

BARRIERS AND STRATEGIES FOR ENHANCING EUCALYPTUS TIMBER UTILIZATION IN ETHIOPIA

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Abstract

Although Eucalyptus was introduced to support Ethiopia's timber production forestry, various barriers hinder its use as an alternative to imported wood. This article's primary aim is to identify key challenges in eucalyptus timber utilization and propose strategies for improvement based on the literature review. The finding indicated technological, economic, social, and policy-related barriers. Secondary data were collected by reviewing scholarly sources from November 2024 to January 2025. Keywords were used to search in Scopus and Web of Science scientific databases and Directory of Open Access Journals (DOAJ). Findings show that the identified challenges limit the utilization of eucalyptus timber. To enhance sustainability, stakeholders should advance wood processing technologies and implement supportive policies and financial incentives.

Keywords

Forest product; Challenges; Approaches; Demand; Wood industries; Ethiopia.

Introduction

Globally, demand for wood products, mainly round wood, is predicted to reach 6 billion m³ by 2050 and will be the primary driver for expanding industrial plantations (Barua et al., 2014). Plantations, forests, and ecosystems provide essential raw materials, vital habitats, and cultural landscapes that meet diverse social and environmental needs (Rodriguez et al., 2014). Ethiopia has a vast, ancient, and unique repository of non-timber and timber resources, providing the foundations for environmental welfare and rural economic stability (Kebbede, 2016). An important basis for developing various industrial sectors is the availability of predefined basic materials (Stock et al., 2018). Ethiopia is a fast-developing African country, and its economy has been growing smoothly for the last 15 years, with an annual Gross Domestic Product (GDP) growth rate of 7–8%, substantial increases in the GDP contributions of both service and agricultural sectors, and a minor contribution from the industrial sector (Schmidt et al., 2018). The industrial sector accounts for approximately 8% of Ethiopia's GDP, and the country's potential for producing wood and wood products remains untapped (World Bank, 2018). The high rural population provides a strong labor supply that heavily relies on agriculture, leading to significant demands for forest-based products. There has been an increasing demand for wood products, which often depend on imported wood, primarily from pine and oak trees, to meet the population's growing needs. This situation presents challenges in effectively utilizing and managing the abundant eucalyptus tree resources in the country (Bayle, 2019). *Eucalyptus* was first introduced to Ethiopia during the regime of

Emperor Menelik II (1868-1907) in 1895 to solve the critical shortage of fuel wood and construction materials in Addis Ababa and other towns in the country (Bahru et al., 2023; Dessie et al., 2019; Gil et al., 2010). In Ethiopia, eucalyptus species such as *E. amygdalina*, *E. bicola*, *E. camaldulensis*, *E. incrassata*, *E. globulus*, *E. melliodora*, *E. resinifera*, *E. rudi*, *E. salubris*, *E. cladocalyx*, *E. cornata*, *E. diversicolor*, *E. leucoxylon*, *E. patens*, and *E. tereticornis* were the first to be brought to Ethiopia (Alemayehu & Melka, 2022). Since its successful introduction, eucalyptus species have spread throughout much of Ethiopia, becoming a vital component of most farming systems in the country. They have dominated the landscape and emerged as one of the most significant tree species. Eucalyptus has become widely distributed across the nation. It is utilized as a substitute raw material to meet the increasing demand for various forest products, including fuelwood, composites, and materials for industrial and construction purposes. Eucalyptus wood, known for its strength, resilience, and pest resistance, produces fuelwood, charcoal, poles, posts, essential oils, and other items (Birhanu & Kumsa, 2018; Gil et al., 2010).

The two most common species of eucalyptus in Ethiopia are *Eucalyptus camaldulensis* and *Eucalyptus globulus*. *Eucalyptus camaldulensis* is more common at lower altitudes, while *Eucalyptus globulus* is more common at higher altitudes (Dessie et al., 2019). Many Ethiopian farmers and wood lot growers now use it as their main species because of its high adaptability, low soil fertility, ability to withstand fire, insect, and browsing animal damage, wide distribution, even on degraded lands, and socioeconomic contribution as a high-yielding cash crop with short rotation.

Ethiopia's wood industries play a crucial role in the country's economy, providing employment opportunities, contributing to national income, and meeting the demand for wood-based products (Daba, 2016). However, the deficit of wood supply in Ethiopia has been a major issue, resulting in significant increases in the price of domestic wood and fuelling a high demand for imported wood products (Girma & Abate, 2021). This situation has prompted the development of the wood industry in Ethiopia to explore potential alternative wooden products. Eucalyptus timber is particularly promising due to its short growth cycle and ability to thrive in various country regions. Given the decline in local timber species and the increased demand for forest products, well-managed eucalyptus species may rank among Ethiopia's best substitutes (Wassie, 2020). Eucalyptus plantations account for 58% of the total area, covering approximately 506,000 hectares (Dessie, 2011; Getahun, 2003). This is followed by *Cupressus* at 29%, *Juniperus procera* at 4%, and pines at 2%. In Ethiopia, the species *Eucalyptus camaldulensis*, *Eucalyptus globulus*, *Eucalyptus grandis*, and *Eucalyptus saligna* are commonly planted (Tesfaye et al., 2020). When these trees are planted in degraded areas with the appropriate density and management practices, they can effectively address the scarcity of wood products for both domestic and commercial use while preserving environmental balance (Muthuri et al., 2023; Pirard et al., 2016; Rajesh Kumar & Rekha, 2024).

Eucalyptus wood is foundational for various sectors, including pulp manufacturing, paper production, and plywood particle board. Due to its strength, it is utilized in joinery, flooring, roofing, and structural framing (Lee et al., 2024; Lee et al., 2022). However, several challenges that must be addressed hinder Ethiopian wood industries from eucalyptus timber utilization (Ghani & Lee, 2021). Many furniture manufacturers in Ethiopia are unfamiliar with the eucalyptus's properties and potential applications in the country's wood industry. Furthermore, the unique characteristics of eucalyptus wood may necessitate specialized processing techniques that are not readily available in Ethiopia. Consequently, eucalyptus is not commonly used for furniture manufacturing in the country despite being a popular alternative to traditional timber species in many other parts of the world (Kaba et al., 2018).

The degradation of land resources is causing severe problems in most highlands and lowlands of Ethiopia. Though magnificent developments are in increasing agricultural production and productivity, the forestry and green energy sectors are still lingering to bridge the energy and construction demand of the growing population (Wassie, 2020). *Eucalyptus* is widely planted due to its ability to meet the growing demand for fuelwood and building materials and its various other uses (Birhanu & Kumsa, 2018; Yimam et al., 2024). For example, in south-central Ethiopia, *Eucalyptus* trees provide over 100% of the construction wood, 20% of the charcoal, and 93% of other wood products (Alemu, 2016). A similar investigation conducted in the Lake Plain area found that *Eucalyptus* was used primarily for fuel wood, income generation, and construction, with little regard for environmental conservation.

Several studies conducted in Ethiopia have emphasized the significant economic importance of the *Eucalyptus* tree (Belachew & Minale, 2025; Zegeye, 2010). Despite prioritizing *Eucalyptus* for various socioeconomic benefits to sustain rural households' income and food security, particularly in harsh conditions, those studies overlook its barriers and strategies of enhancing the *Eucalyptus* tree for timber utilization. Hence, identifying potential barriers and proposing strategies for enhancing *Eucalyptus* timber utilization could help intensify the alternative use of wood industries and bring sustainable development to the nation. Therefore, this literature review aims to identify the main barriers to utilizing eucalyptus wood in Ethiopia's wood industry and suggest alternative solutions.

In summary, *Eucalyptus* plays a crucial role in Ethiopia's economy by meeting the high demand for fuel wood, construction materials, and other wood products, particularly in rural areas. However, the forestry and green energy sectors struggle to bridge the growing energy, and construction demands despite their economic benefits. Studies highlight its widespread use for income generation and construction, but little attention is given to its environmental impact or challenges in timber utilization. The literature review (see Section 1) identifies barriers to eucalyptus timber use and proposes strategies for improvement to promote sustainable development. The literature review methodology (see Section 2) uses keywords searched in reputable scientific databases such as Scopus, Web of Science, and DOAJ. The results (see Section 3) are followed by the discussion (see Section 4) analyzing previous similar research on eucalyptus utilization in Ethiopia, the limitations of this study, and its conclusion.

1 Literature Review

1.1 The History of Eucalyptus in Ethiopia

The name “*Eucalyptus*” is derived from two Greek words: “eu” meaning “well”, and “kalyplos” meaning “hidden” or “well-covered”. This name was given by the French botanist Jacques-Julien Houton de La Billardi re, who classified and named the species in 1799. The evergreen species of *Eucalyptus* are distinct from shrubs and multi-stemmed trees due to their height, with some growing up to 60 meters tall and thriving at altitudes above 1,850 meters above sea level (Belachew & Minale, 2025). In Ethiopia, the natural plantations of *Eucalyptus* could have disappeared without these benefits. The tree plays a crucial role in the socio-economic dimensions of many Ethiopian communities. For many years, Ethiopians have relied on *Eucalyptus* as a primary source of construction material for houses. This fast-growing tree has provided goods and services enabling livelihood development and generating income opportunities for various localities.

Eucalyptus was introduced to Ethiopia in the late 19th century as a sustainable solution to the capital city's firewood and construction timber shortages. Over the years, it has proliferated nationwide, creating significant economic opportunities for many households. Additionally,

its cultivation has played a vital role in minimizing deforestation, contributing to environmental conservation efforts (Belachew & Minale, 2025). There are over 900 species of *Eucalyptus*, but only about 100 are economically significant. The tree is widely cultivated for its wood, paper pulp, gum, and medicinal oil (Malakar, 2024). It was first introduced to Portugal four centuries ago and has since become widely distributed throughout Europe, Latin America, Asia, and Africa. Then, at later ages, the tree was disseminated in various highlands of Ethiopia, and it has gained popularity due to its strong potential to adapt to various ecological settings and from fertile to degraded lands. Its fast-growing nature has also made it an economically viable tree species in the country.

1.2 The Importance of Eucalyptus Timber over Imported Woods

Eucalyptus offers numerous benefits to various countries, including fuelwood, charcoal, poles, posts, essential oils, and paper and pulp for manufacturing. It also provides nectar for bees, shade for animals and humans, and serves as a windbreak.

The choice between *eucalyptus* and imported wood ultimately depends on the final product's specific application, budget, and desired characteristics. Hence, it must address the technological, technical, economic, social, and policy-related barriers hindering the Ethiopian wood industries on *eucalyptus* timber utilization. It may be beneficial to conduct specific comparisons based on *eucalyptus*' intended use and local availability versus imported woods. When comparing *eucalyptus* timber to imported wood products in terms of quality, several factors need to be considered, including physical properties, durability, workability, and suitability for various applications. *Eucalyptus* wood is known for its high density and hardness, making it difficult to work using traditional and straightforward woodworking tools (Kaba et al., 2018).

2 Methodology

This review article was developed by researching keywords such as *eucalyptus*, challenges, strategies, demand, supply, and forest products. Relevant information was gathered from reputable journal articles in scientific databases Scopus, Web of Science, and the DOAJ, a unique and extensive index of diverse open access Journals. The data were then organized into a personal EndNote library database. The review article is based on a comprehensive analysis of the related literature from various materials. The secondary data were collected from November 2024 to January 2025 through an extensive review of scholarly articles, reports, books, and online resources. Additional references were identified by examining the bibliographies cited in the collected literature. This review study extracted data from the Scopus, Web of Science, and DOAJ databases. Criteria were established to select publications for a detailed review, focusing on their relevance to the barriers and strategies for improving *Eucalyptus* timber utilization in Ethiopia.

Twenty-two documents were critically reviewed based on search keywords, such as challenges and prospects for improving *eucalyptus* timber utilization. The most relevant documents addressed the roles of forests, livelihoods, non-timber forest products, and their implications in Ethiopia. Only documents published in English were considered to ensure consistency in understanding and analysis. Studies published within the last 10 years, from 2014 to 2024, were included to ensure the relevance and timeline of the information. Documents that do not directly discuss the barriers and strategies of *eucalyptus* timber utilization in Ethiopia and documents published outside the specified date range were excluded, as they may not reflect current trends or knowledge in the field. Non-English documents that could not be accurately translated or understood were also excluded.

3 Results

3.1 Eucalyptus and the Need for Alternative Timber Species

Diversifying the timber supply with alternative species ensures a more resilient and adaptable wood industry, reducing vulnerability to fluctuations in the availability and prices of specific timber species (Girma & Abate, 2021). Although there are more than 300 Indigenous, fast-growing, and exotic tree species that may be used to produce a range of wood products in Ethiopia, 85% of the wood demand has been covered by limited commercially important indigenous timber species and imported woods that were becoming endangered (Kaba et al., 2018; Kaba & Desalegn, 2020).

Alternative timber species with unique properties, colors, and grain patterns offer opportunities for diversifying wood products and meeting consumer preferences in domestic and international markets (Lahr et al., 2018). It also encourages the innovation of wood industries in product development, design, and manufacturing processes (Skorupińska et al., 2024; Stendahl, 2009). According to a study conducted in central Ethiopia by (Alemayehu & Melka, 2022; Daba, 2016), the main reasons why farmers plant eucalypts were the following: the growing demand for wood products, the scarcity of wood, their high biomass production rate, their ease of cultivation and adaptability; the fact that they are not palatable to livestock; the reduction in agricultural land productivity; and the reduction in off-farm employment opportunities.

It can be logged and processed quickly, making it a viable alternative to the limited supply of imported wood products. Additionally, eucalyptus is a sustainable source for generating self-sustained income, supporting the construction of private houses, industries, and infrastructure development. The availability of eucalyptus timber helps address the high demand for housing and commercial needs, bridging the demand-supply gap. This approach helps prevent deforestation and promotes the creation of sustainable and reliable timber supplies in Ethiopia.

3.2 Challenges of Ethiopian Wood Industries Eucalyptus Timber Utilization

Wood is considered a promising raw material for the industrial sector, offering significant competitive advantages over other feedstock due to its non-seasonal growth, high polysaccharide content, availability, and ability to thrive on set-aside land, thereby supporting rural development (Penín et al., 2020). In Ethiopia, the demand for wood products is consistently rising due to rapid economic development, population growth, increasing urbanization, and a growing construction sector (Girma & Abate, 2021; Tesfaw et al., 2021). Ethiopia's forestry industry holds substantial potential, but its ability to produce high-quality wood products is currently constrained. As a result, the country relies heavily on imports to satisfy local market demands for essential forest products, including sawn timber, wood panels, pulp, and paper. The most planted hardwood is eucalyptus, a valuable biomass source for manufacturing materials, chemicals, and fuels.

The rising demand for building materials and firewood has led to robust markets for eucalyptus products. This growing interest in eucalyptus has significantly contributed to the expansion of its acreage throughout the region, reflecting the plant's increasing commercial viability and importance (Dessie & Erkossa, 2011). In Africa, including Ethiopia, eucalyptus trees are significant in various socioeconomic aspects. Ethiopians have been associated with it for a long time because it is the primary source of building materials for homes (Alemu, 2016). Numerous products made from eucalyptus have good economic returns (Gomes et al., 2021). These include fuelwood, poles, construction materials, pulp wood, timber, oil,

medicine, tannin, fiber and particle board, livelihood support, honey production, and employment, among many other uses. Four significant eucalyptus species are worldwide (*E. Grandis*, *E. E. urophylla*, *Camardulensis*, and *E. globulus*) (Gomes et al., 2021). Among these species, *E. globulus* and other hybrids cover about 80% of the world (Rockwood et al., 2008).

According to Lemenih and Kassa (2014), demand for wood products is rapidly increasing in Ethiopia due to population growth, urbanization, and economic development. In 2013, the Ministry of Environment, Forest, and Climate Change (MEFCC, 2017) reported that approximately 124 million m³ of wood products were consumed. Of this amount, 116 million m³ were used for charcoal and fuel wood, 6.7 million m³ for the building industry, 0.17 million m³ for sawn wood, primarily from domestic production, 0.5 million m³ for round wood, and 0.8 million m³ for paper and furniture industries. According to Desalegn et al. (2015), the forest products import amount and the corresponding hard currency value between the years 2000-2013 has been 170,721.3 tons costing a capital of 159 million USD.

The wood balance in this construction sub-sector indicates a supply gap of approximately 1.4 million m³ in volume during the same period, and the supply-demand imbalance reached its peak in 2013 at 38.8 million m³ (MEFCC, 2017). Belachew et al. (2023) pointed out that if no intervention measures are considered, the import bill by the year 2035 will reach about 3 billion USD. Importing large wood products would demand a sizeable foreign currency, compromising the country's economic development. Moreover, it is projected that over the next two decades, the local wood industries' inadequate productivity, population expansion, and urban development will increase the need for processed wood products in the country (Jaleta et al., 2016).

Consequently, the domestic wood industry will not meet the country's demand for processed wood products. Various wood products have been imported, and several natural forests have been exploited to address the country's growing need for processed wood products. This can be attributed to an absence of a steady supply of raw materials for the wood industry, a dearth of technology, information, and knowledge on the processing and production of various wood products in the domestic wood industry, a scarcity of state-of-the-art machinery in the local wood sector, a deficiency of a proficient workforce in the domestic wood industry, and other various uncertain factors. Studies have indicated that eucalyptus timber species and their innovative manufacturing and utilization technology are among the alternative species and technologies that can be applied for the production of high-quality wood products in the domestic wood products manufacturing industry to minimize the country's demand and supply gap for processed wood products, reduce and replace the importation of wood products, reduce the shortage of raw materials, and so minimize reliance on a few common commercial softwood species in the domestic wood industry (Lee et al., 2022). According to Sori et al. (2023), relying solely on imported timbers is unwise, and alternative sources must be sought to meet this increasing demand for timber.

Eucalyptus plantations are becoming a cash crop supporting income generation and employment opportunities. In Ethiopia, 506,000 hectares of land are believed to be covered by eucalyptus. *E. globules* and *E. camaldulensis* are the main species of eucalyptus growing in the highlands of Ethiopia (Alemu, 2016). Despite the abundance of wood from this species in Ethiopia, its current capacity to supply high-quality wood products for industrial uses is not vast and faces several challenges. Hence, the imported species satisfy our short-term timber requirements; planning for the local fast-growing tree species like eucalyptus is essential to supply the required timber for the construction and furniture industries. Eucalyptus was introduced for multipurpose use and to rescue the remaining indigenous forests from being destroyed. The forestry sector has prohibited the harvest of *Hagenia abyssinica*, *Cordia*

Africana, *Afrocarpus* (*Podocarpus*) *falcatus*, and *Juniperus procera* but allowed obtaining forest products for household use. Laws in later years have also addressed natural resources and the environment. Customized provisions for the private sector's involvement in forestry development have also been made. About 70 species of eucalyptus are available in Ethiopia, most of which are widely spread in many regions. However, most industries (92.9%) still use or depend upon well-known valuable timber species such as *Cordia Africa* for their furniture production across all the towns. Eucalyptus globulus has been studied in Ethiopia for its lumber characteristics by Tadele and Teketay (2014) and for pulp and paper. Waktole et al. (2024) studied the Variation of Physical Properties of Eucalyptus globulus grown in Ethiopia; their result suggested using eucalyptus globules for multiple wood products, including pulp and paper.

Using eucalyptus wood in the furniture industry presents several challenges that must be addressed (Ghani & Lee, 2021). Addressing these challenges requires specialized knowledge, equipment, and techniques to effectively utilize eucalyptus wood in furniture making while ensuring quality, durability, and sustainability. Eucalyptus wood is known for its high density and hardness, making it challenging to work using traditional and straightforward woodworking tools (Kaba, 2024). As a result, specialized equipment may be required to cut, shape, and sand eucalyptus wood effectively (Sori et al., 2023). When eucalyptus timber is not properly sawed, seasoned, and dried, it might divide, distort, or break and dry unevenly (Desalegn et al., 2015; Kaba & Desalegn, 2020). Another important problem with fast-growing hardwoods, such as eucalyptus, is dimensional instability (Cao et al., 2023; Vasileios et al., 2017). Attaining accurate moisture content and stability for furniture making requires careful drying and monitoring (Kaba & Desalegn, 2020). Some species of eucalyptus wood can be prone to long-end cracking, primarily if not adequately handled during processing and manufacturing (Famiri et al., 2001). This can lead to challenges in crafting intricate or delicate furniture designs.

Thus, it is an important characteristic for wood quality assessment, and it reflects the suitability of wood for most types of processing and many end-uses (Zanuncio et al., 2022). For example, lower-density wood is preferred for wall panels, which do not have to be strong and stiff, whereas high-density wood is preferred for construction poles and beams, which must be strong and stiff (Sadegh, 2012). Eucalyptus wood is known for its relatively high density, ranging from 450 kg/m³ to 900 kg/m³, depending on the species and growth conditions (Gil et al., 2010; Sadegh, 2012). This density contributes to its strength and durability, making it suitable for various structural applications (Kaba & Desalegn, 2020).

Ethiopia's increasing demand for wood products and declining natural forest resources have led to a growing reliance on imported timber. This dependence on imports has significant economic and environmental implications. Eucalyptus plantations, with their rapid growth rate and adaptability, offer a promising alternative to address the country's wood supply needs. However, Ethiopian industries face several challenges that limit the broader application of eucalyptus timber. These issues include technological, technical, economic, social, and policy-related challenges that were the primary barriers hindering the Ethiopian wood industries on eucalyptus timber utilization.

3.2.1 Technological Barriers

In Ethiopia, the forest supply is not well advanced in technology and final Harvested Wood Products (HWP), with most HWP used for products with short lifespans, such as fuel wood. There are numerous species of eucalyptus, but only a few are well-known and widely used (Pirralho et al., 2014). Ethiopia's most commonly used timber species are often the exotic ones introduced from other regions, notably certain varieties of eucalyptus, which thrive in the

country's diverse climate (Zerga et al., 2021). Eucalyptus timber is recognized for its excellent physical and mechanical properties, making it suitable for various applications such as edge-glueing, lamination, plywood production, and interior cabinetry (Lee et al., 2022). It is also used in packaging, pallets, and other related uses, supporting local industries and the economy.

3.2.2 Technical Barriers

Not all eucalyptus species exhibit desirable wood properties. Some may have low density, low strength, or poor durability, limiting their suitability for specific applications. Likewise, particular species may be prone to defects like knots, gum veins, and decay, which can reduce the quality and value of the timber. Others can be pretty hard and dense, making working with traditional woodworking tools difficult. Specialized tools and techniques may be required to cut, shape, and finish the wood. Understanding clonal eucalyptus wood shrinkage enables us to implement appropriate measures to lessen their impact (such as collapses) during drying (Amer et al., 2022). A shortage of skilled labor and technical expertise in timber processing hampers the efficient use of eucalyptus timber in Ethiopia. The lack of adequate processing facilities limits the production of high-value products like furniture and construction materials.

Additionally, challenges such as the shrinkage and expansion of eucalyptus wood can lead to dimensional instability in furniture. Inefficient drying techniques contribute to quality issues like warping, cracking, and fungal decay, particularly in species requiring specialized drying methods. Overall, the industry's development is further hindered by the shortage of skilled labor in areas like kiln drying and wood preservation.

3.2.3 Economic Barriers

Establishing eucalyptus plantations in Ethiopia requires significant initial investment, which can challenge small-scale farmers. Costs include land preparation, high-quality seedlings, equipment, and irrigation systems, making it difficult for those with limited resources to enter the market. Eucalyptus trees typically have long rotation periods of 7 to 15 years, delaying returns on investment and impacting economic viability. Additionally, price fluctuations in the timber market can affect profitability, as rising prices can increase revenue while declines can lead to losses. Therefore, monitoring market trends is essential for making informed decisions about eucalyptus operations and investments.

3.2.4 Social Barriers

Uncertain land tenure rights pose significant challenges for Ethiopian wood industries, particularly for farmers in eucalyptus plantations. Farmers may hesitate to invest in long-term tree farming without clear legal rights to the land, prioritizing short-term gains over sustainable practices. This not only limits the growth of the wood industry but also reduces long-term economic benefits for farmers and communities. Additionally, local communities often resist eucalyptus plantations due to concerns over water scarcity, as these trees consume large amounts of water, impacting local agriculture and drinking supplies. There are also fears about soil erosion since eucalyptus roots can destabilize soil in rainy regions, leading to the degradation of arable land. Furthermore, biodiversity loss is a significant issue, as eucalyptus plantations displace native plants and wildlife. These factors contribute to community opposition, stemming from fears of lasting ecological and social consequences.

3.2.5 Policy Barriers

Insufficient policies and regulations can significantly obstruct the growth and progress of the eucalyptus timber industry. When regulatory frameworks are lacking or poorly designed, they can create challenges in sustainable harvesting practices, environmental protection, and market access. Without clear guidelines, businesses may struggle to operate responsibly, leading to overexploitation of resources and detrimental impacts on local ecosystems. Moreover, inadequate policies can impede investment opportunities, stifle innovation, and result in inconsistent quality standards, all of which can undermine the industry's potential for economic development and sustainability in the long term. Besides this, weak enforcement of forest laws and regulations can lead to illegal logging and deforestation, undermining the sustainability of eucalyptus plantations in Ethiopia. Insufficient financial incentives, such as subsidies and tax breaks, can discourage investment in eucalyptus plantations.

3.2.6 Environmental Concerns

Eucalyptus trees are often criticized for their environmental impact, particularly due to their high-water consumption and adverse effects on local biodiversity (Desta et al., 2023; Zerga et al., 2021). Their extensive cultivation can lead to groundwater depletion in water-scarce regions, affecting surrounding ecosystems and diminishing resources for native flora and fauna (Zegeye, 2010). Eucalyptus plantations frequently outcompete indigenous plants, altering local wildlife and threatening species survival, which results in significant biodiversity loss (Ping & Xie, 2009). This situation has led to resistance from local communities and environmental groups against expanding eucalyptus plantations, as many believe the ecological costs outweigh the economic benefits. Therefore, sustainable management of eucalyptus plantations is essential, although achieving this is challenging without adequate training and resources (Birhanu & Kumsa, 2018; Yimam et al., 2024; Rode et al., 2016).

3.2.7 Legal Barriers Hindering Eucalyptus Utilization in Ethiopia

Eucalyptus timber utilization in Ethiopia is hindered by significant legal barriers that impede its cultivation and commercial use. A major challenge is the complexity and fragmentation of forestry regulations, particularly those concerning land use, which often restrict eucalyptus planting due to ecological concerns. Relevant policies aim to preserve indigenous species and prevent land degradation, complicating the establishment of eucalyptus plantations (Gebretsaniik et al., 2020). The Forest Law (2018) also adds to this complexity, requiring a management plan approved by authorities for forest use, while emphasizing local community participation in forest management (Article 19(4)) of the Federal Democratic Republic of Ethiopia (FDRE, 2018). These regulations create uncertainty for investors regarding ownership and land use permits, deterring investment and limiting market growth (Tesfaw et al., 2021). The government's stringent environmental policies, aimed at protecting biodiversity, often result in the underutilization of eucalyptus resources valued for their rapid growth (Bayle, 2019; de Carvalho Balieiro et al., 2020). There is a need for a balanced policy review to support both environmental sustainability and economic development (Batra, 2023). Furthermore, a lack of clear legislative guidelines on eucalyptus cultivation contributes to uncertainty for farmers and industries (Tesfaw et al., 2021). Inconsistent law enforcement and bureaucratic inefficiencies further complicate compliance and exacerbate legal challenges, making it essential to streamline administrative procedures for effective eucalyptus timber utilization in Ethiopia.

4 Discussion

Eucalyptus offers significant socioeconomic and environmental benefits in Ethiopia, but constructive dialogue among researchers and stakeholders is essential to assess its impact. While some highlight concerns about its cultivation, others see advantages and consider a balanced evaluation (Dessie et al., 2019). This article reviews the barriers to and strategies for improving Eucalyptus timber utilization in Ethiopia. Key challenges include inadequate processing facilities and a lack of standardized grading systems (Bazzana et al., 2020). Addressing these requires investment in modern processing technologies and establishing national quality standards. Lessons from countries like Brazil and Australia indicate that such advancements can boost utilization rates. Economic barriers, including high production costs and limited market access, hinder investment in Eucalyptus processing (Carias Vega & Page, 2023). Strengthening value chains and providing financial incentives could enhance local production and utilization. Policy barriers are significant, with a lack of clear legal frameworks leading to sustainable harvesting and processing inconsistencies. Establishing defined regulations and enhancing institutional support will be crucial. While environmental concerns exist, such as soil depletion and water resource consumption, research shows that sustainable management practices can mitigate these impacts. Promoting mixed-species plantations and agroforestry can also benefit soil health. The European Union Deforestation Regulation will impact Ethiopia's Eucalyptus sector, requiring producers to ensure their practices do not contribute to deforestation. Compliance may necessitate improved monitoring systems but could also open new markets for sustainably sourced timber (European Commission, 2025; United Nations, 2023). In conclusion, enhancing Eucalyptus timber utilization in Ethiopia necessitates a holistic approach integrating technological investments, market expansion, policy reforms, and sustainable practices. The results presented in this article are limited in scope to Ethiopia and rely solely on secondary data from various databases. Additionally, it has limitations in keyword selection, which may affect the study's comprehensiveness.

Conclusion

The use of eucalyptus timber in Ethiopia has significant potential to meet growing wood product demands, reduce imports, and conserve indigenous forest resources. However, various technological, economic, social, policy-related, and environmental challenges impede this potential. To address these issues, a comprehensive approach is needed, including investments in advanced processing technologies, capacity-building initiatives, policy reforms, and community engagement. Promoting sustainable eucalyptus management and value-added products can strengthen Ethiopia's wood industry and close the timber supply-demand gap. Increasing public awareness and providing financial incentives to small-scale farmers can further facilitate the adoption of eucalyptus. Collaboration among policymakers, researchers, and industry stakeholders is essential for ensuring sustainable eucalyptus timber use. Future research should focus on improving processing techniques, exploring innovative wood applications, and examining the environmental impacts of eucalyptus plantations. Collecting primary data through field surveys and case studies will offer deeper insights into timber utilization. Lastly, enhancing perceptions of eucalyptus, developing supportive policies, and investing in training programs for foresters and entrepreneurs will help overcome barriers to eucalyptus utilization and improve timber quality through breeding and silvicultural practices.

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PŘEKÁŽKY A STRATEGIE PRO ZVÝŠENÍ VYUŽITÍ EUKALYPTOVÉHO DŘEVA V ETIOPII

Přestože byl eukalyptus zaveden, aby podpořil etiopské lesní hospodářství, jeho využití jako alternativy k dováženému dřevu brání různé překážky. Hlavním cílem tohoto článku je identifikovat klíčové problémy při využívání eukalyptového dřeva a na základě přehledu literatury navrhnout strategie pro zlepšení. Zjištění poukázala na technologické, ekonomické, sociální a politické překážky. Sekundární údaje byly shromážděny na základě rešerše odborných zdrojů v období od listopadu 2024 do ledna 2025. K vyhledávání byla použita klíčová slova ve vědeckých databázích Scopus a Web of Science a DOAJ. Zjištění ukazují, že zjištěné problémy omezují využití eukalyptového dřeva. Pro zvýšení udržitelnosti by zúčastněné strany měly pokročit v technologiích zpracování dřeva a zavést podpůrnou politiku a finanční pobídky.

HINDERNISSE UND STRATEGIEN FÜR DIE STEIGERUNG DER NUTZUNG VON EUKALYPTUSHOLZ IN ÄTHIOPIEN

Obschon der Eukalyptus für die Bedürfnisse der äthiopischen Wälder eingeführt wurde, wird dessen Nutzung als Alternative zu importiertem Holz von verschiedenen Faktoren behindert. Das Hauptziel dieses Artikels besteht in der Identifizierung der Schlüsselprobleme bei der Nutzung von Eukalyptusholz, wobei auf der Grundlage einer Literaturübersicht Strategien für eine Verbesserung vorgeschlagen werden sollen. Die daraus hervorgehenden Feststellungen weisen auf technologische, ökonomische, soziale und politische Hindernisse hin. Die Sekundärangaben wurden auf der Grundlage der Recherche fachlicher Quellen von November 2024 bis Januar 2025 gesammelt. Für das Heraussuchen wurden Schlüsselwörter in den wissenschaftlichen Datenbanken Scopus, Web of Science und DOAJ verwendet. Die Ergebnisse zeigen, dass die festgestellten Probleme die Nutzung von Eukalyptusholz einschränken. Zur Steigerung der Nachhaltigkeit sollten die beteiligten Parteien in den Technologien der Holzverarbeitung voranschreiten und eine unterstützende Politik sowie finanzielle Anreize einführen.

PRZESZKODY I STRATEGIE ZWIĘKSZENIA WYKORZYSTANIA DREWNA EUKALIPTUSOWEGO W ETIOPII

Pomimo tego, że eukaliptus został wprowadzony w celu wsparcia etiopskich lasów, jego wykorzystanie jako alternatywy dla drewna importowanego napotyka różne przeszkody. Głównym celem niniejszego artykułu jest identyfikacja kluczowych problemów związanych z wykorzystaniem drewna eukaliptusowego oraz zaproponowanie strategii poprawy sytuacji na podstawie przeglądu literatury. Wyniki badań wskazały na przeszkody technologiczne, ekonomiczne, społeczne i polityczne. Dane wtórne zebrano na podstawie kwerendy specjalistycznych źródeł w okresie od listopada 2024 roku do stycznia 2025 roku. Do wyszukiwania wykorzystano słowa kluczowe w naukowych bazach danych Scopus, Web of Science i DOAJ. Wyniki wskazują, że zidentyfikowane problemy ograniczają wykorzystanie drewna eukaliptusowego. Aby poprawić zrównoważony rozwój, zainteresowane strony powinny rozwijać technologie przetwórstwa drewna oraz wprowadzić politykę wspierającą i zachęty finansowe.