CONSTRUCTION INDUSTRY PROFESSIONALS' PERSPECTIVES ON THE BARRIERS TO TIMBER ADOPTION IN KENYA

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ABSTRACT

PURPOSE

This study investigates the barriers to the adoption of timber in the Kenyan construction industry despite the increasing prevalence of engineered wood and modern timber technologies around the world.

DESIGN

The study utilised semi-structured interviews of stakeholders within the Kenyan construction industry to gather insights into the perceived barriers limiting the adoption of timber in Kenyan construction.

FINDINGS

Key findings reveal that inconsistent timber treatment and supply chain inefficiencies undermine the viability of timber construction in Kenya, negatively influencing the perception of timber and, ultimately, market acceptance. Additionally, a lack of awareness about timber and societal biases associating timber with poverty and environmental concerns hinder broader adoption.

RESEARCH LIMITATIONS / IMPLICATIONS

This study is limited to the perspectives of professionals, suggesting future studies explore broader societal views and assessments.

VALUE

This study provides valuable insights into the perceptions and challenges surrounding timber construction in Kenya, offering practical recommendations for industry stakeholders.

Keywords: *Timber Construction, Technology Adoption, Kenyan Professionals, Kenya.*

INTRODUCTION

The building industry accounts for around 39% of worldwide carbon dioxide (CO2) emissions each year and more than a third of overall energy consumption in industrialised and developing countries[1]. As awareness about global warming and climate change increases, the construction industry is considering leveraging materials with a relatively lower global climate change impact and decreasing the consumption of high-energy-intensive materials[2]. Timber construction presents a viable alternative to address multiple socioeconomic and environmental issues[3,4].

Timber provides several benefits. Thomas[5] found that the end-of-life costs of timber construction can be up to 30% cheaper than those of conventional materials. Similarly, Scouse[3] reported that replacing the cast-in-place steel and concrete construction elements with engineered timber products reduces construction time by 61%, while overall construction costs are reduced by 22%. According to Gustavsson[6], wood-framed construction is a more sustainable material for construction since it requires less energy and emits less CO2 into the atmosphere than concrete-framed construction.

Despite the technologies available to use timber for construction, masonry, concrete and steel dominate, and the reasons for this low adoption require attention[5]. Previous studies have investigated the barriers to timber construction in various physical contexts and have provided some suggestions. Additionally, resistance to emerging technologies often hinders the adoption of alternative construction methods[7].

Timber availability is one of the more significant barriers to its adoption in the construction industry[8]. The constraints on the availability of timber are multifaceted and include challenges regarding sustainable sourcing, forest management strategies, geographic distribution, and supply and demand fluctuations. The limited supply of timber can affect the scalability and viability of timber construction projects compared to traditional construction materials, as well as the economic feasibility and overall appeal of such projects[9]. Concerns about the cost competitiveness of timber construction may also discourage stakeholders. The initial cost of construction of timber buildings can be higher than that of conventional buildings[10,11], which represents a significant obstacle because of an emphasis on maximising profits[12].

One primary obstacle to the adoption of wood as a structural material is the limitation of building codes regarding the structural use of timber[8]. Building codes have historically favoured traditional construction materials like concrete and steel, making it challenging for timber to gain widespread adoption. Many of these restrictions persist and continue to limit the use of timber, especially in multi-storey construction[13]. Other barriers include the lack of expertise among professionals and the conservative culture of the construction industry[8]. The lack of information, lack of academic or continuing learning, lack of support for technical aspects, lack of experience, knowledge, and skills with regard to wood, and lack of research findings transferred to the industry are some of the reasons provided for this lack of expertise[8].

Misperception of timber use among stakeholders cannot be discounted[14]. Studies on wood construction have focused on the perspectives of construction professionals, where the users' perceptions of timber material are strongly connected to elements of past experiences and conservative industry practices[15]. Perceptions impact the preferences of architects and structural engineers for construction materials, their attitudes towards the wood properties and beliefs regarding the control and ease of constructing with wood[16].

Before undertaking this study, a desk study was conducted on Scopus and Web of Science to determine if previous studies had sought to investigate the adoption of timber construction in Kenya (see Appendix I for search terms). Overall, 28 results (including duplicates) were returned, with none exploring the adoption of timber in Kenya (see Appendix II for results). This gap is particularly important given that developing countries such as Kenya face significant housing and infrastructure development challenges[17,18], and the use of timber in construction could offer an affordable housing alternative. According to Roos[19], the perceptions of construction industry professionals influence the adoption of timber. We, therefore, sought the perceptions of construction industry professionals towards timber construction in Kenya.

This study provides two critical contributions to the literature. Firstly, it examines the perspectives of construction professionals in Kenya about timber construction. Secondly, based on the barriers identified, it provides recommendations unique to the local context for overcoming these barriers. This study, therefore, presents valuable insight for improving the integration and acceptability of timber as a sustainable building material in Kenya, thereby promoting a more environmentally responsible and economical construction industry.

METHODS

This study used a qualitative approach to gather the perspectives of various experts in the Kenyan construction industry about the factors impacting the adoption of timber construction. As an exploratory study, the authors assumed the constructionist epistemology position that several realities exist, so the researcher must collect various viewpoints and the opinions and experiences of a wide range of people[20]. This research was carried out in two phases. In the first phase, a scoping review was used to identify the barriers to the adoption of timber construction based on previous studies. Table 1 lists the themes identified from the review. The goal was to identify frequently mentioned barriers rather than a comprehensive review of all possible barriers; therefore, the list below may not reflect all possible barriers to the adoption of timber in the construction industry.

Table 1: Barriers to the adoption of timber construction

Barriers	References
Outdated building codes	[8,13,21 –24]
Cost concerns	[10,21,22,25 –29]
Lack of awareness and knowledge transfer	[8,9,16,27,30,31]
Perceptions of timber buildings	[8,13,15,16,26,27,29,31 –37]
Regulatory issues	[27,29,32,33,38]
Resistance to technology adoption	[28,39 –42]
Timber availability and supply	[8,9,38,43 –47]

The results of this step provided fundamental information for the next phase of the study, which employed semi-structured interviews (SSI) with construction industry experts in Kenya to identify context-specific barriers to the adoption of timber in construction. SSI employs a combination of closed- and open-ended questions, with follow-up how or why questions[48]. The use of interviews is an established data-gathering process in qualitative studies[49]. According to Randall[50], convenience sampling is considered highly acceptable for expert opinion surveys, so it was used in this study. In selecting participants, preference was given to English-speaking Kenyan professionals based on the first author's experience and referrals. Ethics approval (Appendix III) was sought from the authors' institution, and once obtained, several construction professionals were approached directly and through recommendations to participate in the study. Fifteen professionals indicated willingness to participate in the study and were interviewed.

There were 12 questions in the interview. Question 1 aimed to gather participants' perspectives on the barriers to timber construction without influence from existing literature. Afterwards, participants were presented with the barriers identified in the literature and asked whether they agreed or disagreed. These queries were covered by questions 2 to 9. This process helped to clarify the applicability of the previously identified barriers to the Kenyan context. The final three questions (10-12) were intended to gauge the level of knowledge respondents had about modern timber construction. Table 2 outlines the questions that were asked in the interviews.

Table 2: Overview of participants and their awareness of timber construction

Participant number	Job title	Code
1	Construction Manager	CM1
2	Civil Engineer	CE1
3	Project Manager	PM1
4	Civil Engineer	CE2
5	Contractor	C1
6	Civil Engineer	CE3
7	Architect	A1
8	Civil Engineer	CE4
9	Civil Engineer	CE5
10	Contractor	C2
11	Contractor	C3
12	Project Manager	PM1
13	Contractor	C4
14	Civil Engineer	CE6
15	Civil Engineer	CE7

PERCEPTIONS OF BARRIERS IDENTIFIED IN THE LITERATURE

LACK OF AWARENESS AND KNOWLEDGE TRANSFER

The lack of awareness about timber construction is a common barrier to its adoption[8,9]. The lack of information, inadequate training on timber and limited research on timber contribute to this lack of awareness[9,16]. Various studies have consistently identified gaps in knowledge as fundamental obstacles affecting the perception and incorporation of timber as a viable building material[16,52]. Similarly, in this study, the lack of timber education and training at the tertiary education level was of concern to all participants. The Kenyan civil engineering curriculum was specifically blamed for not training professionals and equipping them with enough knowledge to confidently handle and use timber in construction.

"There is a gap in the education system from the training professionals received from the universities…I think the professionals and people stopped talking about timber…I can't remember the last time I had that conversation about how to address challenges that have been experienced [in] timber construction." ~ CM1.

"Professionals in Kenya are trained fundamentally at the campus level. And I think the education system mostly concentrates on the design aspect of timber, and they're not letting us know about other benefits of construction using timber." ~ PM1.

"…handling of timber is a problem because these professionals are not well-trained. So, the final products they deliver do not meet the standards; therefore, it discourages us from using timber for construction. Thus, people end up using other materials that have better finishes and whose quality and durability are assured." ~ Ce2.

There are also limitations in capacity building for professionals to upskill with knowledge about timber construction.

"I think there should still be the creation of a lot of awareness because I believe most people do not understand the importance and the use of timber in the construction industry…there's a lack of expertise in terms of the use of timber and its design. So, there's a lot of capacity building that is required, and training to understand how timber works and how it's supposed to be used" ~ C1.

"There's no transfer of knowledge from people who have constructed using timber…transfer of knowledge requires money and resources to organise training sessions, pay professionals, or rather applications. So, I think that institutions are not willing to provide money for or invest in these trainings." ~ CE1.

This barrier highlights the significant gap in the understanding and knowledge of the benefits and potential of timber construction among professionals in Kenya. However, this is not just a local challenge. Previous studies in Europe[53] and South Africa[54] have emphasised the limited educational content on timber construction in schools and recommended its development. Ensuring that the next generation of construction professionals is well-versed in timber construction should be a priority to support its adoption.

COST CONCERNS

The cost of timber and the financial uncertainty associated with timber applications were other barriers that all participants agreed on. Participants noted that timber is expensive in Kenya. Cost elements identified by participants include the cost of timber, construction costs and maintenance costs.

"I think most of the timber that we use, mainly in Nairobi, comes from Congo …the scarcity raises the prices of timber quite high, especially if you want to get some good quality timber that can stand the test of time." ~ CM1.

"Timber is expensive for construction use and requires large quantities of wood for a specific project… With time, what will remain will be maybe using timber for doors and maybe doing the finishes due to these concerns of availability, cost and standardisation." ~ PM1.

"Let me give you an example of cypress, it can only be sourced from places like Mount Kenya or Bomet, which also increases the prices since you have to factor in the transportation cost and the tollgate payments. And now, some of these factors are the ones that make timber so expensive in places where timber is not found… Supply chains also determine the processing and delivery delays because they take part in the main process of timber delivery. The success of sales and marketing relies on effective supply chain models that help ensure that the right quality product is available at the right place and at the right time." ~ C1.

"…the main financial barrier when it comes to timber construction is the maintenance costs at the use phase and the purchase cost for higher quality timber at the construction phase compared to the other materials." ~ A1.

"…of course, timber is expensive, as are both the materials and the expertise necessary to do modern structural building and structures using timber. Still, it's very beautiful, and that's why people who are able to afford it would pay more for it." ~ CE7.

"Using timber means that there are other things you need to be aware of, such as fire resistance. I think designing for fire resistance in timber can be done, but again, it is very expensive." ~ CE3.

"…if you're really considering the timber issues, you will look at soundproofing and fireproofing, which might end up being more expensive." ~ C3.

Cost is a regularly cited barrier in the literature. According to Jones[27], the high cost of timber construction represents a significant obstacle to the implementation of timber construction. Some studies have observed that the financial cost of timber construction may include a premium of up to 5% more than conventional construction activities[22,25], which may prove prohibitive for an industry that is very conscious of its bottom line[27]. Several premiums are a result of perceived risks attached to timber construction, such as the need for extra fire protection systems specific to timber buildings[26]. Kremer[55] noted that insurance companies may charge higher premiums for timber buildings.

REGULATORY ISSUES

Regulation was another barrier that all participants agreed is a significant barrier to the adoption of timber in the Kenyan construction industry. They emphasised the difficulties in obtaining approvals for timber used in certain types of construction and the complex regulatory environment governing timber use. Most participants were concerned about obtaining approvals for timber construction projects and the government policies and regulations that limit the sourcing and use of timber in the country. They cited the following.

"I think someone wanting to build a maisonette using timber may encounter approval issues since there has not been extensive use of timber in high-rise buildings. If you want to build a high-rise building in Kenya, then structural drawings are required." ~ CM1.

"Whenever a new government is in place, it may impose new policies. As we have seen before, some of those policies restrict the cutting down of trees, and people are given a certain volume of trees they can cut within a specified period. Additionally, there is no structure in the industry on how to effectively and sustainably harvest and use timber in construction." ~ CE2.

Muthike [38,45] has researched the effect of strict regulations in the Kenyan context. Regulatory barriers have restricted timber harvesting since the enactment of a ban at the beginning of the century[38,45]. Additionally, weak legal structures have hindered the ability of the forest department to effectively manage resources outside of gazetted forests, as well as the participation of the private sector and communities in forest management[45]. These regulatory challenges seem to play a key role in influencing how timber is sourced and used in Kenya, according to the participants.

"There are many regulations around timber because you cannot cut timber everywhere. For example, most of the places that can produce timber in large quantities are owned by the government." ~ C1.

Ultimately, the contractors believe that by addressing the regulatory issues, some of the concerns about the costs and availability of timber will also be resolved, therefore increasing the interest in timber as a construction material.

"…the government can implement policies that then enhance the licensing and the quality of the timber used in construction and generally the regulation of the whole supply chain." ~ C3.

"The other challenge is the government restrictions, which are making timber a scarce resource, as well as bribing and fines in Kenya if you are caught transporting it without a license. So, even the government has a very big role to play when it comes to the supply and availability of timber in general and its costs in the Kenyan market." ~ C4.

"…I believe the recent decision by the Kenyan government to establish a public holiday dedicated to tree planting is something that could be done regularly." ~ C1.

"Most of our timber is sourced from Congo directly via the border, and throughout the transportation, the police on the road require that they be given money, and the corruption now brings the costs even higher and riskier; therefore, timber becomes unreliable. For instance, mahogany is the most imported timber product; it is also the most expensive that we have here in Kenya." ~ C2.

TIMBER AVAILABILITY AND SUPPLY

According to Gosselin[8], availability is one of the more significant barriers to the adoption of timber in the construction industry. The constraints on the availability of timber are multifaceted and include challenges regarding sustainable sourcing, forest management strategies, geographic distribution, and supply and demand fluctuations[8]. When discussing timber availability, supply was one of the most common factors that participants highlighted.

"Supply chains significantly influence the availability of timber, as they largely control its supply. They also regulate the importation and pricing of timber products in the market, which directly affects timber costs. As a result, buyers may face uncertainty regarding timber prices." ~ CE6.

"The availability of timber is one thing we tend to forget because I think there were so many regulations banning logging some years back. I also think most of the timber in Kenya is imported from Congo. Therefore, the scarcity raises the prices of timber quite high, especially if you want to get some good quality timber that can stand the test of time." ~ CM1.

"Timber is not readily available right here in Kenya, with most of it being sourced from Congo, which limits the local supply. As a result, timber tends to be quite expensive. For example, a 3x2 timber beam currently costs over 60 Kenyan shillings per foot." ~ CE3.

In the case of Kenya, regulatory barriers have restricted the harvesting of timber since the enactment of a ban at the beginning of the century, and participants pointed to this restriction as an influence on availability[38,45].

"There are restrictions on the sizes of timber available for structural use in Kenya, unlike other materials like steel. This creates challenges in boosting the use of timber without needing special adaptations for its application." ~ CE3

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"As a contractor, I tend to avoid using timber in construction due to the complex and time-consuming process involved in its sourcing, transportation, and application. This is mainly because working with timber requires navigating through multiple layers, including dealing with suppliers, adhering to regulations, and obtaining permits, all of which add to the overall cost. For contractors who need timber in large quantities, it can be challenging to find a single supplier capable of delivering within tight deadlines. As a result, many opt for alternative materials that offer similar properties." ~ C2.

Additionally, weak legal structures have hindered the ability of the Forest Department to effectively manage resources outside of gazetted forests, as well as the participation of the private sector and communities in forest management[45].

"In Kenya, the use of timber in construction presents significant challenges due to the lack of industry regulations. There are no guidelines for sourcing or supply, and the government tends to turn a blind eye when timber is brought up in discussions." ~ A1.

Some contractors highlighted the importance of the demand for the supply of timber.

"Demand drives supply. Therefore, I don't see supply as the primary issue here; the real question is about demand. Is the market ready for timber? If it is, there will always be suppliers. It all begins with the user; if they want timber, it will be supplied. Ultimately, users influence whether professionals should design with traditional materials like stone and steel or explore alternative options such as timber." ~ C3.

"I think that timber adoption is a supply-demand issue. If [nobody is] even asking for it, that means fewer people are supplying." ~ C4.

One participant said that the public's awareness of wood would also influence the availability of timber.

"...I think the first thing that should be done is public awareness [of] the importance of growing timber. Therefore, anyone planning on making timber more popular in the construction industry in Kenya should also note the importance of planting more timber." ~ C1.

Espinoza[53] has noted that the lack of public awareness of timber may be contributing to the limited adoption of timber products in the construction industry.

RELUCTANCE TO CHANGE

Compared to other industries, the lack of innovative work practices to advance the construction sector has led to the construction industry being characterised as outdated and stagnant[42]. A common contributing factor to the resistance is the need for more understanding and familiarity among industry participants. Notably, new technologies have historically struggled to gain traction and develop due to the lack of user acceptance brought on by misconceptions, uncertainties, and negative perception [28]. The construction industry's tendency to be conservative has also been recognised as a contributing factor to the limited adoption of timber construction in this study, including the broader adoption of wood in construction.

Ten participants in this study agreed that reluctance to change within the construction industry has resulted in a slow adoption rate for timber as a construction material. They attributed this to the lack of awareness about the benefits of timber and a preference for the traditional ways of construction.

"I believe that professionals have the knowledge or are aware of the benefits of timber. However, there is stagnation, or rather a rigid mentality, when it comes to implementation. We continue doing construction using concrete because it has been the standard construction material for a long time, and it's considered easier to work with." ~ CE1.

"People have gotten comfortable with what they've known, what has been practised for probably decades, generation after generation. So, I think that poses reluctance to embrace this new technology. I think there is a need for exposure because once they can see it being done, look at the data, and evaluate the benefits, that could be a good place to start." ~ PM1.

"People are scared of trying things alone and will want to try things that other people have been normalising." ~ C1.

"Again, people, even professionals, do not like change. They want to use those things that they feel are well-tested, and they don't want to risk themselves. They do not want to try those things which have not been done before either." ~ CE3

"In order to push a certain new material in the industry, like engineered timber, you will require many stakeholders to believe in it enough to give it a chance to thrive and become the new normal. It, therefore, requires a lot of marketing and pitching, also highlighting the exact benefits of the product." ~ A1.

"The major reason why people are reluctant is just awareness. People are not aware of the benefits and possibilities of timber." ~ CE6.

"I believe the reluctance to embrace timber construction stems from a lack of education and awareness about its feasibility. People are often hesitant to adopt unfamiliar methods. However, if we took a bold step to introduce timber construction and implemented the necessary measures to create a favourable environment, it would encourage clients to consider this sustainable alternative." ~ CE7.

PERCEPTIONS OF TIMBER BUILDINGS

Participants repeatedly mentioned common perceptions about timber buildings. Structural and durability concerns were of major concern, as 14 participants mentioned issues around the effect of moisture, insects and pest attacks on buildings. They highlighted the risks involved and further the cost uncertainties and structural integrity consequences that might need to be met.

"Timber, if not treated well, when it comes to the test of time, the house will not be as durable and structurally stable." ~ CM1.

"Of course, again, timber requires much work. This means that before you implement it for a building, you need to season it to prevent insect infestation or from being destroyed by moisture exposure, which affects the overall durability of the structure." ~ CE1.

"There are also concerns over exposure to fire, termites, and changes in temperatures and moisture, which also lower the quality and durability of the structures." ~ C3.

"If you don't get well-seasoned timber obtained from a mature tree, it will have excessive moisture content, and if used for construction, after some time, it starts deteriorating and rotting. Therefore, it affects the structural integrity of the structure." ~ CE2.

"The major risks in timber structures are the rotting of timber or infestation by termites, which can lead to the collapse of the structure; I think it's not a structurally strong construction material." ~ CE5.

"Timber is also prone to attack by termites, and if it is not seasoned well, there will be the problem of rotting with time. It would also be prone to close cupping, twisting, squeaking and checks. Therefore, there will be many defects and structural issues in the timber structure with time." ~ C1.

"Most people believe that timber structures cannot stand in the long term due to termites. They also believe that changes in the weather cause timber to rot, and the house eventually fails." ~ C2.

"Mostly, the areas where you can find houses made of timber are the tropical regions of the country due to the availability of timber. These areas are affected by insects and pests and experience hot weather and cold weather patterns, and exposure to frequent expansion and contraction affects their durability. So, there is concern about the changing temperatures and moisture exposure conditions." ~ CE2.

Another nine participants mentioned fire safety as a crucial drawback for timber structures. Timber is generally considered to be intrinsically more combustible than materials like steel in Kenya. The dry climate of Kenya was cited as a possible contributor.

"I think fire safety is a societal concern for timber structures because people assume timber will definitely catch fire easily as opposed to steel. I think fire is one of the risks that people might have concerns about." ~ PM1

"…in some communities, timber is at higher risk of catching fires, and so most people are choosing to build with alternative materials." ~ CE6

"For places that are prone to catching fire often, if you dare [to] use timber in the entire construction, you may incur a lot of losses." ~ C1

Perceptions and misperceptions about timber buildings are a common occurrence. A study in Australia found that even experienced construction industry professionals still have negative perceptions about the fire and moisture performance of timber despite the availability of evidence to disprove these perceptions[34]. Similarly, Gosselin[8] found that the technical aspects of wood, such as its stability, stiffness, strength, moisture resistance and fire resistance, are viewed negatively in the industry. Another study in South Africa suggested that misperceptions about timber buildings influence low adoption[14]. A lack of awareness may also fuel these perceptions[16]. In this study, it must be noted that most of the participants stated that they did not have any knowledge about modern timber products, such as engineered wood products or had not been involved in structural timber construction. This might be a possible influence on these perceptions.

OTHER BARRIERS TO THE ADOPTION OF TIMBER CONSTRUCTION

TIMBER QUALITY CONCERNS

Concerns about the quality of timber in Kenya were common. Timber quality in Kenya was frequently mentioned in the interviews as a significant concern. In contrast, the literature review did not emphasise it as a major issue, instead linking concerns about timber more broadly to general perceptions of wood as an unsuitable material[31]. Specific concerns revolved around what several participants called the "seasoning" of timber, referring to the lack of standardised quality and treatment procedures for lumber. They also emphasised the poor handling of timber for construction purposes.

"…in Kenya, we are getting unseasoned timber that is not even well-dried. It still has some high moisture content, so when you do your floor or in the other member, for that matter, you realise it's not meeting expectations… even with the seasoning issues, we are also cutting the trees before the age of maturity, which also greatly affects the quality of the timber we get." ~ CE3.

"…most of the houses built in the past using timber would not last long because, by then, technology was not good enough to season timber and ensure that it [was] of the best quality to endure all the varying climatic conditions." ~ CE4.

"Timber construction is largely dependent on the quality of the wood and how it is managed during storage, transportation, and treatment. Improper handling can lead to problems like warping and other factors that compromise the appearance and overall quality of the timber products." ~ A1.

"I believe that there are issues of standardisation on the quality of timber that is being used for the construction industry. When getting the timber for construction, you are never sure whether you are getting good quality. This could be due to grading inconsistencies or inadequate seasoning. They do not specify any standards unless the timber undergoes all the specific tests that are supposed to be done and passes the tests." ~ CE2.

Other than the seasoning of timber for construction, the lack of standardised sizing in the timber market and the complexities of the supply chain pose significant challenges to the quality of wood available in the construction industry and affect the overall broader adoption of timber.

"In certain environments, such as urban areas, the supply chain to the end user often involves multiple middlemen, who can affect the timber's quality and even alter its length. As a result, the only way to ensure the specific quality you require is if you plant and harvest your timber." ~ CE5.

"The timber trade in Kenya faces significant product authenticity challenges. For instance, clients may purchase cypress but end up receiving a different wood type, such as eucalyptus. These inconsistencies, therefore, discourage the use of timber, as many clients are wary of buying from certain yards due to concerns over quality and reliability." ~ Cm1.

"There are places where you can get quality timber, especially from those who are usually exporting and have legal permits to distribute timber, but generally, there is no clear way of validating quality in the market currently or the standards they need to meet." ~ C3.

"Quality is often compromised when distributors prioritise the cheapest options to maximise profits. As a result, if cost becomes the primary focus, quality tends to suffer. In Kenya, there are only a few companies that can be trusted to provide high-quality wood, and these tend to be quite expensive. This has led to a monopolisation of the timber trade, where those who truly understand timber and its uses must turn to reliable sources, as others are flooding the market with substandard products." ~ C2.

COMPETING ALTERNATIVES

Another often-referenced barrier noted in the transcripts was the emphasis on the presence of easily accessible alternatives. Apart from concrete, other materials such as stone, sand, bricks and even light-gauge steel appear to be the preferred options.

"Alternative construction materials like quarry stone, sand, and gravel are more available and much easier to obtain, which makes these materials more appealing than wood." ~ C3.

"…In rural areas, people prefer using burnt bricks from clay that they make themselves and then generally do plastering." ~ C1.

"When you specify timber for flooring or other finishes, developers believe it is very expensive, particularly in our local markets. This is in comparison with using tiles and other alternative finishes. So, when you mention timber for the house, especially in the urban areas' developments, there is this feeling that it already speaks to high-end finishes. People are now opting for other engineered products, like laminates. So, I would imagine that because of the risk involved, then timber construction will attract even higher insurance premiums compared to conventional construction methods." ~ A1.

"Timber is more expensive compared to other materials like steel, which are easily available since you will only need to ask for a quotation and can acquire it from the factory at an affordable price…that is why people are looking for other alternatives despite timber being a viable option for construction…for people who are in retailing, affects their profit margins, and then for the buyers it gets expensive." ~ CE4.

CULTURAL AND SOCIETAL INFLUENCE

Several participants highlighted the societal perception that timber is an inferior construction material that has been used primarily by people experiencing poverty and mainly for constructing temporary structures. The extent and frequency of these influences also led to separating this theme from perceptions. Below are some comments from participants.

"Most of the people associate constructing using timber as a form of poverty. So, in terms of aesthetics, people feel like it's more prestigious to have a brick-and-mortar house as opposed to those constructed with timber." ~ PM1.

"Building with timber is a thing of the past, and other materials have now outpaced it. So, people who are still using timber for construction are believed to be poor. It seems that if you're using timber to build, you don't have money to employ the new construction methods." ~ CE2.

"People believe that a timber structure is not permanent, and I usually see people use timber in building storehouses. However, for those people who really understand it well and how it's supposed to be used, they consider it expensive." ~ C2.

"There is a perception that houses made of timber are a bit more temporary than permanent. So, people build with timber with the hope that they will build with bricks later." ~ C4.

Another societal and cultural perception mentioned by the participants is the protection of participants living in timber structures.

"Some places are extremely hot, like the North-Eastern regions of the country and therefore, people are afraid that snakes and other animals may get into the timber shelter looking for water." ~ CE6.

"Not all cultures are open about using timber as a construction material because they believe that it is like killing a being, 'the tree,' to use it for the construction of a shelter." ~ CE1.

These comments suggest that changing the culture around timber is critical for improving adoption. According to Mallo[56], the adoption of modern mass timber products seems greater in areas where a culture of using wood already exists. Awareness of the benefits of timber is high in areas in Europe where timber is typically used structurally, such as in Sweden[57]. One study in the United Kingdom observed that the adoption of wood products in construction was boosted by the use of wood during the London Olympics in 2012[58].

SUSTAINABILITY CONCERNS

Climate change and global warming were also cited by 11 participants as a barrier to the adoption of timber construction in Kenya.

“People are now more aware of sustainability and the impacts of deforestation, which has led to fewer people actively engaging in timber harvesting. Another concern relates to the source of the timber. If trees are being cut for timber, does that promote logging, and how does it align with sustainability efforts?” ~ C3.

“People are unwilling to use timber as a construction material [because] they believe that there are other alternative materials available for use in buildings that wouldn't require destroying the environment to get them at the same intensity.” ~ PM2.

“The biggest issue in Kenya is deforestation, which is getting better mainly because there's mass hysteria in terms of climate change, summits and meetings that occur now and then, and so that has really sparked questions on sustainable development within the country looking at using renewable energy and also using sustainable material raw material in construction.” ~ CE7.

Many people still associate it with deforestation and environmental harm since the idea of using timber often suggests cutting down trees and damaging nature.” ~ A1.

These fears are not unfounded. Logging and deforestation in the Amazon have been linked with global climate change[59], and concerns have also been expressed about the cutting down of trees for charcoal and firewood[60]. Unlike cutting down wood for farming and firewood, timber construction allows for continued carbon storage by the wood beyond the forest floor, allowing buildings to be a sustainable addition to forests[61].

FURTHER INSIGHTS AND POSSIBLE SOLUTIONS FOR INCREASING THE ADOPTION OF TIMBER CONSTRUCTION IN KENYA

The barriers to timber construction highlighted in this study largely align with barriers from studies in other countries. Some differences, however, exist between the findings of this study and the literature. One example is the lack of building codes, a common barrier to timber construction in the literature[21,62,63]. However, this was largely disregarded by participants with regulatory barriers limiting the use of timber highlighted as the bigger challenge. Some participants observed that building codes in Kenya contain specifications for using timber. Instead, the problem is limited knowledge among professionals due to the infrequent use of timber in the country.

For timber construction to become a feasible option in Kenya, there must be investment in awareness, education and training of construction professionals. Increasing knowledge, awareness and access to information on timber products and timber construction has been prescribed as a solution for increased adoption[22]. In another study, construction professionals requested more data on timber construction[64]. Additionally, perceptions of timber must be dispelled. The promotion and marketing of timber is a valuable tool in this process. It is important that stakeholders who want to increase the use of timber in construction exert more effort in combating the perceptions around timber with facts and examples of the benefits of timber construction[65]. Regulations around the cutting down of trees must be revisited as governmental policy plays a major role in shaping the use of timber[58]. All of these should also be based on in-depth studies of the feasibility of timber construction as a viable option for the industry.

CONCLUSIONS & RECOMMENDATIONS

The findings from this study have highlighted several barriers to the adoption of timber construction in Kenya. A lack of awareness about the benefits of timber was attributed to gaps in the education system, limited opportunities for knowledge transfer amongst professionals, and a lack of knowledge amongst clients. The cost of purchasing timber, maintenance of timber structures and lack of expertise were some of the cost-related barriers that were observed. Furthermore, regulations limiting the logging and use of timber have impacted the timber trade in Kenya. As a result, the structural integrity of the timber that makes it to the market is questionable as there is no certified chain of custody. Other barriers include the proliferation of conventional materials and the appeal of other innovative alternatives, cultural and societal perceptions and even negative perceptions around the sustainability of cutting down trees.

Our results can, therefore, be translated into several recommendations and improvements to increase timber construction adoption. First, a thorough analysis of the feasibility of timber construction in Kenya must be undertaken. If such a study shows that timber construction is a viable option in Kenya, then it will be important to develop systems that position timber as a competitive, sustainable, affordable construction material must be prioritised. Regulatory reforms that streamline and promote sustainable timber production, sourcing and use in construction must be enacted. Similarly, timber proponents must develop strategies to raise awareness about modern timber treatments and engineering innovations that address and mitigate negative timber perceptions. They must also reinforce the presence of industry-wide standards for timber quality.

Despite the contributions made by the present study, there are some limitations. Due to the variability of timber adoption barriers across different contexts, the conclusions made in this study may not be universally applicable. The study relied on globally published literature to establish the adoption barriers, which additionally introduced bias because of the limited availability and accessibility of literature relevant to the research. Secondly, there is potential non-representation of the perspectives from the SSIs as the responses were based on the individuals' opinions rather than a consensus from the entire industry stakeholders. Therefore, while this study focuses on and is limited to the perceptions of Kenyan construction industry professionals, further studies could investigate the broader societal perceptions of timber adoption.

In terms of outlook, the barriers identified in this study could be assessed further according to their impact and the recommendations proposed to develop an actionable roadmap for sustainable timber construction adoption in Kenya. The local relevance of this study may have regional repercussions, as Kenya is a developing country in the African continent and, consequently, for any other interested economies that recognise similarities to exchange knowledge and development strategies. Further empirical studies intend to explore the findings of this paper and test the applicability of the identified barriers in a broader population. This study, therefore, serves as a valuable foundation for any future studies that seek to investigate timber construction adoption in Kenya.

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APPENDIX I – SEARCH TERMS FOR INITIAL LITERATURE SEARCH OF ARTICLES ON THE ADOPTION OF TIMBER CONSTRUCTION IN KENYA

Search Date	8 December 2024
Search Terms	("timber" OR "wood") AND ("construction" OR "building" OR "built environment") AND ("adoption" OR "uptake" OR "implementation" OR "diffusion") AND "Kenya"
Databases (Results)	Scopus (7) Web of Science (21)

APPENDIX II – SEARCH RESULTS FOR INITIAL LITERATURE SEARCH OF ARTICLES ON THE ADOPTION OF TIMBER CONSTRUCTION IN KENYA

Authors	Article Title	Year
Goverse, T; Hekkert, MP; Groenewegen, P; Worrell, E; Smits, REHM	Wood innovation in the residential construction sector; opportunities and constraints	2001
Clemens, H; Bailis, R; Nyambane, A; Ndung'u, V	Africa Biogas Partnership Program: A review of clean cooking implementation through market development in East Africa	2018
Waswa, F; Mcharo, M; Mworia, M	Declining wood fuel and implications for household cooking and diets in tigania Sub -county Kenya	2020
Kamau, AW; Shauri, H; Hugé, J; Van Puyvelde, K; Koedam, N; Kairo, JG	Patterns of Mangrove Resource Uses within the Transboundary Conservation Area of Kenya and Tanzania	2024
Kimutai, SK; Kimutai, IK; Manirambona, E	Impact of biogas adoption on household energy use and livelihood improvement in Kenya: an overview on a roadmap toward sustainability	2024
Cisek, CR; Klein, K; Koseki, S; Wood, R	Strengthening family planning stewardship with a total market approach: Mali, Uganda, and Kenya experiences	2019
Mwirigi, J; Balana, BB; Mugisha, J; Walekhwa, P; Melamu, R; Nakami, S; Makenzi, P	Socio-economic hurdles to widespread adoption of small-scale biogas digesters in Sub -Saharan Africa: A review	2014
Muhati, GL; Olago, D; Olaka, L	Participatory scenario development process in addressing potential impacts of anthropogenic activities on the ecosystem services of Mt. Marsabit forest, Kenya	2018
Escoffery, C; Lebow -Skelley, E; Haardoerfer, R; Boing, E; Udelson, H; Wood, R; Hartman, M; Fernandez, ME; Mullen, PD	A systematic review of adaptations of evidence -based public health interventions globally	2018
Makai, L; Popoola, O	Assessment and selection of a micro -hybrid renewable energy system for sustainable energy generation in rural areas of Zambia	2024

Kariuki, C; Kathambi, B; Inyega, J	Assessment of leadership actions for Environmental Stewardship Enhancement in public schools	2023
Wassie, YT; Adaramola, MS	Potential environmental impacts of small -scale renewable energy technologies in East Africa: A systematic review of the evidence	2019
Mahoney, AD; Westphaln, KK; Covelli, AF; Mullan, F	Advancing Social Mission in Nursing Education: Recommendations From an Expert Advisory Board	2020
Dumont, ES; Bonhomme, S; Pagella, TF; Sinclair, FL	Structured stakeholder engagement leads to development of more diverse and inclusive agroforestry options	2019
Robertson, K; Liner, J; Hakim, J; Sankale, JL; Grant, I; Letendre, S; Clifford, D; Diop, AG; Jaye, A; Kanmogne, G; Njamnshi, A; Langford, TD; Weyessa, TG; Wood, C; Banda, M; Hosseinipour, M; Sacktor, N; Nakasuja, N; Bangirana, P; Paul, R; Joska, J; Wong, J ; Boivin, M; Holding, P; Kammerer, B; Van Rie, A; Ive, P; Nath, A; Lawler, K; Adebamowo, C; Royal, W; Joseph, J	NeuroAIDS in Africa	2010
Amuyunzu -Nyamongo, M; Owuor, JO; Blanchard, C	The Consortium for NCD Prevention and Control in Sub -Saharan Africa (CNCD -Africa): from concept to practice	2013
Buchholz, T; Tennigkeit, T; Weinreich, A; Windhorst, K; DaSilva, I	Modeling the profitability of power production from short -rotation woody crops in Sub -Saharan Africa	2013
Thulstrup, AW; Habimana, D; Joshi, I; Oduori, SM	Uncovering the challenges of domestic energy access in the context of weather and climate extremes in Somalia	2020
Cooper, PJM; Leakey, RRB; Rao, MR; Reynolds, L	Agroforestry and the mitigation of land degradation in the humid and sub -humid tropics of Africa	1996
Gyau, A; Chiatoh, M; Franzel, S; Asaah, E; Donovan, J	Determinants of farmers' tree planting behaviour in the north west region of Cameroon: the case of Prunus africana	2012
Kamau A.W.; Shauri H.; Hugé J.; Van Puyvelde K.; Koedam N.; Kairo J.G.	Patterns of Mangrove Resource Uses within the Transboundary Conservation Area of Kenya and Tanzania	2024
Waswa F.; Mcharo M.; Mworia M.	Declining wood fuel and implications for household cooking and diets in tigania Sub -county Kenya	2020
Huxham M.; Emerton L.; Kairo J.; Munyi F.; Abdirizak H.; Muriuki T.; Nunan F.; Briers R.A.	Applying Climate Compatible Development and economic valuation to coastal management: A case study of Kenya's mangrove forests	2015
Muhati G.L.; Olago D.; Olaka L.	Participatory scenario development process in addressing potential impacts of anthropogenic activities on the ecosystem services of MT. Marsabit forest, Kenya	2018
Zumer -Linder M.	Constraints to implementation of wood and forage production in an arid, pastoral part of Africa: a case study of a revegetation programme in Turkana, Kenya.	1986
Kimutai S.K.; Kimutai I.K.; Manirambona E.	Impact of biogas adoption on household energy use and livelihood improvement in Kenya: an overview on a roadmap toward sustainability	2024
Clemens H.; Bailis R.; Nyambane A.; Ndung'u V.	Africa Biogas Partnership Program: A review of clean cooking implementation through market development in East Africa	2018

Gatti, RC; Reich, PB; Gamarra, JGP; Crowther, T; Hui, C; Morera, A; Bastin, JF; de -Miguel, S; Nabuurs, GJ; Svenning, JC; Serra -Diaz, JM; Merow, C; Enquist, B; Kamenetsky, M; Lee, J; Zhu, J; Fang, JY; Jacobs, DF; Pijanowski, B; Banerjee, A; Giaquinto, RA; A lberti, G; Zambrano, AMA; Alvarez -Davila, E; Araujo - Murakami, A; Avitabile, V; Aymard, GA; Balazy, R; Baraloto, C; Barroso, JG; Bastian, ML; Birnbaum, P; Bitariho, R; Bogaert, J; Bongers, F; Bouriaud, O; Brancalion, PHS; Brearley, FQ; Broadbent, EN; Bussot ti, F; da Silva, WC; César, RG; Cesljar, G; Moscoso, VC; Chen, HYH; Cienciala, E; Clark, CJ; Coomes, DA; Dayanandan, S; Decuyper, M; Dee, LE; Pasquel, JD; Derroire, G; Djuikouo, MNK; Do, TV; Dolezal, J; Dordevic, ID; Engel, J; Fayle, TM; Feldpausch, TR; Fr idman, JK; Harris, DJ; Hemp, A; Hengeveld, G; Herault, B; Herold, M; Ibanez, T; Jagodzinski, AM; Jaroszewicz, B; Jeffery, KJ; Johannsen, VK; Jucker, T; Kangur, A; Karminov, VN; Kartawinata, K; Kennard, DK; Kepfer-Rojas, S; Keppel, G; Khan, ML; Khare, PK; Kileen, TJ; Kim, HS; Korjus, H; Kumar, A; Kumar, A; Laarmann, D; Labrière, N; Lang, M; Lewis, SL; Lukina, N; Maitner, BS; Malhi, Y; Marshall, AR; Martynenko, OV; Mendoza, ALM; Ontikov, PV; Ortiz -Malavasi, E; Camacho, NCP; Paquette, A; Park, M; Parthasarathy , N; Peri, PL; Petronelli, P; Pfautsch, S; Phillips, OL; Picard, N; Piotto, D; Poorter, L; Poulsen, JR; Pretzsch, H; Ramírez -Angulo, H; Correa, ZR; Rodeghiero, M; Gonzáles, RDR; Rolim, SG; Rovero, F; Rutishauser, E; Saikia, P; Salas - Eljatib, C; Schepaschen ko, D; Scherer - Lorenzen, M; Seben, V; Silveira, M; Slik, F; Sonké, B; Souza, AF; Sterenczak, KJ; Svoboda, M; Taedoumg, H; Tchebakova, N; Terborgh, J; Tikhonova, E; Torres -Lezama, A; van der Plas, F; Vásquez, R; Viana, H; Vibrans, AC; Vilanova, E; Vos, VA; Wang, HF; Westerlund, B; White, LJT; Wiser, SK; Zawila -Niedzwiecki, T; Zemagho, L; Zhu, ZX; Zo -Bi, IC; Liang, JJ	The number of tree species on Earth	2022

APPENDIX III

Ethics approval for this study was granted on 11 April 2024 by the Committee for Research Ethics and Integrity of the Faculty of Engineering, Built Environment and Information Technology of the University of Pretoria. The reference number is EBIT/84/2024.