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Original Article

Resources Assessment for Urban Tourism Opportunity at Tengeru Institute of Community Development Campus Natural Forest Patch in Arumeru District, Tanzania

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ABSTRACT

Forest resource assessment in tourism is vital for evaluating, appreciating, and sustainably managing attractions like landscapes, biodiversity, and ecosystems. Forest resource assessment was conducted at the TICD natural forest patch to determine plant species richness, diversity and distribution. Also, tree species volume and carbon stock were evaluated. Tree regeneration was determined to reveal the health of the forest patch. Tourist opportunities, activities and threats to the forest patch were recorded. A total of 83 plant species were determined, including 23 shrubs and woody climbers, 28 herbaceous plants, and 32 mature trees. 30 tree species seedlings were recorded, including two, Syzygium jambos L. Alston and Turraea robusta Gurke, that did not have mature representatives. The calculated diversity index for mature trees, seedlings, shrubs and woody climbers was >1.5, revealing high diversity. The plant species with the highest relative frequency were judged to be the most distributed taxon. Those trees with the largest diameter also captured the largest volume, biomass, and carbon stock. The evaluated tourist opportunities were the TICD arboretum, forest cover, water springs, and different plant species. Tourist activities were camping, environmental cleaning, hiking, walking, native tree planting, visiting a Polish burial site, training and awareness creation on sustainable environment and development. Noticeable forest resources threats were encroachment, tree cutting, and the invasion of alien invasive plant species. Further study is needed to detect resource composition changes, restoration of degraded forest patches, review on actual boundaries and size, and construct a tourist's rest house/lodge, involvement of stakeholders in the conservation of the site and nearby forest patches.

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INTRODUCTION

Training institutions face significant gaps in addressing the evolving needs of urban tourism, primarily due to a reliance on supply-driven curriculum rather than industry demand, leading to skill shortages in operational roles (Ghanbari & Nouraeizadeh, 2025). The urban tourism development key gaps include a lack of focus on digital transformation (AI/VR), sustainability, and tailored training for small-scale, local tourism providers (Kabii et al., 2019). Digital transformation is the strategic integration of digital technologies across all business areas, fundamentally changing how organisations operate and deliver value to customers (Schiliro, 2024). The global community is increasingly integrating sustainability into tourism to ensure that income generation supports the restoration and protection of urban biodiversity (Althobaiti & Abulibdeh, 2026). Rather than treating urban areas solely as built environments, initiatives like the World Economic Forum's Biodiversity by 2030 aim to transform cities into regenerative ecosystems where human well-being and nature mutually reinforce each other (IUCN Urban Alliance, 2022). Learning institutions and urban tourism are increasingly recognised as powerful, complementary tools for promoting sustainability, environmental stewardship, and biodiversity conservation (Børresen et al., 2023). Campuses function as living laboratories for human development and biodiversity, while sustainable urban tourism acts as a mechanism to promote these values to the wider public (Vieira et al., 2023). The rapid growth of cities, particularly in developed countries, has historically resulted in significant environmental degradation, including the depletion of vegetation, habitat destruction, and, over time, the creation of urban heat islands due to the replacement of natural surfaces with concrete and asphalt (Gohar, 2021). This environmental deterioration prompted a shift in focus towards sustainable urban tourism, which emerged as a way to manage, conserve, and showcase both natural and cultural heritage in developed areas (Asare et al., 2025).

Urban tourism has indeed emerged as a vital strategy for development and ecological sustainability in Africa, where many countries are rapidly developing (Signe, 2020). Urban tourism functions as a catalyst for economic growth, providing foreign exchange, creating jobs, and enhancing infrastructure, while offering opportunities to integrate cultural heritage and environmental protection into city planning (Seraj et al., 2025). Since most African countries are still developing in terms of agriculture, settlements, and processing industries, planning for sustainability can be easily set to sustain the existing biodiversity (Scherr & McNeely, 2007). It has been supported that the premise that developing African countries can strategically plan for sustainability to protect biodiversity is well-supported by current research, as these nations have the unique, "leapfrog" opportunity to adopt sustainable models rather than retrofitting outdated, high-impact industrial approaches (FAO, 2020). As many African countries are currently developing agricultural, settlement, and processing infrastructures, there is a crucial window to integrate biodiversity-friendly practices (Adolph et al., 2023).

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Tanzania is actively integrating sustainability into its urban development, treating urban tourism as a crucial component to drive economic growth, create jobs, and foster sustainable livelihoods (Nyerere, 2020). It has been stated that Tanzania is increasingly focusing on sustainable urban development, with urban tourism identified as a critical, high-potential sector to drive economic growth, employment, and infrastructure modernisation (Lwoga, 2013). Tanzania's Vision 2050 framework and recent policy initiatives aim to move beyond traditional nature-based tourism to include urban, cultural, and conference tourism in major cities like Dar es Salaam, Arusha, and Stone Town (Zanzibar) (United Republic of Tanzania, 2025). In Tanzania, the vegetation cover found in botanical gardens, reserved native vegetation patches, water catchment areas, and buildings/old buildings are among tourism attractions opportunities (Munishi, 2025). Protected areas are essential for conserving biodiversity and maintaining flows of ecosystem services, including storing carbon and providing regular water flows, and are also an important buffer against climate change (Ract et al., 2024).

Arusha in northern Tanzania is the most famous region in terms of the tourism industry, with a good number of tourists visiting various attractions within settlements, avenues, botanical gardens/arboreta and reserved water catchment areas. It has been supported that Arusha is widely recognised as the primary hub for the tourism industry in Tanzania and the gateway to the renowned Northern Circuit safari destinations (Mato & Musoma, 2022). Located at the foot of Mount Meru, the region serves as a starting point for tours to Serengeti National Park, Ngorongoro Crater, Lake Manyara, and Tarangire (Nko & Mbwambo, 2024). Arusha serves as the ultimate safari capital gateway, offering readily accessible, high-value, and unique attractions for tourists waiting for or returning from extended northern circuit safaris, with the key, easily accessible attractions include the scenic Arusha National Park for day game drives and walking safaris, the cultural Hub at the Cultural Heritage Centre, and the relaxing Chemka/Kikuletwa Hot Springs (African Environments, 2026).

The Tengeru Institute of Community Development (TICD) has attractive surroundings together with relatively cool weather for the greater part of the year, an environment that is highly conducive to learning activities. For about 62 years, the institute has been a fountain of knowledge and skills to thousands of community development professionals supporting community efforts towards national development. Tengeru Institute of Community Development (TICD), apart from occupying only 14 ha, including only 1 ha of natural riverine forest (Garmin GPS 65s) on the southeast corner, harbours appreciating flora and fauna, beautifying the area**.** However, ecological tourism has never been considered before as one of the sustainable income-generating interventions**.** TICD has embarked on thinking of urban tourism as a panacea for sustainable environmental management. Various scholars, including Ochumbo (2019) and Blancas et al (2023), have pinpointed that higher learning Institutions (HLIs) are uniquely positioned to operate urban tourism, driving economic growth while promoting environmental sustainability through campus-based, educational, and sustainable tourism models. By leveraging existing infrastructure, expertise, and a focus on sustainable practices, universities can turn campus environments into attractions, foster local development, and advance educational goals (Abo-Khalil, 2024; Atstaja, 2025). This assessment focused on the forest resources examination, tourist opportunities evaluation and activities that can be performed by tourists, and outlining threats to the natural forest vegetation composition.

MATERIALS AND METHODS

Location of TICD Campus Natural Forest Patch

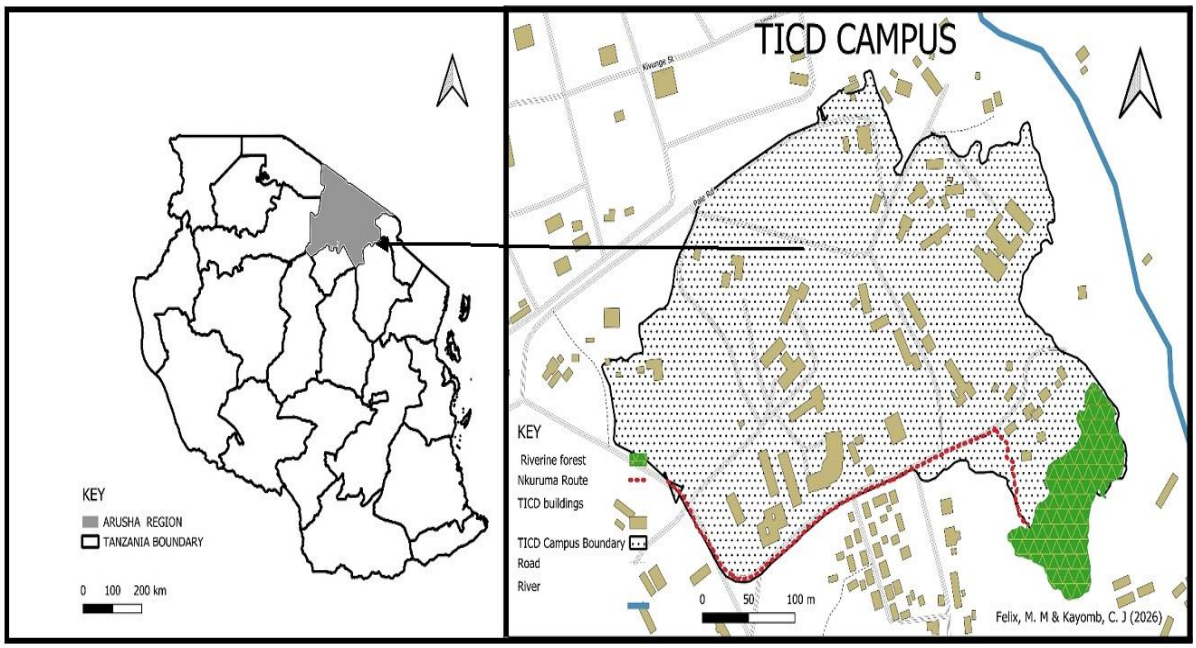
The institute is located 13 kilometres east of the city of Arusha, along the Arusha-Moshi highway. Her nearest neighbours are the Livestock Training Agency (LITA – Tengeru), Horticultural Research and Training Institute (HORTI –

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Tengeru), Tanzania Plant Health and Pest Authority (TPHA – Tengeru), and Tanzania Official Seed Certification Institute (TOSCI – Tengeru). The Tengeru Institute of Community Development (TICD) is situated at 1.5 km southeast of Tengeru town centre. TICD closely borders the Livestock Training Institute (LITA) on the south and west, on the north it borders 78 Duluti Street, and on the east it borders Village (Field Data, 2026). It belongs to the Akheri ward in Arumeru District (Figure 1). The forest patch is located at 37 M 0256200 East, UTM 9625963 South, with an altitude range of 1224 to 1250 m a.s.l, and it is 0.5 km southeast of the TICD Administration Block through Nkuruma road. There is only one hectare (2.5 acres).

Figure 1: Location of Tengeru Institute of Community Development (TICD) and Natural Forest patch



Data Collection Methods

Purposive systematic sampling was applied to determine the plant species of the forest patch. Purposive systematic sampling is a non-probability technique combining targeted selection with structured intervals to select sites or participants with specific, relevant characteristics (Tajik et al., 2024). Whittaker's nested vegetation sampling method was employed during this survey. It has been stated that nested plots for vegetation surveys use a hierarchical, multi-scale approach, such as small nested subplots within larger plots to efficiently sample diverse species, sizes, and growth stages simultaneously, and typically, this involves sampling herbs in small quadrats (Stohlgren et al., 1995).

A total of 17, 10 m x 10 m (100 m^2) plots were established at an interplot distance of 25 m (Figure 2). The sampling intensity was 6.8%.

Trees Species Sampling Pocedure

The found tree species with a diameter of ≥2 cm were measured for diameter (at 1.3 m from ground level) using a diameter caliper, and height was measured using a Suunto hypsometre and recorded for their botanical names. When trees with a diameter of ≥2 cm are considered, it implies that this low threshold (beginning) suggests the study is likely focused on regeneration, understory, or secondary forest, as many commercial inventories only count trees ≥10 cm or ≥15 cm (Karyat et al., 2017). All trees with a diameter <2 cm were treated as seedlings, hence were just counted for their number of individuals

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and recorded for their botanical names within a nested plot of 1 m x 1 m (1 m^2).

Non-Tree Woody Plants Sampling

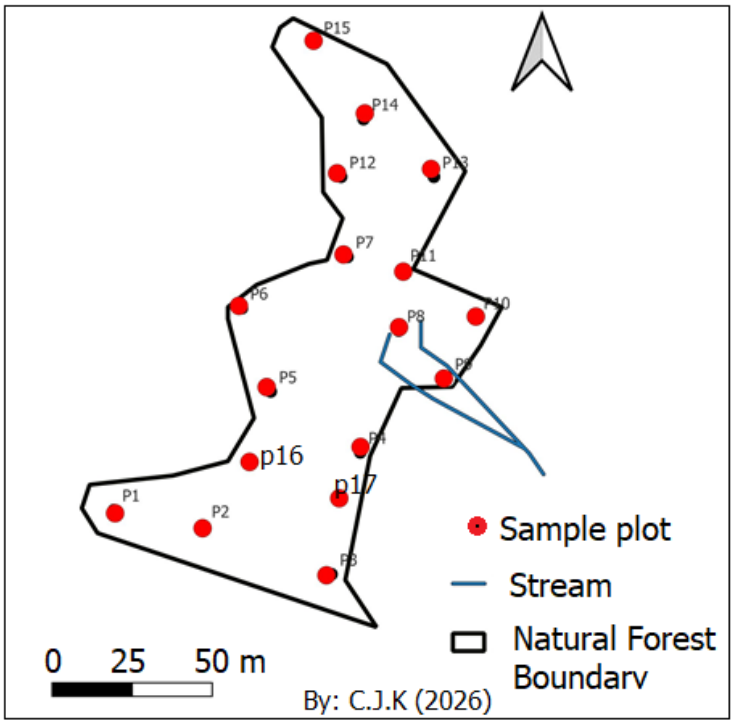
Non-tree woody plants include shrubs, lianas (woody climbers), and sub-shrubs; they are perennial plants with lignified, persistent stems that do not grow to tree size (Bożek et al., 2023). The non-tree woody plants were counted and recorded in the nested plot of 2 m x 5 m.

Herbaceous Plants

Herbaceous plants are vascular plants with soft, green stems that lack persistent woody tissue above ground, often dying back seasonally (Hou et al., 2023). Herbaceous plants include annuals, biennials, and perennials, such as grasses, ferns, and forbs (broad-leafed herbs). Sampling herbaceous plants often uses 0.5 m x 0.5 m or 1 m x 1 m sampling quadrats to measure density, frequency, and percentage cover (Kumar, 2025).

All herbaceous plants (ferns, grasses, and herbs) were recorded and estimated for their percentage cover within the nested plot of 1 m x 1 m (1 m^2).

Figure 2: Layout of Sample Plots



Data Analysis

Richness and Diversity

The richness (S) was just read from the overall list of plants as determined from sample plots. The species richness represents the total number of unique plant species identified within the sampling plots, and is a foundational measure of biodiversity that counts different types of species present, without accounting for the number of individuals or their relative abundance (Wilson et al., 2012). Diversity index was calculated using Shannon Wiener Diversity index (H') $=-\sum pi \times lnpi$; where H'= shannon wiener diversity index; pi = proportion of total individuals of a single species to the overall total individuals of all species from sample plots; ln = natural logarithm. Calculating a diversity index is crucial for quantifying ecological community structures, moving beyond simple species counts to include species richness and evenness (Bhardwaj et al., 2023). Calculating the diversity index enables scientists to monitor environmental health, assess the impact of pollutants or habitat changes, and prioritise conservation efforts (IPBES, 2019). The common indices like Shannon-Wiener and Simpson's help determine ecosystem stability (Teillard et al., 2016).

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Plant Species Structure

Plant species structure in this paper focuses on relative density, distribution, importance value index (IVI), tree species volume and carbon stock.

Relative Density (RD)

Relative density measures the abundance of a specific species compared to the total number of all tree individuals in an area, identifying dominant, rare, or regenerating species, and it is a critical component of the Importance Value Index (IVI), which guides forest management, restoration, biodiversity assessment, and ecological succession studies (Beason et al., 2023). The relative density was calculated through;

$$\mathrm{RD} = \frac{\mathrm{nD!}}{\mathrm{ND!}} \text{ x } 100$$

Where RD = relative density; nD = density of a single species; ND = an overall total of densities of all plant species recorded from sample plots; where 100 is a constant.

Distribution

Evaluation of plant distribution allows scientists to map species, analyse community structure (composition and abundance), predict responses to climate change, and manage invasive species (Rahman et al., 2021).

The distribution was calculated based on the relative frequency as reflected from the frequency of each species:

$$\mathrm{RF} = \frac{\mathrm{nF!}}{\mathrm{NF!}} \text{ x } 100$$

Whereby, RF = relative frequency; nF! =frequency of a single species; NF! = an overall total of frequency from all recorded plant species; and 100 = constant.

Importance Value Index

The Importance Value Index (IVI) is a critical tool in ecology for assessing the structural, functional, and ecological significance of a species within a plant community. By combining relative density, relative frequency, and relative dominance, IVI determines which species are dominant, co-dominant, or rare (Bulenga et al., 2023). IVI was calculated through:-

$\mathrm{IVI} = \mathrm{RD} + \mathrm{RF}$; Whereby IVI = Importance Value Index; RD = relative density; RF = relative frequency.

Volume

The volume of tree species was evaluated through;

$$\mathrm{G} = \frac{\pi \text{ x } \mathrm{D}^2}{4}; \quad \mathrm{G} = \frac{\pi \text{ x } \mathrm{D}^2}{0.68}$$

Where, G = volume in cubic metres; $\pi = 3.14$; 4 = constant; D = diameter (cm); 0.68 was derived from computation of sampled plots size in hectares (17 x 100m^2) ÷ (10,000m^2) x 4. Measuring tree volume is essential for sustainable forest management, enabling accurate estimation of timber inventory, growth rates, and economic value for timber sales (Mauya et al., 2014). Tree volume (G) is critical for calculating forest biomass, carbon sequestration capacity to combat climate change, and guiding decisions on management interventions (Liu et al., 2019; Likunguraine et al., 2020).

Carbon Stock

AGB = 0.9635*(dbh)$^{1.9440}$ as per Masota et al. (2014). Then the AGB (kg) was multiplied by the carbon factor 0.47 to get AGtC. While the total carbon stock (TtC) was calculated through

AGtC = 80%

X = 100%

X = TtC= 1.25 * AGtC.

Hence, the total carbon stock (TtC) was calculated through: TtC = 1.25*AGtC; where AGtC = aboveground carbon stock; 80% is the total contribution to an overall carbon stock; X = represents an overall carbon stock (above ground stock and below ground stock. Based on recent research and established ecological studies, the claim that aboveground stock is 80% of the whole carbon stock specifically refers to the distribution of carbon within terrestrial ecosystems or forest

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biomass, not the total carbon content of the planet (Mensah et al., 2020).

RESULTS

Vegetation Type and Dominant Plant Species

The forest patch is a riverine type of forest (Plate 1) dominated by *Allophyllus africanus, Celtis africana, Chaetacme aristata, Croton megalocarpus, Ficus lutea, F. sycomorus, F. thonningii, Rauvolfia caffra, Ricinus communis, Sorindeia madagascariensis, Tabernaemontana ventricosa, Trilipesium madagascariensis,* mixed with exotic trees of *Cedrela odorata, Grevillea robusta, and Senna spectabilis.* The recorded woody climbers were *Salacia madagascariensis, Toddalia asiatica,* mixed with the invasive alien woody climber *Caesalpinia decapetala.* The shrubs were *Acalyoha fruticosa*, *Hibiscus calyphyllus,* mixed with invasive alien shrubs of *Lantana camara, Montanoa hibiscifolia and Tithonia diversifolia.* Herbaceous plants included *Achyranthes aspera, Afromomum angustifolia, Canna indica, Colocasia esculenta, Commelina benghalensis, Commicarpus plumbagineus, Ipomoea obscure, Laggenaria abyssinica, Mirabilis jalapa, Momordica foetida, Musa accuminata*, and *Oplismenus hirtellus.*

Plate 1: Natural Forest Patch



PLANT SPECIES COMPOSITION AND STRUCTURE

Plant Species Composition

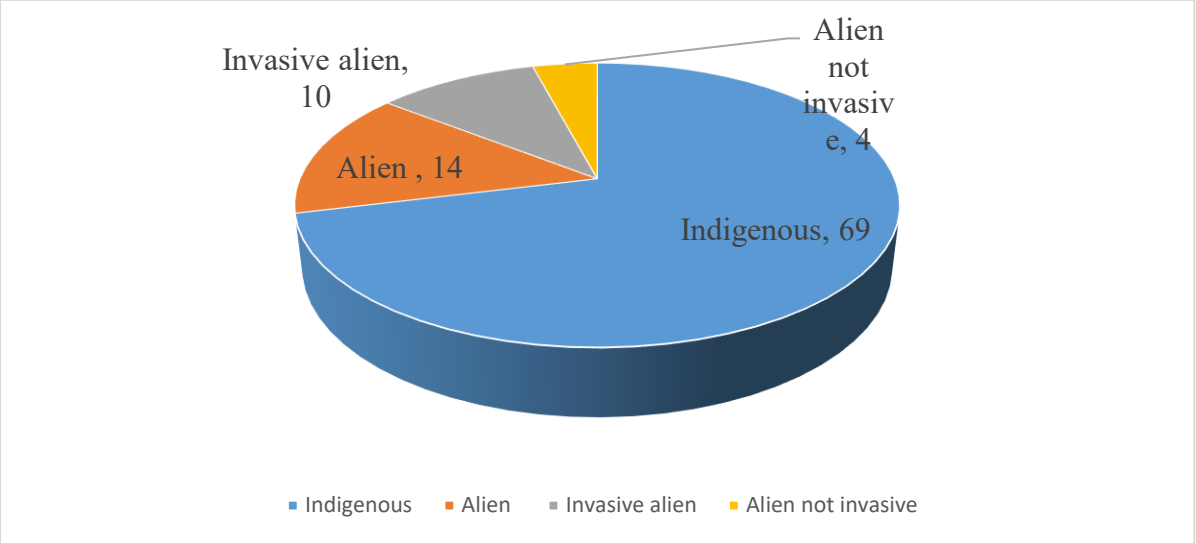
Trees Richness and Diversity

A total of 83 plant species (trees, shrubs and woody climbers, and herbaceous plants) were recorded at Tengeru Institute of Community Development (TICD) natural forest patch, including 69 indigenous and 14 alien species (Figure 3).

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Figure 3: Plant Species Determined at TICD Natural Forest Patch



In plant species composition, the richness (total number of species recorded from sample plots) and diversity (diversity index) were considered. A total of 32 tree species were recorded with the H' = 2.30 (Table 1).

Tree Species Structure

Relative Density

The highest relative density was recorded in *Cedrela odorata* L. and *Tabernaemontana ventricosa* A.DC, with the RD ≥41 (RD = 45.9). The moderately dense were *Celtis africana* Burm.f., *Ficus sycomorus* L., with the RD of ≤40 - ≥5, and those with the RD <5 were less dense (Table 1).

Importance Value Index (IVI)

The highest IVI was recorded for *Tabernaemontana ventricosa* Hochst. ex A. DC. (IVI = 65). The moderate IVI ranged from ≤18.7 - ≥11.9 and was recorded in *Cedrela odorata* L (IVI = 16), *Celtis africana* Burm.f. (IVI = 11.9), and *Ficus sycomorus* L. (IVI = 18.7), while the least IVI (Table 1)

Distribution

Three tree species, Cedrela odorata L. (9.2), *Ficus sycomorus* L., and *Tabernaemontana ventricosa* Hochst. ex A.DC. were known to be the most distributed with the RF of >8.9. The moderately distributed got the RF ranging from ≤8.9 - ≥5.8), and the members were *Cedrela odorata* L., *Celtis africana* Burm.f. (6.9), and *Rauvolfia caffra* Sond (RF = 6.9), and the rest were the least distributed with the RF of ≤5.7 (Table 1).

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Table 1: Tree Species Richness, Diversity Index, Relative Density, Relative Frequency, and Importance Value Index (IVI)

S/N	Botanical name	Author	Family	SST	F	H'	D	RF	RD	IVI
1	*Albizia gummifera*	(J.F. Gmel.) C.A.Sm.	Fabaceae	2	2	0.04	11.8	2.3	0.9	3.2
2	*Allophyllus africanus*	P.Beauv.	Sapindaceae	2	1	0.04	11.8	1.1	0.9	2.1
3	*Blighia unijugata*	Baker	Sapindaceae	2	1	0.04	11.8	1.1	0.9	2.1
4	*Bridelia micrantha*	(Hochst.) Baill	Euphorbiaceae	1	1	0.02	5.9	1.1	0.5	1.6
5	*Cedrela odorata*	L.	Meliaceae	15	8	0.18	88.2	9.2	6.8	16.0
6	*Celtis africana*	Burm.f.	Cannabaceae	11	6	0.15	64.7	6.9	5.0	11.9
7	*Chaetacme aristata*	Planch	Cannabaceae	1	1	0.02	5.9	1.1	0.5	1.6
8	*Combretum molle*	R.Br. ex G.Don	Combretaceae	2	2	0.04	11.8	2.3	0.9	3.2
9	*Cordia africana*	Lam.	Boraginaceae	2	2	0.04	11.8	2.3	0.9	3.2
10	*Croton macrostachyus*	Hochst. ex Delile	Euphorbiaceae	1	1	0.02	5.9	1.1	0.5	1.6
11	*Croton megalocarpus*	Hutch.	Euphorbiaceae	6	2	0.10	35.3	2.3	2.7	5.0
12	*Croton sylivaticus*	Hochst.	Euphorbiaceae	2	2	0.04	11.8	2.3	0.9	3.2
13	*Ehretia cymosa*	Thonn.	Boraginaceae	3	1	0.06	17.6	1.1	1.4	2.5
14	*Ficus thonningii*	Blume	Moraceae	2	1	0.04	11.8	1.1	0.9	2.1
15	*Ficus lutea*	Vahl.	Moraceae	2	1	0.04	11.8	1.1	0.9	2.1
16	*Ficus sur*	Forssk	Moraceae	1	1	0.02	5.9	1.1	0.5	1.6
17	*Ficus sycomorus*	L.	Moraceae	21	8	0.22	123.5	9.2	9.5	18.7
18	*Grevillea robusta*	A. Cunn. ex R.Br.	Proteaceae	7	5	0.11	41.2	5.7	3.2	8.9
19	*Newtonia buchananii*	(Bak.) G.C.C. Gilb. & Bout.	Fabaceae	1	1	0.02	5.9	1.1	0.5	1.6
20	*Olea capensis*	L.	Oleaceae	1	1	0.02	5.9	1.1	0.5	1.6
21	*Persea americana*	Mill.	Lauraceae	2	1	0.04	11.8	1.1	0.9	2.1
22	*Psychotria riparia*	(K. Schum. & K. Krause) Petit	Rubiaceae	1	1	0.02	5.9	1.1	0.5	1.6
23	*Rauvolfia caffra*	Sond.	Apocynaceae	6	6	0.10	35.3	6.9	2.7	9.6
24	*Ricinus communis*	L.	Euphorbiaceae	2	2	0.04	11.8	2.3	0.9	3.2

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S/N	Botanical name	Author	Family	SST	F	H'	D	RF	RD	IVI
25	*Senna spectabilis*	(DC.) H.S.Irwin & Barneby	Fabaceae	6	1	0.10	35.3	1.1	2.7	3.9
26	*Sorindeia madagascariensis*	(Spreng.) DC	Anacardiaceae	1	1	0.02	5.9	1.1	0.5	1.6
27	*Strychnos usambarensis*	Gilg ex Engl.	Loganiaceae	2	2	0.04	11.8	2.3	0.9	3.2
28	*Tabernaemontana ventricosa*	Hochst. ex A.DC.	Apocynaceae	102	17	0.36	600.0	19.5	45.9	65.5
29	*Trichilia emeticaa*	Vahl.	Meliaceae	2	2	0.04	11.8	2.3	0.9	3.2
30	*Trilipesium madagascariensis*	DC.	Moraceae	3	3	0.06	17.6	3.4	1.4	4.8
31	*Vernonia amygdalina*	Del.	Asteraceae	6	2	0.10	35.3	2.3	2.7	5.0
32	*Vernonia myriantha*	Hook.f.	Asteraceae	**4**	1	0.07	23.5	1.1	1.8	3.0
	Grand Total			**222**	**87**	**2.30**	**1305.9**	**100.0**	**100.0**	**200.0**

SST = sum of stock of trees; F = frequency; H' = Shannon wiener diversity index; D = density; RF = relative frequency; RD = relative density; IVI = importance value index

(**Source:** *Field Data, 2026*)

Tree Species Volume (G) and Carbon Stock (tC)

The highest volume (G) in cubic metres was recorded in *Albizia gimmifera, Celtis africana, Ficus lutea, Ficus sycmorus, Grevillea robusta,* with values of ≤25,249,594.3 - ≥1,000,000. The tree species with the highest G also captured the highest carbon stock (tC), and vice versa is true (Table 2).

Table 2: Tree Diameter, Basal Area (g), Volume (G), and Carbon Stock of TICD Natural Forest Patch

S/N	Botanical name	Author	Family	SST	SDBH	SHgt	Sg/Ha	SG/Ha	SAGB/Ha	SAGtC	StC/Ha
1	*Albizia gummifera*	(J.F.Gmel.)C.A.Sm.	Fabaceae	2	157	28.5	110,957.4	2,884,459.4	25,670.8	12,065.3	15,081.6
2	*Allophyllus africanus*	P.Beauv	Sapindaceae	2	9.5	7.0	236.7	905.1	65.9	31.0	38.7
3	*Blighia unijugata*	Baker	Sapindaceae	2	10	8.0	230.9	923.5	64.7	30.4	38.0
4	*Bridelia micrantha*	(Hochst.) Baill.	Euphorbiaceae	1	2	2.5	18.5	46.2	5.5	2.6	3.2
5	*Cedrela odorata*	L.	Meliaceae	15	180	97.5	14,208.5	124,036.9	3,702.2	1,740.0	2,175.0

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S/N	Botanical name	Author	Family	SST	SDBH	SHgt	Sg/Ha	SG/Ha	SAGB/Ha	SAGtC	StC/Ha
6	*Celtis africana*	Burm.f.	Cannabaceae	11	326.5	91.5	155,244.1	3,673,407.5	36,422.9	17,118.8	21,398.5
7	*Chaetacme aristata*	Planch.	Cannabaceae	1	7	5.0	226.3	1,131.3	62.3	29.3	36.6
8	*Combretum molle*	R. Br. ex G. Don	Combretaceae	2	100	27.0	23,319.1	307,881.6	5,743.0	2,699.2	3,374.0
9	*Cordia africana*	Lam.	Boraginaceae	2	104	21.5	48,060.5	960,867.7	11,383.3	5,350.2	6,687.7
10	*Croton macrostachyus*	Hochst. ex Delile	Euphorbiaceae	1	25	12.0	2,886.0	34,632.4	739.5	347.6	434.5
11	*Croton megalocarpus*	Hutch.	Euphorbiaceae	6	147.5	64.0	26,628.8	438,034.6	6,620.9	3,111.8	3,889.8
12	*Croton sylivaticus*	Hochst.	Euphorbiaceae	2	7.5	5.0	144.3	404.0	40.8	19.2	24.0
13	*Ehretia cymosa*	Thonn	Boraginaceae	3	51.5	21.0	4,094.7	28,662.9	1,071.3	503.5	629.4
14	*Ficus thonningii*	Blume	Moraceae	2	46	20.0	4,968.6	49,685.9	1,277.3	600.3	750.4
15	*Ficus lutea*	Vahl	Moraceae	2	176	50.0	73,078.9	1,826,972.1	17,420.4	8,187.6	10,234.5
16	*Ficus sur*	Forssk.	Moraceae	1	56.5	20.0	14740.7	294,813.7	3608.5	1,696.0	2120.0
17	*Ficus sycomorus*	L.	Moraceae	21	1860	354.0	1,225,962.2	25,249,594.3	283,576.5	133,281.0	166,601.2
18	*Grevillea robusta*	A. Cunn. ex R. Br.	Proteaceae	7	431	131.0	147,683.9	2,843,210.0	35,477.9	16,674.6	20,843.2
19	*Newtonia buchananii*	(Bak.f.) G.C.C.G. & Bout.	Fabaceae	1	2	2.5	18.5	46.2	5.5	2.6	3.2
20	*Olea capensis*	L.	Oleaceae	1	92	18.0	39,083.8	703,507.8	9,309.9	4,375.7	5,469.6
21	*Persea americana*	Mill.	Lauraceae	2	5.5	5.0	75.0	206.6	21.6	10.2	12.7
22	*Psychotria riparia*	(K.Sch. & K.K) E.M.A.Petit	Rubiaceae	1	5	3.0	115.4	346.3	32.4	15.2	19.0
23	*Rauvolfia caffra*	Sond.	Apocynaceae	6	168.5	76.0	32,091.5	566,977.8	7,944.2	3,733.8	4,667.2
24	*Ricinus communis*	L.	Euphorbiaceae	2	8.5	8.0	195.1	917.8	54.6	25.6	32.0
25	*Senna spectabilis*	(DC.) H.S.Ir. & Barn.	Fabaceae	6	36.5	29.0	1,127.9	5,870.2	310.3	145.8	182.3
26	*Sorindeia madagascariensis*	(Spreng.) DC.	Anacardiaceae	1	2	2.0	18.5	36.9	5.5	2.6	3.2
27	*Strychnos usambarensis*	Gilg.	Loganiaceae	2	122.5	26.0	45,166.4	625,344.9	10,799.2	5,075.6	6,344.5
28	*Tabernaemontana ventricosa*	A.DC	Apocynaceae	102	954.5	560.0	81,569.6	762,583.6	20,747.4	9,751.3	12,189.1

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S/N	Botanical name	Author	Family	SST	SDBH	SHgt	Sg/Ha	SG/Ha	SAGB/Ha	SAGtC	StC/Ha
29	*Trichilia emetica*	Vahl.	Meliaceae	2	9.5	8.0	236.7	1,253.7	65.9	31.0	38.7
30	*Trilipesium madagascariensis*	DC.	Moraceae	3	9.5	9.0	176.6	772.3	49.9	23.4	29.3
31	*Vernonia amygdalina*	Del.	Asteraceae	6	37.5	30.0	1,317.2	8,284.1	359.4	168.9	211.2
32	*Vernonia myriantha*	Hook.f.	Asteraceae	4	30	21.0	1,133.6	6,753.3	308.6	145.0	181.3
	Total			**222**	**5,180.5**	**1,763.0**	**205,5015.7**	**41,402,570.4**	**482,968.0**	**226,995.0**	**283,743.7**

SST = sum of stocking; SDBH = sum of diameter in centimetres; SHgt = sum of height; Sg/Ha = sum of basal area; SG/Ha = sum of volume in cubic metres; SAGB = sum of aboveground biomass in kilogram; SAGtC/Ha = sum of aboveground carbon stock; StC/Ha = sum of carbon stock

(**Source:** *Field Data, 2026*)

Tree Regeneration (seedlings)

A total of 30 species of seedlings were recorded. Of all those, 20 species (66.7) were also recorded at tree level, while 10 tree species (33.3%) were not recorded at tree level (mature tree level) (Table 3). While a total of 32 mature tree species were recorded, the seedlings were only 30 species and *Senna spectabilis* (DC.) H. S. Irwin & Barneby and *Vernonia myriantha* Hook.f. did not get members at the seedling level (Tables 2 & 3). On the other hand, *Cussonia holstii* Harms ex Engl. and *Syzygium jambos* (L.) Alston did not get representatives at the tree level (Table 2 & Table 3). The highest relative was recorded in *Albizia gummifera , Cedrela odorata, Celtis africana, Clausena anisata, Croton macrostachyus, Rauvolfia caffra, and Tabernaemontana ventricosa* (RF = ≤13.6 - ≥4.5) making a total RF of 54.6, while the rest capture the Rf of 45.4 (Table 3).

Table 3: Tree Species Regeneration (Seedlings)

S/N	Botanical Name		Family	SST	H'	F	D	RF	RD	IVI	ATLR	NTLR
1	*Albizia gummifera*	(J.F.Gmel.)C.A.Sm	Fabaceae	46	0.22	6	27058.8	5.5	9.4	14.9	1	0
2	*Allophyllus africanus*	P.Beauv.	Sapindaceae	23	0.14	7	13529.4	6.4	4.7	11.1	1	0
3	*Blighia unijugata*	Baker	Sapindaceae	9	0.07	4	5294.12	3.6	1.8	5.5	1	0
4	*Bridelia micrantha*	(Hochst.) Baill.	Euphorbiaceae	4	0.04	2	2352.94	1.8	0.8	2.6	1	0
5	*Cedrela odorata*	L.	Meliaceae	15	0.11	7	8823.53	6.4	3.1	9.4	1	0

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S/N	Botanical Name		Family	SST	H'	F	D	RF	RD	IVI	ATLR	NTLR
6	*Celtis africana*	Burm.f.	Cannabaceae	39	0.20	9	22941.2	8.2	8.0	16.2	1	0
7	*Chaetacme aristata*	Planch	Cannabaceae	5	0.05	2	2941.18	1.8	1.0	2.8	1	0
8	*Clausena anisata*	(Willd.)Hook.f.ex.Ben	Rutaceae	22	0.14	5	12941.2	4.5	4.5	9.1	0	1
9	*Coffea arabica*	L.	Rubiaceae	4	0.04	2	2352.94	1.8	0.8	2.6	0	1
10	*Cordia africana*	Lam	Boraginaceae	2	0.02	1	1176.47	0.9	0.4	1.3	1	
11	*Cordia monoica*	Roxb.	Boraginaceae	3	0.03	1	1764.71	0.9	0.6	1.5	0	1
12	*Croton macrostachyus*	Hochst. ex Delile	Euphorbiaceae	14	0.10	5	8235.29	4.5	2.9	7.4	1	
13	*Cussonia holstii*	Harms ex Engl.	Araliaceae	1	0.01	1	588.235	0.9	0.2	1.1	0	1
14	*Diospyros abyssinica*	(Hiern.)F.White	Ebenaceae	9	0.07	3	5294.12	2.7	1.8	4.6	0	1
15	*Euclea divinorum*	Hiern.	Ebenaceae	3	0.03	1	1764.71	0.9	0.6	1.5	0	1
16	*Garcinia huillensis*	Baker.	Clusiaceae	3	0.03	1	1764.71	0.9	0.6	1.5	0	1
17	*Newtonia buchananii*	(Bak.f.) G.C.C.G. & Bout.	Fabaceae	6	0.05	2	3529.41	1.8	1.2	3.1	1	0
18	*Persea americana*	Mill.	Lauraceae	4	0.04	1	2352.94	0.9	0.8	1.7	1	0
19	*Psychotria riparia*	(K.Sch. & K.K) E.M.A.Petit	Rubiaceae	2	0.02	1	1176.47	0.9	0.4	1.3	1	0
20	*Rauvolfia caffra*	Sond.	Apocynaceae	17	0.12	6	10000	5.5	3.5	8.9	1	0
21	*Ricinus communis*	L.	Euphorbiaceae	32	0.18	3	18823.5	2.7	6.6	9.3	1	0
22	*Sorindei madagascariensis*	(Spreng.) DC.	Anacardiaceae	7	0.06	2	4117.65	1.8	1.4	3.3	1	0
23	*Strychnos usambarensis*	Gilg ex Engl.	Loganiaceae	23	0.14	7	13529.4	6.4	4.7	11.1	1	0

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S/N	Botanical Name		Family	SST	H'	F	D	RF	RD	IVI	ATLR	NTLR
24	*Syzygium jambos*	(L.) Alston	Myrtaceae	1	0.01	1	588.235	0.9	0.2	1.1	0	1
25	*Tabernaemontana ventricosa*	A.DC	Apocynaceae	151	0.36	15	88823.5	13.6	31.0	44.6	1	0
26	*Trichillia emetica*	Vahl.	Meliaceae	10	0.08	5	5882.35	4.5	2.1	6.6	1	0
27	*Trilipesium madagascariensis*	DC.	Moraceae	14	0.10	4	8235.29	3.6	2.9	6.5	1	0
28	*Turraea robusta*	Gurke	Meliaceae	5	0.05	3	2941.18	2.7	1.0	3.8	0	1
29	*Vangueria infausta*	Burch.	Rubiaceae	3	0.03	1	1764.71	0.9	0.6	1.5	0	1
30	*Vernonia amygdalina*	Del.	Asteraceae	10	0.08	2	5882.35	1.8	2.1	3.9	1	0
	Total			**487**	**2.65**	**110**	**286,471**	**100.0**	**100.0**	**200.0**	**20**	**10**

Key: SST = sum of stoking; H' = Shannon wiener diversity index; F = frequency; D = density; RF = relative frequency; RD = relative density; IVI = importance value index; ATLR = also tree level recorded (Table 1&2); NTLR = No tree level recorded (Table 1&2)

(**Source:** *Field Data, 2026*)

Shrubs and Woody Climbers

A total of 23 plant species with the H' = 2.76 were recorded from this group, of which 11 species were shrubs, and 12 were woody climbers. The recorded woody climbers were *Adenia gummifera, Ampelocissus africana, Caesalpinia decapetala, Capparis tomentosa, Clerodendrum johnstonii, Combretum paniculatum, Dracaena laxissima, Oncinotis tenuiloba, Opilia celtidifolia, Saba comorensis, Salacia madagascariensis, and Toddalia asiatica.* The highest IVI was recorded in *Acalypha fruticosa, Adenia gummifera, Lantana camara, Oncinotis tenuiloba, and Salacia madagascariensis* (IVI = ≤22.35 - ≥15), making a total of 95.87. The plants with the highest IVI also captured the highest RD (Table 4).

Table 4: Shrubs and Woody Climbers of Natural Forest Patch

S/N	Botanical name	Author	Family	GF	SST	F	D	H'	RF	RD	IVI
1.	*Abutolon longicuspe*	Hochst.	Malvaceae	SR	2	1	1176.5	0.03	1.45	0.68	2.13
2.	*Acalypha fruticosa*	Forssk	Euphorbiaceae	SR	40	6	23529.4	0.27	8.70	13.65	22.35
3.	*Acalypha ornata*	Hochst. Ex. A.Rich	Euphorbiaceae	SR	4	1	2352.9	0.06	1.45	1.37	2.81
4.	*Adenia gummifera*	(Harv.) Harms	Passifloraceae	LN	24	8	14117.6	0.20	11.59	8.19	19.79

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S/N	Botanical name	Author	Family	GF	SST	F	D	H'	RF	RD	IVI
5.	*Cissus integrifolia*	(Baker)Planch	Vitaceae	LN	7	3	4117.6	0.09	4.35	2.39	6.74
6.	*Caesalpinia decapetala*	(Roth) Alson	Menispermaceae	LN	12	4	7058.8	0.13	5.80	4.10	9.89
7.	*Capparis tomentosa*	Lam.	Capparaceae	LN	15	3	8823.5	0.15	4.35	5.12	9.47
8.	*Clerodendrum johnstonii*	Oliv	Verbenaceae	LN	6	2	3529.4	0.08	2.90	2.05	4.95
9.	*Combretum paniculatum*	Vent	Combretaceae	LN	5	2	2941.2	0.07	2.90	1.71	4.61
10.	*Dracaena laxissima*	Engl.	Dracaenaceae	LN	2	1	1176.5	0.03	1.45	0.68	2.13
11.	*Hibiscus calyphyllus*	Cav.	Malvaceae	SR	15	3	8823.5	0.15	4.35	5.12	9.47
12.	*Lantana camara*	L.	Verbenaceae	SR	40	5	23529.4	0.27	7.25	13.65	20.90
13.	*Manihot esculenta*	Crantz.	Euphorbiaceae	SR	3	1	1764.7	0.05	1.45	1.02	2.47
14.	*Montanoa hibiscifolia*	Benth	Asteraceae	SR	24	3	14117.6	0.20	4.35	8.19	12.54
15.	*Oncinotis tenuiloba*	Stapf.	Apocynaceae	LN	20	7	11764.7	0.18	10.14	6.83	16.97
16.	*Opilia celtidifolia*	(G. & P.) E. ex W.	Opiliaceae	LN	2	1	1176.5	0.03	1.45	0.68	2.13
17.	*Phyllanthus maderaspatenis*	L.	Phyllanthaceae	SR	8	2	4705.9	0.10	2.90	2.73	5.63
18.	*Saba comorensis*	(B. ex A.DC.) Pichon	Apocynaceae	LN	2	1	1176.5	0.03	1.45	0.68	2.13
19.	*Salacia madagascariensis*	(Lam.) DC.	Celasteraceae	LN	21	6	12352.9	0.19	8.70	7.17	15.86
20.	*Senna bicapsularis*	(Linn.) Roxb.	Fabaceae	SR	3	1	1764.7	0.05	1.45	1.02	2.47
21.	*Solanum macrocarpon*	L.	Solanaceae	SR	2	1	1176.5	0.03	1.45	0.68	2.13
22.	*Tithonia diversifolia*	(Hemsl.) A.Gray.	Asteraceae	SR	15	1	8823.5	0.15	1.45	5.12	6.57
23.	*Toddalia asiatica*	(L.) Lam	Rutaceae	LN	21	6	12352.9	0.19	8.70	7.17	15.86
	Total				**293**	**69**	**172352.9**	**2.76**	**100**	**100**	**200**

(**Source:** *FieldData, 2026*)

Herbaceous Plants

These include ferns, forbs, grass, and sedges. The herbaceous plant species that were the most distributed got the RF ranging from ≤15.25 - ≥8.47, and those were *Achyranthes aspera* Linn, *Commicarpus plumbagineus*, *Justicia scandens*, and *Oplismenus hirtellus*, with an overall total RF of 44.06, while the remaining 23 species got the RF ≤8.46 (Table 5).

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Table 5: Herbaceous Plant Species Distribution

S/N	Botanical name	Author	Family	F	RF
1	*Achyranthes aspera*	Linn	Amaranthaceae	9	15.0
2	*Afromomum angustifolia*	(Sonn.) K.Schum.	Zingiberaceae	3	5.0
3	*Asparagus setaceus*	(Kunth.) Jessop.	Asparagaceae	2	3.3
4	*Canna indica*	L.	Cannaceae	2	3.3
5	*Ceropegia daemia*	Decne	Apocynaceae	1	1.7
6	*Cissampelos mucronata*	A.Rich	Menispermaceae	1	1.7
7	*Colocasia esculenta*	(L.)Schott	Araceae	1	1.7
8	*Commelina benghalensis*	L.	Commelinaceae	2	3.3
9	*Commicarpus plumbagineus*	(Cav.) Standl.	Nyctaginaceae	6	10.0
10	*Conyza bonariensis*	(L.) Cronquist	Asteraceae	1	1.7
11	*Cylosorus interrupta*	(Willd.) H.Itô	Thelypteridaceae	1	1.7
12	*Cynanchium viminale*	(L.) L.	Apocynaceae	1	1.7
13	*Dahlia variabilis*	L.	Asteraceae	1	1.7
14	*Desmodium repandum*	(Vahl.) Poir	Fabaceae	2	3.3
15	*Ipomoea obscura*	(L.) Ker Gawl.	Convolvulaceae	1	1.7
16	*Ipomoea wightii*	(Wall.) Choisy	Convolvulaceae	2	3.3
17	*Justicia scandens*	Vahl.	Acanthaceae	5	8.3
18	*Laggenaria abyssinica*	(Hook.f.) C.Jeffrey	Cucurbitaceae	2	3.3
19	*Leersia hexandra*	Sw.	Poaceae	1	1.7
20	*Mirabilis jalapa*	L.	Solanaceae	2	3.3
21	*Momordica foetida*	Schumach	Cucurbitaceae	2	3.3
22	*Oplismenus hirtellus*	(L.) P. Beauv.	Poaceae	6	10.0
23	*Panicum trichocladum*	Hack. ex K.Schum.	Poaceae	1	1.7
24	*Parthenium hysterophorus*	L.	Asteraceae	1	1.7
25	*Setaria megaphylla*	(Steud.) T.Durand & Schinz	Poaceae	1	1.7
26	*Smilax anceps*	Willd.	Smilacaceae	1	1.7
27	*Tragia brevipes*	Pax	Urticaceae	1	1.7
28	*Zehneria scabra*	(L.f.) Sond.	Cucurbitaceae	1	1.7
	Total			**60**	**100**

(**Source:** *Field Data, 2026*)

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Tourist Opportunities (Attractions) and Activities

Tourist Opportunities

- TICD Campus, together with old buildings with remnants of native plant species

The buildings, together with the planted native and exotic trees (Plate 2), are among the tourist opportunities that attract tourists.

Plate 2: Old Building with Native Plant Species, *Rauvolfia caffra* Sond.



- Natural riverine forest remnant

The natural forest remnant vegetation together with plant species composition, large tree diameter, and trees are among tourists' opportunities (Plate 3).

Plate 3: Part of Natural Forest Patch at TICD Campus



- Stream within the remnant of the catchment forest

The forest patch harbours a spring of waters (Plate 4) channelling into two streams, even though they finally meet downslope to make one stream flowing to Malala main stream through horticulture greenhouses.

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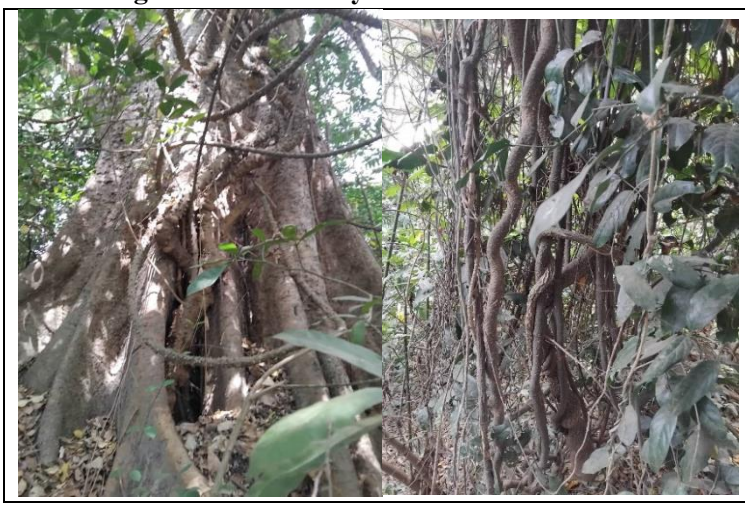
Plate 4: Stream Flowing from Springs within the Forest Patch




- Big trees and woody climbers

The biggest trees belong to *Ficus sycomorus* with large buttresses, and the woody climbers of *Combretum paniculatum, Oncinotis tenuiloba,* and *Toddalia asiatica* (Plate 5) are among commodities to be marketed to tourists.

Plate 5: Big Tree and Woody Climbers



- **Irrigation farming**

Irrigation agriculture practised by horticulture students (Plate 6) is among the tourist opportunities to visit.

Plate 6: Irrigation



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- Greehouse

Greenhouse nearby belonging to Horticulture Training Institute (HTI) (Plate 7).

Plate 7: Greenhouses near Natural Forest Patch



- Polish Burial Site

This is a site where the Polish were buried, with abundant history displayed on walls (Plate 8), even though understanding the history requires translation by a person who can translate the Polish language.

Plate 8: Polish Burial Site near TICD (< 0.4 km away)



- Fauna species

A variety of birds (Aves), small mammals, and reptiles such as *Chamaeleo jacksonii* (Jackson's chameleon) (Plate 9).

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Plate 9: *Chamaeleo jacksonii* (Jackson's chameleon)



Tourist Activities

- **Walking**: Walking is the general, everyday activity of moving on foot for leisure or exercise on smooth, urban, or paved surfaces.
- **Hiking:** hiking refers specifically to longer, more vigorous walks, often on rustic (rural/pastoral) trails, in nature, or through mountainous, unpaved terrain. Hiking is typically done for pleasure, health, or to explore areas.
- **Camping:** this is a popular outdoor recreational (fun) activity involving overnight stays in temporary shelters like tents or cabins to connect with nature.
- **Native tree planting**: these can be planted by tourists and staff around the forest boundary or inside the forest patch.
- **Teaching/facilitating on biodiversity**: fostering a deep understanding of ecological interdependencies, promoting awareness of environmental impacts, and encouraging actionable and sustainable behaviours.
- **Visiting the local community**: this involves visiting the Meru tribe at the nearby village.
- **Bird watching**: the patch harbours an enormous variety of birds that can be watched by visitors.
- **Cooking over firewood made fire**: to foreigners it feels like a new enjoyment experience.
- **Visit Polish burial site**: as a result of the First and Second World Wars

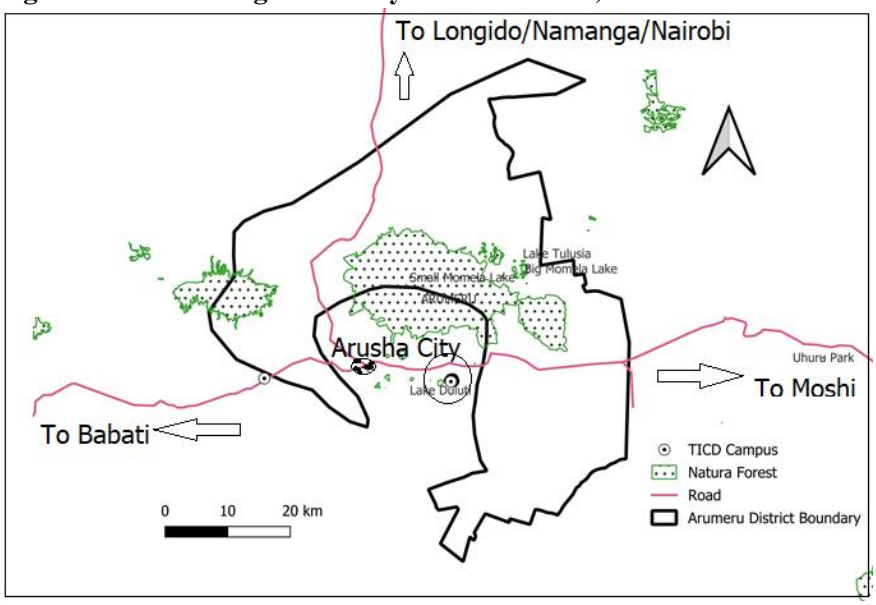
Other Services

Environmentally friendly tourist huts have to be constructed a few metres from the native forest patch and the stream. The Tengeru Institute of Community Development (TICD) is very close to Duluti Lake Forest Reserve, which is globally known as a centre for urban tourism, from which urban tourism is possible through linking the Duluti (Figure 3), Scottish burial site, Forestry Training Institute-Olmotonyi, different tourism companies around Arusha city centre, Arusha National Park and any other parks, etc.

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Figure 3: Networking Possibility between TICD, Duluti Tourist Centre, and Arusha City



Amenities

These are the areas of comfort. These include accommodation, restaurants, transport, signage, public restrooms, high-speed internet, security services, and recreational (fun, entertainment (sports), etc.) facilities, often enhancing the overall enjoyment of a trip.

Threats to Natural Forest Patch

The recorded prominent threats to the vegetation and biodiversity of the natural forest patch were:-

- **Encroachment and invasion of alien plants**: the borders are heavily converted into banana farms (Plate 7).

Plate 7: Encrached Area for Banana, while also *Lantana camara* L. is Invading the Cleared Area



The other areas were known to be occupied by alien plant species. A total of 14 alien species were recorded, including only four (4) (28.6%) that were alien but not invasive, while 10 (71.4%) were invasive alien species (IAS) (Table 6 & Plate 7).

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Table 6: Alien and Invasive Alien Plants of TICD Natural Forest Patch

S/N	Botanical name	Author	Family	T	SR	HB	A	IAS	NIAS
1	*Canna indica*	L.	Cannaceae	0	0	1	1	1	0
2	*Colocasia esculenta*	(L.)Schott	Araceae	0	0	1	1	1	0
3	*Erigeron bonariensis*	(L.) Cronquist	Asteraceae	0	0	1	1	1	0
4	*Dahlia variabilis*	L.	Asteraceae	0	0	1	1	0	1
5	*Mirabilis jalapa*	L.	Solanaceae	0	0	1	1	1	0
6	*Parthenium hysterophorus*	L.	Asteraceae	0	0	1	1	1	0
7	*Montanoa hibiscifolia*	Benth.	Asteraceae	0	1	0	1	1	0
8	*Manihot esculenta*	Crantz	Euphorbiaceae	0	1	0	1	0	1
9	*Senna bicapsularis*	(L.) Roxb	Fabaceae	0	1	0	1	1	0
10	*Tithonia diversifolia*	(Hemsl.) A.Gray	Asteraceae	0	1	0	1	1	0
11	*Cedrela odorata*	L.	Meliaceae	1	0	0	1	1	0
12	*Coffea arabica*	L.	Rubiaceae	1	0	0	1	0	1
13	*Persea americana*	Mill.	Lauraceae	1	0	0	1	0	1
14	*Senna spectabilis*	(DC.) H.S.I & Bar.	Fabaceae	1	0	0	1	1	0
	Total			**4**	**4**	**6**	**14**	**10**	**4**

- **Tree cutting**: tree cutting for firewood and poles was evident, and most stumps were new cuts.

Plate 8: Tree Cutting at Forest Patch



DISCUSSION

Evaluating species composition and structure provides vital, additional information that significantly boosts the value of forest resources, serving as a foundation for effective ecotourism interventions (Zakari, 2021). A thorough assessment of these elements allows for the identification of unique, attractive, and sustainable natural areas for tourism, moving beyond mere landscape viewing to in-depth ecological appreciation (Ameha et al., 2016). The recorded 82 plant species with the H' of 2.3 for trees and 2.76 for shrubs and woody climbers

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implied how rich the vegetation is and high diversity for such a small forest patch (Table 6). Biodiversity indices are crucial in determining the stability of an ecosystem, and an ecosystem with high biodiversity is generally more stable and resilient to environmental disturbances such as climate change or pollution (Mukherjee, 2023). The Shannon Wiener diversity index values for high diversity range from 0 to 5, with common ranges usually between 1.5 to 3.5 (Arzamani et al., 2018).

Table 6: Trees, Shrubs and Woody Climbers, and Herbaceous Plants of Natural Forest Patch

Growth form	Richnes	H'	Remarks
Mature trees	32	2.3	High diversity
Shrubs/Woody climbers	23	2.8	High diversity
Herbaceous plants	28	-	-
Total	**83**		

The tree species seedling H' of 2.7 implied high regeneration diversity and richness of 30 showed how diverse the forest patch is (Table 3).

The tree species with the largest diameter were also revealed to capture the largest amount of carbon stock (tC/Ha) (Table 2), an implication that diameter sizes are significant for the storage of carbon and thus contribute to a high level of reduction of greenhouse gases in the atmosphere. Tree species diversity and carbon stocks are generally positively related, suggesting a win-win scenario where more diverse forest patches tend to hold higher amounts of carbon (Nero et al., 2018).

Plant species with the highest relative frequency were termed the most distributed in the study area (Table 1, 3-5). In ecological, botanical, and forestry surveys, the relative frequency (RF) of a plant species is a measure of its spatial distribution or ubiquity across a study area (Table 1, 3-5). It is calculated by dividing the frequency of one species by the total frequency of all species, usually expressed as a percentage (Gebremedhn et al., 2017). Species with the highest relative frequency is interpreted as being the most commonly occurring, widely distributed, or ubiquitous species in the study area, as they appear in the largest number of sample plots or quadrats (Abba & Timothy, 2021).

Natural vegetation within the institutions' campuses, settlements, or farms is always a home for wildlife, regulates climate, and draws attention to visitors (Muhati et al., 2018). It has been supported that natural vegetation within institutional campuses, settlements, and farms serves as a critical, multi-functional green infrastructure that supports biodiversity, moderates the local environment, and enhances the aesthetic and psychological value of the landscape for people (Price et al., 2021). The available natural forest patch with a cool environment implies how suitable the area is for ecological tourism as a source of income and biodiversity sustainability, and climate change impact reduction and mitigation. EAMCEF (2021) pointed out that a natural forest patch with a cool environment is highly suitable for ecological tourism, acting as a catalyst for economic growth, biodiversity conservation, and climate change mitigation. The cool, microclimate-regulated, and biodiverse nature of such areas attracts eco-conscious tourists, offering a sustainable alternative to conventional tourism that directly funds conservation and supports local livelihoods (FAO, 2017).

Fauna species have a unique attraction to tourists, especially ecological tourists with an interest in the behaviour of species. Scholars, including Higginbottom et al (2001) and the World Bank Group. (2018) have supported that wildlife is crucial to tourists as a primary motivator for travel, offering unique, aesthetic, and educational experiences in natural environments. The presence of wild fauna species drives global tourism, fosters environmental awareness, and

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funds conservation efforts, while providing tourists with opportunities to connect with nature, reduce stress, and support local economies (Kaltenborn et al, 2011).

The TICD campus is suitable for designing walking and hiking trails that connect the Duluti lake, Scottish burial sites, Akheri hill, and Ndurumanga forest reserve in Usariver town. Furthermore, tourists are in the position to tour the local community, camping near the patch while also watching birds, small mammals, and planting native trees at forest edges and gaps. Ecological tourism within settlements and institutions highlights a comprehensive model of community-based ecotourism, which focuses on providing immersive, low-impact, and educational experiences that directly benefit both the environment and the local population (Muhta & Sulkava, 2014).

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The TICD natural forest patch within such a small area of one hectare (2.5 acres) accommodates a very high diversity of plants, tree volumes, biomass, and carbon stock, revealing a high contribution to environmental sustainability and climate change impacts reduction, while also maintaining natural scenery and reducing erosion through water runoff. It furthermore serves as a windbreak to campus houses. Getting into ecological tourism, the community will earn income for improving its livelihood. Thus appreciating the presence of the environmental resources. The limitation of the study remains in the small sample size that was sampled. However, this did not invalidate the findings because a reasonable number of plots was considered at a short inter-plot distance, revealing more data within a small forest patch. Also, fauna species were not explored for every single species because of limited resources, thus leaving a gap to be dealt with in the near future.

Recommendations

The TICD natural forest patch has existed for many years, and plays a role as a water catchment area, home for wildlife, regulates climate, provides a resting venue to people, even though there have not been a serious sustainable or non-consumable utilisation. This paper recommends:

- Further study of flora and fauna
- Establishment of ecological tourism
- Use the site to train community development offices on how to simply collect data for carbon computation and conservation strategies
- Protect the area from encroachment for small-scale farming (gardening)
- Revisit the correct boundaries of the natural forest patch and restore the encroached borders
- Organise a seminar with the bordering institutions or stakeholders, including the livestock institute, agriculture institute, political leaders, village natural resources committees, tourist companies, foreseters, wildlife management stakeholders and students

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Article DOI: https://doi.org/10.37284/eajfa.9.1.4717

REFERENCES

Abba, H. M. & Timothy, H. (2021). Assessment of Herbaceous Species Diversity in Lede and Galumji, Wawa-Zange Forest Reserve, Gombe State, Nigeria. *American Journal of Plant Sciences*, 12 (11): 1741-1753.

Abo-Khalil, A. G. (2024). Integrating sustainability into higher education challenges and Opportunities for universities worldwide. Heliyon, 10 (9). https://doi.org/10.1016/j.heliyon.

Adolph, B., Griffiths, G. & Hou-Jones, X. (2023). Analysis of The Implications of Africa's Food Systems Development on Environmental Sustainability Discussion Document. International Institute for Environment and Development (IIED) Final Report. WWF, 28 rue Mauverney, 1196 Gland, Switzerland.

African Environments. (2016). A weekend walking trip to Arusha National Park. https://www.africanenvironments.com/2016/03/a-weekend-walking-trip-to-arusha-national-park/(Retrived on 29th January 2026).

Althobaiti, A., Abulibdeh, A. (2026). Assessing community engagement and sustainability Outcomes of regenerative tourism in the Red Sea region. *Discover Cities*,3 (8). https://doi.org/10.1007/s44327-026-00185-4.

Ameha, A., Meilby, H., & Feyisa, G. L. (2016). Impacts of participatory forest management on Species composition and forest structure in Ethiopia. International Journal of Biodiversity Science, Ecosystem Services & Management, 12(1– 2), 139– 153. https://doi.org/10.1080/21513732.2015.1112305.

Arzamani, K., Vatandoost, H., Rassi, Y., Akhavan, A. A., Abai, M. R., Alavinia, M., Akbarzadeh, K., Mohebali, M. & Rafizadeh, S. (2018). Richness and Diversity of Phlebotomine Sand Flies (Diptera: Psychodidae) in North Khorasan Province, Northeast of Iran. Journal Arthropod Borne Diseases, 12(3):232–239.

Asare, R. K., Nortjé, G. P. & Takase, M. (2025). The environmental and economic impacts of Urban development in mountainous areas of Africa – with special reference to Ghana [version 1; peer review: 1 not approved]. F1000Research, 4:290. https://doi.org/10.12688/fl000research.160370.1.

Atstaja, D. (2015). Leveraging Sustainable Development Goals to Transform Higher Education and Advance Sustainability Science. *MDPI Sustainability*. 17(17):7807. DOI: 10.3390/su17177807.

Beason, R. D., Riesch, R. & Koricheva, J. (2023). Investigating the effects of tree species diversity and relative density on bird species richness with acoustic indices. Ecological Indicators, 154. https://doi.org/10.1016/j.ecolind.2023.110652.

Bhardwaj, M., Tiwari, R., Bhardwaj, V. P. & Bhardwaj, S. (2023). A Short Review on Various Biodiversity Indices. *International Journal of Advanced Research in Science Communication and Technology*. DOI: 10.48175/IJARSCT-13153.

Blancas, A., Cader, I., Galan-Muros, V., Gallegos, G. & Roser-Chinchilla, J. (2023). The Contribution of Higher Education Institutions to Sustainable Cities and Communities Partnership Between. United Nations Educational, Scientific and Cultural Organization (UNESCO) & International Institute for Higher Education in Latin America and the Caribbean) Reports (IESALC) Report. https://unesdoc.unesco.org/ark:48223/pf000038827.6.

Børresen, S. T., Ulimboka, R., Nyahongo, J., Ranke, P. S., Skjaervø, G. R., & Røskaft, E. (2023). The role of education in biodiversity conservation: Can knowledge and understanding alter locals' views and attitudes towards ecosystem services? Environmental Education Research, 29(1), 148–163. https://doi.org/10.1080/13504622.2022.2117796.

 This work is licensed under a Creative Commons Attribution 4.0 International License.

Article DOI: https://doi.org/10.37284/eajfa.9.1.4717

Bożek, M., Denisow1, B., Strzałkowska-Abramek, S., Chrzanowska, E. & Winiarczyk, K. (2023). Non-Forest Woody Vegetation: A Critical Resource for Pollinators in Agricultural Landscapes—A Review. *Sustainability*, 15(11), 8751. https://doi.org/10.3390/su15118751.

Bulenga, G. B., Maliondo, S. M. S., Katani, J. Z. & Nyberg, G. (2023). Tree Species Diversity and Edaphic Factors Associated with Different Land Uses in Tropical Forest Ecosystems, Tanzania. *Open Journal of Ecology*, 13 (10). DOI: 10.4236/oje.2023.1310046.

EAMCEF (2021). The EAMCEF Work across the Eastern Arc Mountains of Tanzania: Biodiversity Conservation and Climate Change Mitigation. EAMCEF, Morogoro, Tanzania.

FAO. (2017). Analysis of forests and climate change in Eastern Africa. Forests and Climate Change Working Paper 16. Food and Agriculture Organization of the United Nations Rome.

FAO. (2020). Biodiversity: Its central role in the sustainable development of Africa, Nature & Faune, 33(1). Accra.

Garmin GPS. GPSMAP 65s. MULTI-BAND. Global Posioning System.

Gebremedhn, H., Darcha, G. & Mezgebe, K. (2017). Distribution and abundance of *Hypoestes forskaolii* (Vahl) in the exclosures of Tigray, northern Ethiopia. *Livestock Research for Rural Development* 29 (8): 148-148 (Retrieved February 2, 2026, from http://www.lrrd.org/lrrd29/8/haft29148.html).

Ghanbari, S. & Nouraeizadeh, N. (2025). Examining the role of urban managers in the Flourishing of urban tourism: a case study: Zahedan City. Urban Economics and Planning 7(4):142-157.

Gohar, A. (2021). Tourism and Urbanization, An Interconnected Evolution. *Sustainability in Environment,* 6(3):96-135.

Higginbottom, K., Northrope, C. & Green, R. (2001). Positive Effects of Wildlife Tourism on Wildlife. Status Assessment of Wildlife Tourism in Australia Series. Wildlife Tourism Research Report Series: No. 6Cooperative. Research Centre for Sustainable Tourism. file:///C:/Users/HP/Downloads/Positive_Effects_of_Wildlife_Tourism_on.pdf (Retrieved on 22/3/2026).

Hou, S., Tian, C., Meng, J., Liu, C., & Yao, Z. (2023). The Impact of Urbanization on the Distribution of Spontaneous Herbaceous Plants in an Ancient City: *A Pilot Case Study in Jingzhou, China. Plants*, 12(19), 3353. https://doi.org/10.3390/plants12193353.

IUCN Urban Alliance. (2022). BiodiverCities by 2030: Fostering nature-positive urban Development. https://iucnurbanalliance.org/biodivercities-by-2030-fostering-nature-positive-urban-development/ (Retrieved on 29th January 2026).

IPBES. (2019). Global assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Brondízio, E. S., Settele, J., Díaz, S., Ngo, H. T. (Eds). IPBES secretariat, Bonn, Germany, ISBN: 978-3-947851-20-1.

Kabii, F., Wamathai, A. N., John, K. M. & Jilo, N. (2019). Analysis of the Skills Gap in Tourism and Hospitality Industry in Kenya. Asean Journal on Hospitality and Tourism 17(2):95. DOI:10.5614/ajht.2019.17.2.3.

Kaltenborn, B. P., Nyahongo, J. W. & Kidegesho, J. R. (2011). (2011). The Attitudes of Tourists Towards the Environmental, Social and Managerial Attributes of Serengeti National Park, Tanzania. *Tropical Conservation Science*, 4(2):132- 148. DOI: 10.1177/194008291100400204.

Karyat, K., Ipor, I. P., Jusoh, I. & Wasli, M. E. (2017). The diameter increment of selected tree Species in a secondary tropical forest in Sarawak, Malaysia. *Biodiversitas Journal of*

 This work is licensed under a Creative Commons Attribution 4.0 International License.

Article DOI: https://doi.org/10.37284/eajfa.9.1.4717

Biological Diversity, 18(1):304-311. DOI:10.13057/biodiv/d180140.

Kumar, P. (2025). Study of herbaceous plant population by quadrate method in Laxmi Venkatesh Desai College campus Raichur, Karnataka State, India. *International Journal of Modern Research in Engineering and Technology (IJMRET)*. www.ijmret.org, 10 (04).

Likunguraine, L., Kayombo, C. J. and Kashindye, A. (2020). Comparative Study on Volume Estimation Using a Model with one and Model with two Independent Variables in Meru/USA Forest Plantation, Northern Tanzania. *East African Journal of Forestry and Agroforestry*, 2(2):54-63. DOI:10.37284/eajfa.2.2.236.

Liu, J., Feng, Z., Mannan, A., Khan, T. U. & Cheng, Z. (2019). Comparing Non-Destructive Methods to Estimate Volume of Three Tree Taxa in Beijing, China. *Forests,* 10(2), 92. https://doi.org/10.3390/f10020092.

Lwoga, N. B. (2013). Tourism Development in Tanzania Before and After Independence: Sustainability Perspectives. The Eastern African Journal of Hospitality, Leisure and Tourism, 1 (2).

Masota, A. M., Zahabu, E., Bollandsas, O. M. & Eid, T. H. (2014). Volume models for single trees in tropical rainforests in Tanzania. *Journal of Energy and Natural Resources*, 3(5): 66-76. doi: 10.11648/j.jenr.20140305.12.

Mato, M. & Mosoma, D. (2022). Factors Influencing Domestic Tourism in Tanzania: A Case of Arusha City. *International Journal of Engineering Business and Management*, 6(4):1-11. DOI:10.22161/ijebm.6.4.1.

Mauya, E. W., Mugasha, W. A., Zahabu, E., Bollandsas, O. M. & Eid, T. (2014). Models for Estimation of tree volume in the miombo woodlands of Tanzania. *Southern Forests: a Journal of* Forest Science. http://dx.doi.org/10.2989/20702620.2014.957594.

Mensah, S., Noulèkoun, F., Ago, E. E. (2020). Aboveground tree carbon stocks in West African Semi-arid ecosystems: Dominance patterns, size class allocation and structural drivers. *Global Ecology and Conservation,* Vol. 24. https://doi.org/10.1016/j.gecco.2020.e01331.

Muhati, G. L., Olago, D. & Olaka, L. (2018). Participatory scenario development process in Addressing potential impacts of anthropogenic activities on the ecosystem services of Mt. Marsabit forest, Kenya. *Global Ecology and Conservation*, Vol. 14, e00402

Muhta, E. & Sulkava, P. (2014). The Impact of Nature-Based Tourism on Bird Communities: A Case Study in Pallas-Yllastunturi National Park February. Environmental Management 53(5). DOI: 10.1007/s00267-014-0253-7.

Mukherjee, R. (2023). Measurement of Biodiversity –Simpson's Diversity and Evenness Index; Shannon-Weiner Diversity Index Department of Geography, Samsi College, Malda, West Bengal. https://www.samsicollege.ac.in/wp-content/uploads/2023/05/MEASUREMENT-OF-BIODIVERSITY_UPDATED.pdf.

Munishi, L. (2025). Tanzania: The Eastern Arc Mountains Forests as World Natural Heritage—Status and Future Prospects. In: Lapin, K., Oettel, J., Braun, M., Konrad, H. (eds) Ecological Connectivity of Forest Ecosystems. Springer, Cham. https://doi.org/10.1007/978-3-031-82206-3_35.

Nero, B. F., Callo-Concha, D. & Denich, M. (2018). Structure, Diversity, and Carbon Stocks of the Tree Community of Kumasi, Ghana. *Forests*, 9 (9), 519. https://doi.org/10.3390/f9090519.

Nko, G. D. & Mbwambo, A. (2024). The Influence of Tourist Attractions on the Performance of Tourism Industry in Arusha, Kilimanjaro and Manyara Regions in Tanzania. International *Journal of Research and Innovation in Social Science*, viii (xi).

 This work is licensed under a Creative Commons Attribution 4.0 International License.

Article DOI: https://doi.org/10.37284/eajfa.9.1.4717

DOI: https://dx.doi.org/10.47772/IJRISS.2024.8110239.

Nyerere, C. Y. (2020). Determinants of Sustainable Urban Tourism in Tanzania: The Mediation Role of Strategic Planning. ["eprint_fieldopt_thesis_type_phd" not defined] thesis, The Open University of Tanzania [https://repository.out.ac.tz/2971/: Retrieved on 24/3/2026).

Ochumbo, A. J. (2029). The Role of Universities in Influencing Service Behaviour in Tourism in Tanzania. *Ruaha Journal of Business, Economics and Management,* 12 (1). 141 – 165.

Price, M. F., Gratzer, G., Duguma, L. A., Kohler, T., Maselli, D. & Romeo, R. (2011). Mountain Forests in a Changing World - Realizing Values, addressing challenges. FAO/MPS and SDC, Rome.

Ract, C., Burgess, N. D., Dinesen, L., Sumbi, P., Malugu, I., Latham, J., Anderson, L., Gereau, R. E., de Lima, M. G., Akida, A., Nashanda, E., Shabani, Z., Tango, Y., Mteleka, S., Silayo, D. S., Mwangi, J., Lyatuu, G., Platts, P. J., Rovero, F. (2024). Nature Forest Reserves in Tanzania and their importance for conservation. PLoS One, 5; 19(2): e0281408. doi: 10.1371/journal.pone.0281408.

Rahman, I. U., Afzal, A., Iqbal, Z., Hashem, A., Al-Arjani, A. F., Alqarawi, A. A., Allah, E. F. A, Abdalla, M., Calixto, E. S. & Bussmann, R. W. (2021). Species Distribution Pattern and Their Contribution in Plant Community Assembly in Response to Ecological Gradients of the Ecotonal Zone in the Himalayan Region. *Plants,* 10(11), 2372.

Scherr, S. J., McNeely, J. A. (2007). Biodiversity conservation and agricultural Sustainability: towards a new paradigm of 'ecoagriculture' landscapes. *Philos Trans R Soc Lond B Biol Sci.,* 363 (1491): 477 – 494. doi: 10.1098/rstb.2007.2165.

Schiliro, D. (2024). Digital Transformation and Its Impact on Organizations Canadian Center of Science and Education. *International Journal of Business and Management*, 19(6): 71 – 71. DOI:10.5539/ijbm.v19n6p71.

Seraj, M., Ike, O.C. & Ozdeser, H. (2025). The contribution of tourism on GDP growth and Sustainable tourism development in Africa. *Future Business Journal*, 11(115). https://doi.org/10.1186/s43093-025-00532-8.

Signe, L. (2020). Unlocking Africa's Business Potential. Trends, Opportunities, Risks, and Strategies. doi.org/10.5771/9780815737391. https://doi.org/10.3390/plants10112372.

Stohlgret, T. J. (1995). Falkner, M. & Schell, L. D. (1995). State of California A Modified-Whittaker nested vegetation sampling method. *Plant Ecology*, 117(2):113-121. DOI: 10.1007/BF00045503.

Teillard, F., Anton, A., Dumont, B., Finn, J.A., Henry, B., Souza, D.M., Manzano, P., Milà i Canals, L., Phelps, C., Said, M., Vijn, S., White, S. (2016). A review of indicators and methods to assess biodiversity – Application to livestock production at global scale. Livestock Environmental Assessment and Performance (LEAP) Partnership. FAO, Rome, Italy.

Tajik, O., Golzar, J. & Noor, S. (2024). Research Education| Non-empirical Article. *International Journal of Educational and Life Sciences* (JELS), 2(2). DOI:10.22034/ijels.2025.490681.1029.

TICD. (2013). About tengeru institute of community development (TICD). TICD History. https://ticd.ac.tz/ticd-history/# (Retrived on 29th January 2026).

United Republic of Tanzania. (2025). Tanzania Development Vision 2050. Dodoma: National Planning Commission.

Vieira, C. L. Z., Rumenos, N. N., Gheler-Costa, C., Toqueti, F., Spazziani, M. L. (2023). Environmental education in urban cities: Planet regeneration through ecologically educating children and communities.

 This work is licensed under a Creative Commons Attribution 4.0 International License.

Article DOI: https://doi.org/10.37284/eajfa.9.1.4717

International Journal of Educational (12). https://doi.org/10.1016/j.ijedro.2022.100208.

Wilson, J. B., Peet, R., Dengler, J. & Pärtel, M. (2012). Plant species richness: the world records. *Journal of Vegetation Science*, 23 (4): 796 - 802. DOI: 10.2307/23251355.

World Bank Group. (2018). Supporting Sustainable Livelihoods Public Disclosure Authorized Through Wildlife Tourism. 1818 H Street NW Washington, DC 20433. https://www.thegef.org/sites/default/files/publications/123765-WP-P157432-PUBLIC.pdf (Retrieved on 22/3/2026).

Zakari, A. (2021). Evaluation of Tree Species Composition for Sustainable Eco-Tourism Development of Maladumba Lake and Forest Reserve, Bauchi-Nigeria. European Journal of Biology and Biotechnology, European Open Science Publishing. https://doi.org/10.24018/EJBIO.2021.2.1.141.

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