars of sustainability, namely, environmental, social, and economic, are concerned [26]. The National Environmental Management Act (EMA) No. 20 of 2004 through the National Environment Management Council (NEMC) guides all issues pertaining to the environment in the country. However, the Environmental Impact Assessments (EIAs) that were undertaken for building construction as a consequence of EMA have been insensitive of green building practices and have been unable to influence the selection and use of building materials and design to reduce greenhouse gas emissions. Moreover, the Professional Registration Acts, such as the Architects and Quantity Surveyors Registration Act No.4 of 2010, the Engineers Registration Acts No 15 of 1997, and the Contractor Registration Acts of 1997, do not offer adequate guidelines for GBP. As such, these current acts and policies do not provide clear mandates to create tangible instruments for green buildings practices in the country.

The previous policy-level discussion has indicated that there is a certain level of recognition of GBP in Tanzania, but it is uncertain whether there is awareness and uptake at the same level. Arguably, 'awareness' is a relative and subjective construct. The current study sought to analyze the concept of GBP using quantitative methodologies intended to scrutinize the data and explain findings more objectively. The researcher focused more attention on examining the design features of green buildings and the importance attached to them by different stakeholders in the construction sector. The study sought to answer four research questions. First, what is the stakeholders' level of awareness of GBP? Second, are the green building features that are considered important by stakeholders in line with what is considered important in GBRS? Third, what are the triggers of GBP? Fourth and last, how can GBRS uptake be attained to enhance GBP in Tanzania?

2. Materials and Methods

2.1. Study Context

The study was conducted in the City of Dar es Salaam, Tanzania, employing participation of a diverse groups of construction industry stakeholders, including property managers, engineers, architects, and quantity surveyors. Dar es Salaam city is near to the Indian Ocean Coast, at latitude 6°52′ S and longitude 39°12′ E. The region is located in a hot, humid tropical climate as indicated in Köppen-Geiger climate class Köppen-Geiger Climate classification Aw map for Eastern Africa [31], shown in Figure 1. The yearly average temperatures vary from 28 °C to 32 °C while the average minimum temperatures range from 19 °C and 26 °C. There is a monthly average temperature variation of 4.5 °C. This location offers minimal seasonal fluctuations throughout the year, which is crucial for making informed decisions regarding green building designs and the integration of renewable energy sources. The city is also rapidly growing in terms of population and building complexities, to the effect that it is almost becoming a mega city. These critical factors rationalized a need to consider building designs that are sensitive to energy consumption. The current study is built upon a previous study conducted by [29] focusing on an evaluation of the occupants' satisfaction rate with two certified green office buildings and fifteen non-green office buildings in Dar es Salaam. Nkini et al. [27] conducted an additional study that compared the energy performance of these green and non-green office buildings in Dar es Salaam.

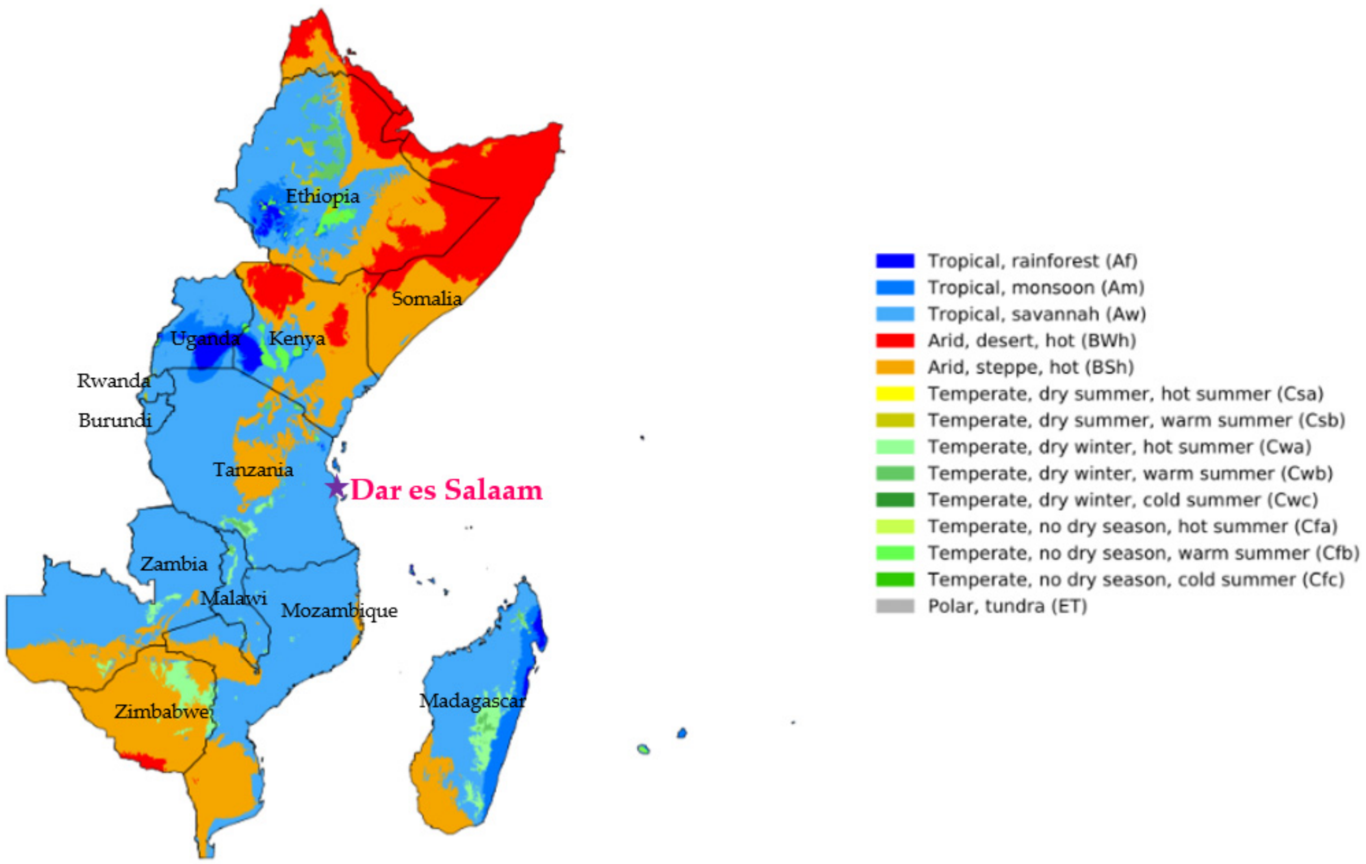

Figure 1. Climate classification map for Eastern Africa adapted from [31].

2.2. Surveys among Construction Professionals

The questionnaire survey method has been a successful technique widely used in green building awareness research [13,32–34]. The questionnaires were organized as follows: The first stage involved data collection on the respondent's background information. In the second section, the respondents were asked questions related to their basic awareness, knowledge, and understanding of green building practices and were thereafter prompted to select their own perspective on the matter. They were also asked if they had ever used or heard anything about GB rating systems. Afterwards, the questionnaires collected data on the perceived importance of features of GB practices, GB drivers, and GB triggers using the Five Likert scale rating ranging from the worst (1) to the best (5). The last section explored strategies that can enhance awareness and uptake of the green building design and performance. The questionnaires were delivered in person, through email, and via an online survey using the available contact information from professional registration boards and property management firms. The researcher administered some questionnaires at Continuous Professional Development (CPD) conferences where a wide range of stakeholders participated. Participants in this study encompass a diverse range of professionals, including individual architects, engineers, quantity surveyors, and property managers employed in private firms, non-governmental organizations, government officials (policy makers), and cooperative organizations such as financial institutions. The firms actively involved in the design and construction of green buildings in Tanzania were contacted to identify the initial respondents. A comprehensive analysis was made on the documentary evidence, including CPD documents and university curricula, to identify concerns pertaining to GB practices. A total of 412 respondents were obtained overall.

2.3. Data Analysis and Statistical Methods

The most prevalent descriptive statistics of mean and standard deviation (SD) were utilized for the analysis of survey data ranking the importance of design features, drivers, triggers, and strategies used in ensuring green building practices as perceived by stakeholders. Stakeholders' perceived importance of design features was studied through ranking and comparing with LEED 4.1 and Green Mark 2017 credits. To conduct comparison of the stakeholders, and owing to the ordinal distribution of the data, the Kruskal–Wallis H test and ordinal logistic regression were used. The Kruskal–Wallis test tests whether there was a difference between several groups of the values of an ordinal variable. An ordinal logistic regression allowed evaluation of the impact of several independent variables Xi on an ordinal dependent variable Y. It assumes a causal relationship of all the Xs on Y. To test if the respondents assigned comparable importance to two ordinal variables, the non-parametric Wilcoxon's signed rank test was used as recommend by Darko and Chan [35] and Wu et al. [36]. Given that in the Wilcoxon's signed rank test comparisons there were many combinations of variables to test, the Holm–Bonferroni correction was used to interpret these results for 'statistical significance'. Due to the number of tests, differences were regarded to be significant when p was smaller than 0.001.

3. Results and Discussion

3.1. Results and Discussion

This section presents the study results and discussion. The section is structured in six subsections that are organized as follows: Description of the respondents' characteristics (Section 3.2); Level of green building awareness (Section 3.3); Perceived importance of GB design features (Section 3.4); Drivers of green building practices (Section 3.5); Triggers of GB practices (Section 3.6); and Strategies to improve GB practices (Section 3.7).

3.2. Description of the Respondents' Characteristics

Table 1 presents the composition of the study population: 421 study participants, of which 67% were males and 33% were females. Moreover, 43% of the respondents were aged between 31–40. The respondents with a Bachelor's degree accounted for 67%. Approximately 38% of the respondents were architects, while 25% were property managers; 32% of the respondents had professional experience ranging between 6–10 years and 30% 5 years or less. As such, it can be inferred that quite a diverse group of stakeholders participated in the study.

Table 1. Respondent's profiles.

Respondents' Characteristics	N = 421	Frequency	Percent
Gender	Male	275	67
	Female	137	33
Age (in years)	Under 30	114	28
	31–40	176	43
	41–50	86	21
	51–60	20	5
	above 61	16	3
Level of Education	Secondary school/certificate/diploma	9	2
	Bachelor degree	274	67
	Postgraduate diploma/Master degree	117	28
	PhD or above	12	3
Current occupation	Architects	157	38
	Property managers	104	25
	Quantity surveyors	80	19
	Engineers	71	18
Professional experience	5 or less	125	30
	6–10	131	32
	11–15	94	23
	16–20	22	5
	Above 21	40	10

3.3. Stakeholders' Level of Awareness of Green Buildings

The study examined the level of awareness of green building practices among the stakeholders sampled from the construction sector in Tanzania. In a response to the question "what is your level of awareness of GBP", Figure 2 demonstrates that 50% of the stakeholders considered themselves moderately aware of green building practices, while 33% called themselves very aware. These findings are consistent with those of Anzagira et al. [37] from Ghana, who reported that 88.4% of practitioners were aware of GBP, and Kibwami and Tutesigensi [38] from Uganda, who reported a moderately high awareness rate of 53%.

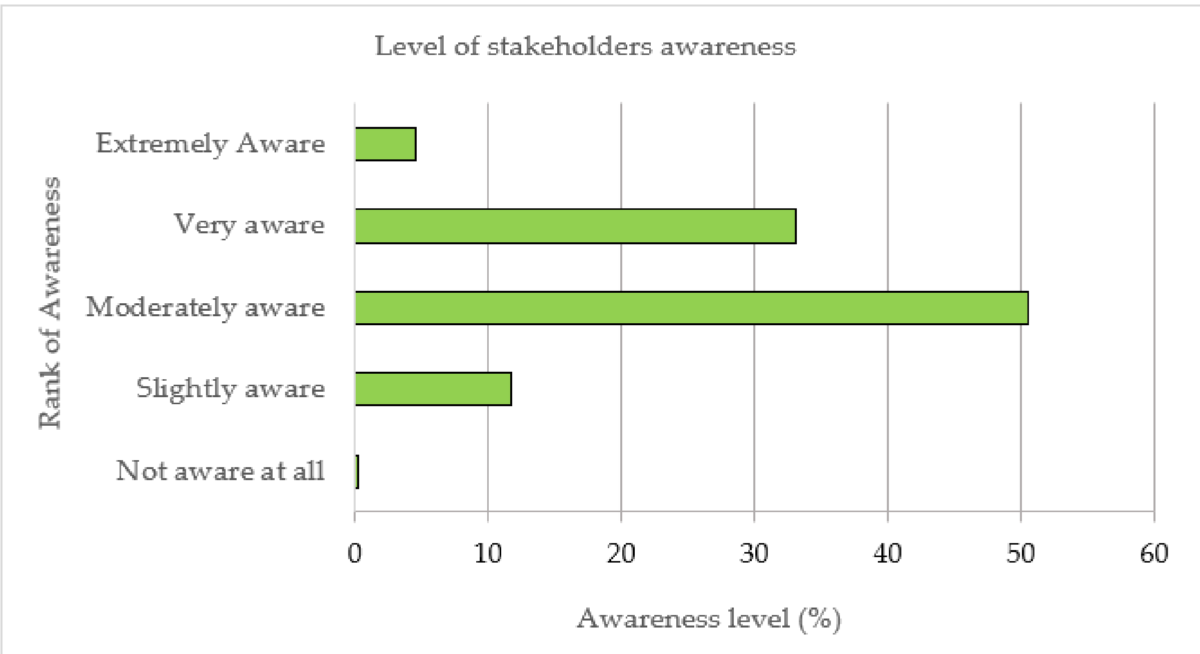

Figure 2. Stakeholder's level of awareness of GB practices (N = 412).

An ordinal logistic regression analysis was conducted to examine if the awareness level of stakeholders depended on gender, age, occupation, education, years of professional experience, and sources of awareness the respondent had experienced. Only those variables that had a significant impact on the level of awareness were retained in the regression equation: education, occupation, and source of awareness. The variables gender, age, and professional experience appeared not to have a significant impact on the level of awareness. These findings are consistent with those of Xie et al. [39] who found that gender, age, and years of experience in green building do not have significant moderating effects on the level of GB practices awareness.

In Table 2, the reference occupation is 'architect', while the reference education is 'Bachelor', and the reference source of awareness is 'none'. If the estimate is positive or negative, the awareness either increases or decreases relative to the reference situation respectively. The grey boxes mark statistically significant variables.

Table 2. Factors determining stakeholder's levels of awareness in a logical regression.

Analysis of Maximum Likelihood Estimates						
Parameter		**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept	5	1	−4.17	0.34	149.15	<0.0001
Intercept	4	1	−1.25	0.23	30.56	<0.0001
Intercept	3	1	1.73	0.24	50.79	<0.0001
Intercept	2	1	5.93	1.02	33.91	<0.0001
Education	PhD	1	1.67	0.62	7.35	0.007
Education	master	1	0.66	0.22	8.69	0.003
Education	secondary	1	−1.69	0.68	6.09	0.013
Occupation	other	1	−2.18	0.73	8.81	0.003
Occupation	electrical engineer	1	−1.10	0.55	4.09	0.043
Occupation	mechanical engineer	1	−0.96	0.44	4.85	0.028
Occupation	structural engineer	1	−0.91	0.39	5.29	0.021
Occupation	property manager	1	−0.37	0.26	1.96	0.162
Occupation	quantity surveyor	1	−0.42	0.28	2.27	0.132
Awareness_FT		1	0.98	0.21	21.56	<0.0001
Awareness_BR		1	1.27	0.30	17.37	<0.0001
Awareness_DP		1	0.90	0.25	12.97	0.0003

Legend: source of awareness: FT = formal training; BR = building regulations; DP = demonstration projects.

3.3.1. Level of Green Building Awareness with Education Level and Occupation

Table 2 demonstrates that an increase in education was linked to an increase in the level of stakeholder's stated awareness of GBP. The results show that there was a significant difference ($p < 0.05$) in the level of stated awareness of those with a PhD or postgraduate or Master's degree compared to those with a Bachelor's degree. The stakeholders with lower education level (secondary) were significantly less aware than those with Bachelor's degree. There is a correlation between declared awareness and education and training (The concept of "training" will be discussed in Section 3.3.2). The respondents regarded training as the most important strategy for GB uptake.

Regarding occupation, architects were significantly more aware of green building practices than all other occupations. This observation was unsurprising since the high level of awareness demonstrated by architects might have been linked to frequent engagements in designing and constructing buildings, familiarity with theoretical the issues emerging in the field, participation in formulating regulations, and demonstration of projects. Consistent with this argumentation, Song et al. [40] remarked that architects, as guardians of the built environment, were particularly aware of GBRS compliance in architectural design from the early GB movements.

3.3.2. Level of Green Building Awareness and Attained Sources of Awareness

Table 2 reveals that stakeholders who had learned about green practices from formal training, building regulations, or demonstration projects are significantly ($p < 0.05$) more aware of green building than those without these sources of awareness. Novieto et al. [41] and Xie et al. [39] support formal training and education for raising awareness of GB practices. The development of green building demonstration projects served as learning strategies, thereby increasing GB awareness [13,42]. Reinforcing the findings of the current study, the researcher, as a practicing architect, attended one of the seminar presentations bearing the title: "Green Buildings Concepts" in March 2014. The researcher closely observed the seminar proceedings, emerging discussions, and reactions to the paper presented. The resource person who presented the paper was from Singapore, using the KAM building as a case study. The main topics discussed were green design, energy efficiency, environmentally friendly design, and integrated design, with a specific focus on design and construction activities. Many participants at the conference had a poor grasp of the concept of Green Building. The attendees held a widespread belief that it was unnecessary to prioritize the energy consumption of the building given the insufficient energy production in the country. Others seemed to question the legitimacy of green buildings as merely a business label. Considering that Tanzania has been grappling with frequent power-cut interruptions, which are counterproductive to the development of the nation, GB uptake could be one of the viable methods for power saving. This suggests the necessity to enhance training and comprehension of GBPs and GBRS among the construction industry stakeholders in Tanzania.

3.3.3. Level of Green Building Awareness and Listed Green Building

The respondents were asked to name a green building they were aware of in Tanzania. Figure 3 shows that out of 412 respondents, 40% mentioned only correct green buildings, 6% mentioned both correct and wrong buildings, 8% of the respondents mentioned only wrong buildings, and 46% did not mention any building. The correct green buildings were subdivided into two groups: 'real' green buildings and 'almost' green buildings. The 'real' green buildings are those with certification from sustainability rating system (Green Mark, LEED, and Green Star). The 'almost' green buildings are buildings with green building features observed by the first author, such as solar panels, solar water heater, integrated rainwater harvesting, grey water recycling, shading of external buildings facades using a combined system of vertical and horizontal louvers, and natural ventilation. Only two of the four certified buildings, namely GK and GL, were specifically identified. The GK building appears to be better-known as a certified green building than the GL building. GK was mentioned by 36% of the respondents whereas only 3% mentioned GL. This might be linked to the fact that GK was a public building and is more often presented in media articles and seminars, whereas GL was a private building and is therefore less promoted as a certified building. Additionally, the location of the GK building, which is adjacent to a shared transportation corridor (Ali Hassan Mwinyi Road), might have an impact on popularizing the building.

3.4. Importance of GB Design Features Perceived by Stakeholders vs. in LEED 4.1 and Green Mark 2017

Table 3 shows the overall importance that stakeholders assigned to detailed features for evaluating and implementing green buildings. The mean score for each feature was greater than 3, which was the midpoint of the rating scale, indicating that each feature was considered important. From the mean score results in Table 3, the top four important features of GB practices (mean $\geq$ 4.33) were: use of daylighting (IF05), use of renewable energy sources (IF07), increased ventilation (IF11), and use of energy efficient appliances and equipment (IF09). These four important features of GB practices, ranked among different stakeholders, are discussed below, along with the use of local materials (IF15), as the relatively low rank of this features seems surprising.

Table 3. Assigned importance design features of green building practices on a scale 1 to 5.

		All Respondents			Architect N = 157			Quantity Surveyor N = 80			Engineers N = 71			Property Manager N = 104				
Important Design Features of GB	**Code**	**Mean**	**SD**	**Rank**	**Mean**	**SD**	**Rank**	**Mean**	**SD**	**Rank**	**Mean**	**SD**	**Rank**	**Mean**	**SD**	**Rank**	**K-W**	***p*-Value**
Use of Day lighting	IF05	4.42	0.92	1	4.41	0.92	3	4.50	0.89	1	4.37	1.07	3	4.40	0.85	3	1.53	0.675
Use of renewable energy Sources	IF07	4.37	0.98	2	4.37	0.99	5	4.30	1.05	2	4.32	1.03	8	4.46	0.90	2	1.08	0.782
Increased ventilation	IF11	4.36	0.92	3	4.48	0.88	1	4.23	0.91	3	4.28	0.97	11	4.35	0.95	5	7.63	0.054
Use of Energy Efficient Appliances and Equipment	IF09	4.33	0.96	4	4.25	0.99	6	4.14	1.10	4	4.51	0.83	2	4.48	0.82	1	8.12	0.044 [a]
Thermal Performance of Building Envelope	IF06	4.30	0.98	5	4.41	0.89	2	4.03	1.16	7	4.34	0.98	5	4.32	0.93	7	7.58	0.056
Indoor thermal comfort	IF10	4.30	0.99	6	4.37	0.98	4	4.04	1.08	5	4.31	1.04	9	4.39	0.87	4	8.72	0.033 [a]
Water efficient Fixtures	IF02	4.23	1.00	7	4.11	1.04	8	4.04	1.14	6	4.58	0.69	1	4.33	0.93	6	13.68	0.003 [a]
Building Energy Management system	IF08	4.15	1.01	8	4.10	1.01	9	3.94	1.02	11	4.34	0.97	6	4.28	1.00	9	11.22	0.011 [a]
Rain Water Harvesting	IF01	4.13	1.05	9	3.98	1.14	12	4.01	1.16	8	4.35	0.68	4	4.30	1.00	8	7.40	0.060
Water recycling	IF03	4.09	1.03	10	3.96	1.08	13	3.95	1.03	10	4.34	0.91	7	4.24	1.00	10	11.92	0.008 [a]
Use of materials that can be reused or recycled after the building life.	IF14	4.02	1.09	11	4.09	1.05	10	3.74	1.18	14	4.14	1.14	12	4.06	1.02	13	7.31	0.063
Prevention of noise within and outside the building.	IF13	4.00	1.22	12	3.99	1.05	11	3.85	1.10	12	3.85	1.21	14	4.10	1.02	12	2.83	0.419
Innovative waste water use	IF04	4.00	1.00	13	3.94	1.07	14	3.84	1.04	13	4.13	0.98	13	4.13	0.83	11	4.99	0.173
Low-emitting materials-flooring systems, paints and coatings	IF12	3.89	0.60	14	4.17	0.99	7	3.99	0.95	9	4.31	1.02	10	4.03	1.07	14	8.17	0.043 [a]
Use of local materials (No imports)	IF15	3.56	1.24	15	3.82	1.21	15	3.29	1.12	15	3.28	1.41	15	3.55	1.21	15	14.46	0.002 [a]

Note: [a] The Kruskal–Wallis H test (K-W) result is significant at the significance level of 0.05 (p-value < 0.05).

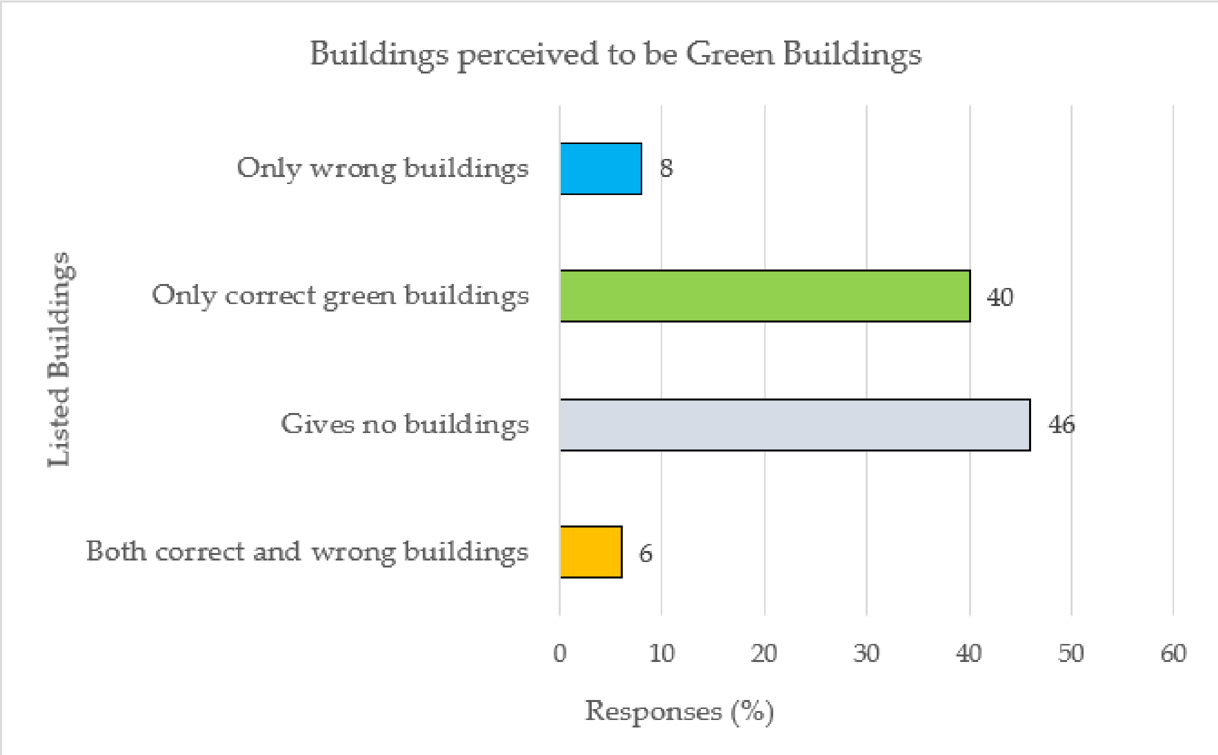

Figure 3. Buildings perceived by the respondents to be "Green Buildings".

3.4.1. The Use of Daylighting (IF05)

The use of daylighting (IF05) received the highest mean score (M = 4.42) and thus was ranked first (Table 3). All professional groups ranked IF05 as one of the three most important GB design features. Moreover, the Wilcoxon's signed test results in Table 4 indicates that IF05, together with IF07, was statistically significantly more highly assessed than the nine features not ranked among the top four features: IF02, IF08, IF01, IF03, IF14, IF13, IF12, IF04, IF12, and IF15 (the meanings of these codes can be found in Table 3). These results represent that IF05 was considered the most important GB design feature. Different countries and regions have a range of GB design features [43] and stakeholders have shown that the use of daylighting is an essential GB design feature. This is consistent with Owoha et al. [43], who remarked that daylight features increase the value of green buildings by substantially contributing to annual energy savings for both lighting and cooling systems. The importance of this feature is also supported by Chien and Tseng [44], Nkini et al. [29], and Gupta et al. [45], who disclose that use of daylighting is a matter of concern to enhance building performance, energy efficiency, and productivity as well as occupants comfort and satisfaction in buildings.

The stakeholders' ranking on the use of daylighting did not correlate with the rankings given in both LEED 4.1 and Green Mark 2017 credits. For example, the use of daylighting is ranked by LEED 4.1 in the first third of the categories but also in the last part of the ranking, while Green Mark 2017 ranked it in the last third of the categories (Table 5). This is because the use of daylighting has an impact on both thermal comfort, lighting comfort, and electrical lighting energy efficiency, all of which are sub-criteria that are ranked in both LEED 4.1 and Green Mark 2017 credits. For LEED certification, 90% of building occupants must have individual daylighting control [46], hence efficient daylighting design can save energy.

Table 4. *p*-values of Wilcoxon's signed rank test comparing the assessment of important design features of GB practices.

	IF05	IF07	IF11	IF09	IF06	IF10	IF02	IF08	IF01	IF03	IF14	IF13	IF04	IF12	IF15
IF05		0.289	0.162	0.048	0.003	0.012	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]
IF07			0.846	0.243	0.036	0.104	0.001 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]
IF11				0.605	0.111	0.093	0.007	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]
IF09					0.396	0.437	0.029	0.000 [a]	0.001 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]
IF06						0.913	0.157	0.000 [a]	0.003	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]
IF10							0.218	0.002	0.004	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]
IF02								0.088	0.074	0.004	0.000 [a]	0.000 [a]	0.000 [a]	0.053	0.000 [a]
IF08									0.741	0.363	0.010 [a]	0.001 [a]	0.004	0.654	0.000 [a]
IF01										0.307	0.059	0.008	0.009	0.933	0.000 [a]
IF03											0.110	0.016	0.044	0.449	0.000 [a]
IF14												0.349	0.640	0.073	0.000 [a]
IF13													0.522	0.004	0.000 [a]
IF04														0.015	0.000 [a]
IF12															0.000 [a]
IF15															

Note: [a] "Due to Holm-Bonferroni correction" the Wilcoxon's signed rank test result is significant at the significance level of 0.001 (p-value $\leq$ 0.001) suggesting that the two compared variables are statistically different.

3.4.2. The Use of Renewable Energy Sources (IF07)

The use of renewable energy sources (IF07) was ranked the second most important feature of GB practices by stakeholders (M = 4.37) (Table 2). All professional groups ranked IF07 as one of the most important GB design features (except engineers, who ranked it 8 of 15). Stakeholders ranked renewable energy sources second, whereas LEED 4.1 rated it fourth and Green Mark 2017 credits ranked it sixth (Table 5). Although the proportions of renewable energy are weighted differently by GBRSs [47], the use of renewable energy was assigned considerable importance in both LEED 4.1 credits and Green Mark 2017 credits. Green Mark 2017 was rated a maximum of 6.5 points for the implementation of renewable energy sources within a building, whereas the LEED "On-site renewable energy" credit scored 5 points in its entirety [48].

Nevertheless, integration of renewable energy sources into building designs is hardly observed in Tanzania [49]. Currently, Tanzania is significantly dependent on non-renewable energy sources. It is imperative that stakeholders acknowledge the importance of renewable energy resources as essential green building design features. This may be attributed to the academic environment in higher education institutions, where there is a focus on training about renewable energy technology in both undergraduate and postgraduate courses. However, there is still a shortage of exposure to Green Building Rating Systems (GBRS) in our academic curriculum that could inspire the future professionals to become aware and confident in adopting GBP. Despite the efforts made in intensifying training in Tanzania about renewable energy technologies, there have been no notable changes in GB practices. Connected to that, previous scholars [50], including Kassenga [51], recommended the uptake of renewable energy technologies for self-sustainability in order to reduce the environmental impact caused by the consumption of fossil fuels.

Table 5. Comparison of stakeholder ranking of GB important design features with LEED 4.1 and Green Mark 2017 credits.

Categories	LEED 4.1 Credits	Total Point	LEED Rank	ST Rank	Stakeholders GB Important Design Features	Categories	Green Mark 2017 (2020 Update) Credits	Total Point	GM Rank	ST Rank	Stakeholders GB Important Design Features
Energy	Optimize Energy Performance	18	1	4.5	Use of Energy Efficient Appliances and Equipment Thermal Performance of Building Envelope	Energy	Natural/Mechanical Ventilation Performance	17	1	3	Increased ventilation
Water	Indoor Water Use Reduction	6	2.5	7	Water efficient Fixtures	Energy	Air Conditioning System Operating Efficiency	16	2	4	Use of Energy Efficient Appliances and Equipment
Energy	Enhanced Commissioning	6	2.5	8	Building Energy Management system	IEQ	Energy Monitoring	11	3	8	Building Energy Management system
Energy	Renewable Energy	5	4.5	2	Use of renewable energy Sources	Water	Water Efficient Fittings	7	4.5	7	Water efficient Fixtures
Material	Building Life-Cycle Impact Reduction	5	4.5	11	Use of materials that can be reused or recycled after the building life.	Material	Green Products and Materials	7	4.5	15	Use of local materials (No imports)
IEQ	Low-Emitting Materials	3	6.5	14	Low-emitting materials—flooring systems, paints and coatings	Energy	Renewable Energy	6.5	6	2	Use of renewable energy Sources
IEQ	Daylighting	3	6.5	1	Use of Day lighting	Energy	Lighting System Efficiency	6	7	4	Use of Energy Efficient Appliances and Equipment
Water	Outdoor Water Use Reduction	2	12.5			IEQ	Occupant Comfort	5.5	8	6	Indoor thermal comfort
Water	Cooling Tower Water Use	2	12.5			IEQ	Demand Control	5	9.5	8	Building Energy Management system
Energy	Grid Harmonization	2	12.5			IEQ	Integration and Analytics	5	9.5		
Material	EPD	2	12.5			IEQ	Lighting Quality	4	11		
Material	Sourcing of Raw Materials	2	12.5	15	Use of local materials (No imports)	Material	Recycling Facilities	3.5	12		
Material	Material Ingredients	2	12.5			Energy	Ventilation in Common Areas	3	13	3	Increased ventilation
Material	Waste Management	2	12.5			Water	Reduction in Water Consumption of Cooling Towers	2.5	15		
IEQ	Enhanced Indoor Air Quality Strategies	2	12.5	3	Increased ventilation	IEQ	Enhanced Filtration Media	2.5	15		
IEQ	Indoor Air Quality Assessment	2	12.5	3	Increased ventilation	IEQ	Indoor Contaminants	2.5	15		
IEQ	Interior Lighting	2	12.5	4	Use of Energy Efficient Appliances and Equipment	Energy	Façade performance	2	20	5	Thermal Performance of Building Envelope
Water	Water Metering	1	21	7	Water efficient Fixtures	Energy	Ventilation in Car Park	2	20	3	Increased ventilation
Energy	Advanced Energy Metering	1	21	8	Building Energy Management system	Energy	Energy Efficient Practices and Features	2	20	4	Use of Energy Efficient Appliances and Equipment
Energy	Enhanced Refrigerant Management	1	21	8	Building Energy Management system	Water	Use of Alternative Water Sources	2	20	9	Rain Water Harvesting
IEQ	Construction Indoor Air Quality Management Plan	1	21			Water	Promotion of Waste Reduction	2	20	13	Innovative waste water use
IEQ	Thermal Comfort	1	21	6	Indoor thermal comfort	Material	Waste Monitoring	2	20		

Table 5. *Cont.*

Categories	LEED 4.1 Credits	Total Point	LEED Rank	ST Rank	Stakeholders GB Important Design Features	Categories	Green Mark 2017 (2020 Update) Credits	Total Point	GM Rank	ST Rank	Stakeholders GB Important Design Features
IEQ	Quality Views	1	21	1	Use of Day lighting	IEQ	Biophilic Features	2	20	1	Use of Day lighting
IEQ	Acoustic Performance	1	21	12	Prevention of noise within and outside the building.	Energy	Vertical Transportation System	1.5	24.5	4	Use of Energy Efficient Appliances and Equipment
						IEQ	Outdoor Air Control	1.5	24.5		
						Water	Landscape Irrigation	1	28		
						Water	Water Monitoring and Leak Detection	1	28		
						Water	Water Usage Portal and Dashboard	1	28		
						Material	Storage Area for Recyclable Waste	1	28		
						IEQ	Acoustics	1	28	12	Prevention of noise within and outside the building.

ST—stakeholders, GM—Green Mark, IEQ—Indoor environmental quality.

3.4.3. Increased Ventilation (IF11)

The GB design feature "increased ventilation" (IF11) was ranked third (M = 4.36) in Table 2. All professional groups ranked IF11 as one of the most important GB features (except engineers who ranked it 11th out of 15). The architects assigned IF 11 the highest (M = 4.48) score. The Wilcoxon's signed rank test results in Table 4 indicate that increased ventilation is an important design feature whose assessment was statistically significantly higher than eight other features. Comparing the rankings of stakeholders, LEED v4.1, and Green Mark 2017, the results in Table 5 indicate that natural and mechanical ventilation (increased ventilation) are ranked first by Green Mark 2017 and third by stakeholders, whereas in the LEED v4.1 these parameters were ranked moderately. The intent of increased ventilation, based on LEED, is to provide additional outdoor air ventilation to improve indoor air quality (IAQ) in order to enhance occupant comfort, well-being, and productivity [52]. However, the rankings suggest that LEED appears to place less emphasis on tropical climates, such as Dar es Salaam, in comparison to Green Mark. Increased ventilation has been ranked a high priority by Green Mark 2017 and stakeholders. This finding is consistent with Song et al. [40], who suggested that natural ventilation is an essential passive design strategy emphasized in GBRSs for energy-efficient design and is therefore mandatory for Green Mark (GM) buildings. The alignment between the stakeholder ranking for enhanced ventilation and the priorities delineated in the GM credits ranking is pronounced. In Green Mark 2017, an emphasis is placed on the efficacy of both natural and mechanical ventilation, with a maximum of 17 points required for each [53]. This observation might be representative of tropical environments, where the evaluation scope encompasses both natural and mechanical ventilations.

3.4.4. Use of Energy Efficient Appliances and Equipment (IF09)

The GB design feature "the use of energy efficient appliances and equipment" (IF09) was ranked fourth with a mean score of M = 4.33. All professional groups ranked IF09's in the top rank with engineers scoring the highest mean (M = 4.51). The Wilcoxon's signed rank test results in Table 4 indicate that the use of energy efficient appliances and equipment is an important design feature whose assessment was statistically significantly higher than the eight other features. Use of Energy Efficient appliances and equipment is ranked fourth by stakeholders, second ranked in the GM 2017, and ranked first priority in LEED 4.1. The GBRS rankings place a higher emphasis on the use of energy-efficient equipment and appliances in contrast to the stakeholders ranking. For example, GM insisted on the use of energy efficiency and appropriate size of air conditioning systems, refrigeration, lightings systems, and elevators as per the standard code for building services and equipment [53].

Although Tanzania has no guidelines specifying energy efficiency requirements and labelling for energy end-use equipment, stakeholder ranking points to a need to utilize energy-efficient appliances and equipment, thus providing valuable insights for advancing uptake and integration of green building design features, such as energy-efficient appliances and equipment, resulting in substantial energy savings. Consequently, in light of the nation's electricity cost constraints and power rationing, the implementation of energy-efficient equipment and appliances appears to be a critical strategy for managing these challenges.

3.4.5. Use of Local Materials (IF15)

Table 4 shows that the use of local materials (IF15) was the lowest ranked GB feature (M = 3.56). All professional groups ranked IF15 the lowest important feature. The Wilcoxon's signed rank test results in Table 4 indicate that IF15 is ranked statistically significantly lower than all other important features. The analysis of stakeholder ranking indicates that materials with a low environmental impact, regardless of whether they are local materials, are regarded as somewhat unimportant. This aligns with the finding by Kongela [54] that although the majority of construction materials are accessible locally, more than 80% of the materials utilized in the construction of high-rise buildings in Tanzania are imported. The researcher is of the opinion that the respondents' ranking order was in some measures hugely affected by the sourcing of the local materials. Empirical evidence indicates that in many countries, particularly in sub-Saharan Africa, the primary factors hindering widespread usage of local materials are the high costs and limited availability, leaving users with few viable alternatives [55].

Local material use is mandatory for all GBRSs [40]. Agyekum et al. [56] provide evidence that the One Airport Square building, which holds the Green Star SA-Ghana certification, exemplifies the use of local materials in green building construction. These materials include "rammed earth or atakpame walling (derived from laterite)", "sun-dried brick walling/adobe (derived from clay)", and "timber-framed construction". In LEED 4.1, the sourcing of primary materials issue, pertaining to local materials, was ranked fifth. LEED 4.1 designates two credits for the use of locally sourced and manufactured products and materials [57], thereby requiring architects to exhibit reverence for such practices. In Green Mark 2017, a total of eight points can be obtained by adhering to the requirements and utilizing green products that have been certified by authorized local certification bodies. This practice serves to not only conserve local resources but also alleviate environmental consequences linked to transportation while also providing insights for future measures aimed to enhance the uptake of GBP.

In addition to the overall ranking of the importance of GB design features perceived by stakeholders, the Kruskal–Wallis H test (K-W) was implemented to check which of the GB design features would have difference in views to be significant if all the four professional groups are compared. The use of local materials (No imports) (IF15), Water efficient Fixtures (IF02), Water recycling (IF03), Building Energy Management system (IF08), Indoor thermal comfort (IF10), Low-emitting materials-flooring systems, paints and coatings (IF12), and Use of Energy Efficient Appliances and Equipment (IF09) among the four professional were statistically significant (p-value < 0.05) as shown in Table 3. All professional groups ranked IF15 as the least important feature. However, the architect group's assessments of the importance of IF15 were higher than those of other professionals, implying that the identified IF15 encouraged architects to adopt GB practices. This finding is consistent with [58], which stated that architects have the responsibility for making decisions and selecting green local building materials during the design decision-making process. Additionally, there were statistically significant differences regarding the importance of IF02, IF03, IF08, and IF09. It can be observed that these GB design features are primarily concerned with energy and water efficiency, which continue to be contentious issues in the uptake of GB [10,59,60]. Consequently, it is unsurprising that professionals have different rankings on these issues, with engineers ranking them higher than other professionals. This may be because of the involvement of engineers in building engineering services works that contribute to the project's uptake of GB design features, including IF02, IF03, IF08, and IF09. Based on a comparative analysis, the GBRS ranking prioritized the use of energy-efficient appliances and equipment (IF09), water-efficient fixtures (IF02), and building energy management systems (IF08) over stakeholders. This finding is consistent with [61], that indicated that buildings certified with LEED v4.1 and Green Mark 2017 require greater energy and water efficiency. This implies that, over time, the certified buildings could substantially reduce utility costs, saving building owners and occupants money while the facility is still in operation.

Indoor thermal comfort (IF10) is statistically significant, implying that professionals perceived it as one of the most important GB design features. The property manager group assigned IF10 a higher ranking compared to other professionals. This aligns with the findings of Goulden and Spence [62], who observed that property managers significantly influence the energy consumption of their workplaces while also ensuring the desired level of indoor thermal comfort is maintained, controlled, and satisfied. Based on comparisons, it can be observed that both stakeholders and Green Mark 2017 assign more importance to thermal comfort in comparison to the ranks of LEED 4.1. The similarity in climatic conditions between Dar es Salaam and Singapore, which allows occupants to have control over indoor temperature, might contribute to the close ranking between the stakeholder and Green Mark 2017. Nkini et al. [29] observed that in regions characterized by warm and humid climates, the implementation of mixed mode design, which involves the integration of natural ventilation and mechanical air conditioning systems, has been observed to enhance the comfort and satisfaction of occupants.

3.4.6. Correlation between the Rankings of GB Design Features by Stakeholders, LEED 4.1, and Green Mark 2017

The scatter plot analysis performed to illustrate the correlation between stakeholder ranking and the LEED and Green Mark is depicted in Figure 4. No correlation was found between the ranking of stakeholders and the LEED and Green Mark. Moreover, stakeholders misconceived green building practices and the essential requirements for effective implementation of GBRS. As a result, the rankings do not align with GBRS expectations. The results imply that stakeholders have very limited knowledge of green building practices. That can help explain why GBRS is only well known by the stakeholders in the construction sector whose daily preoccupations expose them to it. Furthermore, the prevalence of inconsistencies between stakeholder priorities and those of LEED and Green Mark underscores the limited knowledge of GBP. This implies a need for broadening understanding of GBP and application of the participatory approach by policy actors and stakeholders in the construction industry of Tanzania. That could lead to more exposure and in the run efficient uptake of GBRS in the country.

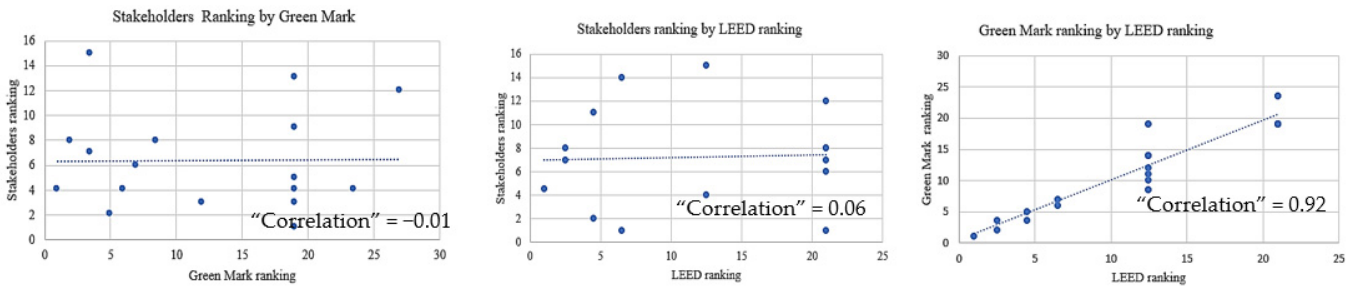

Figure 4. Correlation between the rankings of GB design features by Stakeholders, LEED V4.1 and Green Mark 2017.

Equally importantly, the study finding revealed a significant positive linear correlation between the rankings of LEED and Green Mark, as indicated by the scatter plot. The results are consistent with Suzer's [63] finding that GBRS showed a strong positive linear correlation, indicating that evaluation outcomes should be highly related. Thus, if one GBRS awards a project a high score, the other will probably do the same, and vice versa. An analysis of ranking comparisons between LEED v4.1 credits and Green Mark 2017 credits revealed a significant degree of similarity with respect to credits. In contrast to LEED v4.1, the Green Mark 2017 imposes greater ranking criteria and allocations for ventilation credits. The use of natural ventilation is required for Green Mark (GM) buildings and is an important passive design technique that is stressed for energy-efficient design. This approach is particularly suitable for a location like Dar es Salaam, which is why stakeholders accord the Green Mark 2017 credits.

3.5. Perceived Drivers of Green Building Practices in Tanzania

The respondents were asked to rate the drivers of GB practices in the construction industry of Tanzania. Table 6 shows that the mean scores of the important drivers of the GB practices ranged from 4.20 to 3.62, all greater than 3.00, indicating that all GBP drivers were considered important. Increased awareness among stakeholders (DG08) and increased training and education (DG06) were the most important drivers according to the stakeholders' responses. Increased awareness among the stakeholders (DG08) is ranked first with the greatest mean score (M = 4.20). The Wilcoxon's signed rank test results in Table 7 indicate that DG08 is the driver whose assessment was statistically significantly higher than the other nine drivers. In Zambia, Oke et al. [64] and Zulu et al. [65] identified the increase in stakeholder awareness as one of the primary drivers of GB construction practices. In Ghana, Darko et al. [66] proposed that an increase in stakeholders awareness is a crucial driver in the promotion of GB practices on a large scale. Anzagira [18] indicates that stakeholders' awareness is a motivating factor that drives the adoption and implementation of GB practices. In Nigeria, Opoko et al. [67] advocates for an intensive campaign to raise awareness of the tremendous benefits of green practices. According to Ebekozien et al. [23] and Komolafe and Oyewole [68], awareness and sensitization regarding green building certification is a crucial driver promoting GB practices. While stakeholders consider increased awareness among stakeholders (DG08) to be the most important perceived driver, there is still limited uptake of GBP due to a lack of knowledge and awareness on the advantages of GBRS. This lack of awareness hinders the project's execution and uptake.

In Table 6, increased training and education (DG06) is ranked second with the highest mean scores (M = 4.05). Compared with other professionals, engineers ranked increased training and education (DG06) as the most significant driver. The Wilcoxon's signed rank test results in Table 7 indicate that DG06 is a perceived driver whose assessment was statistically significantly higher than other five drivers. The importance of the provision of training and education to stakeholders cannot be overestimated, as it is a crucial driver for uptake of GB practices. In Ghana, Darko et al. [69] noted that stakeholders' awareness of GB practices will increase as a result of improved education training and information dissemination. Aghimien et al. [70] identified an increase in education and training regarding GB as the most important driver in the execution of GB projects in South Africa. Marsh et al. [71] insisted that stakeholders should have access to education, training, and upskilling through GB organizations such as Green Building Council of South Africa (GBCSA).

Table 6 shows the results of the Kruskal–Wallis H test, four perceived important drivers of GB practices, Increased training and education (DG06), Tenant satisfaction and productivity (DG05), Competitive advantage (DG10), and Rising energy costs (DG01), were statistically significant. The result indicates these DGs are significantly important in driving and shaping the GB practice in the Tanzania construction industry. Property managers consider "Tenant satisfaction and productivity" (DG05) an essential factor in driving GB practices, possibly because they are responsible for day-to-day operations. Nurick and Thatcher [72] assert that green buildings significantly impact occupants' health and comfort, thereby enhancing productivity. This driver could explain why incorporation of personal control with natural lighting, air movement, and ventilation was recommended in [29,73] for further improvement of tenant satisfaction and productivity in green buildings. The statistical significance of competitive advantage (DG10) suggests that professionals are seen as the primary driver of GB practices. This result aligns with the findings of Windapo [74] in South Africa, where the integration of green building principles into projects is driven by the pursuit of competitive advantage. In comparison to the present embryonic stage of the green building and the absence of a regional GBRS, the potential to achieve a competitive advantage through GB practices would be relatively less. The Kruskal–Wallis H test indicates that rising energy costs (DG01) is statistically significant, indicating that professionals consider it to be the most significant GB driver. This implies that given the prevailing electricity cost limits and power rationing in the nation, professionals have identified rising energy costs as the important driver for the uptake of GB practices. Windapo [74] asserts that green building importance drivers are the rising energy costs and the consequent reduced building operating costs. Although ranking professionals emphasized training and education as the most significant driver, rising energy costs demonstrate key factor influencing GB practices.

Table 6. Important drivers of green building practices.

Important Drivers	Code	All Respondents = 412			Architect N = 157			Quantity Surveyor N = 80			Engineers N = 71			Property Manager N = 104				
		Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	K-W	*p*-Value
Increased awareness among the stakeholders	DG08	4.20	1.01	1	4.34	0.92	1	4.04	1.21	1	4.11	1.06	2	4.18	0.91	1	5.00	0.172
Increased training and education	DG06	4.05	1.09	2	4.09	1.09	2	3.74	1.19	4	4.23	0.97	1	4.11	1.05	2	8.68	0.034 [a]
Building code	DG03	3.89	1.19	3	3.92	1.26	4	3.66	1.26	5	4.10	1.12	3	3.88	1.04	5	6.03	0.110
Tenant satisfaction and productivity	DG05	3.88	1.03	4	3.84	1.08	8	3.61	1.02	6	3.93	0.92	6	4.10	0.99	3	11.82	0.008 [a]
Competitive advantage	DG10	3.83	1.11	5	3.73	1.22	9	3.56	1.07	8	4.08	0.89	4	3.99	1.05	4	11.45	0.010 [a]
Greater availability of green materials and products	DG07	3.82	1.14	7	3.86	1.16	7	3.60	1.16	7	3.97	1.24	5	3.82	0.99	6	6.16	0.104
Lower lifecycle costs	DG04	3.82	1.19	6	3.90	1.13	5	4.00	1.01	2	3.45	1.44	10	3.80	1.19	7	5.55	0.136
Rising energy costs	DG01	3.77	1.24	9	3.94	1.23	3	3.89	1.16	3	3.65	1.23	9	3.52	1.29	10	9.28	0.026 [a]
Government policy	DG02	3.77	1.25	8	3.86	1.25	6	3.54	1.25	9	3.89	1.37	7	3.74	1.15	8	6.04	0.110
Green building council	DG09	3.62	1.21	10	3.71	1.26	10	3.34	1.26	10	3.82	1.10	8	3.56	1.12	9	7.84	0.049

Note: [a] The Kruskal–Wallis H test (K-W) result is significant at the significance level of 0.05 (p-value < 0.05).

Table 7. *p*-values of Wilcoxon's signed rank test comparing the assessment of important drivers of GB practices.

	DG08	DG06	DG03	DG05	DG10	DG07	DG04	DG01	DG02	DG09
DG08		0.001 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]
DG06			0.012	0.002	0.000 [a]	0.000 [a]	0.002	0.001 [a]	0.000 [a]	0.000 [a]
DG03				0.830	0.250	0.212	0.287	0.110	0.013	0.000 [a]
DG05					0.374	0.392	0.482	0.241	0.226	0.000 [a]
DG10						0.702	0.873	0.580	0.621	0.001 [a]
DG07							0.747	0.694	0.367	0.000 [a]
DG04								0.87	0.348	0.006
DG01									0.914	0.040
DG02										0.040
DG09										

Note: [a] "Due to Holm–Bonferroni correction" the Wilcoxon's signed rank test result is significant at the significance level of 0.001 (p-value $\leq$ 0.001), suggesting that the two compared variables are statistically different.

3.6. Perceived Triggers of GB Practices in Tanzania

The respondents were asked to rate the importance of triggers suggesting why their companies would be interested in green building practices or otherwise. Table 8 shows the mean scores for the importance of the triggers of GB practices ranged from 4.17 to 3.12. Notable is the fact that the mean score of all triggers was greater than 3, which is the midpoint of the rating scale, indicating that all triggers were considered important. The Wilcoxon's signed rank test results in Table 9 indicate that IG06 is a perceived trigger whose assessment was statistically significantly higher than other five triggers.

Based on the results of the mean analysis, environmental benefit (IG06) is regarded as the most important trigger promoting GB practices for a company. IG01 (financial benefits/reduced costs/increased property value) are also assessed significantly higher than the other four triggers. Contrary to the current study, previous studies [66,75–77] confirmed that most 'green' decisions are not taken because of their benefit for the environment, but for other reasons, mainly costs; this is the second highest concern among stakeholders. The respondents have highly rated the environmental drivers of GB while the literature suggest otherwise. This suggests that their choice of the environmental triggers point to an indication of low awareness. The cost factors might be overriding, especially in Third World countries where poverty is rampant. However, it is important to note that the efficacy of green button triggers varies among countries as a result of contextual environmental, economic, and social elements [75,78,79].

Table 8 presents the findings of the Kruskal–Wallis H test, indicating that the *p*-value associated with the perceived trigger "right thing to do" is statistically significant. Results show that there are differences in perceptions of the trigger "right thing to do" between the four professional groups in relation to GB practices. This result is consistent with [76], where "doing the right thing" is cited by a number of professionals as their primary trigger for promoting GB practices in South Africa. Even though architects were driven by the belief that GB practices were the "right thing to do", cost considerations for future green construction may have been more influential.

Table 8. Important triggers of the GB practices for companies.

		All Respondents = 412			Architect N = 157			Quantity Surveyor N = 80			Engineers N = 71			Property Manager N = 104				
		Mean	**SD**	**Rank**	**Mean**	**SD**	**Rank**	**Mean**	**SD**	**Rank**	**Mean**	**SD**	**Rank**	**Mean**	**SD**	**Rank**	**K-W**	***p*-Value**
Benefit to the environment	IG06	4.17	1.19	1	4.32	1.17	1	4.06	1.14	1	4.15	1.12	1	4.02	1.27	2.00	8.70	0.03 [a]
Financial benefits/reduced costs/increased property value	IG01	3.99	1.33	2	3.83	1.36	3	3.91	1.27	2	4.14	1.33	2	4.17	1.28	1.00	7.36	0.06
Right Thing to Do	IG04	3.64	1.35	3	3.85	1.40	2	3.48	1.34	4	3.62	1.31	4	3.45	1.28	4.00	9.45	0.02 [a]
Environmental Regulations	IG05	3.59	1.36	4	3.56	1.40	4	3.50	1.34	3	3.75	1.38	3	3.59	1.33	3.00	1.57	0.67
Market demand	IG03	3.26	1.35	5	3.11	1.37	5	3.14	1.28	6	3.46	1.40	5	3.42	1.33	5.00	5.56	0.13
Client demand	IG02	3.12	1.31	6	2.92	1.33	6	3.20	1.26	5	3.37	1.40	6	3.17	1.23	6.00	6.35	0.10

Note: [a] The Kruskal–Wallis H test (K-W) result is significant at the significance level of 0.05 (p-value < 0.05).

Table 9. *p*-values Wilcoxon's signed rank test comparing the assessment of important triggers of GB practices for companies.

	IG06	IG01	IG04	IG05	IG03	IG02
IG06		0.011	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]
IG01			0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]
IG04				0.318	0.000 [a]	0.000 [a]
IG05					0.000 [a]	0.000 [a]
IG03						0.015
IG02						

Note: [a] "Due to Holm–Bonferroni correction" the Wilcoxon's signed rank test result is significant at the significance level of 0.001 (p-value $\leq$ 0.001), suggesting that the two compared variables are statistically different.

3.7. Strategies to Improve GB Practices

The respondents were asked to rate the importance of strategies to improve GB practices. The results indicate that the mean score of the important strategies aimed at improving GB practices ranged from 4.60 to 4.04 (Table 10). The mean score of all influential strategies was greater than 4.00, indicating that all GB strategies were considered important. Education and training for stakeholders focusing on green buildings practices (ST02) and availability of better information on cost and benefits of green buildings (ST05) were considered highly important strategies capable of promoting GB practices. The Wilcoxon's signed rank test results in Table 11 indicate that ST02 and ST05 are perceived strategies whose assessment were statistically significantly higher than the other nine strategies. The current findings are in line with Alrashed and Asif [80] and Hafez et al. [60], who noted that education level tend to positively influence the awareness and appreciation of green building practices. Validating the findings generated from the study and the claims that are being made here from previous scholars, quite a lot of documentary evidence was perused. Several universities curricula were reviewed. These include the university prospectus of three Tanzanian universities, namely, the Ardhi University (ARU) [81], the University of Dar es Salaam (UDSM) [82,83], and Mbeya University of Science and Technology (MUST) [84]. The focus was on examining the extent to which the curriculum used by students pursuing Architecture and Engineering reflects the GB component. This review indicated that built environment courses very marginally reflected GBPs and GBRS. The prospectus indicated that the curricula, in both postgraduate and undergraduate programs, are focused on renewable energy and alternative technologies. The design and construction of green buildings were only notable in certain sections of postgraduate courses, including, for example AR 722: Housing Policies and Architecture (ARU) and SD 682 Low Energy Architecture (UDSM). This suggests that architectural and engineering education does not assign sufficient importance to teaching about GBPs and GBRS. This necessitates the need for the integration of a comprehensive foundation into the education and training program of built environment courses within the higher learning institutional curricula, and the integration of a comprehensive foundation into the education and training program of built environment courses within the higher learning institution's curriculum. This integration can effectively respond to the knowledge gap related to GBPs and GBRS. ST02 was ranked first by all professional groups, while ST05 was ranked second by all professionals with the exception of architects. This is consistent with the findings from previous studies [85–87], which established that the availability of more financing plans and education and training for GB practices promotes awareness and encourages the adoption and implementation of GB projects.

Table 10. Influential strategies to improve the level of awareness of the GB practices.

Strategies to Improve Green Buildings		All Respondents N = 412			Architect N = 157			Quantity Surveyor N = 80			Engineers N = 71			Property Manager N = 104				
		Mean	**SD**	**Rank**	**Mean**	**SD**	**Rank**	**Mean**	**SD**	**Rank**	**Mean**	**SD**	**Rank**	**Mean**	**SD**	**Rank**	**K-W**	***p*-Value**
Education and training for stakeholders focusing on green buildings practices	ST02	4.60	0.84	1	4.60	0.85	1	4.56	0.85	1	4.63	0.90	1	4.61	0.77	1	1.39	0.707
Availability of better information on cost and benefits of green buildings	ST05	4.50	0.82	2	4.45	0.97	4	4.56	0.78	2	4.59	0.67	2	4.46	0.70	2	3.77	0.288
Availability of green building codes and regulations (mandatory to apply)	ST06	4.47	0.86	3	4.48	0.94	2	4.40	0.87	4	4.55	0.73	4	4.44	0.81	3	2.79	0.425
Public campaign toward green initiatives through seminars, workshops, and discussions	ST09	4.45	0.87	4	4.44	0.94	5	4.41	0.90	3	4.56	0.71	3	4.41	0.85	4	1.75	0.627
Promotion of successful GB practices through case (Demonstration projects)	ST08	4.41	0.90	5	4.48	0.93	3	4.28	0.90	5	4.45	0.82	5	4.39	0.90	5	6.57	0.087
More publicity of green building through television programs, internet, newspaper, and radio	ST07	4.35	0.94	6	4.43	0.98	6	4.20	0.93	7	4.30	0.90	8	4.38	0.91	6	6.96	0.073
Availability of institutional frameworks for the effective implementation of GB guidelines	ST10	4.32	0.91	7	4.34	0.99	8	4.19	0.93	8	4.35	0.78	7	4.36	0.86	7	3.55	0.315
Recognizing and rewarding Green building adopters publicly	ST11	4.29	0.99	8	4.32	1.08	9	4.11	0.98	9	4.44	0.79	6	4.29	0.88	9	6.81	0.078
Development of green building check list by local government	ST03	4.22	0.99	9	4.41	0.89	7	4.10	1.01	10	3.86	1.20	11	4.27	1.00	8	15.13	0.002 [a]
Financial incentives from the government (e.g., taxes, soft loans) for green building practices.	ST04	4.15	1.05	10	4.15	1.16	10	4.23	0.99	6	4.08	1.05	9	4.14	0.90	10	1.94	0.584
Promoting green building rating systems	ST01	4.04	1.10	11	4.02	1.25	11	4.03	1.11	11	4.07	0.95	10	4.05	0.94	11	0.88	0.831

Note: [a] The Kruskal–Wallis H test (K-W) result is significant at the significance level of 0.05 (p-value < 0.05).

Table 11. *p*-values Wilcoxon's signed rank test comparing the assessment of influential strategies to improve the level of awareness of the GB practices.

Code	ST02	ST05	ST06	ST09	ST08	ST07	ST010	ST011	ST03	ST04	ST01
ST02		0.002	0.001 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]
ST05			0.326	0.194	0.045	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]	0.000 [a]
ST06				0.797	0.341	0.007	0.004	0.000 [a]	0.002	0.000 [a]	0.000 [a]
ST09					0.505	0.008	0.001 [a]	0.000 [a]	0.001 [a]	0.000 [a]	0.000 [a]
ST08						0.109	0.037	0.000 [a]	0.009	0.000 [a]	0.000 [a]
ST07							0.570	0.017	0.381	0.001 [a]	0.000 [a]
ST10								0.101	0.637	0.004	0.000 [a]
ST11									0.215	0.102	0.001[a]
ST03										0.009	0.000 [a]
ST04											0.105
ST01											

Note: [a] "Due to Holm–Bonferroni correction" the Wilcoxon's signed rank test result is significant at the significance level of 0.001 (p-value $\leq$ 0.001), suggesting that the two compared variables are statistically different.

The most surprising aspect of the results was the comparatively low ranking of the "promoting green building rating systems" (ST01) strategy. Although the stakeholders perceived this as an important strategy for implementation of GBP, even those who declared to be aware actually did not really know what GBRS were all about. This implies that there are misconceptions among the stakeholders about what GB practices are and what is necessary for their better implementation. Regarded from another point of view, there was low awareness of the importance of GBRS. That could be a reason why the green council was ranked as the lowest driver of GB practices, and government policy the second lowest. Argued along the same line of thinking, promotion of green building rating systems was ranked the lowest among the strategies required to improve GB practices awareness. These contradictory scenarios highlight that the road map to a full-fledged uptake of GB practices remains thick and thorny. To address this misconception among stakeholders, several developing countries, such as South Africa, Kenya, Ghana, and Egypt, have employed their respective Green Building Councils to adapt green building rating systems to the local context and encourage the adoption of GB practices.

Table 8 displays the Kruskal–Wallis H test results, with local government green building checklist development (ST03) being the only statistically significant strategy. The significance of this strategy is further supported by the findings of [88], in which the local green building checklist in Kenya was highly recognized as a viable technique for GB practices. The author proposed stricter urban land and planning regulations, increased government enforcement of green principles, and prioritized education and training in GB practices. In Tanzania, Marwa [26] noted that municipal officials are responsible for inspecting the site prior to issuing permits and subsequently verifying that the building construction process aligns with the approved drawings. This implies that the strategies of using local government green building checklists and incorporation of green building principles, such as water efficiency, energy efficiency, and resource and waste reduction, is feasible during the building permit application process. By adopting a local government green building checklist strategy that incorporates both local and international green building standards, stakeholders can effectively address misconceptions about GB practices and enhance awareness of the significance of GBRS. On the one hand, as the study has disclosed, there exists considerable "subjectively perceived" awareness of what GB as a concept entails, but on the other hand the real practice is overshadowed by an evident tendency to avoid the high costs associated with the implementation of GB practices [89,90]. This mismatch between the knowledge of GB practice on the ground might possibly be rooted on a lack of responsive and affirmative policy action providing for the implementation of GB in the construction sector in Tanzania.

4. Conclusions, Limitations and Recommendations

The study concludes that a significant majority of the stakeholders in the construction sector in Tanzania are inadequately informed of GBP. The ranking score of GB design features revealed no correlation with their ranking in GB rating systems. Some of the GB design features rated highly by the respondents were in fact less prioritized in GB uptake in the practical sense. Since green building is still in its infancy stage in Tanzania, there is still a long way to go in terms of GB uptake and awareness creation among stakeholders.

Additionally, the findings of this study demonstrate that the use of daylighting, use of renewable energy sources, increased ventilation, and use of energy efficient appliances and equipment constituted four important GB design features promoting GBP uptake. Furthermore, each GB design feature exhibited a statistically significant difference. Moreover, upon comparing the top and the bottom GB design features of the stakeholders ranking, the features largely diverged and show no correlation from those of LEED 4.1 and Green Mark 2017 credits ranking. This implies that stakeholders misconceived green building practices, green building design features, and the essential requirements for the implementation of GBRS. The implication of this finding is that these GB design features were prioritized by stakeholders and GBRS need more attention to promote GBP uptake in the country.

The analysis demonstrates that stakeholders prioritize the integration of daylighting methods to a greater extent, while mostly overlooking material-related GB design features such as the use of local materials, low-emitting materials, and the use of materials that can be reused or recycled. Despite its relatively low ranking compared to the GBRS ranking, stakeholders expressed significant agreement over the utilization of energy-efficient equipment and appliances, water-efficient fixtures, and the implementation of energy management systems. This suggests that stakeholders are conscious of the cost associated with building operations, and that this action is intended to preserve energy and water while encouraging the adoption of green building features. Additional comparisons indicate that certain stakeholders give higher importance to the use of renewable energy sources in their rankings, which closely corresponds to the ranks of LEED 4.1 and Green Mark 2017.

Although there is currently no local (GBRS) in place, it is important to acknowledge and adapt the range of worldwide tools used as performance-based tools and design guides, such as LEED and Green Mark, to the local context. In fact, it may even be necessary to develop a locally based tool to effectively address the unique requirements and considerations of the region. Stakeholders suggested implementing a local government green building checklist as a potential strategy. Local governments or municipal councils, as responsible stakeholders in the construction sector, can include green building checklists, featuring items such as water efficiency, energy efficiency, and green building materials, during the design and construction approval process. This approach can be implemented to comply with local governmental rules to obtain building permits and certificates of occupancy, hence facilitating the adoption of green building practices. By adopting a local government green building checklist strategy that incorporates both local and international green building standards, stakeholders can effectively address misconceptions about GB practices and enhance awareness of the significance of GBRS. Several adaptation considerations must be considered for a GBRS to adequately evaluate GBP in Tanzania, including the evaluation of building energy consumption and the incentive of superior performance on water or materials in particular regions.

4.1. Study Limitations

Considering the study's limitations, although the objective was successfully accomplished, the research was not free of limitations. One of the limitations of this study was the respondent's subjective experiences regarding evaluation of the GB design features. This limitation was encountered by involving the stakeholders directly involved in the design and construction of existing certified green buildings. This assisted in the triangulation of results, which revealed that the limitation had no effect on the overall outcome. Furthermore, it was noted that the GB design features that were considered unimportant by GBRS were not necessarily considered important by stakeholders. The absence of plausible explanations for why stakeholders consider their ranking to be more significant than the GBRS ranking may also contribute to a knowledge gap, thereby underscoring the significance of this study. Also, the potential impact on the respondents' ranking may be influenced by absence of knowledge, skills, and practices of GBRS in Tanzania. Further limitation may result from regional climatic differences in Tanzania, which impact stakeholders' experiences regarding GB practices; therefore, this research suggested this be addressed in the further study. This points to a need to devise some realistic, concrete, and objective measures that can trigger GB uptake, some of which are recommended below.

4.2. Study Recommendations

The study provides the following recommendations:

4.2.1. For Building Professionals

- Professionals in the construction sector should emphasize GB practices uptake, focusing on the cost-benefit analysis of these building designs.
- Registration Boards for architects, engineers, and contractors should acknowledge, advocate for, and lobby for uptake of green building practices and certifications (GB). This involves taking a proactive stance in convincing clients and developers to embrace GBP. Professional development seminars should prioritize the involvement of stakeholders in GB practices, with a specific emphasis on the design and construction processes employed in existing certified buildings.

4.2.2. For Government and Building Policymakers

- The government should develop and enforce policies, standards, laws, and incentives that provide sufficient guidance for the planning, design, and construction of GB projects. For example, the government can formulate beneficial policies that support the extensive use of renewable energy and GBRS for buildings as part of global efforts to achieve GB practices.

4.2.3. For Green Building Certification Systems

- Considering that Tanzania is yet to have her own green building rating systems, integrating local and international standards and prioritizing credits to resolve local challenges can improve local design practices.

4.2.4. For Researchers and Educators

- Universities should play a more proactive role in providing education, research, and innovation, which are essential to promoting GB practices awareness in the construction industry. It appears necessary and worthwhile to integrate GB practices into undergraduate and graduate curricula and to prioritize research on green building rating systems order to promote GB uptake. Research on GB uptake has to be communicated through organizing conferences, public lectures, leaflets, and policy briefs, to be disseminated countrywide and shared regionally and globally.
- Additionally, the Tanzania Green Building Council ought to strengthen ties with domestic and international green building researchers and construction players to streamline the process of contextualizing GBRS or create a locally applicable tool.

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