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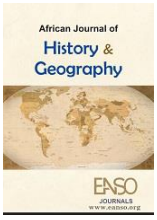

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Original Article

Effects of Socio-cultural Attributes on Dominant Tree Species Diversity in Ugenya Sub-County Siaya County, Kenya

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ABSTRACT

The households' socio-cultural characteristics are vital indicators of land use practices and human development. Attributes, for example, culture, education, and gender affect the tree species' cover distribution. However, it is little known if they influence the dominant tree species diversity. The effort to alleviate low-level education, gender inequality accelerated by the local cultural beliefs and traditions has proved ineffective. This survey assessed the effect of culture, analysed the effect of education level, and evaluated the effect of gender on tree species diversity. A sample of 384 household heads was interviewed. A descriptive cross-section survey design and systematic random sampling were applied. Data sources were; Focus Group Discussions, key informants, observation, measurement, enumeration, and photography. Shannon Wiener's diversity index was applied. Data was analysed using R statistics. Culturally non-adhering households t (363) = 2.62, p = .011, registered significant higher mean score (M = 1.49, SD = 0.82) compared to culturally conservative (M = 1.77, SD = 0.87). Households with higher education level registered (M = 2.02, SD = 0.12) which demonstrated lower score, compared to the households characterized by basic level of education (M = 2.43, SD = 0.26) with a significance of t (382) = 1.74, p =.036, There was insignificant mean score in species diversity contrast in the gender categories, t (382) = 0.639 p = .051, despite males (M = 2.40, SD = 0.26) attaining a lower diversity mean score (M = 2.43, SD = 0.12). The local dominant tree species' diversity is affected by socio-cultural characteristics. Therefore, for the restoration and conservation of the tree species diversity, the socio-cultural functions should be addressed in the Ugenya Sub-County to attain net carbon sink prospects.

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INTRODUCTION

The presence of diverse dominant tree species is a symbol of effective, resilient livelihood in combating climate change through the sustenance of carbon sequestration (Vliet et al., 2015). The outcome of the tree species richness/diversity, according to Tarasuk et al. (2019), associated higher tree species richness with cultural conservation. Both the results on species' evenness and abundance, as researched by Yeboah (2020), showed a variation in the tree species' evenness and abundance among individuals practising traditional and modern cultures. The research on culture and tree species is important because it reinforces the need for the inclusion of indigenous ethnobotany in tree species conservation. Material culture has been related to the conservation of native biodiversity, for instance (Trees), which are used to perform rituals and a number of cultural practices (Sottile et al., 2014). The native cultural non-adherence and erosion are associated with societal and ecological changes driven by the adoption of foreign ideas and materials. The cultural divide is known to affect the nature and mode of human practices, such as agriculture, settlement, and other infrastructure development. It is however unclear if cultural difference affects the tree species diversity, richness, evenness, and abundance.

In matters relating to education level and the tree species, Mackenzie (2003) through qualitative justification, concluded a possible difference in tree species richness and diversity in basic and higher education household groups. The research discoveries by Tanui (2015) assessed tree canopy and reported no visible difference in tree species' evenness among the socio-cultural categories. The report by GoK (2019) found no tangible statistical association between education level and natural resource management. Surveys about the role of education in natural resource management and conservation are appreciated. The GoK (2019) planned inclusion of natural resource management into the high school curriculum is likely to improve the value with which the tree species are handled. Despite the initiative, nothing is known about the role of education level on tree species diversity, richness, evenness, and abundance.

The revelations based on snowball sampling by Meske et al. (1994) reported a difference in the tree species richness and diversity in gender-based categories. However, the research in Siaya county by Oloo (2013) failed to address the effect of gender inequality on tree species diversity, richness, evenness, and abundance. However, surveys acknowledged that female-headed households were culturally excluded from a number of forest management functions, as emphasised by (Dittoh et al., 2015). The results on species abundance by Mukundente et al. (2019) indicated a possibility of higher tree species abundance in male-headed households. Gender parity is among the global issues, therefore an attempt to bring gender equality in tree species conservation is a brilliant idea. Female members of the society are claimed to be marginally represented in socio-cultural, political, and economic arenas. The conclusions by Oloo (2013) relied only on enumerations, observations, interviews and simply computed central tendencies which are considered non-parametric measurements and are known for statistical bias. However, despite the higher agricultural

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productivity attributed to female-headed households in rural areas, nothing is parametrically understood about the gender category and how it affects the tree species diversity, richness, evenness, and abundance.

MATERIALS AND METHODS

Study Area

The Ugenya Sub-County is a rural village located in Western Kenya. It is found in 0^0 02, 0^0 18'N and 34^0 06', 34^0 23'E (See *Figure 1*). It is one of the Sub-Counties in Siaya County (SCADP, 2017). It has four political electoral wards: East Ugenya, North Ugenya, Ukwala, and West Ugenya. The Sub-County covers an approximate area of 322.3 Km^2. The latitudinal gradient determines the spatial-temporal distribution, characteristics, and adaptation. The agroecological zone of the Ugenya Sub-County ranges from ML1 to ML 2. The rainfall distribution is of class B bimodal rainfall between 1200-2200 mm per annum. The thermal zoning falls between 1 and 3, which is 22.5^0 C - > 25.0^0 C. The main precipitation is experienced around March to June, while the short rains begin from September to December (GoK, 2019). The topography rises from 1140 m along the lower Nzoia flood plains to 1440 m above sea level, according to Abura et al. (2017). Located in the Inter-Tropical Convergent Zone, the Ugenya Sub-County has been home to several dominant tree species, both indigenous and exotic, while some are considered endemic species (Kokwaro, 1994). The locality is perceived to have a wide range of medicinal plant species, though the reported dominance of 27 tree species. The classification of vegetation is Subtropical, moist biozone. Poverty, low level of education, and HIV prevalence are the main social characteristics and challenges in Ugenya Sub-County. A society has socio-cultural norms that its members adhere to. For example, according to Oloo (2013), there is the cultural exclusion of female-headed households in Siaya County from classified tree growing practices apart from weeding and watering. Crop and livestock farming represent nearly (80%) of total economic activities and a sizable fraction of employment opportunities in the Sub-County (SCADP, 2017). Youths in the Sub-County are exploring the gap in the transport system contributed to by the numerous distributions of weather roads which favour the motorcycle taxi business.

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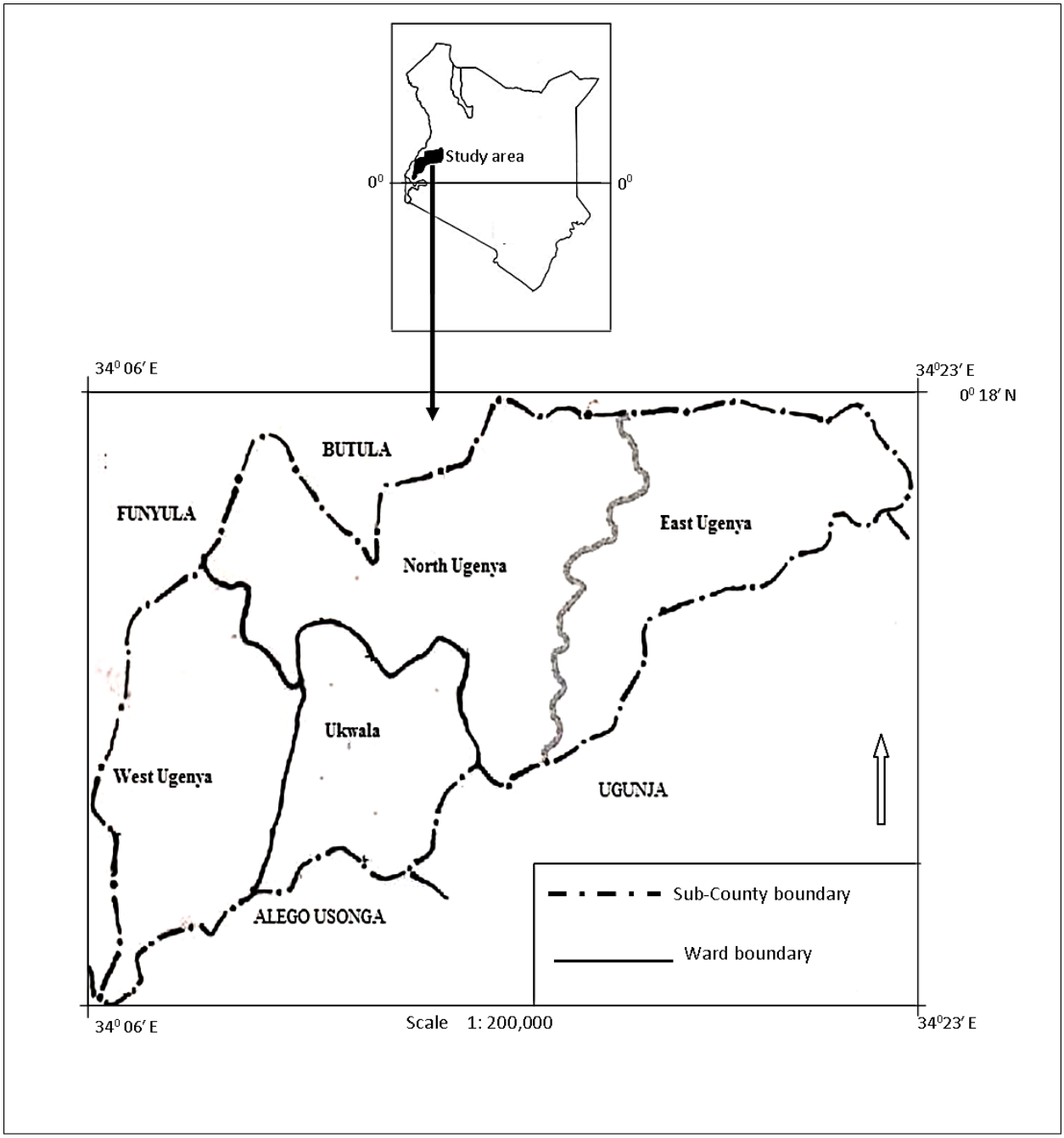
Figure 1: A Map showing the location and outline of the study area



Source: adapted and modified from SCADP (2017)

Questionnaires, interviews, focused group discussions, and observations were used to collect primary data on the socio-demographic characteristics of the respondents. Textbooks, journals, print media, and audiovisuals were relied on. Key informants included; Educators, the gender department, female-based focus groups, Village cultural heads, ward administrators, chainsaw operators, county physical planners, a forest department officer, and the Sub-County land registry office. Based on the recommendations by Lizuka (2018), the tree *DBH* was measured using D-tape. Only three species of DBH ≥ 5.0 inches were included in the survey.

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RESULTS AND DISCUSSION

Table 1: Data on the distribution of Socio-cultural attributes

Education Level	Gender	Culture/beliefs
N = 384	Female = 222	Yes Group = 75
Basic = 246	Male = 162	No Group = 290
Higher = 138		Undecided = 19

Source*:* Field data 2021

Education Level and the Dominant Tree Species Diversity

The majority (nearly 64%) had acquired at least basic education, as shown in *Table 1*, 1st column. According to an interview with Caren (real name withheld), a high school teacher of Geography, on February 16 2022, the acquisition of higher education was low owing to higher school dropout rates catalysed by the prevailing socio-demographic and economic hardship.

Table 2: Group statistics and t-test results: education level, dominant tree species diversity, richness, evenness, and abundance

	Education	N	Mean	SD	T-test
Diversity(H)	Basic	246	2.43	0.26	t(382) = 1.74, *p*
	Higher	138	2.02	0.12	=.036
Richness	Basic	246	15.00	2.00	t(382) =1.62, *p*
	Higher	138	16.50	1.29	= .028
Evenness	Basic	246	.97	0.016	t(382) = 1.52, *p*
	Higher	138	.90	0.018	= .055
Abundance	Basic	246	30.20	5.63	t(382) = 2.85, *p*
	Higher	138	34.25	3.30	= .003

Source: Field data 2021

For verification, a t-test was applied in comparing if a significant inequality in the mean score of Shannon Wiener's diversity index, species Richness, Evenness, and Abundance in households with a higher level of education and those with basic education was prevalent, refer to table 2. The 138 households with higher education levels registered (*M* = 2.02, *SD* = 0.12) demonstrated lower scores on Shannon Wiener's diversity index compared to the 246 households characterised by a basic level of education (*M* = 2.43, *SD* = 0.26) with a statistical significance of t (382) = 1.74, *p* =.036, as portrayed in table 2. The mean score of the tree species richness was significantly lower among the respondents with higher education (*M* = 15.00, *SD* = 2.00) in relation to households with a basic level of education (*M* = 16.50, *SD* = 1.29) and a corresponding t-test significance, t (382) = 1.62, *p* = .028 as illustrated in table 2. Evidenced by a t-test significance of, t (382) = 2.85, *p* = .003, the same statistical direction was replicated in species abundance where, a significant high mean score, (*M* = 34.25, *SD* = 3.30) in tree species abundance was observed among the respondents with higher education levels in comparison to (*M* = 30.00, *SD* = 5.63) for the basic level of education Therefore, the null hypothesis was declined at (95%) confidence interval, *p-value = .05*. Conversely, the null hypothesis was retained at (95%) confidence interval, *p-value = .05* because there was no significant statistical effect for education level, t (382) = 1.52, *p* = .055 despite the respondents with basic education level (*M* = .97, *SD* = 0.016) attaining a higher mean score in dominant tree species' evenness than the ones with higher levels of education (*M* = .90, *SD* = 0.018). Von Thunen's theory hypothesised the role of social dynamics on rural land use practices (Vliet et al., 2015).

There was a tally in results on species diversity, richness, and the observations in Murang'a county by Mackenzie (2003), which, through qualitative justification, concluded a possible disproportion in tree species richness and diversity in basic and higher education categories. As illustrated in *Plate 1*, the low mean score in species diversity and richness in the higher education category was likely due to more emphasis put on a few exotic

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tree species by the high school geography syllabus with no mention of the importance of planting indigenous tree species (Ikeke, 2013). The results of species' evenness depicted the research justifications by Tanui (2015) in Nandi County that by assessing tree canopy reported no visible imbalance in tree species' evenness among the households irrespective of education level. The equality in tree species' evenness reported was likely because unlike the current research, the previous survey was based on a short-term observation period of 4 months (Zhang[a], 2017). The limitation of observation as a research methodology is that it requires a longer time frame to realise the statistical power of prediction. Furthermore, it is inapplicable in assessing the non-linear latent variables that are crucial in tree species adoption (Ochola, 2018). The results on species abundance concurred with the GoK (2019) that found no tangible statistical relationship between education level and tree species abundance. The imparity was likely occasioned by the fact that GoK's (2019) survey data was sourced from the national tree farms inventory records. The periodic forest inventory records are known for data obsoleteness because real-time forest changes are inevitable (Pak, 2021).

Plate 1: Ground closeup photo: depicting a typical home of the educated and culturally modernised household in N. Ugenya ward

Notice the distribution of the exotic tree species in the middle centre ground. Education and cultural modernity have been associated with the introduction of the exotic dominant tree species. Photo by the researcher (2021)

Gender and the Dominant Tree Species

More than half (58%) of the interviewed household heads comprised females. See table 1, 2nd column. Female spouses were the custodians and caretakers of rural homes, while males pursued employment opportunities in urban centres. Female-headed households were culturally restricted from interacting with some dominant tree species, as illustrated in *Table 3*. To verify the distribution of dominant tree species diversity in cross-gender categories, a t-test for independent samples was useful in detecting if a significant inequality in the mean score of Shannon Wiener's diversity index, species Richness, Evenness, and Abundance in female- and male-headed households prevailed as shown in table 3. The null hypothesis was maintained at (95%) confidence interval, *p-value = .05*. There was no significant mean score contrast in the Shannon Wiener's diversity index in female and the male categories, t (382) = 0.639 p = .051, despite males (M = 2.40, SD = 0.26) attaining a lower mean score of the Shannon Wiener's diversity than the females (M = 2.43, SD = 0.12). However, no data was reported for the intersex gender category. In a similar manner, the females scored a higher mean in the tree species richness (M = 6.60, SD = 1.40); even so, the score was insignificantly different from the mean tree species richness posted by the males (M = 5.26, SD = 0.96) and corresponding t-test

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insignificance, t (382) = 0.494, p = .065. The null hypothesis was disputable at (95%) confidence interval, *p-value = .05*, the 222 female-headed households registered (M = .85, SD = 0.03) which demonstrated lower mean score in tree species' evenness, compared to the 162 households characterized by the male respondents (M = .91, SD = 0.03) with a statistical significance of t (382) = 1.61, p = .033. Identified by a t-test significance of, t (382) = 2.55, p = .017, a similar order was again depicted in species abundance where, a significant low mean score, (M = 21.20, SD = 2.88) in tree species abundance was observed in female-headed households in comparison to (M = 30.75, SD = 2.63) for the males. The Thunen model treated gender equality in rural agricultural land use (Kanianska, 2016).

Table 3: Group statistics and t-test results: gender, dominant tree species diversity, richness, evenness, and abundance

	Gender	N	Mean	SD	T-test
Abundance	Male	162	30.75	2.63	t (382) = 2.55, p =
	Female	222	21.20	2.88	.017
Evenness	Male	162	.91	0.03	t (382) = 1.61, p =
	Female	222	.85	0.03	.033
Richness	Male	162	5.26	1.14	t(382) = 0.494, p =
	Female	222	6.60	0.96	.065
Diversity(*H*)	Male	162	2.40	0.26	t(382) = 0.639 p =
	Female	222	2.42	0.12	.051

Source*:* Field data 2021

On species diversity and richness, the findings are inconsistent with the study outcome by Meske et al. (1994), which reported a possible dissimilarity in the tree species richness and diversity in gender-based categories. The results reported in Oban the Hill sector of Nigeria by Meske et al. (1994) were likely because the option to adopt and maintain tree species is dictated by attitude, which is a latent variable which affects everyone irrespective of gender (Saka et al., 2012). The results of species' evenness differed from Oloo (2013), which reported an insignificant mean score imparity in values of tree species' evenness in female and male-headed households. The likely reason for the insignificant mean score was because Oloo (2013) used the snowball sampling technique in recruiting the tree farmers along the gender divide. Snowball is a biased technique whose samples share a common dependent characteristic which compromises statistical independence (Deisser & Njuguna, 2016). Results on species abundance supported the research by Mukundente et al. (2019) that depicted a significantly higher mean score in male-headed households. The possible contributing factor was because of gender parity occasioned by the culture/beliefs, which barred females from a number of the tree-growing practices in the Ugenya Sub-County (Wanjira, 2019).

Culture/Beliefs Orientation and Dominant Tree Species Diversity

Table 4: Dominant tree species, gender roles, and taboos/beliefs

dominant tree species	gender roles	taboos/beliefs
Markhamia lutea	Female members are prohibited by culture from panting, cutting, or climbing the tree when the spouse is alive	The act is an evil spell and may cause the death of the male spouse
Euphorbia tirucalli *Melicia excelsa* *Ficus capensis* *Albizia coriaria*	Female members are prohibited from negotiating the sale of these trees. For example, *Melicia excelsa* requires a male-dominated ritual before cutting.	Young females engaging in such practices are unlikely to get married because it is an abomination.
All the fruit-bearing dominant tree species	Mature female members are prohibited from climbing these trees with the intenti -on of either collecting fruits or firewood	The affected tree species may yield no fruit anymore

Source*:* Field data 2021

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Table 5: Group statistics and t-test results: culture/beliefs, dominant tree species diversity, richness, evenness, and abundance

	Culture	N	Mean	SD	T-test
Diversity(H)	No Group	290	1.49	0.82	t(363) = 2.62, *p* = .011
	Yes Group	75	1.77	0.87	
Richness	No Group	290	8.67	4.95	t(363) = 1.95, *p* = .019
	Yes Group	75	11.00	4.34	
Evenness	No Group	290	.85	0.09	t(363) = 0.877, *p* = .095
	Yes Group	75	.87	0.06	
Abundance	No Group	290	32.82	9.04	t(363) = 0.941, *p* = .052
	Yes Group	75	32.12	13.69	

Source*:* Field data 2021

From a total of 384 household heads questioned, (76%) dissociated with traditional cultural practices, (20%) were culturally conservative, while four percent were undecided, as shown in table 1, 3rd column. A number of dominant tree species performed certain cultural functions with gender restrictions, as depicted in *Table 4*. Respondents, who disagreed with the traditional cultural practices, argued that the culture was based on unnecessarily prohibitive and retrogressive ideologies, which undermined socio-cultural and economic development. Conversely, the proponents of cultural conservation held the view that culture was the only societal ancestral heritage which needed to be conserved at all costs.

To justify if a significant disproportion in the mean score of Shannon Wiener's diversity index, species richness, evenness, and abundance in households with cultural non-adherence and culturally conservative possibly did exist, as illustrated in *Table 5*, the two-sample t-test was conducted. The null hypothesis was dismissed at (95%) confidence interval, *p-value = .05*. The 290 households associated with cultural non-adherence registered (*M* = 1.49, *SD* = 0.82) which demonstrated lower score of Shannon Wiener's diversity index, compared to the 75 households that were considered culturally conservative (*M* = 1.77, *SD* = 0.87) with a statistical significance of t (363) = 2.62, *p* = .011, while 19 household heads remained non-committal. The mean score of the tree species richness was significantly lower in culturally unaffected households, (*M* = 8.67, *SD* = 4.95) in relation to the culturally conservative, (*M* = 11, *SD* = 4.34) and a corresponding t-test significance, t (363) = 1.95, *p* = .019. There was no significant mean score anomaly in the tree species' evenness in non-cultural and the culturally conservative categories, t (363) = 0.877, *p* = .095, therefore, the null hypothesis was retained at (95%) confidence interval, *p-value = .05*, despite the culturally conservative households (*M* = .87, *SD* = 0.06) attaining a higher mean score of the species' evenness than the non-cultural group (*M* = .85, *SD* = 0.09). The culturally conservative scored a lower mean in the tree species abundance (*M* = 32.12, *SD* = 13.69); even so, the score was insignificantly different from the mean tree species abundance posted by the non-cultural households (*M* = 32.82, *SD* = 9.04) and corresponding t-test insignificance, t (363) = 0.941, *p* =. 052. Von Thunen emphasised the role of external interaction, which is a prerequisite for tree species diversification and richness.

The Shannon Wiener's diversity index results differ from the survey by Vliet et al. (2015) in Europe, which reported no significant effect of culture on species diversity. This is because the said study relied on Simpson's index; unlike Shannon Wiener, the Simpson index is known for insensitivity to rare species (Marcon & Zhang, 2017). The outcome of the tree species richness was corroboration by Tarasuk et al. (2019), that associated higher tree species richness with cultural conservation. This was possibly attributed to the fact that the functions of indigenous culture and traditions depended on a diverse community of trees (The World Bank, 2019). Both the results on species' evenness and abundance portrayed an inconsistency with the conclusions by Yeboah (2020) in Africa, which portrayed a contrast in the tree species' evenness and abundance in traditional and non-cultural categories. This was likely because in Nigeria, establishing indigenous trees is synonymous with African culture, while the exotic trees are perceived as a symbol of cultural modernity as categorised in Borneo, Malaysia (Vernick, 2020). The recent forest conservation studies in Africa have registered a

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lower species' evenness and higher tree population for the dominant exotic tree compared to higher species' evenness and lower population for the indigenous tree species (Mauro & Aquino, 2020).

Planting and harvesting required matrimonial rituals. In the absence of a male spouse, the mentioned farming practices are at a standstill. The respondents that unsubscribed to culture perceived the planting of some tree species as a backward act. Households that grow "Ojuok" [*Euphorbia tirucalli*] hedges are considered uncivilised. "Ja Ojuok" ["uncivilised person"]. The negative attitude is linked to tree species diversity loss (in the words of Mr. Fredrick Ooko on December 19 2021) a key informant in forestry issues, the inception of alien tree species has been received with cultural suspicions, and others are perceived as arsenal with black magic potentiality.

A section of the population was likely practising ethnobotanical culture. A number of the dominant tree species are associated with negative omen as portrayed. For example, from the interview, a respondent said: "Umbrella was an exotic dominant tree species in the Sub-County in the late 90s. The tree is however associated with unprecedented mortality among the households when grown within the homestead. The species is being uprooted or cut down due to fear of death(s) in the family" (own words of Mrs. Helida Were Oduor on December 20 2021). The planting of the Jack tree is another bad omen in a home; the tree is linked with misfortune and poverty.

CONCLUSIONS

Higher education is appreciated for positive awareness creation in tree growing. However, the individuals with higher levels of education were likely to plant pure tree stands, which negatively affected the dominant tree species diversity, richness, and evenness. Although statistically insignificant, the female-headed households registered higher mean scores in values of dominant tree species diversity and richness. Conversely, the values of the species' evenness and abundance were significantly higher among the male-headed household groups. Conservation of local traditional culture and beliefs is likely linked to the availability of higher tree species diversity and richness. The species' evenness was however unaffected by cultural orientation. The households that shunned the local culture and beliefs are likely to report significantly higher mean scores in dominant tree species abundance. To promote and sustain the tree species diversity for stabilising carbon sinks in the Ugenya Sub-County, there is an urgent requirement for addressing the socio-cultural imparities.

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