

A Preliminary Physical Property Characterization of *Artocarpus blancoi* (Antipolo) from Maguindanao Province of Mindanao

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ARTICLE INFO

Received: 8 Apr 2026
Received in revised: 20 Jul 2026
Accepted: 27 Jul 2026
Published online: 22 Sep 2026
DOI: 10.32526/ennrj/24/20260141

Keywords:

Basic density/ Height levels/
Moisture content/ Philippine
endemic species/ Volumetric
shrinkage

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ABSTRACT

This study examined the physical properties of *Artocarpus blancoi* wood, focusing on moisture content (MC), basic density (BD), and directional and volumetric shrinkage across tree samples and height levels. Three trees aged approximately 5 to 10 years, were sampled from Maguindanao del Norte in the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM), Philippines. Testing procedures based on ASTM D143 standards were employed. Results showed that tree 1 recorded the lowest MC (98.58%) and the highest BD (384.28 kg/m³). Along height levels, the top portion exhibited the lowest MC (110.51%), while the bottom portion recorded the highest BD (398.62 kg/m³). For shrinkage properties, tree 2 consistently showed the lowest values for tangential shrinkage (TS) (4.59%), radial shrinkage (RS) (2.44%), and longitudinal shrinkage (0.17%), and the lowest volumetric shrinkage (VS) (6.93%). Relative to height levels, the top portion exhibited the lowest TS (4.34%) and VS (7.14%), whereas RS and LS did not differ significantly among height levels. Statistical analyses revealed significant differences in MC and BD among both individual trees and height levels. The RS, LS, and VS varied significantly among individual trees, while TS and VS differed across height levels. Based on the classification systems for density and volumetric shrinkage established by the Forest Products Research and Development Institute (FPRDI), *A. blancoi* falls under low density and falls within the low to moderately low shrinkage classes. These findings suggest that *A. blancoi* has potential as a resource for value-added wood products from high end to standard grade furniture and other non-structural applications, light weight and dimensional stability are of great advantageous. However, it is vital to note that this study was limited to physical property assessment, and did not encompass anatomical and mechanical characterization, durability and/or processing tests, which are valuable for a more comprehensive evaluation of this species.

HIGHLIGHTS

This study employed a systematic sampling approach that examined physical properties of *A. blancoi* wood, including moisture content, basic density, and directional and volumetric shrinkage across tree samples and height levels (bottom, middle, and top), with statistical comparisons performed through analysis of variance. Results revealed significant difference in all measured properties among tree samples, except for tangential shrinkage. Moreover, moisture content, basic density, and tangential and volumetric shrinkages decreased significantly from bottom to top portions. Classification according to FPRDI standards positions *A. blancoi* in low density and within low to moderately low volumetric shrinkage groups, indicating preliminary suitability for non-structural applications pending further mechanical and durability assessment.

1. INTRODUCTION

Wood is one of the most used renewable raw materials and the main source of livelihood of the people belonging to the forest products sector. As a

structural material, wood can be used in many forms of construction, but it is fundamental to know the properties and its relationship. In the Philippines, the demand for wood and other timber products has

Citation: Dres BG, Acob RT, Villareal JF, Poclis CE, Benavides RC, Marasigan OS. A preliminary physical property characterization of *Artocarpus blancoi* (Antipolo) from Maguindanao Province of Mindanao. Environ. Nat. Resour. J. 2026;24(X):xx-xx.

increased over the years (Mendoza et al., 2019). The country possesses significant potential for a thriving wood industry due to its rich biodiversity of over 3,600 native tree species, of which 65% are endemic (Fernando et al., 2008), which could also serve as sustainable raw material sources. However, this potential resource remains largely unexploited due to inadequate evaluation of lesser-known species, persistent research gaps, habitat loss, and socioeconomic and other human-caused pressures, which collectively result in inefficient utilization and missed economic opportunities (DENR-FMB, 2020). Moreover, the Philippine government, in pursuant to Executive Order 23 Series 2011, declares a moratorium on the cutting and harvesting of timber in the entire country's natural and residual forests (Government of the Philippines, 2011).

Artocarpus blancoi, commonly known as 'Antipolo', a fast-growing and endemic species to the Philippines, exemplifies this challenge. It naturally thrives from low to mid-elevation forests in various provinces, from Luzon to Mindanao islands (EDC, 2020). Considering its significant contribution culturally and traditionally for furniture and carving, its potential remains constrained by critical knowledge gaps in wood science, particularly in understudied regions like Maguindanao. It is locally known as 'Tegep', characterized as a medium to large tree reaching a height of 30 m and a diameter up to 60 cm valued for its durable wood, and classified as moderately low strength (Alipon et al., 2022). *A. blancoi* also serves as a substitute for *Artocarpus heterophyllus* (Jackfruit) in construction purposes, furniture, cabinets, and musical instruments. Its bark possesses antimicrobial properties, its leaves are consumed by the Aeta people in Porac, Pampanga, and burned as a mosquito repellent, and its seeds are edible when boiled (Malabrigo and Umali, 2022).

Basically, *A. blancoi* faces dual threats like ecological vulnerability and technical neglect. Under the Philippine Native Plants Conservation Society, *A. blancoi* is classified as Vulnerable (Stuart, 2020). Its populations are declining due to habitat loss from urbanization, mining operations, small-scale and large-scale logging operations, and other unsustainable farming practices (DENR-FMB, 2020). Despite these threats, *A. blancoi* was globally assessed as Least Concern, considering its widespread distribution all throughout the country (EDC, 2020). Simultaneously, the absence of comprehensive wood

property data hampers sustainable industrial use. Current knowledge of *A. blancoi* in the Philippines is predominantly limited to basic botanical descriptions, anatomical features, and silvicultural assessments (FPRDI, 1986; EDC, 2020; Malabrigo and Umali, 2022). A recent characterization of its physical and mechanical properties, along with other fruit-bearing and underutilized tree species, was conducted on samples collected from Caraga region, Batangas city, and Quezon province (Alipon et al., 2022). The study classified *A. blancoi* wood under moderately low density, comparable to *Artocarpus heterophyllus* and *Sandoricum koetjape*, and falls under moderately low volumetric shrinkage, similar to *Litsea perrottetti*.

However, wood properties typically vary with site conditions, and the existing findings cannot reliably extrapolate across geographic locations. Notably, no comprehensive study has been conducted of *A. blancoi* growing specifically in the Maguindanao region, leaving a critical gap in region-specific physical and mechanical property data. This leads to a consequence that *A. blancoi* species remains largely underutilized as firewood or low-value timber, frequently misapplied in structural uses without proper engineering data, and harvested unsustainably because of undefined growth-yield relationships (Alipon and Bondad, 2008). Nevertheless, previous reports have acknowledged the potential of *A. blancoi*'s trunks as a good source of timber for suitable medium weight construction applications such as posts and boats, among others (EDC, 2020), a prospect that needs urgent region-specific evaluation, particularly for Maguindanao region.

Being part of the biodiversity-rich island of Mindanao and the neighboring area of the largest freshwater wetlands in the island (the Ligawasan Marsh), the Maguindanao region presents unique edaphoclimatic conditions that may influence *A. blancoi*'s wood properties (Tanalgo et al., 2024; PhilAtlas, 2026). Despite being common in the region, studies documenting the material characteristics of *A. blancoi* at the local level remain limited, contributing to its underutilization and a major constraint for effective conservation (EDC, 2020; Alipon et al., 2022). In consideration also to the historical armed conflict in the area, research efforts are still very scarce (Tanalgo et al., 2024), like ecosystem assessment and comprehensive characterization of native and underutilized tree species, including *A. blancoi* tree. By situating *A.*

blancoi within regional forestry and industrial contexts, this research aims to support evidence-based conservation strategies and promote sustainable utilization of Philippine native tree species. Therefore, this study aims to characterize the key physical properties *A. blancoi* including moisture content, basic density, and both directional and volumetric shrinkage, across inter-tree and height level variations in Maguindanao. The findings provide essential data for scientifically assessing the potential of *A. blancoi* wood for value-added applications such as crafts, furniture, interior construction, veneer, and ceiling panels. Moreover, by establishing region-specific physical properties, this research would address the current improper utilization of the species due to limited characterization data, and facilitates evidence-based species grading.

2. METHODOLOGY

2.1 Plant materials and wood samples collection

Three (3) mature *A. blancoi* trees, approximately 5 to 10 years old, were sampled from Barangay Ambolodto, Datu Odin Sinsuat (DOS), Maguindanao del Norte, in the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM), Philippines. Considering that all tree

samples were sourced from a naturally regenerated stand, the tree age range was estimated based on the local landowner knowledge with morphological indicators like diameter at breast height (DBH, 1.3 m from the ground level) and bark surface rugosity, with DBH values of 27 cm, 30 cm and 26 cm recorded for trees 1, 2, and 3, respectively. The geographic coordinates and elevation for each tree were recorded as follows: tree 1 (7° 3' 40" N, 124° 19' 45" E; 90 m a.s.l.), tree 2 (7° 3' 48" N, 124° 19' 28" E; 110 m a.s.l.), and tree 3 (7° 3' 41" N, 124° 19' 45" E; 85 m a.s.l.), with a pairwise distance of 580.24 m between trees 1 and 2, 30.19 m between trees 1 and 3, and 565.32 m between trees 2 and 3 (Figure 1). Both trees 1 and 3 grown in a swampy area and sparse forest canopy, where trees are widely spaced with low canopy cover, and the ground layer was dominated with shrubs and grasses, while tree 2 thrives in a semi-dry area and moderately closed canopy with coconut trees where canopy cover is significant but gaps are still present. The site was experiencing a tropical monsoon climate (Köppen classification: Am), with a mean annual temperature of 35.41°C and an average monthly rainfall of 91.02 mm. Wood samples were collected from the selected trees for subsequent analysis.

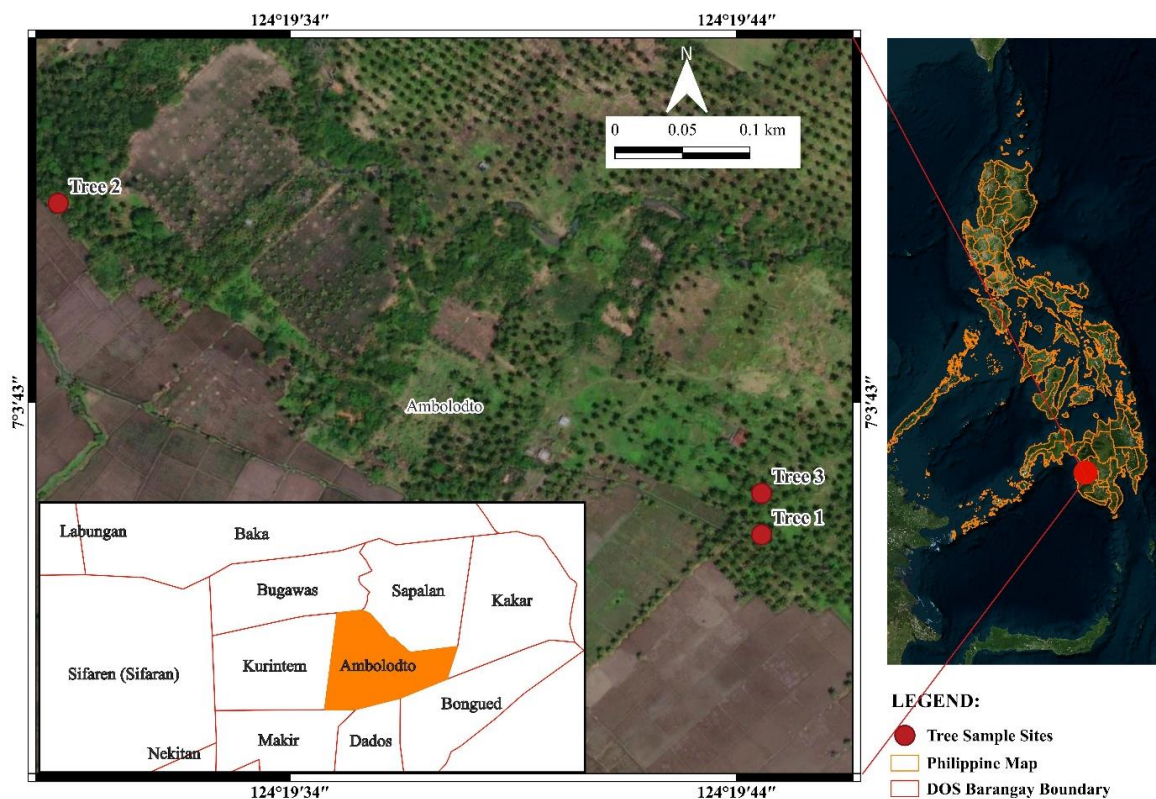


Figure 1. Location map of the *A. blancoi* tree samples in Maguindanao del Norte, Philippines (Source: Geoportal.gov.ph for administrative boundary & Google Earth for satellite image)

2.2 Sampling and sample preparation

Each trunk was divided into three height levels from the DBH level (1.3 m from the ground level): the bottom, middle, and top portions, each measuring 2.4 m length. From these portions, a total of nine disks (152 mm thick) were obtained and designated for the determination of physical properties (Figure 2). Sample preparation followed the ASTM standard for small clear specimens of timber (ASTM, 2019). Wood samples were collected across the cross-section of the stem to capture radial variability in properties. For moisture content (MC, %) and basic density (BD, kg/m³), wood sample cubes (25 mm × 25 mm × 25 mm) were cut from each disk. While for shrinkage properties, rectangular samples (25 mm × 25 mm × 100 mm) were cut. Each height level within each tree constituted an experimental unit, represented by multiple replicate specimens for each test. Right after preparation, samples were soaked in a container of water at ambient temperature to prevent moisture loss until testing commenced.

The green moisture content (MC), basic density (BD), and shrinkage properties were determined

following the ASTM D143 (2019). For MC and BD, the fresh weight of each specimen was determined using a analytical balance, and its volume was obtained by water displacement. Subsequently, the samples were oven dried at 103±2 °C until constant mass was achieved. A total number of 54 samples (18 per tree) were evaluated for MC and BD and the values were obtained using Equations 1 and 2.

$$MC (\%) = \frac{\text{Green weight} - \text{Oven dried weight (kg)}}{\text{Oven dried weight (m}^3\text{)}} \times 100 \quad (1)$$

$$BD \left(\frac{\text{kg}}{\text{m}^3} \right) = \frac{\text{Oven dried of wood (kg)}}{\text{Green volume of wood (m}^3\text{)}} \quad (2)$$

The directional and volumetric shrinkage, the radial (R), tangential (T), and longitudinal (L) were identified, and the dimensional changes were measured using a digital caliper. For each tree, 18 samples were prepared and tested, for a total of 54 samples. The shrinkage percentage was calculated using Equation 3:

$$\text{Shrinkage (\%)} = \frac{\text{Green volume} - \text{Oven dried volume}}{\text{Green volume}} \times 100 \quad (3)$$

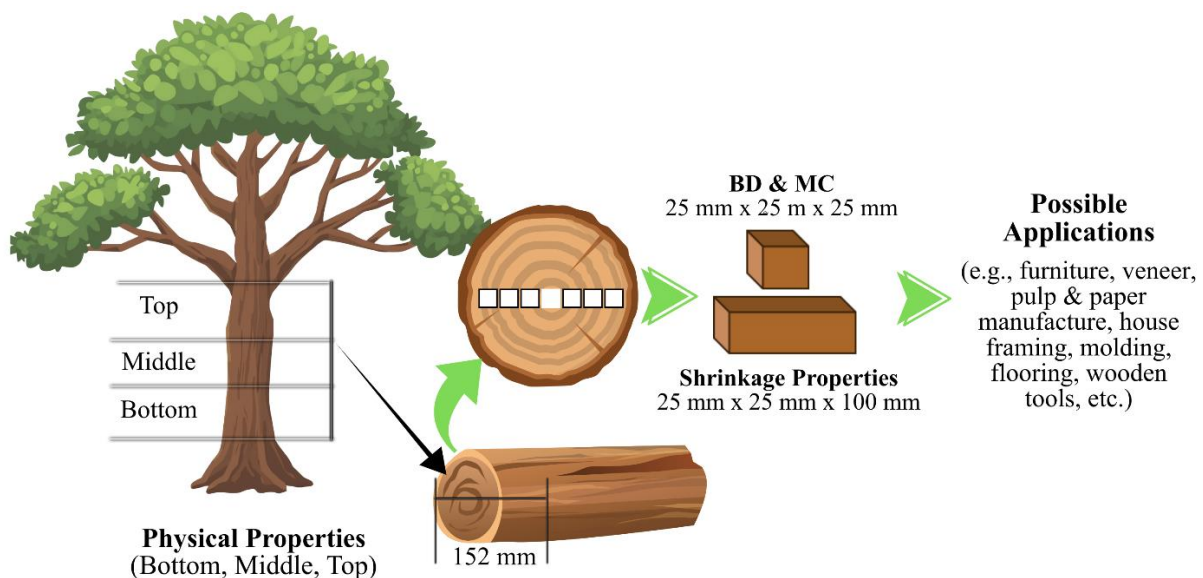


Figure 2. The schematic sampling followed in the study

2.3 Data analysis

Two-way analysis of variance (ANOVA) was used to compare the physical properties (moisture content, basic density, and shrinkages) of *A. blancoi*, across tree samples and height levels (bottom, middle, and top portions). Before the analysis of variance (ANOVA), the Kolmogorov-Smirnov normality test

showed no significant results ($p > 0.05$), confirming that the data were normally distributed. Tukey's Honestly Significant Difference (HSD) post hoc test was subsequently used to identify specific significant differences among group means. Moreover, the statistical analyses were performed using Jamovi version 2.3 (Jamovi Project, 2022).

Table 1. The moisture content and basic density of *A. blancoi* wood samples across tree samples and height levels

Parameters	Moisture content (%)	Basic density (kg/m ³)
Tree No.		
1	98.58b (21.52)	384.28a (61.10)
2	185.85a (68.31)	287.92c (56.26)
3	105.24b (10.64)	344.90b (65.68)
p-value	<0.0001*	<0.0001*
Height Levels		
Bottom	139.05a (42.48)	398.62a (51.62)
Middle	140.11a (82.48)	321.04b (68.82)
Top	110.51b (30.14)	297.44b (54.86)
p-value	<0.0001*	<0.0001*

Means in the same column followed by common letters are not significantly different 5% by Tukey's post hoc test; *significant; values in parentheses denote standard deviation.

3. RESULTS AND DISCUSSION

The physical properties of *A. blancoi* wood were presented in [Tables 1](#) and [2](#). In evaluating the sources of variability, a two-way analysis of variance (ANOVA) was performed ($\alpha=0.05$), revealing significant variations in wood properties both among sample trees and across height levels.

3.1 Moisture content (MC, %)

MC strongly influences most physical and mechanical properties of wood. Hence, accurate determination of MC is essential prior to conducting any tests ([Shmulsky and Jones, 2019](#); [Forest Products Laboratory, 2021](#)). In this study, tree 2 exhibited exceptionally high MC of 185.85%, which was significantly greater than tree 1 with 98.58% and tree 3 with 105.24%. The statistical result confirms that the difference of results is highly significant between tree 2 and both tree 1 and tree 3, displaying a p-value of less than 0.0001 ([Table 1](#)). The present MC was likely influenced by site-specific differences and canopy cover, as tree 2 grown in a moderately closed canopy, while trees 1 and 3 grown in sparse forest canopy, which aligns with the previous reports by [Zobel and van Buijtenen \(1989\)](#), [Alipon et al. \(2022\)](#) and [Tian et al. \(2025\)](#). Relative to tree height levels, the MC values decreased towards the top portion, wherein the bottom portion (139.05%) and middle portion (140.11%) were statistically comparable, signifying no meaningful variation of MC between these two height portions. However, a significant decreased of MC was observed at the top portion, where the value drops at 110.51% having a p-value of less than 0.0001, signifying a high degree of difference between the top portion and both the bottom and middle portions. This result demonstrates that MC remains relatively stable

at the bottom and middle portions of the tree height but markedly decreased towards top portion.

The present result value differs from the 152.68% reported for Philippine-grown *A. blancoi* ([Alipon et al., 2022](#)), suggesting possible site-specific environmental effects or genetic variation. Moreover, the observed axial variation in MC aligns with the typical moisture gradients documented in hardwoods ([Kollmann and Côté, 1968](#)), and with established findings on MC distribution in wood components, recognizing spatial heterogeneity in MC as a critical determinant of material behavior ([Tian et al., 2025](#)). The decreasing trend of MC towards the top portion observed in this present study is consistent with the findings of [Van Duong et al. \(2019\)](#) and [Marasigan and Munding \(2024\)](#) on *Melia azedarach* grown in the Vietnam and the Philippines, respectively. This MC variation along the height level was also attributed to density differences and relatively affected by various anatomical properties such as cell wall thickness and fiber length, among others ([Shmulsky and Jones, 2019](#); [Forest Products Laboratory, 2021](#); [Van Duong et al., 2021](#)). Also, the sapwood to heartwood transition or ratio was reported as a source of MC variation between and within species, wherein the amount of MC decreases accompanied by the deposition of extractives as wood in a tree change from sapwood to heartwood ([Shmulsky and Jones, 2019](#)). MC greater than 150% implies extended kiln-drying requirements, increased susceptibility to fungal degradation, and dimensional instability during processing, affecting the performance and serviceability ([Dietsch et al., 2015](#); [Forest Products Laboratory, 2021](#)). It was also reported that elevated MC significantly influences moisture-induced stresses and shrinkage cracking during drying while serving as

a critical factor in fungal decay resistance (Shmulsky and Jones, 2019; Li et al., 2025). However, proper drying could address this higher MC issue of *A. blancoi* wood, ensuring favorable overall performance and serviceability.

3.2 Basic density (BD, kg/m³)

BD is widely considered as a key indicator of wood quality and suitability of wood for multi-applications (Shmulsky and Jones, 2019; Forest Products Laboratory, 2021). In this study, the BD of *A. blancoi* revealed distinct differences among tree samples examined. Particularly, tree 1 demonstrated the highest BD value, followed by tree 3 and tree 2, respectively. Statistical analysis confirmed that the observed differences in *A. blancoi*'s BD values among tree samples were significantly different, displaying a p-value of less than 0.0001 (Table 1). In consideration to the established role of BD in influencing wood mechanical properties and other processing behavior, tree 1 reflects greater mass per unit volume among tree samples examined. This inter-tree variation, suggests the influence of inherent variability like cambial age, and localized micro-environmental factors like site fertility, spatial distribution, canopy cover, temperature, precipitation, and elevation (Zobel and van Buijtenen, 1989; Fajardo et al., 2022; Stöd et al., 2025; Fischer et al., 2026).

Furthermore, the mean BD values across the height levels exhibited a decreasing trend of values from bottom (398.62 kg/m³) to top (297.44 kg/m³) portions demonstrating a clear axial gradient along the stem. The analysis of variance revealed a significant difference, displaying a p-value of less than 0.0001 (Table 1), particularly the bottom portion relative to the two upper portions. This axial decrease in wood BD towards the top portion is consistent with the findings in tropical hardwoods, where such patterns are attributed to physiological gradients, cambial age, and mechanical loading requirements along the height position (Zobel and van Buijtenen, 1989; Fajardo et al., 2022; Dimou et al., 2025). Also, axial variation of density can directly reflects cellular compositions/types like a greater proportion of mature cells with thicker cell walls and narrower empty spaces or vessel diameter will give densier wood and improve mechanical properties, making wood more resistant and durable (Tanabe et al., 2016; Mendoza et al., 2019; Shmulsky and Jones, 2019; Hamdan et al., 2020; Forest Products Laboratory, 2021; Eloy et al., 2024; de Oliveira Monteiro et al., 2026). Between the density

and mechanical properties, a correlation was also recorded by Izeke et al. (2010), Machado et al. (2014), and Fanny et al. (2018). Additionally, wood density exhibited a positive relationship with strength properties (Alipon et al., 2005). This report was corroborated by Hamdan et al. (2020), who indicated that wood density serves as a strong predictor for modulus of rupture, modulus of elasticity, compression parallel to grain, and shear parallel to grain, showing positive correlations that ranged from weak-to-strong. Given the BD result (low density, Table 1) of *A. blancoi*, the mechanical performance and potential applications of this species might be projected, associated with the observed MC and shrinkage performance. Although this present study only explores *A. blancoi*'s physical properties and does not extend to an investigation of physical-anatomical-mechanical relationships. This comparison of the present findings with previously reported properties may nonetheless offer valuable insights to predict the technological behavior and potential uses of the species and provide further information for future research and comprehensive wood characterization.

Based on the classification system established by the Forest Products Research and Development Institute (FPRDI) (Alipon et al., 2005), *A. blancoi* BD result falls under low density (≤ 360 kg/m³). This BD result positions *A. blancoi* in the same class with *Falcataria falcata*, but was lighter compared to *Gmelina arborea* (moderately low density, 370-440 kg/m³), and *Swietenia macrophylla* (medium density, 450-530 kg/m³), the most common industrial tree plantation species in the Philippines (Marasigan et al., 2025). Moreover, Alipon et al. (2022) reported a relatively higher density of *A. blancoi* with 470 kg/m³, along with other fruit-bearing and underutilized tree species such as *Sandoricum koetjape*, *Artocarpus heterophyllus*, *Alstonia macrophylla*. While *Durio zibethinus* and *Litsea perrottetti* fall under the same class of the present result. Furthermore, thirteen senile fruit-bearing trees in the country were studied by Marasigan et al. (2024). As compared to the present result, *A. blancoi* exhibited lighter density to *Mangifera indica*, *Mangifera altissima*, *Persea americana*, *Lansium domesticum*, *Sandoricum koetijape*, *Artocarpus heterophyllus*, *Syzygium cumini*, *Antidesma bunius*, *Citrus maxima*, and *Manikara zapota*, while falls in same density class with *Artocarpus odoratissimus*, *Annona muricata*, and *Annona squamosa* (Marasigan et al., 2024).

Compared with other *Artocarpus* species documented internationally, the present BD of *A. blancoi* exhibited lighter BD than of *Artocarpus heterophyllus* (500 kg/m³) from Tanzania (Hamza et al., 2001), *Artocarpus altilis* from southwestern Nigeria (581 kg/m³) (Areo et al., 2020) and Gambari Forest Reserve, Oyo State, Nigeria (~571-603 kg/m³) (Areo, 2021), and four among the six *Artocarpus* species from Central Kalimantan, Indonesia, namely, *A. dadah* (490 kg/m³), *A. nitidus* (475 kg/m³), *A. anisophyllus* (740 kg/m³), and *A. odoratissimus* (548 kg/m³) (Takeuchi et al., 2019). The remaining two Indonesian species, *A. elasticus* (210 kg/m³) and *A. tamaran* (345 kg/m³) exhibited BD values comparable to the present range.

Overall, the placement of *A. blancoi* BD as low density carries some implications for potential material use as non-structural applications such as carving, veneer, furniture webbing, though may require reinforcement for any load-bearing purposes, and eco-friendly preservative treatments for favorable exterior use against termites and fungal decay.

3.3 Shrinkage properties (%)

Wood is an anisotropic material, naturally displaying directionally dependent (shrinkage or swelling) along tangential, radial, and longitudinal sections (Shmulsky and Jones, 2019; Forest Products Laboratory, 2021). In this study, the shrinkage

properties of *A. blancoi* across tree samples and height levels were examined, as shown in Table 2.

3.3.1 Tangential shrinkage (TS)

Although tangential shrinkage (TS) numerically varied among *A. blancoi* tree samples (Table 2), the differences were not statistically significant ($p=0.234$), indicating comparable tangential dimensional behavior across sampled trees. Compared with previous reports, the TS values obtained in this study (4.59-5.12%) were slightly higher than those reported for *A. blancoi* (3.64%) (Alipon et al., 2022), and for related species, including *A. odoratissimus* (4.56%) and *A. heterophyllus* (4.54%) (Marasigan et al., 2024). Such differences may reflect intraspecific variability associated not only with genetic factors but also with site-specific edaphoclimatic conditions that influence wood formation processes (Zobel and van Buijtenen, 1989; Almeida et al., 2026). Variations in soil nutrient availability, moisture regime, and local precipitation patterns can affect cambial activity, cell wall deposition, and anatomical development, thereby contributing to differences in shrinkage behavior and dimensional stability among trees growing under different environmental conditions (Fajardo et al., 2022; Pumijumnong et al., 2023). Nevertheless, because environmental variables were not directly measured in this study, these mechanisms should be interpreted cautiously and warrant further investigation.

Table 2. The shrinkage of properties of *A. blancoi* wood across tree samples and height levels

Parameters	Shrinkage properties (%)			
	Tangential	Radial	Longitudinal	VS
Tree No.				
1	5.12a (1.33)	3.14a (0.90)	0.46a (0.73)	8.11a (1.26)
2	4.59a (1.15)	2.44b (1.64)	0.17b (0.12)	6.93b (1.19)
3	5.03a (0.88)	2.64ab (1.58)	0.23b (0.13)	7.55a (1.28)
p-value	0.234 ^{ns}	0.031*	0.010*	0.001*
Height levels				
Bottom	5.44a (1.50)	2.74a (1.49)	0.32a (0.73)	8.04a (1.69)
Middle	4.96ab (1.10)	2.57a (1.58)	0.32a (0.23)	7.41b (1.27)
Top	4.34b (0.77)	2.92a (0.88)	0.23a (0.16)	7.14b (0.65)
p-value	0.004*	0.444 ^{ns}	0.617 ^{ns}	0.010*

Means in the same column followed by common letters are not significantly different 5% by Tukey's post hoc test; *significant; ns-not significant; VS-volumetric shrinkage

TS showed a significant axial decrease along tree height ($p=0.004$; Table 2), indicating improved dimensional stability toward the upper portions of the stem. This pattern is consistent with previous observations in hardwood and softwood species,

where variation in shrinkage behavior along the stem has been associated with cambial age (Shmulsky and Jones, 2019; Forest Products Laboratory, 2021; Stöd et al., 2025). Also, the direct interplay between wood density and shrinkage towards the top is an important

influencing factor, where higher TS generally associates to higher density (Forest Products Laboratory, 2021; Stöd et al., 2025), corroborating the findings of the present result. Moreover, wood generally exhibits greater dimensional change in the tangential direction than in the radial and longitudinal directions due to its anisotropic nature, particularly affected by some anatomical traits difference like the presence of ray tissue, pits, and amount of cell wall material variability (Shmulsky and Jones 2019; Forest Products Laboratory 2021).

3.3.2 Radial shrinkage (RS)

Relative to RS, result revealed that tree 1 was significantly higher shrinkage value than the other tree samples, displaying a p-value of 0.031 (Table 2). When compared to previously reported findings, the present RS results (ranging from 2.44% to 3.14%) were notably lower than 5.68% reported for *A. blancoi* species by Alipon et al. (2022), while relatively comparable for *A. odoratissimus* (2.13%) and *A. heterophyllus* (2.91%) (Marasigan et al., 2024). This observed differences of findings suggest that age differences, and/or genetic factors may play a pivotal role in the shrinkage characteristics of the samples (Stöd et al., 2025; de Oliveira Monteiro et al., 2026), accompanied by some properties like MC and cell wall microfibril angle variation, which also significant factors affecting both strength and directional shrinkage properties of wood (Shmulsky and Jones, 2019).

With respect to height levels, RS did not differ significantly among the bottom, middle, and top portions ($p=0.444$; Table 2), indicating relatively uniform radial dimensional behavior of *A. blancoi* along the stem. This result suggests that height levels had limited influence on RS within the sampled trees.

3.3.3 Longitudinal shrinkage (LS)

Longitudinal shrinkage (LS) differed significantly among tree samples ($p=0.010$; Table 2), indicating variation in longitudinal dimensional behavior within *A. blancoi*. The LS values obtained in this study were generally comparable with previous reports for *A. blancoi* (Alipon et al., 2022) and related *Artocarpus* species reported by Marasigan et al. (2024). Minor differences among studies may reflect variation in provenance, local growth conditions, and tree age, which can influence wood formation and dimensional behavior. Given that the sampled trees in this study were relatively young (5-10 years old), differences in growth environment and site conditions may have contributed to the observed variation.

Similar influences of growth conditions and site-related factors on variation in wood properties have been documented in previous studies (Stöd et al., 2025; Fajardo et al., 2022). Nevertheless, these factors were not directly evaluated in the present study and should therefore be interpreted cautiously.

Relative to height levels, LS did not vary significantly along the height levels ($p=0.617$; Table 2). In general, LS remains minimal compared with TS and RS and is often considered negligible for most practical applications (Shmulsky and Jones, 2019; Forest Products Laboratory, 2021).

Overall, the directional shrinkage values observed in this study clearly demonstrate the anisotropic behavior of wood. Consistent with typical wood behavior, TS exceeded RS, while both transverse directions exhibited greater dimensional change than LS, reflecting differences in wood structure across anatomical directions. This anisotropic behavior and dimensional stability are influenced by the combined effects of wood anatomical heterogeneity, including variation in cell type proportions, cell dimensions, and wood maturity, rather than by isolated structural factors alone (Stöd et al., 2025; de Oliveira Monteiro et al., 2026).

3.3.4 Volumetric shrinkage (VS)

Volumetric shrinkage (VS) varied significantly among tree samples ($p=0.001$; Table 2). This variation may reflect the combined influence of environmental conditions, wood anatomical adjustments, and potential genetic variability (Butterfield, 2003; Pandey, 2021; Fajardo et al., 2022; Haryjanto et al., 2024; Stöd et al., 2025; de Oliveira Monteiro et al., 2026). Wood properties are recognized as phenotypic responses shaped by genotype $\times$ environment interactions, and differences observed among sampled trees may partly reflect localized growing conditions in Maguindanao alongside inherent biological variability (Butterfield, 2003; Shmulsky and Jones, 2019; Fajardo et al., 2022; Stöd et al., 2025). However, these factors were not directly evaluated in the present study.

Along height levels, the VS result showed a significant decrease towards the top portion, displaying a p-value of less than 0.010 (Table 2). The VS results indicate that the top portion of *A. blancoi* is more dimensionally stable, which relates to its lighter density. Moreover, this corroborates to the previous reports of Bello (1997) and Alipon et al. (2022), where they highlighted the strong linear correlation of VS and BD, and also emphasized the significant

contribution of BD to the VS performance of wood. Furthermore, the typical trends of cambial age along the tree height, relatively affect dimensional stability (Shmulsky and Jones, 2019; Forest Products Laboratory, 2021; Stöd et al., 2025). Anatomical properties also influenced wood shrinkage behavior, where a greater number of narrow vessels, a higher proportion of fibers, and taller and wider rays exhibited greater shrinkage values (de Oliveira Monteiro et al., 2026). The present findings demonstrated that *A. blancoi* exhibits a consistent alignment between density and shrinkage behavior. This supports the principle that denser wood generally undergoes greater dimensional change from the green to oven-dried condition (Schulgasser and Witztum, 2015).

The present VS of *A. blancoi* (ranging from 6.93% to 8.11%) was relatively comparable to the findings of Marasigan et al. (2024) for *A. odoratissimus* (6.59%) and *A. heterophyllus* (7.32%), while it was slightly lower than the result obtained by Alipon et al. (2022) for the same *A. blancoi* species (9.07%). Under the FPRDI wood shrinkage classification system (Alipon et al., 2020), the VS values of *A. blancoi* in this study fall within the range of low shrinkage (Group 5; $\leq 7.8\%$) to moderately low shrinkage (Group 4; 7.910.5%). This classification indicates that the wood is favorable for wide range of application from high end to standard grade furniture production, as well as other applications such as rotary cut veneer for plywood, house framing, moldings, parquet, flooring, ceiling and even musical instruments, tool handles, and sporting goods, among others (Bowyer et al., 2007; Alipon et al., 2020).

Overall, the combined attributes of light density and low to moderate shrinkage performance of *A. blancoi* suggested its viability for various value-added wood products from high end to standard grade furniture and other non-structural applications, where light weight and dimensional stability are of great advantageous.

4. CONCLUSION

Based on the Forest Products Research and Development Institute (FPRDI) classification system, *A. blancoi* is classified as a low density wood with low to moderately low volumetric shrinkage. These properties indicate its potential for value-added products, particularly furniture and other non-structural applications. The findings provide baseline information to support the sustainable utilization and

conservation of *A. blancoi* in the BARMM region while promoting its responsible use as a native timber resource. Further studies on its anatomical, mechanical, durability, and processing properties are recommended for a more comprehensive evaluation.

ACKNOWLEDGEMENTS

The authors are thankful to the faculty and staff of the Mindanao State University-Maguindanao, particularly to the College of Forestry and Environmental Studies, and to the personnel of the Physical and Mechanical Division of the Forest Products Research and Development Institute - Department of Science and Technology for their valuable technical assistance.

AUTHOR CONTRIBUTIONS

BGD, RTA, JFV, CEP, RCB, and OSM conceptualized and finalized the methodology of the study; BGD, RTA, and JFV collected the data and wrote the first draft; BGD, RTA, JFV, and OSM analyzed and validated the data, edited the manuscript, and finalized.

DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interests.

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