



Relative Influence of Moisture Content Fluctuations on Hardwood Species

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Abstract

Wood is extensively employed in construction, furniture, and joinery works; however, its hygroscopic and anisotropic nature leads to dimensional instability induced by fluctuating moisture content. This study evaluated the effects of moisture content variations on five West African hardwood species (African Mahogany, Afrormosia, Iroko, Obeche, and Teak). 100% defect-free specimens (20 per species of 300 × 50 × 30 mm each) machined and conditioned to MCs of 5%, 10%, 15%, 20%, and 25%. Tangential, radial, and longitudinal swelling were measured along principal anatomical directions, while water absorption was determined after 12, 24, and 48 hours of immersion. Results showed positive correlations between MC and swelling in all directions ($r = 0.883-0.952$, $p < 0.001$), with an almost perfect correlation between tangential and radial swelling ($r = 0.997$). Dimensional stability decreased relatively from Teak > Afrormosia > Iroko > African Mahogany > Obeche. Obeche exhibiting 40% more swelling than Teak and the most water absorption is recommended for interior uses and requires effective treatments to reduce swelling; African Mahogany and Iroko necessitates being controlled for dimensional movement while Teak and Afrormosia are for exterior joinery and moisture-variable usages.

Keywords: Anisotropy, Dimensional Stability, Hygroscopicity, Moisture Content, Swelling.

1. Introduction

Physical changes such as tangential swelling (TS), radial swelling (RS), longitudinal swelling (LS), and water absorption (WA) are characteristic responses of hygroscopic materials to variations in their surrounding environment. The structural integrity and service life of wood products are adversely affected by these changes, particularly in tropical environments characterized by significant seasonal fluctuations in temperature and relative humidity. Wood, being a hygroscopic and anisotropic material, undergoes continuous moisture exchange with the atmosphere, resulting in dimensional changes that are determined by species characteristics, equilibrium moisture content (EMC), and ambient relative humidity. In tropical regions such as West Africa, where temperature and humidity fluctuate seasonally, these moisture-induced dimensional variations are particularly pronounced and pose significant challenges to the performance of wood products.

African Mahogany (*Khaya ivorensis*), Afrormosia (*Pericopsis elata*), Iroko (*Chlorophora excelsa*), Obeche (*Triplochiton scleroxylon*), and Teak (*Tectona grandis*) are among the most widely utilised hardwood species in West Africa for construction, furniture, joinery, and interior applications. These species are valued for their availability, aesthetic appeal, and favourable mechanical properties. However, despite their extensive use, differences in anatomical structure, constituents, density, and chemical composition cause these species to respond differently to moisture content (MC) fluctuations, often resulting in uneven swelling, shrinkage, and loss of dimensional integrity during service.

The hygroscopic behaviour of wood involves the absorption and desorption of moisture primarily within the cell wall, leading to anisotropic dimensional changes that occur significantly in the tangential and radial directions, with minimal changes along the longitudinal axis as illustrated in Figure 1. When such dimensional changes are not adequately controlled, they manifest as defects such as checking, warping, openings in lids, doors and windows, delamination, and failure at joint lines. These problems underscore the need for species-specific information on dimensional response and moisture absorption behaviour, particularly under climatic conditions typical of West African countries.

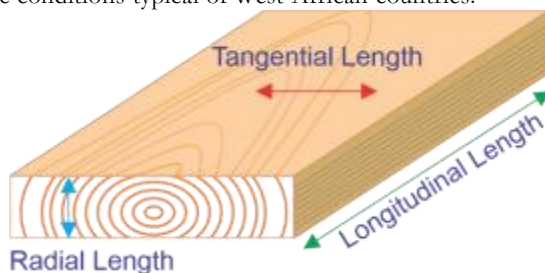


Figure 1: Principal anatomical directions in wood



Although previous studies have established the general moisture–dimension relationship in wood, comparative data on the dimensional changes, dimensional stability, and moisture absorption rates of African Mahogany, Afrormosia, Iroko, Obeche, and Teak under fluctuating moisture conditions are scanty. Definite information on the responses of these hardwoods to MC variations is essential for informed material selection, improved design practices, and enhanced durability of wood-based products in the region.

Wood's inherent hygroscopy causes it to exchange water vapour with the atmosphere until it reaches moisture equilibrium. This movement is governed by absorption kinetics, which determine the rate of moisture flow within the material (Thybring et al., 2019). These changes in moisture often lead to swelling and shrinking, but since wood is anisotropic, the deformation occurs unevenly across its different planes (Fu et al., 2023). This behaviour is dictated by specific anatomical features and chemical properties, such as the hydro-affinity of polymers in the cell walls. Since these internal structures vary across different types of wood, species exhibit different levels of dimensional stability, which is a critical factor in their application for engineering and construction (Riki et al., 2019).

Moisture equilibrium and hygroscopic characteristics of wood

Wood is both a hygroscopic and anisotropic material where moisture fluctuations below the fiber saturation point (FSP) drive dimensional instability. Water sorption into cell wall polymers causes differential swelling (tangential > radial > longitudinal) governed by microfibril orientation. Since volumetric change is generally linear up to 30% MC, this study investigates these dynamics by quantifying dimensional changes, stability, and moisture absorption kinetics (Dinwoodie, 2000; Forest Products Laboratory, 2021).

Effect of Moisture Content Fluctuations on Dimensional Changes

Dimensional response is minimal longitudinally, moderate radially and greatest tangentially, and is proportional to moisture content within service range. While Glass and Zelinka (2021) attributed specific magnitude variations to species and methodology, Aliu and Fakuyi (2019) highlighted the central role of equilibrium moisture content (EMC) in performance. However, the scarcity of comparative data on African hardwoods under controlled conditions necessitates a systematic assessment of their moisture-induced dimensional behaviour.

Anisotropy in wood: swelling and shrinkage behaviour

Wood shrinkage is a physical manifestation of anisotropy, quantified as the linear reduction from green (D_g) to oven-dry (D_{od}) dimensions (Hoadley, 2005):

$$S_{(n)} = \frac{(D_g - D_{od})}{D_g} \times 100$$

Where $S_{(n)}$ represents shrinkage in the tangential, radial, or longitudinal direction. Typically, tangential shrinkage (6–12%) doubles that of the radial direction (3–6%), while longitudinal movement remains negligible (0.01–0.3%) (Fu et al., 2021). It was expounded by Kureli and Dongel (2020) that when applications are subjected to cyclic humidity, internal stresses cause differential movement such as warping, checking, and delamination. Quantifying these patterns is essential for evaluating comparative dimensional stability among species.

Comparative dimensional stability among wood species

Dimensional stability is governed by intrinsic variables including density, anatomy, and extractive content. It was demonstrated by Bowyer et al. (2003) that extractive-rich hardwoods such as Teak and Iroko possess improved dimensional stability and greater resistance to deformation relative to low-density species such as Obeche. This observation corroborates the findings of Adewole and Akindahunsi (2011), who reported that low-density woods such as Obeche exhibit higher moisture uptake and correspondingly greater hygroscopic swelling and shrinkage. However, systematic comparisons of these specific African hardwoods are rare. Consequently, a quantitative evaluation is required to rank the relative stability of African Mahogany, Afrormosia, Iroko, Obeche, and Teak under uniform moisture fluctuations.

Kinetic of moisture absorption in wood materials

In wood, both water absorption and water adsorption have influence on the moisture-induced responses and performance of wood. While water adsorption is the buildup of water molecules on the surface of the wood, water molecules penetrate into the wood body in water absorption. Water absorption occurs via capillarity and diffusion into cell walls, influencing both magnitude and rate of dimensional changes. Rapid moisture uptake can produce swelling stresses leading to warping and surface defects. Sorption kinetics are affected by porosity, vessel distribution, grain orientation, and surface exposure (Walker, 2006). It was posited by Awoyemi and Jones (2011) that most studies concentrated on softwoods and temperate hardwoods, with limited data on tropical African species. Species with high extractive content, like Teak, show lower water uptake, indicating stronger moisture exclusion and reduced swelling.

Comparative evaluation of absorption rates for selected hardwoods is necessary to understand hygroscopic behaviour. In an experiment conducted by Aliu and Fakuyi (2019), it was reported that a mahogany workpiece before immersion weighed 194.75 g but after subjection into water, its weight increased to 203 g within the first 30 minutes and 1.16 % increment in the next 30 minutes interval and 1.09% in further 30 minutes. Similar time-dependent increases in WA have been widely reported for hardwoods exposed to liquid water (Forest Products Laboratory, 2021). According to Corbett (2017), shrinkage is the behaviour of timber as it dries, whereas movement is the tendency to expand or shrink after it has been seasoned and conditional to its prevailing environmental conditions.



Anatomical and chemical determinants of moisture behaviour

Wood anatomy and chemical composition fundamentally dictate moisture undercurrents. Moisture pathways are regulated by anatomical structures such as pith structure, vessel size, and ray frequency (John, 2001), while cell wall voids are occupied by extractives mitigated by hygroscopicity (Hill, 2007). Iroko and Teak (Hoadley, 2005) display "bulking effect" caused by superior dimensional stability observed in extractive-rich species. Integrating these determinants is essential for interpreting species-specific absorption and dimensional behaviour. Beyond intrinsic properties, stability can be enhanced through modification: thermal treatments degrade hemicelluloses to lower equilibrium moisture content (EMC), chemical impregnations limit water access, and emerging structural innovations (laser-drilling with functional coatings) decouple moisture uptake from macroscopic deformation.

However, there is scantiness of data concerning the specific effects of moisture content fluctuations on the dimensional stability and moisture absorption rates of these African hardwoods. This study investigates the effects of moisture content fluctuations on the dimensional changes of African Mahogany, Afrormosia, Iroko, Obeche, and Teak; to evaluate and compare their dimensional stability under varying moisture content conditions in correlation with swelling; and also determine the rate at which moisture content is absorbed by each specie being investigated.

2. Methodology

Materials and Sample Preparation

Five hardwood species (African Mahogany, Afrormosia, Iroko, Obeche, and Teak) were obtained from southwestern Nigeria. A total of 100 defect-free specimens (20 per species) measuring 300 × 50 × 30 mm, were machined to align with the principal anatomical directions (tangential, radial, and longitudinal). Initial oven-dry weight and dimensions were established by drying samples at 103 ± 2 °C (ASTM D4442). Dimensions were measured with a digital Vernier calliper (±0.01 mm accuracy). For dimensional stability analysis, specimens were subsequently conditioned to reach target moisture contents of 5%, 10%, 15%, 20%, and 25%.

To evaluate hygroscopic behaviour, oven-dried samples were immersed in distilled water at ambient temperature. Specimens were removed at 12, 24, and 48-hour intervals, surface-wiped to remove free water, and immediately weighed. Water absorption (WA) was calculated as:

$$WA(\%) = \frac{W_t - W_{ov}}{W_{ov}} \times 100$$

Where W_t is the weight at time t and W_{ov} is the oven-dry weight.

3. Results and Discussion

Tangential Swelling

Tangential swelling increased progressively with moisture content for all species between 5% and 25% MC as illustrated in Table 1, reflecting the hygroscopic expansion of wood as bound water accumulates within the cell wall. At all moisture levels, tangential swelling exceeded typical radial responses (not shown here), confirming the anisotropic nature of wood and the greater susceptibility of tangential directions to moisture-induced deformation.

Table 1: TS and Ranking of Selected Hardwoods at Varied Moisture Contents

MC (%)	African Mahogany	Afrormosia	Iroko	Obeche	Teak
5	0.89	0.80	0.90	1.10	0.69
10	2.44	2.10	2.35	2.90	1.74
15	4.00	3.40	3.80	4.70	2.80
20	5.56	4.70	5.25	6.50	3.86
25	7.11	6.00	6.70	8.30	4.91
Mean TS	4	3.4	3.80	4.70	2.80
Coefficient of Variation (CV) = $\frac{SD}{mean} \times 100$	61.5%	60.9%	60.3%	60.6%	59.6%
Standard Deviation (SD)	2.46	2.06	2.29	2.85	1.67
Variance	6.05	4.23	5.26	8.10	2.79
Relative TS Rank	2 nd	4 th	3 rd	1 st	5 th

Teak (mean TS = 2.80%, SD = 1.67%, and Variance = 2.79) consistently exhibited the lowest mean tangential swelling across the moisture range (0.69–4.91), indicating superior dimensional stability. This behaviour is commonly attributed to its high extractive content and reduced permeability, which limit moisture sorption and cell wall expansion. From the result, it is ideal for high precision applications, outdoor use, and moisture-variable environment. It is 40% less swelling than Obeche.

Afrormosia (mean TS = 3.40%, SD = 2.06%, and Variance = 4.23) showed slightly higher but still restrained swelling (0.80–6.00), suggesting good dimensional stability with more consistent performance (lower SD) suitable for applications exposed to moderate humidity fluctuations. From the result, it is suitable for quality furniture and joinery. It is 28% lower than Obeche in swelling.

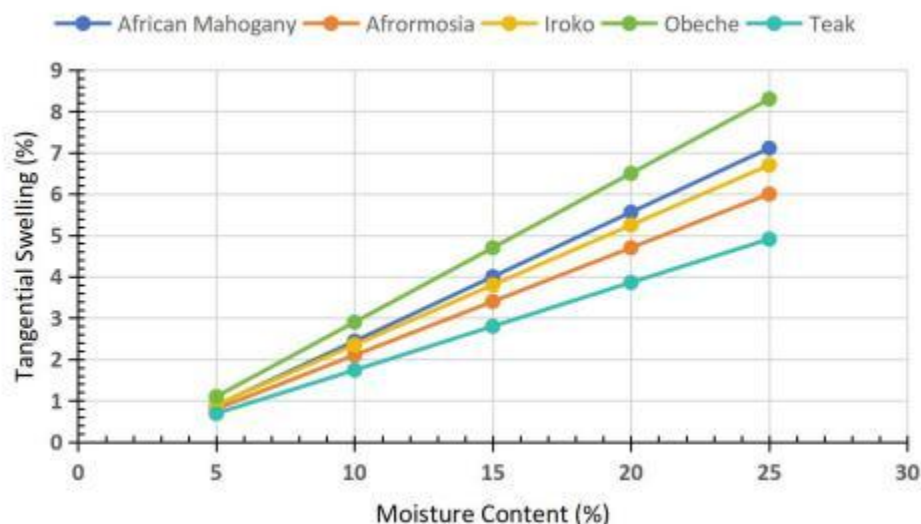


Figure 2: Relative Tangential Swelling of tested Timber

Iroko (mean TS = 3.80%, SD = 2.29%, and Variance = 5.26) shows that it is slightly better than mahogany (5% lower mean). Although they both (Iroko and African Mahogany) have moderate humidity behaviour. The African Mahogany (mean TS = 4.00%, SD = 2.46%, and Variance = 6.05) displayed intermediate to relatively high tangential swelling responses. While both species followed similar trends as shown in Figure 2, African Mahogany consistently recorded higher TS values than Iroko at equivalent moisture contents, indicating lower tangential stability. These differences are consistent with variations in anatomical structure, density, and extractive composition among tropical hardwoods. Obeche (mean TS = 4.70%, SD = 2.85%, and Variance = 8.10) exhibited the highest tangential swelling across all moisture contents (1.10–8.30), demonstrating pronounced sensitivity to moisture variation. The high swelling response of Obeche is associated with its low density, thin cell walls, and high porosity, which facilitate rapid moisture uptake and substantial dimensional change.



Figure 3: Dimensional Stability using TS

The relative ranking of tangential swelling remained consistent throughout the moisture range as Teak < Afrormosia < Iroko < African Mahogany < Obeche. The near-linear increase in TS with moisture content supports the application of linear hygroscopic assumptions within this range and highlights the strong influence of species characteristics on tangential dimensional stability. Conclusively, Teak exhibited lowest mean swelling and lowest variance signifying superior and consistent dimensional stability, while Obeche’s high variance suggests greater unpredictability in dimensional response to moisture fluctuations as demonstrated in Figure 3. These results underscore the importance of species selection in applications where dimensional accuracy and resistance to moisture-induced deformation are critical.

Radial Swelling

Radial swelling increased progressively with moisture content for all species between 5% and 25% MC as reported in Table 2, reflecting the hygroscopic expansion of wood cell walls as bound water content increased below the fibre saturation point. The near-linear trends observed across all species support the applicability of linear interpolation within this moisture range for comparative assessment.

MC (%)	African Mahogany	Afrormosia	Iroko	Obeche	Teak
5	0.44	0.35	0.40	0.55	0.28



10	1.22	1.00	1.10	1.45	0.89
15	2.00	1.65	1.80	2.35	1.50
20	2.78	2.30	2.50	3.25	2.11
25	3.56	2.95	3.20	4.15	2.72
Mean RS	2.00	1.65	1.80	2.35	1.50
Coefficient of Variation (CV) = $\frac{SD}{mean} \times 100$	61.5%	62.4%	61.7%	60.4%	64%
Standard Deviation (SD)	1.23	1.03	1.11	1.42	0.96
Variance	1.52	1.06	1.23	2.03	0.93
Relative RS Rank	2 nd	4 th	3 rd	1 st	5 th

Teak (mean RS = 1.50%, SD = 0.96%, and Variance = 0.93) consistently exhibited the lowest radial swelling values (0.28–2.72), indicating superior dimensional stability in the radial direction. This behaviour is commonly attributed to its high extractive content and reduced permeability, which limit moisture uptake and restrict cell wall expansion. Afrormosia showed slightly higher but still restrained radial swelling (0.35–2.95), suggesting good dimensional stability suitable for applications exposed to moderate humidity variations. Iroko and African Mahogany displayed intermediate swelling behaviour. While both species followed similar increasing trends, African Mahogany consistently recorded higher radial swelling than Iroko at equivalent moisture contents, indicating comparatively lower radial stability. These differences are consistent with variations in anatomical structure, density, and chemical composition among tropical hardwoods as shown in Figure 4. Obeche recorded the highest radial swelling values across all moisture levels (0.55–4.15), demonstrating pronounced sensitivity to moisture changes. The high radial swelling of Obeche is associated with its low density, thin cell walls, and high porosity, which facilitate rapid moisture absorption and greater dimensional change.

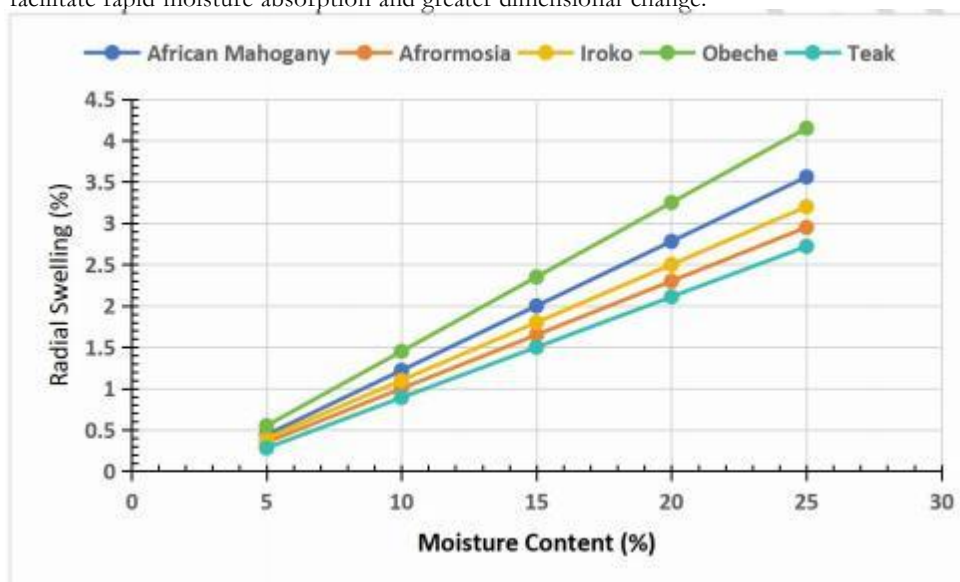


Figure 4: Radial Swelling of Tested Timber

Generally, the relative ranking of radial swelling remained consistent across the moisture range as Teak < Afrormosia < Iroko < African Mahogany < Obeche. When considered alongside tangential swelling results, these findings further confirm the anisotropic nature of wood and highlight the strong influence of species characteristics on dimensional stability. The results underscore the importance of appropriate species selection in applications where resistance to moisture-induced deformation is critical.

Longitudinal Swelling

The longitudinal swelling of all selected hardwoods increased progressively with increasing moisture content from 5% to 25%. Across the species, longitudinal swelling values remained low, ranging from 0.012% to 0.185%, confirming the generally minor dimensional response of wood in the longitudinal direction. At all moisture content levels, Obeche exhibited the highest longitudinal swelling, while Teak consistently showed the lowest values. African Mahogany and Iroko displayed intermediate behavior, with comparable swelling trends, whereas Afrormosia demonstrated relatively better dimensional stability than African Mahogany and Iroko.



MC (%)	African Mahogany	Afrormosia	Iroko	Obeche	Teak
5	0.020	0.015	0.018	0.030	0.012
10	0.045	0.035	0.040	0.065	0.028
15	0.075	0.060	0.070	0.105	0.050
20	0.105	0.085	0.100	0.145	0.070
25	0.135	0.110	0.125	0.185	0.090
Mean LS	0.076	0.061	0.07	0.11	0.05
Coefficient of Variation (CV) = $\frac{SD}{mean} \times 100$	60.5%	62.3%	61.4%	56.4%	62%
Standard Deviation (SD)	0.046	0.038	0.043	0.062	0.031
Variance	0.002	0.001	0.002	0.004	0.001
Relative LS Rank	2 nd	4 th	3 rd	1 st	5 th

The observed increase in longitudinal swelling with moisture content is attributed to the gradual adsorption of bound water within the amorphous regions of the cell wall as MC rises below the fibre saturation point. Although longitudinal swelling is typically minimal due to the alignment of cellulose microfibrils along the grain, species-specific anatomical and microfibril angle differences account for the variations observed.

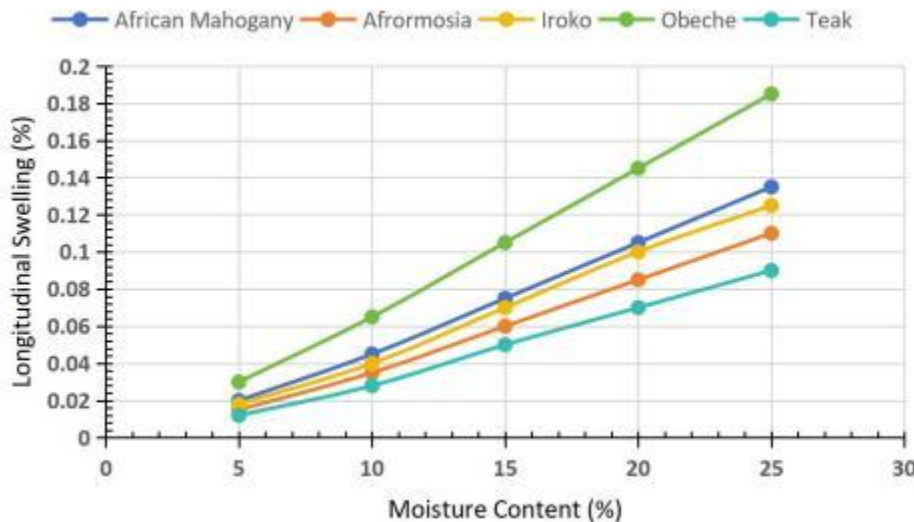


Figure 5: Longitudinal Swelling of Tested Timber

As illustrated in Figure 5, Obeche, being a low-density and more porous hardwood, showed the highest swelling response. Its open cellular structure facilitates faster moisture ingress, leading to greater dimensional changes even along the grain direction. This behavior aligns with its known highwater absorption and low mechanical stiffness. Teak, on the other hand, exhibited the lowest longitudinal swelling across all MC levels. This can be attributed to its high natural extractive content and relatively dense structure, which restrict moisture diffusion and enhance dimensional stability. The superior longitudinal stability of Teak supports its suitability for applications where moisture exposure is frequent. Afrormosia also demonstrated low longitudinal swelling, comparable to Teak at lower MC levels, reflecting its reputation as a dimensionally stable tropical hardwood. African Mahogany and Iroko showed moderate swelling behavior, indicating balanced moisture response characteristics that may require conditioning or protective treatment in moisture-sensitive applications. Cumulatively, the results confirm that while longitudinal swelling is small compared to radial and tangential swelling, it remains species-dependent and moisture-sensitive, and should not be neglected in high-precision structural or joinery applications.

Water Absorption

Water absorption increased with immersion time for all species (Table 4), reflecting progressive moisture uptake into wood through capillary flow and diffusion. The rate and magnitude of water uptake were strongly species-dependent, highlighting the influence of density, anatomical structure, and extractive content on hygroscopic behaviour.

Species	WA at 12 h (%)	WA at 24 h (%)	WA at 48 h (%)	Mean Increase	Relative WA Rank
African Mahogany	15	22	30	7.5	2 nd
Afrormosia	10	15	20	5.0	4 th



Iroko	12	18	24	6.0	3 rd
Obeche	22	32	45	11.5	1 st
Teak	8	12	16	4.0	5 th

Teak consistently exhibited the lowest water absorption at all immersion periods, recording only 8% at 12 h and 16% at 48 h. This low WA is attributed to its high extractive content and natural oils, which reduce permeability and hinder water penetration. Afrormosia also showed relatively low water uptake compared with the other species, indicating good resistance to moisture intake and confirming its reputation as a dimensionally stable hardwood. Iroko and African Mahogany displayed moderate water absorption behaviour. While both species showed steady increases in WA with immersion time, African Mahogany consistently absorbed more water than Iroko. This difference may be linked to variations in vessel size, ray structure, and extractive distribution, which influence permeability and moisture transport. The moderate WA of these species corresponds with their intermediate swelling behaviour observed in radial and tangential directions. As seen in Figure 6, Obeche recorded the highest water absorption values, reaching approximately 45% after 48 h of immersion. The pronounced water uptake of Obeche is associated with its low density, thin cell walls, and high porosity, which promote rapid capillary absorption. High WA in Obeche explains its elevated radial and tangential swelling and its greater susceptibility to moisture-induced degradation.

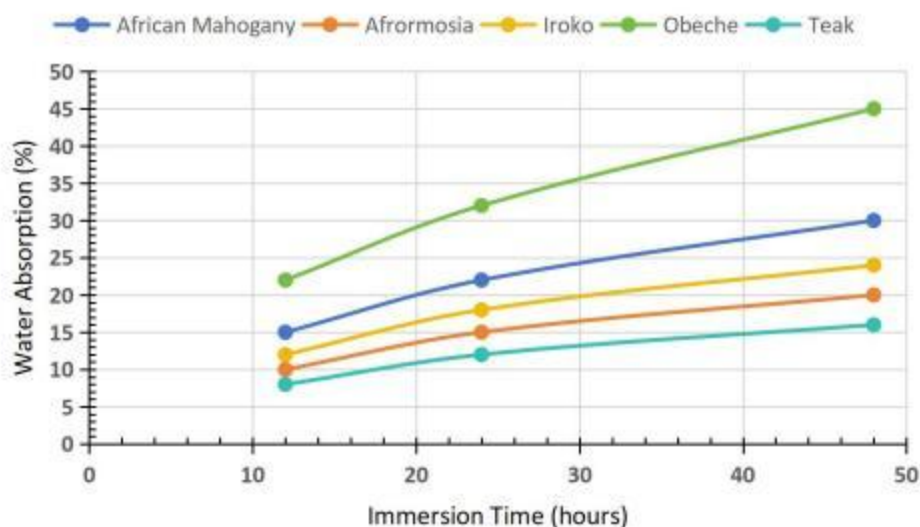


Figure 6: Water Absorption for Tested Timber

Cumulatively, the relative ranking of water absorption remained consistent across immersion times as Teak (5th) < Afrormosia (4th) < Iroko (3rd) < African Mahogany (2nd) < Obeche (1st). This ranking closely mirrors the observed trends in dimensional stability, confirming the strong relationship between water absorption and swelling reactions. These results underscore the importance of species selection for applications exposed to moisture, where low WA is critical for maintaining dimensional stability and mechanical performance. Therefore, ranking Teak as the best and Obeche as the worst.

Relationship between swelling and moisture content

The correlation matrix in Table 5, shows high degree of intercorrelation across all swelling directions ($r = 0.982-0.997$, $p < 0.001$), indicates that moisture-induced expansion is consistent across all planes, reflecting a uniform dimensional adjustment in the wood.

Statistical evidence ($r = 0.883-0.952$, $p < 0.001$) confirms that moisture content is the leading factor in timber's dimensional variability. Tangential expansion ($r = 0.942$) shows a slightly tighter correlation with moisture than either radial ($r = 0.952$) or longitudinal ($r = 0.883$) expansion.



Table 5: Correlations between moisture content and swelling

		Moisture Content (%)	Tangential Swelling (%)	Radial Swelling (%)	Longitudinal Swelling (%)
Moisture Content (%)	Pearson Correlation	1	.942**	.952**	.883**
	Sig. (2-tailed)		.000	.000	.000
	N	25	25	25	25
Tangential Swelling (%)	Pearson Correlation	.942**	1	.997**	.985**
	Sig. (2-tailed)	.000		.000	.000
	N	25	25	25	25
Radial Swelling (%)	Pearson Correlation	.952**	.997**	1	.982**
	Sig. (2-tailed)	.000	.000		.000
	N	25	25	25	25
Longitudinal Swelling (%)	Pearson Correlation	.883**	.985**	.982**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	25	25	25	25

** . Correlation is significant at the 0.01 level (2-tailed).

The data reveals a striking $r = 0.997$ correlation between radial and tangential swelling, indicating that these two factors are precisely proportional. Even though tangential swelling is more pronounced, the two dimensions move together consistently across various moisture levels. Longitudinal swelling also exhibits a strong relationship with the other directions, though the correlation coefficients are marginally lower at 0.982 - 0.985. This is understandable since longitudinal swelling is quite small, usually just 0.1-0.3% compared to the more substantial radial and tangential changes.

4. Discussion of Findings

The results demonstrate that moisture content changes exert a robust and consistent influence on the dimensional responses of the selected West African hardwood species. Across all species, swelling increased progressively as moisture content rose from 5% to 25%, confirming the hygroscopic behaviour of wood below the fibre saturation point and validating linear moisture–swelling relationships within this range. Tangential swelling consistently exceeded radial swelling, while longitudinal swelling remained minimal, reflecting the anisotropic nature of wood governed by cellulose microfibril orientation and anatomical restraint. Strong statistical relationships were observed between moisture content and swelling in all anatomical directions ($r = 0.883-0.952$, $p < 0.001$). The near-perfect correlation between tangential and radial swelling ($r = 0.997$) indicates that although their magnitudes differ, dimensional responses in these directions are proportional to moisture fluctuations. Longitudinal swelling, despite its small magnitude, also showed strong correlations with radial and tangential swelling, confirming that even minor dimensional changes along the grain remain moisture-dependent and species-specific.

At the extremes, Teak exhibited the lowest values across all parameters (TS, RS, LS, and WA) due to its high extractive content, natural oils, and dense structure, which reduce both permeability and moisture diffusion thereby confirming superior moisture resistance while Obeche consistently recorded the highest parameters, indicating the poorest dimensional stability. Afrormosia also demonstrated relatively low swelling and water absorption, indicating good dimensional stability under moderate humidity variations. Iroko and African Mahogany exhibited moderate behaviour; however, African Mahogany consistently showed higher swelling and water absorption than Iroko, due to differences in anatomical structure and extractive composition influencing permeability. Obeche recorded the highest swelling and water absorption values in all anatomical directions and exposure durations. Its low density, thin cell walls, and high porosity promote rapid moisture uptake and pronounced dimensional instability, increasing susceptibility to warping, checking and surface deformation. Specifically, the findings confirm moisture content as a determinant of dimensional variability and underscore the importance of species selection in tropical environments. Future research can consider their performance under corrosive environment and equally investigate other common hardwoods in the West African market.

Therefore, Obeche is primarily recommended for interior uses thereby necessitating potent and effective treatments to address the issues of moisture-induced swelling in cases of exterior use; African Mahogany and Iroko need to be controlled for dimensional movement. However, afrormosia and Teak are far more suitable for exterior joinery and moisture-variable usages.



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