

Review Article

Influence of Natural Fiber Properties on the Mechanical Performance of Unfired Earthen Blocks

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Abstract

Rapid population growth and accelerated urbanization are intensifying pressure on natural resources and the construction sector, which remains heavily dependent on conventional, high-carbon materials such as concrete and steel. In this context, compressed earth blocks are attracting renewed interest due to their environmental and socio-economic advantages. However, their low mechanical strength and limited durability require targeted performance improvements. This review explores natural fiber reinforcement as a sustainable strategy for enhancing the properties of unfired earth blocks. Drawing on over 60 peer-reviewed studies, it examines how fiber characteristics, dimensions, tensile strength, Young's modulus, and biochemical composition, affect the compressive, tensile, and flexural strength of these materials. Findings show that reinforcement efficiency is determined not only by the intrinsic physical and mechanical properties of the fibers but also by fiber–matrix interfacial bonding and the experimental protocols employed. Importantly, fibers with high tensile strength do not necessarily yield improved performance when adhesion between matrix and fibers is poor. The review emphasizes the need for standardized testing procedures, detailed fiber characterization, and optimized surface treatments to improve compatibility with earthen matrices, thereby advancing the development of durable, low-carbon construction materials.

Keywords

Natural Fibers, Earth Blocks, Mechanical Performance, Sustainable Construction

1. Introduction

In recent decades, the growing demographic pressure in many countries has generated major challenges in the construction sector, including increased demand, rising construction material costs, and the proliferation of substandard dwellings, particularly in urban peripheries [1, 2]. This rapid growth also exerts significant environmental pressure through deforestation, pollution, and the progressive depletion of

natural resources [3]. The construction industry remains heavily dependent on conventional materials such as concrete and steel. With nearly 10 billion tonnes produced annually, concrete is currently the most widely used material in the world [4, 5]. Its production requires vast quantities of cement, with global demand projected to reach 8.2 billion tonnes by 2030 [6-8]. The cement industry alone is responsible for an

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Received: 18 August 2025; **Accepted:** 1 September 2025; **Published:** 19 September 2025



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estimated 4–8% of global CO₂ emissions [6, 9, 10]. Furthermore, the intensive extraction of construction-grade sand and the depletion of certain raw materials highlight the limitations of a construction model based on the massive and near-systematic use of cement-based materials.

In this context, the search for sustainable and eco-friendly construction materials has intensified [11–18]. Among the proposed alternatives, earthen blocks, one of the oldest building techniques in the world, is experiencing renewed interest. After being largely abandoned in favor of industrial materials, it is now regaining attention due to its environmental and socio-economic advantage. Compared with conventional cement or lime-based materials and fired blocks, unfired earthen blocks present both advantages and disadvantages. On the one hand, they require very little energy for production [13, 19], generate significantly lower CO₂ emissions [11, 16, 18], are fully recyclable and provide excellent hygrothermal regulation, which contributes to indoor comfort [19–21]. On the other hand, their mechanical strength and durability remain lower than those of cement- or lime-based materials and fired blocks, which are characterized by higher compressive strength and greater resistance to moisture and erosion [21, 22]. These factors highlight the relevance of developing reinforcement strategies for unfired earthen blocks, aiming to improve their strength while preserving their environmental benefits [23–25].

The incorporation of natural fibers into unfired earthen blocks has emerged as an effective approach to improve both mechanical performance and durability [24, 26–28]. Nonetheless, the performance gains depend strongly on the intrinsic properties of the fibers used [29–33]. Despite this, the literature remains limited in providing a detailed analysis of how these physical, mechanical, and chemical properties influence the mechanical behavior of unfired earth blocks.

The present review aims to analyze the impact of parameters such as fiber dimensions, tensile strength, Young's modulus, and biochemical composition on the mechanical performance of earth blocks. By identifying correlations between these characteristics and the resulting performance, this work seeks to provide practical recommendations for the selection and preparation of fibers, with the goal of optimizing the performance of sustainable, locally sourced earthen construction materials.

2. Methodology

The literature search was conducted primarily using Google Scholar and Research Gate databases, employing the following keywords: “Earthen blocks,” “Unfired compressed earth blocks,” “Natural fibres,” “Physical properties,” “Mechanical properties,” “Chemical composition,” “Soil stabilization,” “Fibre–matrix adhesion,” “Durability,” and “Sustainable building materials.” A relevance-based screening,

aligned with the thematic scope of the study, resulted in the selection of more than sixty references. These were predominantly peer-reviewed journal articles providing quantitative data on the physical, mechanical, and chemical properties of natural fibers, as well as on the mechanical performance of both reinforced and unreinforced earth blocks. This review is structured as follows. The first part presents the principal natural fibers used in the stabilization of unfired earthen blocks and describes their physical, mechanical, and chemical characteristics. The second part analyzes the influence of intrinsic fiber parameters such as length, tensile strength, Young's modulus, and biochemical composition on the mechanical performance of the blocks. The third part provides a general conclusion, and the fourth formulates recommendations for optimizing fiber use in the reinforcement of earthen materials.

3. Fibers and Their Characteristics

3.1. Physical and Mechanical Properties

The natural fibers most commonly used to reinforce unfired earth blocks are generally of plant or animal origin. Plant fibers are derived from various parts of plants, such as stems, leaves, seeds, or fruits [22, 31, 32, 34]. Animal fibers, on the other hand, originate from animal secretions or tissues [30, 35, 36].

Table 1 provides a comparative overview of selected physical and mechanical properties of the main plant and animal-based fibers reported in the literature for earthen material stabilization. Key parameters include density, tensile strength, and Young's modulus. The comparison reveals significant variability in properties depending on the nature and origin of the fibers. For example, sisal fibers and Hibiscus cannabinus (Kenaf) fibers exhibit very high tensile strengths and elastic moduli (up to 23 GPa and 136 GPa, respectively), whereas coconut, or bagasse fibers offer more modest mechanical performance. Conversely, some fibers, such as those derived from the date palm, present a favorable balance between strength and lightness.

It should also be noted that certain data are unavailable in the literature for some fibers. Nonetheless, this overview highlights the notable differences linked to the intrinsic physical and mechanical properties of the fibers used for reinforcing unfired earth bricks. Moreover, these properties can vary depending on several factors, including geographical conditions, agricultural practices, and most importantly the age of the plant at the time of fiber extraction, which influences stiffness, strength, and behavior in composite materials [24, 37, 38]. These aspects, however, are not systematically reported by all authors.

Table 1. Physical and Mechanical Properties of Selected Natural Fibers.

Fiber type	Density (g/cm ³)	Tensile strength (MPa)	Young's modulus (GPa)	References
Banana (<i>Poovan</i>)	1.35	115.5	–	[28]
<i>Hibiscus cannabinus</i> (Kenaf)	1.04	1000	136	[24, 29, 39]
Seagrass	0.000721	56	–	[40]
<i>Pinus</i> (<i>halepensis</i> , <i>pinia</i> , <i>pinaster</i>)	–	–	9 – 20.5	[41]
Male date palm	1.40	170 – 290	4.74 – 5.25	[22, 42]
Coconut	0.81	83 – 222	2.3 – 5	[26, 27, 31]
Oil palm	0.77	65 – 141	0.7 – 1.1	[26, 27, 43]
Bagasse	0.56	25 – 62	0.5 – 1.3	[26, 27]
Sisal	0.70 – 1.33	400 – 700	9 – 23	[44–46]
Pig hair	–	99.2	–	[30]

3.2. Chemical Properties

Natural fibers are biological composites composed primarily of cellulose, lignin, and hemicellulose, with occasional traces of pectins. These constituents play a critical role in

determining the performance of fibers for reinforcing earth blocks. For instance, cellulose imparts mechanical strength to the fibers, while lignin enhances their durability against biological degradation. Table 2 presents the chemical composition of the natural fibers listed in Table 1.

Table 2. Chemical composition of selected natural fibers.

Fiber	Cellulose (%)	Hemicellulose (%)	Lignin (%)	References
Banana	55–71	6–25	5–15	[47–49]
Kenaf	40–70	18–22	3–20	[39, 50, 51]
Seagrass	~70	~8	~10	[52, 53]
Date palm	~44	~26	~11.5	[54]
Coconut	32–50	0.15–15	30–46	[45, 46, 55]
Oil palm	33–65	21–33	14–30	[56, 57]
Sugarcane bagasse	40–50	25–35	21–25	[58, 59]
Sisal	64–76	10–27	9–13	[45, 60, 61]

In addition to the fibers listed in Tables 1 and 2, several other natural fibers have been reported in the literature for use in cementitious and earthen mixtures. Table 3 provides a complementary overview of these additional fibers, covering

both plant- and animal-based origins. This broader perspective highlights the diversity of natural fibers tested, while the present review remains primarily focused on unfired earthen blocks.

Table 3. Additional natural fibers reported in the literature for cementitious and earthen mixtures.

Fiber type	Origin (Plant/Animal)	Main use in mixtures	References
Jute	Plant	Concrete, mortars, soil	[31, 45]
Hemp	Plant	Hempcrete, bio-based blocks	[33]
Flax	Plant	Cement composites	[49]
Cotton	Plant	Mortars, cement composites	[49]
Rice Straw	Plant	Adobe, lightweight concrete	[62]
Wheat Straw	Plant	Adobe, composites	[63]
Alfa	Plant	Mortars, adobe	[33]
Fonio Straw	Plant	CEB, adobe	[64]
Bamboo	Plant	Reinforced concrete, soil	[65]
Wool	Animal	Adobe, cement composites	[36]
Horse Hair	Animal	Mortars, earth mixes	[35]
Goat Hair	Animal	Earthen plasters, mortars	[35]
Camel Hair	Animal	Mortars, soil	[31]
Silk	Animal	Cement composites	[31]

4. Influence of Intrinsic Fiber Properties on the Mechanical Performance of Earth Blocks

The incorporation of natural fibers into soils for the production of unfired earth blocks has been extensively investigated in the literature [62-68]. However, most studies focus primarily on fiber content as the main reinforcement factor, without providing a precise characterization of the fibers' intrinsic properties, particularly their physico-mechanical characteristics (e.g., Young's modulus, tensile strength, density). In the present review, the emphasis is placed on studies that have examined the direct influence of these intrinsic properties on the behavior of unfired earth blocks. Given the diversity of experimental protocols, such as soil type, stabilization content, specimen shape and size, it is not appropriate to quantitatively compare values from different sources. Instead, the objective is to identify general trends, key parameters, and technical trade-offs that emerge from the literature.

4.1. Fiber Length and Diameter

Among the intrinsic properties, fiber length emerges as one of the most critical factors influencing the performance of unfired earth blocks. Its effect is generally assessed through the aspect ratio, defined as:

$$n = \frac{l}{d} \quad (1)$$

where l is the fiber length and d is its diameter [69]. This ratio governs the mechanical anchorage capacity and the interactions between the fibers and the earthen matrix. Overall, fiber length tends to play a more decisive role than diameter, the latter often exhibiting lower variability [45, 69].

Several studies have examined the effect of plant fiber length. Before analyzing the results, Table 4 summarizes the fibers investigated, the lengths and diameters tested, and the dimensions of the blocks used in various reference publications.

Table 4. Summary of fiber dimensions and block specifications from selected studies.

Fiber	Lengths (mm)	Diameter (mm)	Block dimensions (mm)	References
Kenaf	30 / 60	0.13	295 × 140 × 100	[24]
Kenaf (other study)	10 / 20 / 30	–	40 × 40 × 160	[29]

Fiber	Lengths (mm)	Diameter (mm)	Block dimensions (mm)	References
Banana	50 / 60 / 70 / 80 / 100	0.14	120 × 120 × 90 and 240 × 120 × 90	[28]
Male date palm	15 / 60	–	–	[42]
Harakeke	70 / 85	0.023	150 × 150 × 175 and 150 × 150 × 600	[70]
Pig hair	7 / 15 / 30	0.16	310 × 105 × 70	[30]
Sheep wool	10 / 20 / 30	0.035	360 × 75 × 75	[36]

Millogo et al. [24] demonstrated that the incorporation of 30 mm long kenaf fibers at 0.4% by weight increased compressive strength by 16%, primarily due to improved fiber dispersion within the matrix. In contrast, the use of longer fibers (60 mm at 0.8%) led to reduced cohesion, attributed to fiber agglomeration and increased porosity. However, it was found that these longer fibers reduced thermal conductivity, but at the cost of greater sensitivity to erosion. Similarly, Laibi et al. [29] confirmed that 30 mm kenaf fibers provide an optimal compromise, offering good mechanical performance alongside a moderate reduction in thermal conductivity.

Results obtained with other plant fibers support this general trend. An exception is reported by Mostafa and Uddin [28], who identified an optimal banana fiber length of 60–70 mm at an incorporation rate of 5%, resulting in a 71% increase in compressive strength and an 82% increase in flexural strength. In contrast, a meta-analysis by Rocco et al. [71] and Ramakrishnan et al. [72], synthesizing results from multiple studies, indicates that short fibers (10–30 mm) primarily enhance compressive strength through improved soil–fiber cohesion, whereas longer fibers (30–60 mm) contribute more to thermal performance improvements. However, the latter may compromise structural integrity if fiber dispersion is inadequate.

Animal fibers exhibit similar behavior. Pig hair, tested at lengths ranging from 7 to 30 mm with a 2% incorporation rate, showed that lengths of 15–30 mm markedly improved toughness and impact resistance [30]. However, excessive fiber content led to agglomeration, reducing material cohesion. In the case of sheep wool, the study by Aymerich et al. [36] reported that only 30 mm fibers, incorporated at 2–3%, significantly improved residual flexural strength, owing to bridging and friction mechanisms. Shorter fibers had a limited effect on mechanical performance.

Overall, fiber length has a pronounced influence on the performance of unfired earth blocks. While no universal optimal length exists, short fibers (< 30 mm) tend to promote higher compaction and greater compressive strength, whereas longer fibers (> 60 mm), when properly dosed and well-dispersed, can enhance post-cracking ductility and thermal insulation performance, though they may in some cases reduce mechanical strength [24, 71]. It is also worth noting that the aspect ratio (length-to-diameter ratio) directly

affects fiber–soil cohesion, stress distribution within the material, crack propagation, and the overall ductility of the block [27, 73, 74].

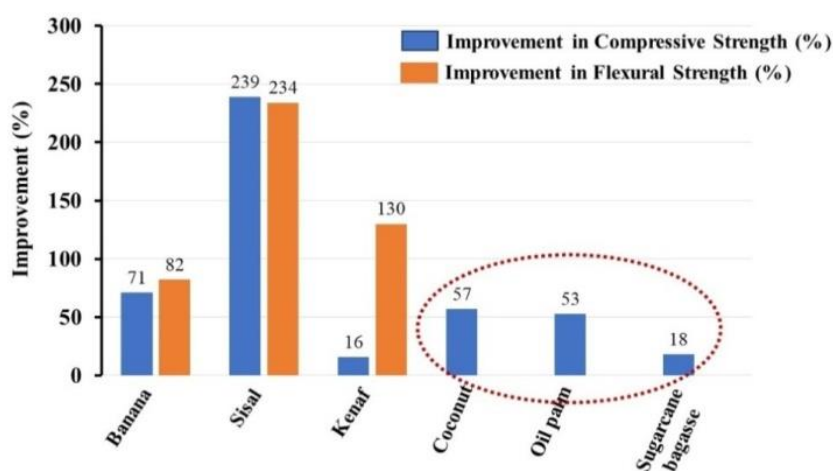
4.2. Mechanical Properties of Fibers and Their Relationship to the Performance of Earth Blocks

This section focuses specifically on studies that provide detailed data on the mechanical properties of natural fibers used for reinforcing unfired earthen blocks. Table 5 summarizes the average tensile strength and Young's modulus values reported in the reviewed literature for the most commonly studied fibers.

Figure 1 provides a comparative synthesis of the mechanical performance of earth blocks reinforced with the different natural fibers listed in Table 5, in terms of improvement in compressive and flexural strength relative to unreinforced blocks [24, 26, 28, 44]. The large variations observed in performance gains depend not only on the fiber type but also on experimental conditions, including soil characteristics, fiber content, specimen dimensions, and drying protocols. As a result, direct comparison between studies is often challenging. However, certain studies, particularly those on coconut, oil palm, and sugarcane bagasse fibers (red ellipse in Figure 1), were conducted under identical experimental conditions (same soil, fiber content, and manufacturing protocol), enabling more reliable correlations between fiber mechanical properties and block performance [25]. Under these controlled conditions, blocks reinforced with coconut fibers showed a 57% increase in compressive strength, while oil palm fibers resulted in a 53% improvement, and sugarcane bagasse fibers produced an 18% increase. These findings suggest that, under similar conditions, the mechanical performance of earth blocks is directly influenced by the intrinsic mechanical properties of the fibers. A fiber with a high Young's modulus and tensile strength tends to enhance block strength more than a less resistant fiber, provided that fiber–matrix adhesion is also optimized [33]. Notably, the chemical composition of these fibers falls within similar ranges (Table 2), further facilitating comparison.

Table 5. Average mechanical properties of selected natural fibers.

Fiber	Tensile strength (MPa)	Young's modulus (GPa)	References
Banana	115.5	–	[28]
Sisal	275–570	13–26	[44]
Kenaf	1000	136	[24]
Coconut	83–222	2.3–2.8	[26]
Oil palm	65–141	0.7–1.1	[26]
Sugarcane bagasse	25–62	0.5–1.3	[26]

**Figure 1.** Mechanical Performance Improvement of Earth Blocks with Natural Fiber Reinforcement.

In contrast, other studies conducted under differing experimental conditions have reported more pronounced performance improvements. Incorporating sisal fibers at 0.9% resulted in increases of 239% in compressive strength and 234% in flexural strength [44]. Banana fibers produced gains of 71% in compression and 82% in flexion [28], while kenaf fibers yielded a 16% increase in compression and a 130% improvement in flexural strength [24]. These results, however, are not directly comparable due to variations in soil types, fabrication methods, and testing procedures. It is also evident that there is no straightforward linear correlation between the mechanical properties of the fibers and those of the reinforced blocks. For example, although kenaf fibers exhibit a much higher tensile strength (~1000 MPa) than sisal (~275–570 MPa), sisal produced the greatest gains in both compressive and flexural strength. This discrepancy can be explained by methodological differences, particularly in processing techniques and fiber–soil interaction.

A study demonstrated the benefits of incorporating *Posidonia oceanica* (seagrass) fibers into adobe blocks to improve their mechanical properties [40]. These fibers have an average tensile strength of 56.01 MPa. When incorporated at a rate of 3% by weight, they significantly enhance block performance. The unreinforced control block exhibited a com-

pressive strength of 1.676 MPa and a flexural strength of 0.411 MPa, whereas the seagrass-reinforced block achieved 2.346 MPa in compression and 0.600 MPa in flexion, corresponding to increases of 40% and 46%, respectively.

In another study, Jové-Sandoval et al. [41] assessed the influence of the intrinsic mechanical properties of different pine needles on adobe block performance, comparing them with bricks reinforced with wheat straw. Three pine species were tested: *Pinus halepensis* (pn1), *Pinus pinea* (pn2), and *Pinus pinaster* (pn3). The pn1 fibers exhibited a dry tensile strength of 20.5 MPa, similar to that of wheat straw (21 MPa). In comparison, pn2 and pn3 fibers showed lower tensile strengths, 16.5 MPa (–19.5%) and 9 MPa (–56.4% relative to pn1), respectively. These differences were generally reflected in block performance. In flexural tests, pn1-reinforced bricks reached 0.22 MPa, representing a 57% improvement over straw-reinforced bricks (0.14 MPa). Blocks with pn2 achieved 0.16 MPa (+14%), while pn3 bricks dropped to 0.10 MPa (–28%). In compression, blocks reinforced with pn1 and pn2 achieved 3.2 MPa and 3.3 MPa, respectively, compared to 2.7 MPa for straw (+18.5% and +22%), whereas pn3 bricks did not exceed 2.4 MPa, registering an 11% decrease. The authors attributed these results to differences in fiber–clay matrix adhesion, influenced by factors such as fiber cross-section and

cell structure (not detailed in the study). These findings indicate that, beyond the intrinsic mechanical properties of fibers, factors such as their interaction with the matrix play a decisive role in the performance of unfired earthen blocks.

The studies also suggest that fiber presence influences the brittle behavior of earthen matrices. In all cases, unreinforced blocks exhibited sudden fracture, whereas fiber-reinforced blocks underwent progressive failure, as shown in Figure 2. This clearly implies that the stronger the fibers, the more resistant the blocks are to sudden breakage. Such failure modes can be explained by the ability of fibers to bridge cracks prior to fracture [26, 28].

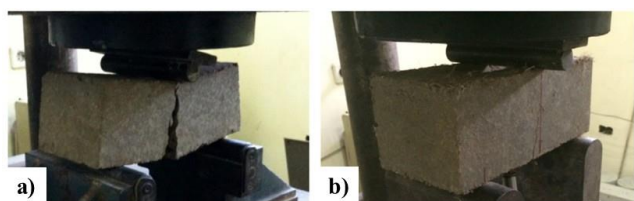


Figure 2. Failure Modes of Blocks in Three-Point Bending Test: a) Unreinforced Block, b) Reinforced Block (reproduced from Mostafa & Uddin [28]).

It is important to emphasize that the addition of natural fibers does not systematically lead to improved mechanical performance in unfired earthen blocks. Some fibers may have a neutral or even negative effect on the material's properties. This is particularly the case for male date palm fibers, which, despite having promising intrinsic mechanical properties, a tensile strength ranging from 170 to 290 MPa and a Young's modulus between 4.74 and 5.25 GPa, result in an overall reduction in mechanical strength when incorporated, even when used in combination with a binder such as cement [22]. This decline in performance can be attributed to several factors related to the nature of the fibers and their interaction with the earthen matrix. First, fiber incorporation increases the overall elasticity of the mixture, which, upon unloading after compaction, causes material expansion and higher porosity, thereby compromising block strength. Second, the low adhesion between the fibers and the matrix leads to slippage under mechanical loading, reducing the efficiency of stress transfer. Finally, the non-uniform distribution of fibers within the matrix can create localized porous zones, further exacerbating strength loss.

4.3. Beyond Mechanical Properties: The Role of Biochemical Components

Beyond their intrinsic mechanical properties, the chemical composition of fibers also plays a crucial role in their interaction with the earthen matrix, although this factor remains relatively underexplored in the literature [28, 32, 75]. As noted by Jesudass et al. [32], cellulose content is strongly

correlated with fiber stiffness and strength, while lignin contributes to chemical stability and resistance to biological degradation. Conversely, hemicelluloses, being hydrophilic in nature, affect the dimensional stability of fibers, which can negatively influence fiber–matrix adhesion, particularly under fluctuating moisture conditions.

To address these limitations when chemical composition is not optimal, natural fibers can be subjected to chemical or physical treatments to improve their compatibility with earth. Several studies have shown that alkaline treatments can partially remove lignin, pectin, and hemicelluloses, thereby exposing more cellulose on the fiber surface [33, 76, 77]. This increases surface roughness, enhances mechanical interlocking with the matrix, and significantly improves the compressive and tensile performance of earth blocks. Among the studies reviewed, only three reported the use of pre-treated fibers prior to their incorporation into earthen matrix [78, 79], and the results were generally positive. For example, alkaline treatment of date palm fibers improved adhesion by removing part of the hydrophobic components and revealing a cellulose-rich surface [79].

5. Conclusion

The incorporation of natural fibers into earth blocks represents a promising strategy for the development of sustainable, high-performance, and environmentally friendly construction materials. However, this review has shown that the mechanical performance of fiber-reinforced earth blocks depends on the intrinsic properties of the fibers, physical, mechanical, and chemical. These characteristics influence not only the effectiveness of reinforcement but also the adhesion mechanisms with the earthen matrix.

Comparative results indicate that a mechanically strong fiber does not necessarily guarantee improved block performance if it is poorly proportioned, inadequately dispersed, or interacts unfavorably with the soil. The case of male date palm fibers illustrates this point well: despite favorable mechanical properties, their incorporation can lead to performance degradation when fiber–matrix adhesion is insufficient or porosity is not properly controlled.

This review has also highlighted the importance of parameters often overlooked in existing publications, such as the type of soil used. The lack of standardization in experimental protocols limits direct comparison between studies and hinders the transfer of research findings into practical applications in the construction sector.

6. Recommendations for Future Research

For research findings to be effectively adopted by construction professionals, particularly in emerging countries, it is essential that future studies be conducted in a more rigor-

ous and well-documented manner. At present, many publications fail to provide detailed information on the fibers used, such as their length, diameter, age, geographical origin, or the type of soils with which they are combined. This lack of data makes results difficult to reproduce and greatly limits their transfer into practical applications.

Future research should therefore include comprehensive characterization of the natural fibers incorporated into earthen mixtures. This should involve precise descriptions of their mechanical properties (e.g., tensile strength, Young's modulus), physical properties (e.g., dimensions, density, surface roughness), and chemical composition (e.g., cellulose, lignin, hemicellulose contents). Such rigor would enable reliable comparisons between different fiber types and help identify those with the greatest reinforcement potential for specific contexts.

Moreover, the considerable heterogeneity of experimental protocols in the literature, regarding soil types, fiber contents, specimen dimensions, and other parameters, makes inter-study comparisons extremely challenging. It would be valuable for some research to be conducted under standardized conditions, at least for a limited set of commonly available fibers. Such studies could produce technical benchmarks directly applicable in practice, enabling consistent performance comparisons between fibers.

In parallel, the chemical composition of fibers, although rarely examined in depth, plays a critical role in their interaction with the earthen matrix. Targeted studies should therefore aim to correlate the proportions of cellulose, lignin, and hemicellulose with fiber–soil adhesion and the resulting mechanical performance of the blocks.

The use of chemical or physical treatments prior to fiber incorporation should also be analyzed more systematically. Treatments such as alkaline processing can enhance fiber–matrix adhesion by removing certain surface compounds and increasing fiber roughness. However, their effectiveness depends on both the fiber type and the soil used, and their environmental and economic impacts must be considered to ensure a truly sustainable approach.

Finally, studies would benefit from combining macroscopic testing (compression, flexural, tensile tests), microscopic analyses (SEM, XRD, etc.), and numerical modeling. Simulations, in particular, could allow rapid evaluation of different configurations without the need for systematically conducting lengthy and costly experimental campaigns. Such integrated approaches would facilitate understanding of fiber–soil interfacial mechanisms while providing construction professionals with actionable data for optimizing their materials. In addition, future work should address real-world implications such as scalability of production processes, cost–benefit considerations, and potential barriers to industry adoption. These aspects often overlooked in laboratory research will be decisive for the widespread implementation of fiber-reinforced earthen blocks in the construction sector.

Abbreviations

CEB	Compressed Earth Blocks
SEM	Scanning Electron Microscopy
XRD	X-ray Diffraction

Author Contributions

Kokouvi Happy N'tsouaglo: Conceptualization, Data curation, Formal Analysis, Methodology, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing

Komlavi Gogoli: Conceptualization, Data curation, Formal Analysis, Methodology, Supervision, Validation, Visualization, Writing – review & editing

Sabankou Kpatadoa: Formal Analysis, Methodology, Validation, Visualization, Writing – review & editing

Soviwadan Drovou: Formal Analysis, Methodology, Validation, Visualization, Writing – review & editing

Conflicts of Interest

The authors declare no conflicts of interest.

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