



BURUNDIAN URBAN CODES 'IMPACT ON GREEN BUILDING TECHNOLOGIES AND RATING SYSTEMS ADOPTION: AN OVERVIEW

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ABSTRACT

Green building policies are a fundamental and effective pathway towards promoting green building. However, few studies have focused on urban codes and other public legislation in the construction sector to assess their influence on the promotion of green building. Therefore, this paper investigates the urban policy system in Burundi in terms of promoting the transition to sustainable construction. The study analyzed Burundian Urban codes from a policy content perspective using qualitative content analysis methods. The results indicate that the urban code incorporates sustainable construction concepts, including Indoor Environmental Quality (IEQ), Energy and Atmosphere (EA), and Materials and Resources (MR) as the main green building technologies found. However, the code implementation has been inadequate due to a lack of documentation and checks before issuing building permits. To enhance the construction sector's contribution to meeting the needs of present and future generations in Burundi, it is crucial to update and improve the articles related to sustainable construction within the current regulations in the construction sector. This study offers valuable insights for improving policy systems to promote green building in Burundi and other regions. Additionally, it provides fresh perspectives on the current urban codes in use in Burundi, which can aid scholars and policymakers in better understanding the green building promotion process.

Keywords: Urban Codes, Green Building, Sustainable Construction, Construction Industry, Green Building Rating System

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1. INTRODUCTION

Global carbon emissions have increased as a result of expanding urbanization and industrialization. Due to this unusual circumstance, global warming has emerged as the biggest threat to humanity [1]. Building construction and operation account for 36% of worldwide energy consumption and 39% of CO₂ emissions, according to the International Energy Agency (IEA) (2019) [2] whereas Darko et al. (2018) argued that the construction industry is responsible for more than 40% of the total global energy consumption and accounts for more than 40% of the global greenhouse gas emissions according to the International Energy Agency (IEA), 2013) as asserted in [3]. The built environment is still being challenged by the expansion of the global population and the development of living standards. In light of this, a global movement known as "green building" (hence referred to as "GB") has evolved to enhance the built environment's energy efficiency, health, and comfort [2]. Similarly, the building and construction industry has received constant criticism over the last few decades for its role in the industry's high energy use and greenhouse gas (GHG) emissions. On the other hand, green buildings (GBs) have been suggested as a potential solution to the problem of reducing energy consumption and GHG emissions in the building sector [2], [4], [5], [6], [7]. According to studies, green buildings (GBs) reduce carbon emissions related to water use, solid waste management, and transportation by 50%, 48%, and 5%, respectively, when compared to conventional buildings (non-GBs) [6]. Since the 1990s, the sustainable building movement has garnered significant attention from countries and organizations worldwide. However, this movement has faced numerous challenges that must be identified and addressed. Researchers have identified public legislation and the adoption of standards related to the green building movement as strengths in various contexts. These standards are important for transferring relevant knowledge and technologies that can be integrated into construction projects to improve the built environment. This can result in energy savings, reduced greenhouse gas emissions, improved user comfort and health, and more. Public authorities are also stakeholders in this movement and can influence other actors towards sustainable practices in all phases of construction projects. To achieve this goal, public legislation plays a crucial role in encouraging practitioners to incorporate sustainable practices into their daily work. National laws and regulations have been implemented in both developed and developing countries to promote the adoption of these practices in their respective construction industries.

According to Li et al. (2014), Countries worldwide have implemented criteria to improve the environment for developing green buildings. The ASHRAE standard 'Energy-saving in Design for New Building' was first adopted in the US in 1975. The UK began developing green building standards in 1990, and as of 2008, all buildings in Britain must meet these standards. In 2009, Britain published its Low Carbon Transition Plan. The plan mandated that all new structures achieve zero emissions by 2016. Additionally, all new public structures must achieve zero emissions by 2018, all office structures by 2019, and all residential construction must complete the installation of smart meters by 2020. The European Union introduced the Building Energy Efficiency Performance Law as a more recent legal framework for energy conservation. By 2020, all newly constructed state-owned or state-used buildings must consume minimal energy. Building energy-saving projects have made significant advancements in certain developed countries since the beginning.

For example, from 1972 to 1985, the heating area in Denmark expanded by 30%, but the amount of energy used for heating decreased by 3.18 million tons of standard coal. Similarly, from the first energy-saving standard to 2011, America saved 43 billion dollars in energy costs and environmental management [5]. According to Chang et al. (2016), China's future urbanization process must be balanced with resource preservation and environmental protection, which is a difficulty. Consequently, the Chinese government has recognized promoting sustainable construction as a key tactic to address these issues and has published a significant number of laws, rules, and regulations to encourage sustainable construction [8]. In addition, China has improved its progress, set more challenging goals, and implemented a "carrot-and-stick" system for GB governance over time [4].

However, some countries, especially those with developing economies, are falling behind their more developed counterparts. These countries require additional efforts to catch up with the rest of the world in transitioning to sustainable construction and mitigating the impact of the construction sector on environmental degradation. The objective of this study is to analyze the regulatory texts that govern the construction sector in Burundi. The objective is to promote the adoption of sustainable building technologies in Burundi and the region by identifying the strengths and weaknesses of the urban code governing the construction sector and other texts governing areas close to the construction sector, particularly environmental protection. The aim is to determine whether the current laws governing construction in Burundi can accelerate the transition from conventional to sustainable building.

2. MATERIALS AND METHODS

This study fills the gaps in order to further promote GB in Burundi by thoroughly reviewing and assessing the structure and trends of Burundian urban codes using the qualitative content analysis method. Qualitative content analysis (QCA), which is increasingly being employed by researchers across a wide range of fields, is described as a potent analytical technique for the systematic and context-dependent subjective interpretation of the contents of qualitative data [9]. Similarly, a well-known technique for data analysis, qualitative content analysis has improved in how it handles textual material. When content analysis was first launched, it was as a strictly quantitative technique that counted instances of previously defined targets in consumer research to gauge their observed frequency. However, the process of content analysis was modified into a more engaging and meaningful technique as the naturalistic qualitative paradigm grew more widespread in social sciences research and researchers were more interested in how individuals behave in natural settings [10]. In addition, qualitative content analysis is suitable for a variety of data [11] but is commonly used for analyzing qualitative data [12]. With the help of specific words or phrases, the qualitative method aims to locate a construct or notion inside the text. It can also provide the text under study a more clear structure. The table below shows terms and definitions used in content analysis method.

Table 1: Terms and Definitions Used in Qualitative Content Analysis, adapted from [10]

Term	Definition
Immersion in the data	The process of becoming intimately familiar with the content being analyzed, through transcription, repeated reading, and/or several iterations of coding
Unit of meaning	Several words, a sentence, or a statement that represents a single idea or concept
Condensation	The process of shortening a unit of meaning while retaining the original meaning
Code	A short (typically 1-3 words) label that describes a unit of meaning/condensed unit of meaning
Category	An organization of several codes that are related in either content or context. In the case of a large number of codes, sub-categories may serve as a useful intermediate grouping
Theme	An organization of two or more categories that represent an underlying meaning. Themes describe behaviors, experiences, or emotions that occur throughout several categories

The qualitative content analysis method is also more often used in construction management [13], [14], [15], [16], [17], [18]. This study utilized a documentary analysis for data collection. It involved a comprehensive theoretical review of online document resources, including the Burundian urban code and other texts related to environmental protection in Burundi. The next step was to interpretively identify categories and limits of various materials and information considered essential to the phenomenon under study. The examination of the documents was based on four criteria: authenticity, credibility, representativeness, and meaning. The research frameworks are summarized in the figure below.

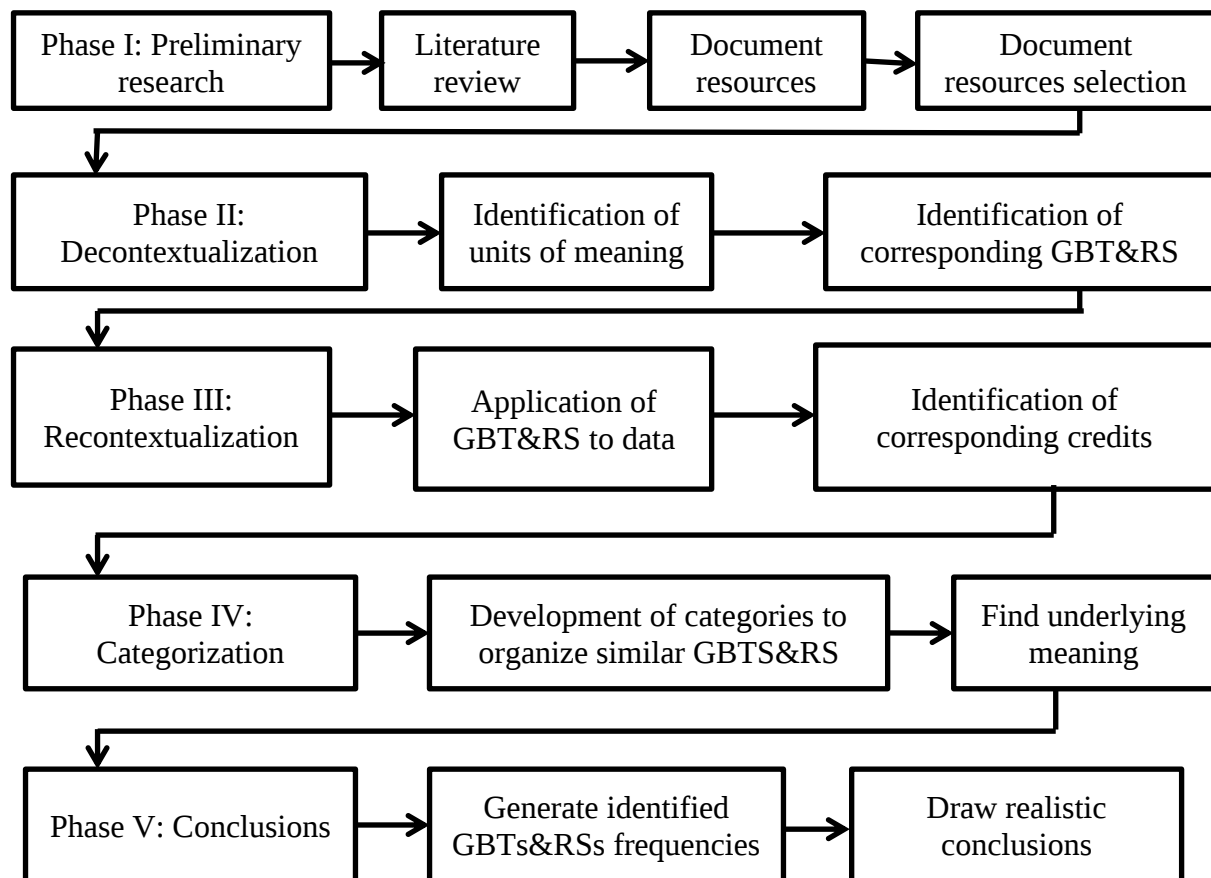


Figure 1: Research methodology flow chart

3. RESULTS

The study's results are based on an interpretation of the provisions found in Burundi's urban planning, housing, and construction codes. Each piece of content is integrated into the corresponding sustainable construction technology or green building assessment and certification system. The Burundian Water and Environmental Protection Code was also considered to assess its potential contribution to sustainable construction promotion. The table below summarizes the results according to the defined methodological framework.

Table 2: Content of the Urban Code and other texts related to the promotion of sustainable construction in Burundi. Contents analysis from [19].

Codes	Contents	Category/GBT/RS
Art89	The buildings must be designed and constructed to ensure a pleasant indoor environment	IEQ
Art89	The buildings must be designed and constructed to ensure minimum energy consumption	EA
Art89a	Thermal comfort must be ensured by natural ventilation	IEQ
Art89a	Mechanical ventilation complies with standard requirements	EA
Art89b	The location, shape and size of openings must allow sufficient natural lighting during the day	EA
Art89b	The location, shape and size of openings must allow sufficient natural lighting during the day	IEQ
Art90	In all buildings, openings must be provided for a natural ventilation system that functions correctly for all rooms	EA
Art91	The orientation of the building and its ventilation openings must help to improve thermal comfort and natural ventilation	IEQ
Art91	The orientation of the building and its lighting openings must help to improve natural lighting	EA
Art92	Indoor environment quality is ensured by the quality of the materials used, and does not cause any health risk to the occupants or damage to the building	IEQ
Art92	Indoor environment quality is ensured by the quality of the materials used	MR
Art93	Water heaters in new or renovated buildings are preferably powered by an alternative energy source	EA
Art94	The architectural design of apartment blocks, workplaces, public buildings, schools and health care facilities must be accessible to people with physical disabilities.	IN
Art102a	The construction of any establishment open to the public must comply with the rules of art and technical standards in force, particularly with regard to the environment of the building, the structures, the natural lighting, the usable volume of each room according to its purpose and the state of the technical installations.	EA

Codes	Contents	Category/GBT/RS
Art102a	The construction of any establishment open to the public must comply with the rules of art and technical standards in force, particularly with regard to the environment of the building, the structures, the natural lighting, the usable volume of each room according to its purpose and the state of the technical installations.	IEQ
Art124b	In all cases, the application for a demolition permit must be accompanied by a descriptive note on the practical arrangements to be observed considering the nature of the work, its location and the impact of demolition work on the environment.	MR
Art135	On the basis of locally available materials and without prejudice to the environment, the Commune's authorities, assisted by the contractor determine the building materials and types of houses to be houses to be built	RP
Art136	When drawing up standard building plans, the Communes must ensure that any construction on a group housing site include rainwater harvesting structures to enable it to be used for other purposes.	WE

The figure bellow summarizes the results.

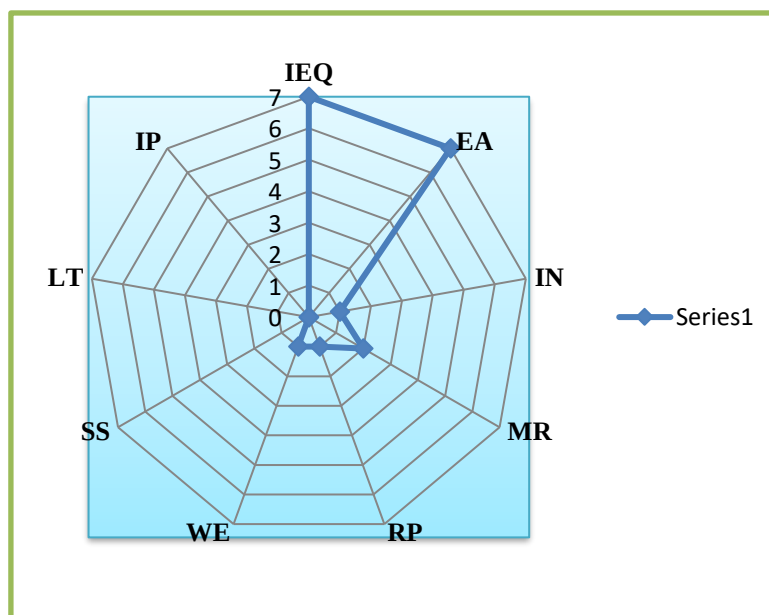


Figure 2: Frequency of concepts assimilated to GBTs according to the LEED standard through the content of the various chapters and articles of the Burundian Urban Planning Code.

4. DISCUSSION

Figure 2 shows that Burundi's urban code prioritizes healthy housing through sustainable building standards. The LEED standard advocates for nine categories of sustainable building technologies, and this study found at least six of them reflected in certain aspects of the code. However, the key issue is enforcement.

The code's actual implementation would depend on the restrictions that building permit applicants must comply with to benefit from this document. Objective monitoring during the work's execution is also crucial. However, the requirements for obtaining this permit do not include those related to sustainable construction.

This presents a significant obstacle to the advancement of sustainable construction in Burundi. Applicants for building permits may be hesitant to incorporate these concepts into their construction projects due to the inability to implement them effectively. Additionally, the code does not differentiate between project sizes to apply specific requirements to those that may be energy-intensive or have a high potential for harming the environment through greenhouse gas emissions, or those that must ensure comfort for all potential users. Differentiating the requirements for projects in the interior of the country from those in urban areas would make an important contribution, since urban construction requires special attention due to its scale. The vision of Burundi as an emerging country in 2040 and a developed country in 2060 foresees a remarkable increase in the urbanization rate from 11% (2022) to 40% (2040) and 70% (2060) [20]. This requires the establishment of solid mechanisms to make a significant contribution to environmental protection in general and sustainable construction in particular. Other codes, such as the Burundian Water Code and the Environmental Code, should also help to promote certain practices likely to improve the level of transition from conventional construction to sustainable construction. The Burundian Water code provides for efficient water management [21], but does not advocate this for buildings, which are the primary consumers. However, efficient water management in buildings would make it possible to protect water as a natural resource, one of the country's most important economic assets. Through the chapter of the Environmental Code dedicated to the fight against climate change, the Government of Burundi is implementing a series of measures to strengthen its adaptive capacity, increase its resilience to climate change, reduce its vulnerability to climate change and contribute to sustainable development. In addition, the Ministry of Environment is promoting measures to improve education, training, awareness, public participation and access to information on climate change. It also proposes a series of measures to reduce greenhouse gas emissions[22]. However, among all the measures advocated by the government in this chapter, the building sector, which plays a major role in environmental degradation, is not singled out. The Global Alliance for Buildings and Construction (GABC), the International Energy Agency (IEA), and UN Environment, all produce annual status reports that emphasize the importance of "buildings" and the "construction industry" in this context. According to these reports, building operations and construction [account for] 39% of energy-related carbon dioxide (CO₂) [emissions] and 36% of global final energy use [23]. It's so obvious that the construction sector should be one of the government's priorities, through the various codes and laws governing the construction sector and other related areas such as environmental protection, to make a significant contribution to the fight against climate change and sustainable development.

5. CONCLUSION

The study's results indicate that Burundi's urban code considers the incorporation of sustainable construction concepts into the construction industry. The main green building technologies found in the Burundian urban code after a thorough analysis are Indoor Environmental Quality (IEQ), Energy and Atmosphere (EA), and Materials and Resources (MR). However, the implementation of this code has been insufficient. For example, the study highlights several issues such as the absence of documentation and checks before issuing building permits, the lack of categorization of buildings by size to indicate their susceptibility to environmental degradation, and the absence of regulations for ecological certification of buildings. However, including ecological certification in the study of high-rise construction projects ensures the integration of sustainable construction concepts.

To improve the construction sector's contribution to meeting the needs of present and future generations in Burundi, it is crucial to update and improve the articles related to sustainable construction. In addition, it is crucial to include indicators that sustainable construction requirements were taken into account as prerequisites for obtaining a building permit for high-end construction projects.

Categorizing construction projects based on their scale and susceptibility to environmental degradation can enhance the sustainability of the construction industry. To enhance the results and conclusions of this study, a quantitative study involving various stakeholders in Burundi's building regulation sector should be conducted to determine the effectiveness of current regulations in promoting sustainable construction.

6. AUTHOR'S CONTRIBUTIONS

The paper was written by Samuel Rudahinyuka, with guidance, revision, and feedback provided by Jean Claude Ngenzi, Li HongBing, Gamaliel Kubwarugira, Xie Hongjie, and Athanase Ndiokubwayo.

7. COMPETING INTEREST DECLARATION

The authors declare no competing interests.

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