Int.J.Curr.Res.Aca.Rev.2026; 14(6): 51-62

International Journal of Current Research and Academic Review

ISSN: 2347-3215 (Online) Volume 14 Number 6 (June-2026)

Journal homepage: http://www.ijcrar.com

doi: https://doi.org/10.20546/ijcrar.2026.1406.007

The Eucalypt Dilemma: Can we Use Eucalypts to Address Wood Deficit and Poverty in Tanzania - Review

Nancy Eliad Pima[1*], Joshua Stanley Maguzu[2], Ashura Abdallah Kaniki[3], Herieth Andrew Nyarobi[1] and Joseph James Chogga[1]

[1]Tanzania Forestry Research Institute, Kibaha Lowland Afforestation Research Centre, P.O Box 30021, Kibaha, Pwani, Tanzania

[2]Tanzania Forestry Research Institute, P.O Box 1854, Morogoro, Tanzania

[3]Tanzania Forestry Research Institute, Lushoto Silviculture Research Centre, P.O Box 95, Lushoto, Tanga, Tanzania

**Corresponding author*

Abstract

Eucalyptus species are among the most widely planted tree species globally due to their fast growth, adaptability to diverse ecological conditions, and wide range of industrial and household applications. In Tanzania, Eucalyptus plantations play an important role in afforestation, farm forestry, and smallholder wood production systems aimed at addressing increasing wood demand and improving livelihoods of rural communities. Despite these benefits, Eucalyptus species remain controversial due to concerns regarding high water consumption, groundwater depletion, allelopathic effects, reduction in biodiversity, and possible soil nutrient depletion. This paper reviews the ecological, hydrological, and socio-economic implications of Eucalyptus planting, with particular emphasis on the Tanzanian context. Evidence from Tanzania and other countries indicates that although Eucalyptus species may consume substantial amounts of water due to their rapid growth, they are also relatively efficient in biomass production per unit of water used when compared with several other native tree species and agricultural crops. Furthermore, Eucalyptus plantations contribute significantly to wood supply, energy production, income generation, and rehabilitation of degraded lands. The paper argues that, when properly managed and planted in suitable sites, Eucalyptus species can contribute substantially to reducing wood deficits and improving livelihoods in Tanzania while minimizing adverse environmental impacts. There is a need to develop appropriate site-specific management guidelines for sustainable Eucalyptus plantation development.

Article Info

Received: 15 April 2026
Accepted: 28 May 2026
Available Online: 20 June 2026

Keywords

Eucalypt Dilemma, Controversy, Tanzania

Introduction

Eucalyptus is among the most widely planted tree genera globally, comprising over 800 species and numerous hybrids (Sharma *et al.,* 2023; Mao *et al.,* 2024). Native primarily to Australia, with a few species occurring naturally in Indonesia and Papua New Guinea (Hutapea *et al.,* 2023), Eucalyptus has become the dominant hardwood in plantation forestry worldwide, covering more than 20 million hectares (Iglesias-Carrasco *et al.,* 2025). Its popularity stems from rapid growth, ecological adaptability, coppicing ability, and diverse industrial applications. Plantations supply poles, timber, pulpwood, fuelwood, charcoal, transmission poles, and bioenergy feedstock, while also providing environmental services such as erosion control, windbreaks, land rehabilitation, and carbon sequestration (Hutapea *et al.,* 2023; Wells *et al.,* 2023; Schulze *et al.,* 2023). The ability to thrive in harsh conditions and poor soils makes Eucalyptus especially attractive for afforestation and reforestation programs worldwide.

In Africa, Eucalyptus plantations have expanded significantly in South Africa, Ethiopia, Kenya, Uganda, and Tanzania, driven by rising demand for wood products, fuelwood, and ecosystem restoration (Wells *et al.,* 2023; FAO, 2024). In Tanzania, the species was introduced in the late nineteenth century to supplement natural forest supplies and support plantation development (Nshubemuki *et al.,* 2001). Since then, Eucalyptus has become central to government plantations, private enterprises, and smallholder woodlots. Commonly planted species include *E. saligna, E. grandis, E. camaldulensis, E. globulus, E. citriodora, E. tereticornis, E. maidenii, E. urophylla,* and hybrid clones among others (Pima *et al.,* 2016). Their popularity reflects rapid growth, adaptability, coppicing ability, and strong market demand for poles, timber, charcoal, pulpwood, and fuelwood (Wells *et al.,* 2023; FAO, 2024).

Despite these economic benefits, Eucalyptus remains controversial due to concerns about water consumption, groundwater depletion, soil nutrient reduction, allelopathic effects, and biodiversity loss (Medeiros *et al.,* 2025; Ferraz *et al.,* 2024). These issues have led to restrictions or bans in regions such as Karnataka (India), and stricter land-use controls in Brazil, Portugal, and Kenya's sensitive zones (Teixeira *et al.,* 2024). In East Africa, debates are particularly intense in water catchment areas and regions facing scarcity (Wells *et al.,* 2023). Yet, recent studies show that Eucalyptus can achieve high water-use efficiency, producing more biomass per unit of water than many crops and tree species, depending on site conditions and management practices (Stape *et al.,* 2004; Hubbard *et al.,* 2010; Otto *et al.,* 2014). Despite extensive debate, there remains limited synthesis of evidence specifically addressing whether Eucalyptus can sustainably contribute to reducing Tanzania's wood deficit while minimizing environmental impacts

Tanzania's growing population, urbanization, and industrial expansion have sharply increased demand for wood, while natural forests continue to decline. This has created a significant national wood deficit, underscoring the need for fast-growing species capable of meeting demand sustainably. This paper reviews the ecological, hydrological, and socio-economic implications of Eucalyptus plantations in Tanzania, and explores whether they can help address wood shortages and poverty while minimizing environmental risks through proper management and site selection.

The Eucalyptus Controversy

Eucalyptus plantations have long sparked debate over their environmental and socio-economic impacts. Critics argue that these species consume large amounts of water, potentially affecting hydrology, groundwater recharge, and streamflow, particularly in water-limited regions (Gelaye and Getachew, 2026; Medeiros *et al.,* 2025). Other concerns include soil nutrient depletion, suppression of understory vegetation through competition and allelopathic effects, and reduced biodiversity when plantations replace natural ecosystems (Wells *et al.,* 2023; White *et al.,* 2022). Such impacts have been documented in India, Kenya, Ethiopia, South Africa, and Tanzania, especially where plantations expand into ecologically sensitive or water-stressed landscapes (Srivastava *et al.,* 2003; Nduwamungu *et al.,* 2007; Albaugh *et al.,* 2013; Otto *et al.,* 2014). Studies in India and South Africa highlight that plantation location, scale, and management are critical in determining environmental outcomes (Calder *et al.,* 1992; Dye, 1996; Dye, 2013).

Researchers also emphasize the advantages of Eucalyptus, including rapid growth, low maintenance, adaptability to poor soils, coppicing ability, disease resistance, and ease of seed collection and storage Despite these concerns, research suggests that many criticisms are generalized and overlook the role of site conditions, species choice, and management practices (White *et al.,* 2022; Hakamada *et al.,* 2020; Lima *et al.,* 2020). Water use, for instance, is strongly influenced by rainfall, soil type, stand density, and plantation age rather than species traits alone (Ryan *et al.,* 2020). Moreover, other fast-growing species such as Pinus may consume comparable amounts of water under similar conditions (White *et al.,* 2022; Medeiros *et al.,* 2025).

In Tanzania, controversy is most pronounced in semi-arid regions and catchment areas, where communities often associate Eucalyptus with drying springs, declining groundwater, and reduced streamflow (White *et al.,* 2022; Pramono *et al.,* 2026). While fast-growing trees generally use more water than slower-growing species due to higher transpiration and leaf area (Whitehead and Beadle, 2004). Studies show that Eucalyptus does not necessarily exceed Pinus in water consumption when efficiency and productivity are considered (White *et al.,* 2022). Long-term hydrological studies in South Africa confirm that plantations can reduce streamflow, though partial recovery may occur after harvesting or removal (Scott and Prinsloo, 2008). Ultimately, sustainable outcomes depend on strict site-specific planning, careful species-site matching, controlled plantation density, and avoidance of wetlands, rivers, and sensitive catchments. When these principles are applied, Eucalyptus can provide economic and livelihood benefits while minimizing environmental risks.

Effects of Eucalyptus on Soil Fertility

The effects of Eucalyptus plantations on soil fertility remain widely debated. Some studies report declines in nutrient availability, microbial biomass, and soil biological activity compared with natural forests, particularly under short-rotation systems with intensive management (Teketay, 2003; Chen *et al.,* 2023). These outcomes are often linked to rapid nutrient uptake, repeated harvesting, and limited return of organic matter to the soil. In contrast, other research shows that Eucalyptus can maintain or even enhance fertility through litter deposition, nutrient cycling, and organic matter accumulation, especially under longer rotations and careful management. Evidence from East Africa also suggests plantations may improve soil structure and micronutrient levels relative to degraded croplands (FAO, 2009). The impacts are site-specific, shaped by species, climate, soil type, stand age, and management intensity rather than the genus itself. Comparative studies with grasslands and agricultural fields often show minimal long-term differences in fertility when plantations are managed sustainably and given adequate rotation periods.

Water Relations in Eucalypt Plantation

Eucalyptus species exhibit high water-use efficiency, enabling survival and rapid growth across diverse environments ranging from humid climates to semi-arid regions. Their deep root systems allow access to soil moisture and, in some cases, groundwater reserves during prolonged dry periods, supporting high biomass productivity and drought tolerance. Water use in Eucalyptus plantations varies widely depending on species, stand age, rainfall, soil type, plantation density, and management practices (Table 1), rather than being uniformly high across all sites (White *et al.,* 2022; Hakamada *et al.,* 2020).

In areas with adequate rainfall and sound management, hydrological impacts may be limited. However, in semi-arid zones or sensitive catchments, large-scale plantations can intensify competition for water and reduce streamflow through elevated transpiration (Dye, 2013;). Studies from South America, Africa, India, and Australia confirm that Eucalyptus can tap deep soil water and groundwater during dry seasons, which underscores the need for strict site-specific planning. These findings highlight the importance of careful site selection, regulation of plantation density, and restrictions on planting near wetlands and sensitive water catchments to ensure sustainable plantation management and minimize hydrological impacts.

Water-Use Efficiency of *Eucalyptus* Plantations

Although Eucalyptus species are often criticized for high water consumption, research shows they achieve remarkable water-use efficiency, producing large amounts of biomass per unit of water consumed, particularly under well-managed silvicultural conditions (White *et al.,* 2022; Hakamada *et al.,* 2020; Lima *et al.,* 2020). Comparative studies demonstrate that Eucalyptus often generates more biomass per litre of water than many agricultural crops and other fast-growing tree species. For example, studies in India found that Eucalyptus hybrids required less water to produce one gram of biomass compared with *Acacia auriculiformis, Albizia lebbeck,* and *Dalbergia sissoo* (Tiwari, 1992; Table 2). Similarly, research in Australia and Brazil reported substantially higher wood yields per unit of water in Eucalyptus plantations compared to conifers, due to rapid growth, efficient physiological regulation, and adaptability to diverse environments (Davidson, 1989). More recent findings confirm that water use is strongly influenced by stand productivity, climate, plantation density, and management practices rather than species traits alone (Ryan *et al.,* 2020; White *et al.,* 2022).

On average, Eucalyptus requires about 785 litres of water per kilogram of biomass (Davidson, 1993), which is significantly lower than crops such as cotton, coffee, and bananas (≈3,200 L/kg) or maize (≈1,000 L/kg) (Davidson, 1993; Figure 1). This efficiency makes Eucalyptus attractive for industrial wood supply, renewable energy, and carbon sequestration. However, efficiency does not eliminate environmental risks. In water-limited regions, wetlands, or sensitive catchments, plantations may still reduce streamflow and groundwater recharge. Therefore, sustainable plantation management must rely on strict site-specific planning, careful species-site matching, regulated plantation density, and clear avoidance of wetlands and ecologically sensitive areas. When these principles are applied, Eucalyptus can deliver substantial socio-economic and environmental benefits while minimizing hydrological impacts.

Wood Demand-Supply in Tanzania

Tanzania's forest sector is characterized by a persistent imbalance between wood supply and demand. Recent national forest assessments and FAO-based analyses confirm that total annual wood supply is insufficient to meet consumption needs due to heavy reliance on biomass energy and unsustainable harvesting practices (NAFORMA, 2015). Currently, national demand driven mainly by household energy consumption, charcoal production, and land-use conversion exceeds 60 million m^3 annually, creating a persistent structural deficit of 19.5 million m^3 in the wood sector (NAFORMA, 2015; Mombo *et al.,* 2022), which is increasingly met through overharvesting of natural forests and illegal extraction from protected areas, accelerating forest degradation and ecosystem loss (NAFORMA, 2015). The private sector in Tanzania, including smallholder tree growers, is seen as crucial in addressing the country's wood deficit by planting Eucalyptus species among others (MNRT, 2000; NAFORMA, 2015; Mwamakimbullah, 2016).

Socio-Economic Contributions

Although *Eucalyptus* plantations have long been associated with environmental controversy, a growing body of recent evidence shows that they provide important socio-economic benefits in many tropical and subtropical countries, including India, Brazil, China, South Africa, Ethiopia, Kenya, Uganda, and Tanzania (Jagger and Pender, 2000; Getahun, 2002; Munishi, 2007; Teshome, 2009; Pima *et al.,* 2015). In these contexts, *Eucalyptus* plantations contribute significantly to rural livelihoods by supplying essential products such as fuelwood, construction timber, poles, and farm materials, thereby reducing pressure on natural forests and supporting household energy security (Zerga *et al.,* 2021; White *et al.,* 2022; FAO, 2022). Studies further indicate that smallholder and private *Eucalyptus* woodlots have become an important income source, particularly for rural households operating on marginal or degraded lands where conventional agriculture is less viable (Mbow *et al.,* 2014). In several African countries, including Tanzania and Ethiopia, the expansion of privately owned *Eucalyptus* plantations has exceeded that of state or industrial plantations, highlighting their role as a key component of decentralized rural forestry systems that support both subsistence needs and cash income generation (FAO, 2022; White *et al.,* 2022).

Value-chain analyses, particularly in countries like Ethiopia, show that multiple actors including farmers, transporters, traders, and processors benefit from the Eucalyptus economy (Zerga *et al.,* 2021).

However, socio-economic assessments also show that negative impacts are often linked to poorly planned plantation establishment or weak land-use governance rather than the species itself. In many developing countries, deforestation for agriculture, fuelwood demand, and uncontrolled harvesting of natural forests has led to widespread environmental degradation, particularly in the absence of effective land-use planning and forest policy enforcement (FAO, 2022; Nkonya *et al.,* 2023). Under such conditions, *Eucalyptus* plantations can play a restorative role by supplying fast-growing wood resources, reducing dependence on natural forests, and contributing to landscape restoration when properly managed. Recent global reviews emphasize that the socio-economic value of *Eucalyptus* is maximized when plantations are integrated into agroforestry systems, smallholder woodlots, and regulated plantation landscapes that balance production with environmental safeguards (White *et al.,* 2022). Therefore, while concerns exist, current evidence suggests that the benefits of *Eucalyptus* are substantial and can contribute positively to rural development and forest sustainability when supported by appropriate policy frameworks and site-specific management strategies.

Cost-Benefits for Growing Eucalyptus

Benefits Associated with Eucalyptus Plantations

Eucalyptus species grow rapidly compared to many indigenous tree species. Depending on site quality and management objectives, rotation ages typically range from 5–15 years for poles and fuelwood, and about 15–25 years for sawlogs and timber. This short rotation period enables investors and smallholder farmers to recover establishment and management costs relatively quickly. In addition, industrial *Eucalyptus* plantations are known for their high biomass production and mean annual increments (MAI), particularly under favorable climatic conditions and appropriate silvicultural practices. These productivity advantages significantly enhance wood supply efficiency and improve overall plantation profitability (Zerga *et al.,* 2021).

Strong market demand further enhances the economic attractiveness of *Eucalyptus* species, as the wood is widely used for transmission and utility poles, construction timber, fuelwood, charcoal, pulp and paper production, furniture, plywood, and essential oils. Evidence from countries such as Ethiopia and Brazil shows well-developed and expanding value chains that generate substantial income for growers, traders, and processors (Dessie *et al.,* 2019; Zerga *et al.,* 2021; Palma *et al.,* 2021). In addition, financial analyses using economic indicators such as Net Present Value (NPV), Internal Rate of Return (IRR), Benefit–Cost Ratio (BCR), and Equivalent Annual Value (EAV) consistently demonstrate positive returns for well-managed *Eucalyptus* plantations. Many studies report favorable outcomes for both industrial and smallholder systems, with positive NPVs and BCR values exceeding unity, confirming strong economic performance (Palma *et al.,* 2021; Alemayehu *et al.,* 2026). For example, studies in Brazil indicate that eucalyptus pulp plantations remain economically viable under a wide range of market conditions, confirming their strong investment potential (Alemayehu *et al.,* 2026; Furo *et al.,* 2026).

Costs Associated with Eucalyptus Plantations

The establishment and management of *Eucalyptus* plantations involve several cost components, most of which are incurred during the initial years of planting. Major cost categories include land preparation (such as clearing, ploughing, and pitting), planting materials (seedlings or clonal stock), and labor for activities like planting, weeding, pruning, and thinning.

Additional recurrent costs include fertilizers and chemicals for pest and disease control, routine maintenance such as fire protection and monitoring, as well as harvesting and transportation costs at maturity. Economic analyses consistently show that establishment costs are highest in the first year, while maintenance costs gradually decline until the harvesting stage (Whitesell *et al.,* 1992; Spinelli *et al.,* 2009; Dougherty and Wright, 2012; Ferreira *et al.,* 2024).

Recommended Planting Spacing and Potential Uses

Initial spacing depends on the objective of planting the eucalypts (KFD, 1996; KFS, 2009). In plantations for production of transmission poles and timber, the spacing is 3 x 3 m, fuelwood and props 2 x 2 m, and for withes and firewood for domestic use 1 x 1 m (Table 3). However, these spacings may vary depending on site and climatic conditions. Wider spacing is used in drylands. Closer spacing results in higher volume yield in early stages of growth but of smaller diameter trees. Large spacing of more than 4 m is usually used where eucalypts are to be mixed with other trees or agricultural crops.

Site Species Matching for Eucalyptus Species

Species-site matching for *Eucalyptus* in Tanzania is strongly influenced by the country's distinct agro-ecological zones, particularly variations in rainfall, altitude, temperature, and soil fertility (Table 4). Evidence from plantation trials and forestry zoning studies in Tanzania and East Africa shows that high-yielding species such as *Eucalyptus grandis*, *E. saligna*, and *E. urophylla* perform best in high rainfall, cool highland environments such as the Southern and Northern Highlands, where deep, well-drained fertile soils and altitudes above 1200 m support rapid growth and high timber productivity (URT, 2021; Mpiluka *et al.,* 2026). In contrast, drought-tolerant species such as *E. camaldulensis* and certain hybrids (e.g., GC and GU clones) are better suited to semi-arid central zones, coastal lowlands, and Miombo woodlands, where rainfall is lower, soils are relatively poor, and water stress is common (Pima *et al.,* 2016; URT, 2021). Intermediate zones such as the Lake Region and Eastern Lowlands support a mix of species depending on local site conditions, with moderately fertile soils and sub-humid climates allowing both productivity and adaptability (Booth, 2013; FAO, 2020; URT, 2021). Therefore, successful plantation performance in Tanzania depends on matching species ecological requirements with site-specific climatic and edaphic conditions, a principle consistently emphasized in regional forestry zoning frameworks and recent plantation performance studies in East Africa (FAO, 2020).

Minimum Planting Distance of Eucalyptus from Water Bodies

In Tanzania, there is no single nationally fixed statutory distance that applies exclusively to Eucalyptus plantations only however, forest plantation and environmental management practice follows riparian protection principles that prohibit tree planting within riparian reserves and wetlands, which are legally and operationally treated as protected buffer zones.

Table.1 Water use of Eucalypts in some countries

Species	Water use (L/day)	Location	Reference
E. grandis* × *E. camaldulensis	30 – 64	Brazil	Dye *et al.,* (2004)
E. camaldulensis* and *E. victrix	20 – 68	India	Keitel and Adams (2009)
E. pilularies, E. cloeziana	9 – 16	Australia	Alcorn *et al.,* (2013)
E. grandis* × *E. camaldulensis	7	Kenya	Senelwa (2009)
E. globules	8 – 38	Ethiopia	Fetene (2012)
E. camaldulensis	20-68	India	Joshi and Palanisami (2011)
E. grandis* × *E. camaldulensis	5 – 14	Tanzania	Pima *et al.,* (2015)
E. grandis	30	Brazil	Dye (1996)

Table.2 Water use of Eucalypts compared with other tree species

Species	Water consumed (litres/yr)	Biomass Produced				Total Biomass Produced per litre of Water (g /Litre)	Water Consumed per g of biomass (litres /g)
		Shoots	Roots	Leaves	Total		
		(g / yr)					
Acacia auriculiformis	1231.50	1023.5	361.6	327.9	1713.0	1.39	**0.72**
Albizzia lebbek	1283.90	1132.4	1085.6	136.8	2354.8	1.83	**0.55**
Dalbergia sissoo	1534.05	1129.3	775.5	99.77	2004.5	1.31	**0.77**
Eucalyptus hybrid	**2526.35**	**2519.0**	**2094.3**	**594.9**	**5209.0**	**2.06**	**0.48**

Source: Tiwari (1992)

Table.3 Recommended spacing, stocking density, rotation age and major uses of Eucalyptus species/ hybrid plantations

Planting spacing	Number of trees (ha^{-1})	Rotation age (years)	Major uses
3.0 × 3.0 m	1,111	10–18	Transmission poles, sawlogs, construction timber, plywood
3.0 × 2.5 m	1,333	8–12	Poles, pulpwood, light construction timber
2.75 × 2.75 m	1,320	6 - 18	Transmission poles, fencing posts, light construction poles, timber
2.5 × 2.5 m	1,600	6–10	Poles, fuelwood, pulpwood
2.0 × 2.0 m	2,500	7	Poles, Pulpwood, biomass production
1.0 × 1.0 m	10,000	2–4	Firewood, charcoal, short-rotation biomass production

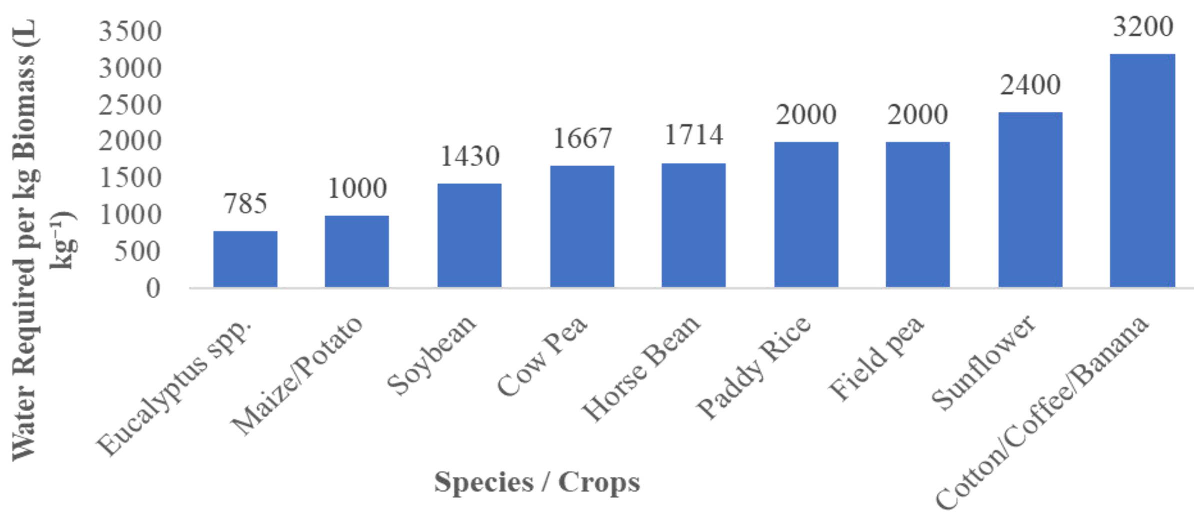
Source: Oballa *et al.,* 2010; Pima *et al.,* 2015; Pima *et al.,* 2015 Laswai *et al.,* 2018

Table.4 Some Eucalyptus Species Suitability across Tanzania Agro-Ecological **Zones**

Tanzania Zone	Eucalyptus Species/Hybrid	Suitable Conditions	Altitude (m)	Rainfall (mm)	Climate / Soil Condition	Common Regions/Areas
Southern Highlands	*Eucalyptus grandis*, *E. saligna*, *E. urophylla*, GC hybrids (GC 15, GC 584, GC 581, and GU 608)	Deep fertile soils, well-drained sites, high rainfall areas	1200–2500	1000–2000	Cool to mild temperatures, high humidity	Iringa, Njombe, Mafinga, Mbeya, Ruvuma
Coastal Zone	*Eucalyptus camaldulensis*, *E. pellita*, *E tereticornis*, *E. citriodora*, GC 15, GC 167, GC 514, GC 584, GC 785, GT 529, GC 940, GU 21	Sandy to loamy soils, drought tolerance required, wind exposure	0–600	750–1200	Warm humid climate, moderate fertility soils	Pwani, Lindi, Mtwara, Tanga, Dar es Salaam
Semi-Arid Central Zone	*Eucalyptus camaldulensis*, *E. populnea*, GC hybrids	Drought-prone sites, shallow soils, low fertility tolerance	900–1500	500–800	Hot semi-arid climate, poor to moderate soils	Dodoma, Singida, Shinyanga
Lake Zone	*Eucalyptus grandis*, *E. urophylla*, GC 167, GC 584 and GC 514	Fertile, well-drained soils with moderate moisture	1100–1800	800–1400	Warm temperate to sub-humid conditions	Mwanza, Kagera, Mara
Northern Highlands	*Eucalyptus grandis*, *E. saligna*, *E. maidenii,* GC 581, GC 584 and GU 608	Volcanic soils, deep fertile soils, high moisture availability	1400–2400	1000–1800	Cool highland climate, fertile volcanic soils	Arusha, Kilimanjaro, Manyara, Lushoto-Tanga
Eastern Lowlands	*Eucalyptus tereticornis*, *E. camaldulensis,* GC 514, GT 529 and GC 940	Well-drained sandy/loam soils, drought tolerant sites	0–800	600–1000	Hot coastal to sub-humid conditions	Morogoro, Coast Region, Tanga
Miombo Woodlands	*Eucalyptus camaldulensis*, GC 15, GC 584 and GC 940	Poor to moderate soils, seasonal water stress tolerance	800–1400	700–1200	Seasonal rainfall, nutrient-poor Miombo soils	Tabora, Kigoma, Katavi

Source: Pima *et al.,* 2016; URT, 2021

Figure.1 Water use per kilogramme biomass produced by different species/crops



In accordance with Tanzania forestry establishment guidelines, all plantation and woodlot developments shall maintain a minimum buffer distance of at least 60 metres from the edge of rivers, streams, lakes, wetlands, and other water bodies, in order to minimize hydrological disturbances, reduce excessive water uptake, and protect water quality, streambank stability, erosion control, and biodiversity conservation (URT, 2021). According to EMA (2004) no human activities of a permanent nature or which may, by their nature, likely to compromise or adversely affect conservation and, or the protection of ocean or natural take shorelines, river bank, water dam or reservoir, shall be conducted within sixty metres. These principles are reinforced through sustainable forest plantation guidelines and environmental management practices that emphasize maintaining natural vegetation buffers along water bodies to protect hydrological functions and reduce ecological degradation in plantation landscapes.

Conclusions

Eucalyptus plantations in Tanzania present both opportunities and trade-offs. Their fast growth, adaptability, and strong market demand make them important option for reducing the national wood deficit, supporting rural livelihoods, and supplying raw material for construction, fuelwood, poles, and industrial uses. At the same time, concerns about water use, soil fertility, and biodiversity loss remain valid, especially where plantations are established in sensitive ecosystems or without proper planning. The debate should therefore focus not only on whether Eucalyptus is inherently good or bad, but on where it is planted, which species or hybrids are selected and how plantations are managed. Sustainable outcomes will depend on site-specific management guidelines, careful species-site matching, and clear land-use policies that prevent planting in ecologically sensitive areas. When planted on suitable sites and guided by sound silvicultural and environmental practices, Eucalyptus can contribute to wood supply, income generation, land restoration, and climate resilience. In addition, when integrated into agroforestry systems, smallholder woodlots, and degraded land rehabilitation programmes, Eucalyptus can reduce pressure on natural forests, generate income, and contribute to climate resilience. Eucalyptus is neither a universal solution nor an ecological threat by default, it is a resource whose benefits and risks hinge on context. However, when planted near wetlands, streams, springs, or water-stressed catchments without safeguards, it may intensify competition for water and create local ecological concerns. With science-based planning, community involvement, and strong governance, Tanzania can harness Eucalyptus to meet its wood demand while safeguarding water, soil, and biodiversity for future generations. There is a need of developing guidelines for planting Eucalypts in Tanzania to minimize adverse impacts and increase benefits from this fast growing and highly productive genus. It also requires promoting mixed land-use systems such as agroforestry, woodlots, and degraded-land rehabilitation, supporting long-term research on water use, soil impacts, biodiversity, and productivity; and training farmers, extension officers, and plantation managers in sustainable silvicultural practices.

Reporting Standards Statement

The authors pledge adherence to recognized reporting standards (for example, CONSORT for randomized trials, PRISMA for systematic reviews and meta-analyses, STROBE for observational studies, ARRIVE for animal studies, etc.).

Authors Contribution

Nancy E. Pima: Conceived the original idea and wrote the manuscript. Literature review on all aspects. Joshua S Maguzu: Gathered information on Site species matching. Ashura Abdallah Kaniki: Water use efficiency and water relations. Herieth Andrew Nyarobi: Literature review on social economic contribution and Cost-benefit analysis. Joseph James Chogga: Literature review on recommended planting spacing.

References

Albaugh, J. M., Dye, P. J., & King, J. S. (2013). *Eucalyptus and water use in South Africa*. International Journal of Forestry Research, 2013: 1–11.

Alcorn, P. J., Forrester, D. I., Thomas, D. S., James, R., Smith, R. G. B., Nicotra, A. B., & Bauhus, J. (2013). Changes in whole-tree water use following live-crown pruning in young plantation-grown *Eucalyptus pilularis* and *Eucalyptus cloeziana*. *Forests*, 4: 106–121.

Alemayehu, A., Birhanu, D., Abate, T., Chanie, K., Furo, G., & Abebe, M. (2026). Financial evaluation of converting agricultural land to plantation forests in Ethiopia. *Trees, Forests and People*, 101282. DOI: https://doi.org/10.1016/j.tfp.2026.101282.

Booth, T. H. (2013). Eucalypt plantations and climate matching models. FAO-supported ecological zoning datasets.

Calder, I. R., Hall, R. L., & Adlard, P. G. (1992). *Growth and Water Use of Forest Plantations*. John Wiley and Sons Publishers, New York. 381pp.

Chen, H., Sloggy, M. R., Dhiaulhaq, A., Escobedo, F. J., Rasheed, A. R., Sánchez, J. J., Yang, W., Yu, F., & Meng, Z. (2023). Boundary of ecosystem services: Guiding future development and application of the ecosystem service concepts. *Journal of Environmental Management*, 344: 118752. DOI: https://doi.org/10.1016/j.jenvman.2023.118752

Davidson, J. (1989). *The Eucalypt Dilemma: Arguments for and Against Eucalypt Planting in Ethiopia*. Seminar Notes Series No.1. Forestry Research Center, Addis Ababa, Ethiopia. 73pp.

Davidson, J. (1993). Ecological aspects of Eucalypt plantations. In: *Proceedings of the Regional Expert Consultations on Eucalyptus*. 35pp.

Dessie, A. B., Abtew, A. A., & Koye, A. D. (2019). Determinants of the production and commercial values of *Eucalyptus* woodlot products in Wogera District, Northern Ethiopia Dessie *et al., Environ Systems Research 8:4*. https://doi.org/10.1186/s40068-019-0132-6

Dougherty, D., & Wright, J. (2012). "Silviculture and economic evaluation of eucalypt plantations in the southern US," *BioResources.* 7(2), 1994-2001.

Dye, P. (2013). Measuring and modelling the soil water balance in South African forestry plantations. *Forest Ecology and Management*, 301: 42–50. DOI: https://doi.org/10.1016/j.foreco.2012.06.030

Dye, P. J. (1996). Climate, forest and stream flow relationships in South African afforested catchments. *Community Forest Review*, 75: 31–38.

Dye, P. J., Jacobs, S., & Drew, D. (2004). Verification of 3-PG growth and water-use predictions in twelve *Eucalyptus* plantation stands in Zululand, South Africa. *Forest Ecology and Management*, 193(2): 197–218.

EMA. (2004). Tanzania Environmental Management Act (EMA), Cap. 191 (2004) and its regulations, 158pp.

FAO. (2009). *Eucalyptus in East Africa: The Socio-economic and Environmental Issues*. FAO Sub-regional Office for Eastern Africa, Addis Ababa.

FAO. (2020). Species distribution and plantation suitability Food and Agriculture Organization (FAO). Global planted forests thematic study: planted forests in East Africa.

FAO. (2024). *Global Forest Resources Assessment / State of the World's Forests 2024*. Food and Agriculture Organization of the United Nations, Rome.

URT. (2021). TECHNICAL ORDER No 1 OF 2021, Ministry of Natural Resources and Tourism, Forestry and Beekeeping Division, 20pp.

Ferraz, C. P. A., Manoel, M. P. S., Chaves, J. V. B., Aiello, L. H. F., da Silva, G. S., Medeiros, G. A. D., & Ribeiro, A. Í. (2024). Environmental impacts of eucalyptus plantations and harvesting systems. *Forests*. DOI: https://doi.org/10.3390/f15081291

Ferreira, F.A.C., Freitas, L.C., Leite, E.S., *et al.,* (2024). Work efficiency and harvester costs in Brazilian eucalyptus plantations. *International Journal of Forest Engineering*, 35(1), 21–28. DOI: https://doi.org/10.1080/14942119.2023.2276577

Fetene, M. (2012). *Studies in Tree Hydrology: Strategies of Water Use in Co-occurring Exotic and Indigenous Species, Munessa Forest*. Addis Ababa, Ethiopia. 43pp.

Furo, G., Gong, Z., & Huo, R. (2026). Economic trade-offs of farmland conversion to Eucalyptus plantations in southern Ethiopia. *Agricultural Systems*, 236, 104739. DOI: https://doi.org/10.1016/j.agsy.2026.104739

Gelaye, Y., & Getachew, K. (2026). Environmental impacts, land-use trade-offs, and sustainable management pathways of *Eucalyptus* plantation expansion in Ethiopia. *The Scientific World Journal*, 2026, Article ID 6629432. DOI: https://doi.org/10.1155/tswj/6629432

Getahun, A. (2002). Eucalyptus farming in Ethiopia: The case for eucalyptus woodlots in the Amhara region. *Bahir Dar Conference Proceedings*, pp. 137–153. Ethiopian Society of Soil Science.

Hakamada, R. E., Hubbard, R. M., Moreira, G. G., Stape, J. L., Campoe, O., & Ferraz, S. F. B. (2020). Influence of stand density on growth and water use efficiency in Eucalyptus clones. Forest Ecology and Management, 466: 118125. DOI: https://doi.org/10.1016/j.foreco.2020.118125

Hubbard, R. M., Stape, J. L., Ryan, M. G., Almeida, A. C., & Rojas, J. (2010). Effects of irrigation on water use and water use efficiency in two fast-growing *Eucalyptus* plantations. *Forest Ecology* *and Management*, 259: 1714–1721. DOI: https://doi.org/10.1016/j.foreco.2009.10.028

Hutapea, F. J., Weston, C. J., Mendham, D. S., & Volkova, L. (2023). Sustainable management of *Eucalyptus pellita* plantations: A review. *Forest Ecology and Management*, 537: 120941. DOI: https://doi.org/10.1016/j.foreco.2023.120941

Iglesias-Carrasco, M., Torres, J., Cruz-Dubon, A., Candolin, U., Wong, B. B. M., & Velo-Antón, G. (2025). Global impacts of exotic eucalypt plantations on wildlife. Biological Reviews, 100(4): 1734–1753. DOI: https://doi.org/10.1111/brv.70022

Jagger, P., & Pender, J. (2000). *The Role of Trees for Sustainable Management of Less-Favored Lands: The Case of Eucalyptus in Ethiopia*. International Food Policy Research Institute, Washington, USA. 82pp.

Joshi, M., & Palanisami, K. (2011). Impact of *Eucalyptus* plantations on groundwater availability in south Karnataka. *ICID 21st Congress*, Tehran, October 2011. International Commission on Irrigation and Drainage.

Kaptein, N.D., Toucher, M.L., Clulow, A.D., Everson, C.S., & Germishuizen, I. (2024). Water use and potential hydrological implications of fast-growing *Eucalyptus grandis x Eucalyptus urophylla* hybrid in northern Zululand, South Africa Water SA 50(1) 57–68. DOI: https://doi.org/10.17159/wsa/2024.v50.i1.4056

Keitel, C., & Adams, M. A. (2009). *Climate, Management and Ecosystem Interactions in the Pilbara: Tree Water Use at Millstream National Park*. Sydney. 30pp.

Laclau, J. P., Deleporte, P., Ranger, J., Bouillet, J. P., & Kazotti, G. (2003). Nutrient dynamics throughout the rotation of *Eucalyptus* clonal stands in Congo. *Annals of Botany*, 91: 879–892. DOI: https://doi.org/10.1093/aob/mcg093

Laswai, F., Malimbwi, R. E., Chamshama, S. A. O., Abdallah, J. M., Balama, C., Pima, N. E., Mugasha, W.A., & Mauya, E. (2018). Rotation age and fibre length of *Pinus patula* at Sao Hill Forest plantation, Tanzania. Proceedings of the 1st TAFORI Scientific Conference on Forestry Research for Sustainable Industrial Economy in Tanzania October, 2018.

Lima, H., Alvares, C. A., Ryan, M. G., & Binkley, D. (2020). Assessing the cross-site and within-site response of potential production to atmospheric demand for water in *Eucalyptus* plantations. *Forest Ecology and Management*, 464: 118068.: https://doi.org/10.1016/j.foreco.2020.118068

Mao, X., Zheng, H., Luo, G., Liao, S., Wang, R., Tang, M., & Chen, H. (2024). Climate change favors expansion of three *Eucalyptus* species in China. *Frontiers in Plant Science*, 15: 1443134. DOI: https://doi.org/10.3389/fpls.2024.1443134

Mbow, C., Smith, P., Skole, D., Duguma, L., & Bustamante, M. (2014). Achieving mitigation and adaptation to climate change through sustainable agroforestry practices in Africa. *Environmental Sustainability*, 6:8–14. DOI: http://dx.doi.org/10.1016/j.cosust.2013.09.002

Medeiros, P. L., Pimenta, A. S., Miranda, N. O., de Melo, R. R., Amorim, J. S., & de Azevedo, T. K. B. (2025). The myth that eucalyptus trees deplete soil water: A review. *Forests*, 16(3): 423. DOI: https://doi.org/10.3390/f16030423

MNRT (2000). Involvement of Private Sector in the Industrial Forest Plantation Development and Management Draft Interim Report. Ministry of Natural Resource and Tourism, Dar es Salaam, Tanzania (2000), p. 59

Mombo, F., Ngaga, Y., Temu, B.J., & Kainyande, A. (2022). Narrowing the wood supply gap through on-farm wood production in Tanzania. Policy Brief. DOI:10.25368/2022.364

Mpiluka, S. R., Madundo, S. D., Balama, C. P., & Mwakalukwa, E. E. (2026). Stem Quality and Wood Basic Density of Eucalyptus Species Grown at Wino Forest Plantation, Ruvuma Region, Tanzania. *East African Journal of Forestry and Agroforestry*, 9(1). DOI: https://doi.org/10.37284/eajfa.9.1.4328

Munishi, P. K. T. (2007). *The Eucalyptus Controversies in Tanzania*. TAF Annual General Meeting, Dodoma, Tanzania. 22pp.

Mwamakimbullah, R. (2016). Private forestry sector in Tanzania: status and potential. AFF Report. African Forest Forum, Nairobi, p. 74.

NAFORMA. (2015). National Forest Resources Monitoring and Assessment of Tanzania Mainland. Ministry of Natural Resources and Tourism, Tanzania. Ministry for Foreign Affairs of Finland & Food and Agriculture Organisation of the United Nations (2015), p. 106

Nduwamungu, J., Munyanziza, E., Nduwamungu, J. D., Ntirugulirwa, B., Gapusi, R. J., Bambe, J. C., Ntabana, D., & Ndizeye, G. (2007). *Eucalyptus in Rwanda: Are the Blames True or False?* Institute Des Sciences Agronomiques Du Rwanda. 78pp.

Nkonya, E., Kato, E., Msimanga, M., & Nyathi, N. (2023). Climate shock response and resilience of smallholder farmers in the drylands of south-eastern Zimbabwe. Front. Clim., Volume 5 - 2023 DOI: https://doi.org/10.3389/fclim.2023.890465

Nshubemuki, L., Chamshama, S. A. O., & Mugasha, A. G. (2001). *Technical Specifications on Management of Forest Plantations in Tanzania*. A report prepared for the Forestry and Beekeeping Division, Ministry of Natural Resources and Tourism, Dar es Salaam, Tanzania. 35pp.

Oballa, P. O., Konuche, P. K. A., Muchiri M. N., & Kigomo, B. N. (2010). *Facts on Growing and Use of Eucalyptus in Kenya*. Kenya Forestry Research Institute, Nairobi, Kenya. 37pp.

Otto, M. S. G., Hubbard, R. M., Binkley, D., & Stape, J. L. (2014). Dominant clonal *Eucalyptus grandis × urophylla* trees use water more efficiently. *Forest Ecology and Management*, 328: 117–121. DOI: https://doi.org/10.1016/j.foreco.2014.05.032

Palma, J. H. N., Hakamada, R., Moreira, G. G., Nobre, S., & Rodriguez, L. C. E. (2021). Using 3PG to assess climate change impacts on management plan optimization of Eucalyptus plantations: A case study in Southern Brazil. *Scientific Reports*, 11, 2708. DOI: https://doi.org/10.1038/s41598-021-81907-z

Pima, N. E., Chamshama, S. A. O., & Iddi, S. (2015). Water use by eucalypt clones growing at Kongowe, Kibaha, Tanzania. *Tanzania Journal of Forestry and Nature Conservation*, 84(2): 46–57.

Pima, N. E., Chamshama, S. A. O., Iddi, S., & Maguzu, J. (2016). Growth performance of eucalypt clones in Tanzania. *Journal of Environment and Ecology Research*, 4(3): 146–154.

Pramono, I. B., Basuki, T. M., Nugroho, H. Y. S. H., Santosa, B. H., Purwanto, E., & Narendra, B. H. (2026). Hydrological consequences of land use/land cover change in Indonesia: Impacts, trends, and disaster mitigation. A review. *Trees, Forests and People*, 25: 101291. DOI: https://doi.org/10.1016/j.tfp.2026.101291

Ryan, M. G., Stape, J. L., Binkley, D., & Alvares, C. A. (2020). Cross-site patterns in the response of *Eucalyptus* plantations to irrigation, climate and intra-annual weather variation. *Forest Ecology and Management*, 475: 118444. DOI: https://doi.org/10.1016/j.foreco.2020.118444

Schulze, K., Malek, Ž., Schepaschenko, D., Lesiv, M., Fritz, S., & Verburg, P. H. (2023). Pantropical distribution of short-rotation woody plantations: Spatial probabilities under current and future climate. *Mitigation and Adaptation Strategies for Global Change*, 28: 28. DOI: https://doi.org/10.1007/s11027-023-10066-5

Scott, D. F., & Prinsloo, F. W. (2008). Longer-term effects of pine and eucalypt plantations on streamflow. *Water Resources Research*, 44: W00A08. DOI: https://doi.org/10.1029/2007WR006781

Senelwa, K., Etiegni, L., Kirongo, B. B., Ototo, G. O., Imo, M., & Ogweno, D. (2009). Misunderstandings of the impacts of planting *Eucalyptus* species in Kenya: Criticisms and misconceptions. Paper presented during FSK Public Debate on Eucalyptus Planting at Kenya Forest Service Headquarters, Nairobi, Kenya, 9 July 2009. pp. 1–32.

Sharma, V., Karnwal, A. A., Sharma, S., Kamal, B., Jadon, V. S., Gupta, S., & Sivanasen, I. (2023). A comprehensive review uncovering the challenges and advancements in the in vitro propagation of *Eucalyptus* plantations. *Plants*, 12(17): 3018. DOI: https://doi.org/10.3390/plants12173018

Spinelli, R., Ward, S.M., & Owende, P.M.O. (2009). A harvest and transport cost model for *Eucalyptus* spp. fast-growing short rotation plantations. *Biomass and Bioenergy*, 33(9), 1265–1270. DOI: https://doi.org/10.1016/j.biombioe.2009.05.010

Srivastava, R. J., Kumar, A., & Prasad, K. (2003). Studies on soil moisture variations under *Eucalyptus* plantation. *Soil Science*, 3: 21–32.

Stape, J. L., Binkley, D., Ryan, M. G. and Gomes, A. N. (2004). Water use, water limitation, and water use efficiency in a *Eucalyptus* plantation. *Bosque*, 25(2): 35–41. DOI: https://doi.org/10.4067/S0717-92002004000200004

Teketay, D. (2003). Experience on *Eucalyptus* plantations in Ethiopia. Presented in the Forum on Eucalyptus Dilemma, Nairobi, Kenya, 5 June 2003. pp. 34–48.

Teshome, T. (2009). Is *Eucalyptus* ecologically hazardous tree species? *Ethiopian E-journal for Research and Innovation Foresight*, 1(1): 128–134.

Teixeira, G., Rodrigues, G. S. S. C., & Bento-Gonçalves, A. (2024). Environmental impacts of eucalyptus territorialization in Brazil and Portugal.

Mercator, 23: e23033. DOI: https://doi.org/10.4215/rm2024.e23033

Tiwari, D. N. (1992). *Monograph on Eucalyptus*. Surya Publications, Dehra Dun, India. 175pp.

Wells, J., Stringer, L. C., Woodhead, A., & Wandrag, E. (2023). Towards a holistic understanding of non-native tree impacts on ecosystem services: A review of *Acacia*, *Eucalyptus* and *Pinus* in Africa. *Ecosystem Services*, 60: 101511. DOI: https://doi.org/10.1016/j.ecoser.2023.101511

White, D. A., Ren, S., Mendham, D. S., Balocchi-Contreras, F., Silberstein, R. P., Meason, D., Iroumé, A., & de Arellano, P. R. (2022). Is the reputation of *Eucalyptus* plantations for using more water than *Pinus* plantations justified? *Hydrology and Earth System Sciences*, 26: 5357–5371. DOI: https://doi.org/10.5194/hess-26-5357-2022

Whitehead, D., & Beadle, C. L. (2004). Physiological regulation of productivity and water use in *Eucalyptus*: A review. *Forest Ecology and Management*, 193: 113–140. DOI: https://doi.org/10.1016/j.foreco.2004.01.026.

Whitesell, C, D., DeBell, D. S., Schubert, T. H., Strand, R. F., & Crabb, T. B. (1992). Short-rotation management of Eucalyptus: guidelines for plantations in Hawaii. Gen. Tech. Rep. PSW-GTR- 137. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 30 p. DOI: https://doi.org/10.2737/PSW-GTR-137

Zerga, B., Warkineh, B., Teketay, D., & Woldetsadik, M. (2021). The sustainability of reforesting landscapes with exotic species: a case study of eucalypts in Ethiopia. *Sustainable Earth Reviews*, 4, 5. DOI: https://doi.org/10.1186/s42055-021-00044-7

How to cite this article:

Nancy Eliad Pima, Joshua Stanley Maguzu, Ashura Abdallah Kaniki, Herieth Andrew Nyarobi and Joseph James Chogga. 2026. The Eucalypt Dilemma: Can we Use Eucalypts to Address Wood Deficit and Poverty in Tanzania-Review. *Int.J.Curr.Res.Aca.Rev.* 14(6), 51-62. doi: https://doi.org/10.20546/ijcrar.2026.1406.007