# Evaluation of Vegetation – Slope Relationship in Shasha River Basin, Southwest, Nigeria

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## ABSTRACT

The analysis of the geographic distribution of vegetation characteristics in relation to environmental factors is key in addressing biodiversity conservation issues. This study identified the distribution of vegetation communities in Shasha River Basin in relation to the spatial variation of slope in the area, with a view to determine the influence of slope on the floristic distribution in the river basin. Field data were collected at 184 randomly determined plots of $100m^2$. All woody species in each plot were identified to species level, enumerated and recorded. Landsat imagery obtained for the area was classified using supervised classification algorithm to determine forest area while SRTM DEM was used to analyze the topography of the area. Data were analyzed using Principal Component Analysis (PCA) and Pearson Correlation to determine slope influence on vegetation characteristics. The results showed that over 70% of the river basin was forest vegetation. Plants species sampled were a total of 8760 individuals, consisting of 324 species belonging to 81 families. Dominant woody species included Funtumia elastica and Albizia zygia, while dominant understory species included Cyathula prostrata, and Culcasia scandens. The elevation of the area ranged from 56m to 685m above sea level, with most areas having slope of less than 10% rise and southward facing slopes. The PCA showed elevation having impact on vegetation distribution. The study concluded that topography had a low influence on vegetation characteristics. However further research may consider including other environmental factors such as agriculture and anthropogenic activities, to strengthen knowledge on vegetation slope relationships.

**Keywords: Forest, Biodiversity, Topography, GIS, Environment**

## 1. INTRODUCTION

Forest covers approximately 33% of the earth's land surface area (Ritchie, 2021). Forests provide basic sources of food and shelter for various organisms. It also serves as a suitable source and store for energy, nutrients and gases (Kio, 1976; Buba, 2015). In Nigeria, forest plays a vital role in not just balancing the climate and environment, but also in the economic and social development of the country (Momodu et al., 2011), as many people depend on the forest for their livelihood. Nigeria's tropical forest is depleting fast, due largely to uncontrolled human activities. The need for maintaining forest vegetation biodiversity has been emphasized worldwide, especially as regards it contribution to climate change and global economic development.

Over the years, various researchers have attempted to characterize vegetation biodiversity to ensure better understanding of global forest systems and our contribution to its maintenance. Previous studies have examined specie-environment relationship in different ecological systems, particularly the tropical ecosystem (Lemma et al., 2025; Mateo et al., 2022). Some of these studies determined the abundance and distribution of plant species at the biotic level, that is, competition, dispersal, predation, conspecific and heterospecific interactions, etc. (Comita et al., 2010; Anderson, 2017), while some at abiotic level (climate, geology, topography etc.), and others a combination of both biotic and abiotic constraints (Toledo et al., 2012; Zellweger et al., 2016).

Studies in plant species and environment relationships emphasize the important influence topography has on ecosystem processes. Topography deals with the nature of the terrain, involving surface roughness, elevation (height), aspect (orientation) and slope (degree or percentage rise). It significantly affects plant processes through drainage and accumulation (Zevenbergen and Thorne, 1987; Jacobs et al., 2017) through factors such as soil type and composition, erosion and runoffs, illumination and visibility as well as accessibility (El Chaal and Aboutafail, 2022). Topography affects vegetation growth by determining local environmental conditions. Chen et al. (1997) found that the tropical rain forest in Taiwan showed that topographic variables were needed to explain variation in vegetation structure and floristic composition. The extent to which a landscape may capture or retain water and nutrient resources determines vegetation pattern, particularly woody plants (Han et al., 2022). Thus underscoring the importance of slope processes in redistribution of minerals necessary for plant growth and biodiversity (Cheng et al., 2023). Wu and Archer (2005) hypothesized that historic changes in woody cover on landscapes will vary based on variations in topography based features. Studies have shown that topography influences pattern of woody plant cover and change at the catena scale (Han et al., 2022). This may even over ride constraints imposed by soil (Feng et al., 2021). For a given catena, soil variability associated with vegetation differences are confounded by slope processes

Although, topography is a key determinant of vegetation patterns (Wu and Archer, 2005) there appears to be limited studies in the African tropical forests on the nature of this relationship (Shetie et al., 2017). It appears that detailed analysis of the influences of topographical factors on vegetation diversity, especially at local scale in the tropics is still lacking. Similarly, vegetation characteristics analysis in natural boundaries such as a watershed have been analysed in arid environments (Liu et al., 2017). However, there are limited studies of watershed vegetation – environment relationships in the tropical ecosystems. Hence, this study attempts to evaluate vegetation-topography relationship characteristics within the Shasha River basin in Southwest, Nigeria, providing knowledge that may be useful in biodiversity conservation and management activities.

The area around the Shasha river have been studied for various natural and man-made phenomena, including the characterization of soils in the flood plain (Adisa et al., 2017) and analysis of floristic composition and forest fragmentation in the Shasha Forest Reserve (Akinyemi and Oke, 2014; Adepoju and Salami, 2017). However, there are limited studies on the relationship between vegetation species and the topography within the basin. The river basin offers a natural boundary within which habitats can be examined based on biotic and abiotic characteristics. This study examined the relationship between soil and topography on vegetation diversity in Shasha River Basin with a view to quantifying the effects of spatial variation of the environmental factors on the vegetal distribution in a typical tropical rain forest, using method that may be replicated in other tropical rain forest watersheds.

## 2.METHODOLOGY

### Study area

The study area is the River Shasha basin, which lies approximately between longitude 4°09'E and 4°50'E and Latitude 6°40'N and 7° 40'N (Figure 1) with elevation ranging from 50 m to 600 m above mean sea level. The Shasha river has a total length of 416 km, passing through Osun State, South West Nigeria and empties into the Lagos Lagoon. The basin covers an area of 3,021 km$^2$. The climate of the study area is tropical humid in nature (Adisa et al., 2017). The area is characterized by wet season, which falls mostly between the months of April and October, and dry season is between the months of November and March. The wet season is associated with the Southwest monsoon wind from the Atlantic Ocean while the dry season is associated with the northeast trade wind from the Sahara Desert (Fink et al., 2017). The rainfall pattern is bimodal with peaks in June/July and September/October. The mean annual rainfall in the area is between 150mm and 3000 mm. The temperature ranges between 21°C and 38°C. The average hours of sunshine in the area is 6.6 hours.

The area falls predominantly in the rainforest region of Nigeria, though portions can be identified as belonging to the derived savannah region. Within this zone, studies such as Salami (1998) documented progressive shifts in the ecological boundaries of the tropical lowland rainforest because of human pressures. Towards the northern boundary, the derived southern Savannah exists (Morgan & Moss, 1965). Studies have shown that most of the area have forest vegetation, though Richards (1939) identified the forest of southwest Nigeria to be mainly secondary. Therefore, the few relics of lowland rainforest zone of south-western Nigeria is confined to protected areas, particularly the forest reserves in eastern Ogun, western Ondo and southern Osun States collectively referred to as Omo-Oluwa-Shasha complex. Woody species that are commonly found in the area include Albizia zygia, Ficus exasperata, Chromoleana odorata and Cyathula prostrata.

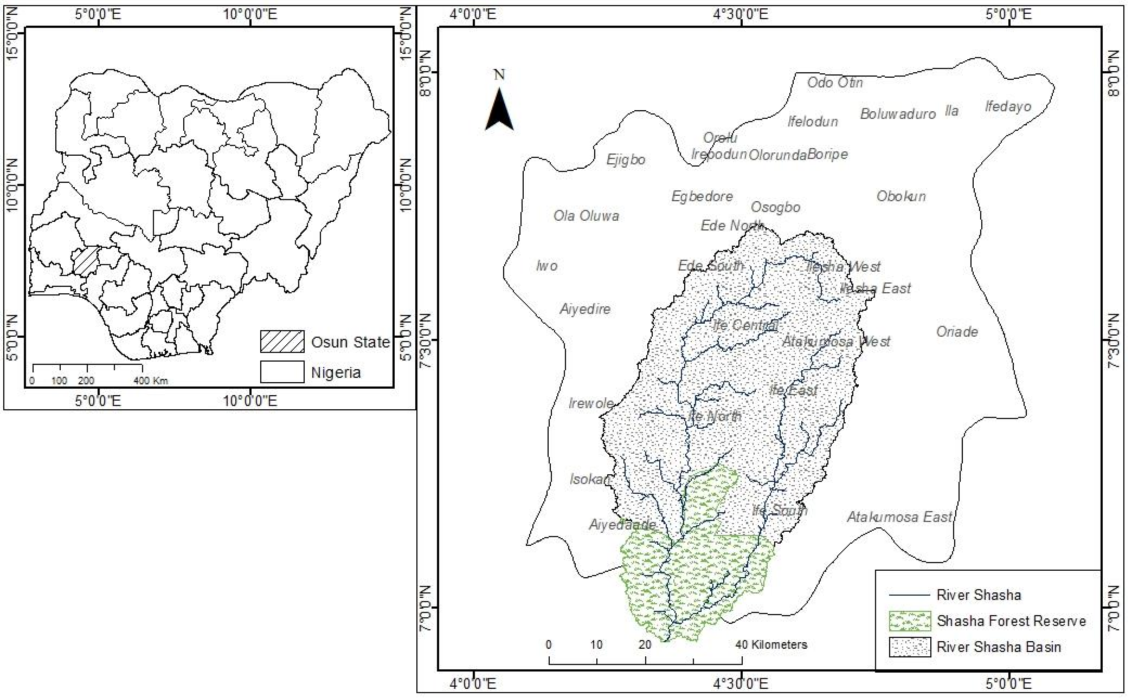


Figure 1: Shasha river basin located in Osun State, Nigeria.

**Data**

Primarily, field survey was conducted to collect data including vegetation characteristics such as species names, plant data (height, diameter at breast height, tree crown etc.), tree density, specie richness and abundance and landscape characteristics (slope and ground elevation). Secondary data used for this study are satellite imagery and digital elevation model (DEM) data of the area. Both were obtained from the USGS data archive site. Landsat satellite imagery (Landsat OLI) of the area for 2025 was collected. The study area was extracted using SRTM DEM data (Coker et al., 2020; Aliyu and Nuhu, 2021). The extracted river basin was then used to extract the study area from the Landsat imagery. The area was classified using the Support Vector Machine (SVM) algorithm (Braun et al., 2010) according to level I of the Anderson (1976) classification scheme into five classes: Agriculture, Urban, Water, Bare surface and forest, based on training sites verified from the field (Olokeogun et al., 2014).

The generated land use map of the river basin was divided into 1km grids using the fishnet function in ArcGIS. 10% of the 1 $km^2$ forest grids were then selected randomly. All selected grid areas were visited with the aid of a GPS device and a team consisting of the researcher, a botanist, a field guide and two soil and vegetation scientists. The field work was done between July and November (predominantly rainy season). A total of 183 plots were visited. Within each selected 1 km by 1 km area, a sample plot of 10 m by 10 m was randomly determined for collecting woody vegetation details based on Iwara et al. (2011). At each 100 $m^2$ plot, using a measuring tape and 1m sticks, a sub-quadrat of 1m by 1m was randomly delineated to sample shrub and understory vegetation. All trees and shrubs in each plot were enumerated, identified and recorded for analysis. Tree plants were measured for girth at breast height and height. The number of occurring plant species in each quadrat was also recorded. environmental data collected at each plot include the topography (elevation) and slope (aspect, angle and percentage rise). This was done using a GPS and an inclinometer.

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## METHODS

The data obtained from primary and secondary sources were analysed both statistically and spatially. Statistical analysis was carried out using Microsoft Excel. Vegetation indices, soils, slope and relationship analysis were carried out using the Paleontological Statistics software (PAST) version 3.19 by Hammer et al. (2016).

Diversity indices of species richness was determined. Species richness is the number of species present within a community, and is a basic measure of biodiversity (Dupuis and Goulard, 2011). The species richness index of Chao1 and Chao2 indices developed by Chao and Chiu (2016) was adopted for this study. The Chao indices are non-parametric estimators based on the incidence and abundance of occurring species. Chao1 is used to determine the species that are represented by a single individual (singletons) and by 2 individuals (doubletons), given in equation 3.2. Chao2 measures the species that are present in only one sample and in two samples, given in equation 3.3.

$$D = \frac{s-1}{\ln N} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \text{equation 3.1}$$

Where s is the number of different species in the sample, and N is the number of individuals in the sample

$$Sest = Sobs + ((\frac{F2}{2G+1}) - (\frac{FG}{2(G=1)2})) \quad \ldots\ldots\ldots\ldots\ldots \quad \text{equation 3.2}$$

$$Sest = Sobs + \frac{L2}{2M} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \text{equation 3.3}$$

Where Sest is the number of species estimated, Sobs is the number of observed species, F is the number of singletons, G is the number of doubletons, L is the number of species that occur in one sample (unique species) and M is the number of species that occur in exactly two samples. Species diversity was also calculated using the Shannon-Wiener, H, index (equation 3.4) and the Simpson's D index (equation 3.5). The Shannon-Wiener index reflects the relative abundance while the Simpsons D is a dominant index, influenced by dominant species.

$$H = \sum_{i=1}^{s} (p_i) \ln (p)_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \text{equation 3.4}$$

Where $(p_i)$ is the proportion of the total number of individuals in the population that are in species 'I'

$$D = \sum (\frac{n_i(n_i-1)}{N_t(N_t-1)}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \text{equation 3.5}$$

Where $n_i$ is the number of individuals in a specie and N is the total number of individuals for the site.

Results from the Shannon-Wiener H and the Simpson's D indices are just indicators and do not effectively give the values of diversity. To translate the indices values to effective number of species, the exponent of the Shannon-Wiener H is determined (equation 3.6) while that of the Simpson's D index is given in equation 3.7.

$$ENS(H) = Exp(H) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \text{equation 3.6}$$

$$ENS(D) = \frac{1}{1-D} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \text{equation 3.7}$$

The topography was extracted from SRTM DEM dataset (Mahmoodi et al., 2022). The SRTM topographic set was the primary source of slope data for the study. To validate the topographic data, elevation, slope and aspect was determined at each study point where vegetation data was collected. Considering that undulation within a 100 $m^2$ area cannot always be avoided, average elevation values was used at locations where multiple elevation values could be read. To determine slope, an inclinometer was used. Slope at each study plot was determined based on the percentage rise and degree of rise on the field. This was used with the SRTM data to calculate the Aspect of the terrain. The Aspect is the direction of slope in relation to the cardinal directions (North, South, East and West).

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To determine the relationship between vegetation and slope, characteristics of each factor was reduced using Principal Component Analysis (PCA). PCA is an effective technique for reducing dimensionality of datasets to increase its interpretability and reduce data loss (Greig-Smith et al., 1967). PCA shows the 'most important' variables which may be used as input into other analysis. Variables with loadings greater than 0.5 was considered to be important. Correlation analysis was used to interpret vegetation patterns with respect to topography (Ekanade and Orimoogunje, 2012). Pearson product-moment correlations was calculated for relationships between the importance value of tree species and topography, altitude, and slope angles. This was used to test the significance of the relationship between topography and vegetation.

## 3.RESULTS

The total area of the river basin is 3021 km$^2$ out of which 634 km$^2$ is covered by the Shasha forest reserve. The result from the analysis shows that forest vegetation occupied approximately 2,173 km$^2$ out of the 3,021 km$^2$ river basin, making up about 72% of the area (Figure 2 and Table 1). The Shasha forest reserve located in the southern part of the river basin is a major contributor to the extent of forest in the study area. Though forest make up a large portion of the area, farmlands are a noticeably dominant feature, accounting for 421 km$^2$ (14%) of the river basin. Built-up area accounts for 8% of the river basin. Major settlement within the basin include Ile-Ife, Sekona, Gbongan, Ago-Owu and Ifewara. However, there are many smaller settlement and farm villages in the area. Even the forest reserve has settlements occupied by farmers, loggers, settlers and natives of the area. Water body and bare-lands make up the smallest land cover in the basin, covering 1% and 4% respectively. Most areas that are bare within the forest reserve where areas where logging activities (tree felling and vehicle movement) have left the ground surface bare. Outside the forest reserve bare lands were areas cleared possibly for construction or where the land has been cut to extract sand for construction. These bare areas are few but noticeable across the area especially close to the settlements.

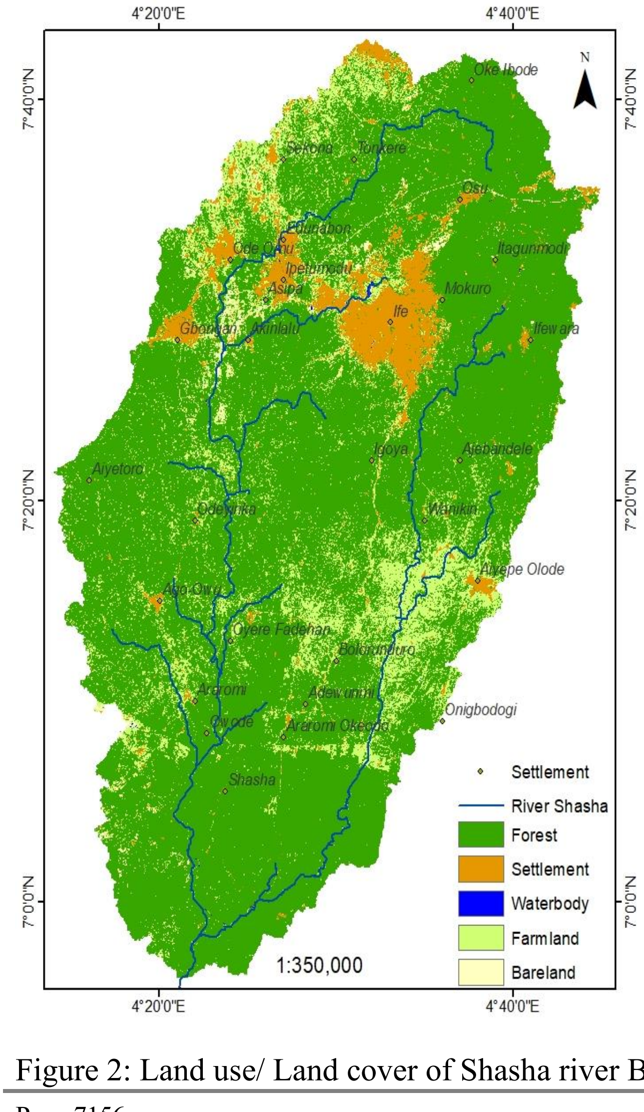


Figure 2: Land use/ Land cover of Shasha river Basin

Table 1: Land use characteristics of Shasha river basin

| Landuse | Area ($km^2$) | Area (%) |
|---|---|---|
| Forest | 2173 | 71.92 |
| Settlement | 249 | 8.24 |
| Waterbody | 35 | 1.16 |
| Farmland | 421 | 13.94 |
| Bareland | 143 | 4.73 |

A total of 8760 individual plants were sampled in this study. This consisted of 324 species belonging to 81 families. 51.4% of the species were woody vegetation, consisting of 169 species of 51 families, with 17% occurring as saplings in the understory vegetation. Understory vegetation had 48% consisting 155 species of 49 families (including climbers (13%), grass (4%), fern (0.6%), herbs (16%) and shrubs (15%). Woody species with the highest number of individuals were Funtumia elastica Albizia zygia, Ficus exasperata and Bridelia micranta. Seventeen (17) woody species were found only once in the area. These include Anthocleista liebrechtsiana, Cassia siamea, Hildergardia barteri and Treculia africana. Among the understory vegetation, Cyathula prostrata and Culcasia scandens were the most present species. Mean diameter at breast height (DBH) of woody species in the area was 15.36 cm, with a range of values from 1.5 cm (Bridelia micrantha, Funtumia elastica and Monodora tenuifolia) to 2 m (Trichilia prieureana, Albizia zygia and Ficus exasperata). However, Irvingia gabonensis had the highest mean DBH of 44.48 cm though it had only 17 individuals. Albizia zygia had a mean DBH of 22 cm while the most dominant woody species, Funtumia elastica had an average DBH of 7.17 cm.

Assessing species richness using the Chao indices (Table 2) shows that Shasha river basin has a Chao1 value of 351.82. Woody species have a Chao1 value of 188 while understory vegetation had a value of 233.13. The Chao2 value for all vegetation within the river basin is 407.6 with woody species being 198.93 and understory vegetation being 297.11, The Shannon-Weiner H’ diversity value is 4.79 for all vegetation species in the river basin. Both the woody species and understory vegetation had the same Shannon-Wiener H’ value of 4.24. Converting these values to effective number of species (ENS) show that both the woody and understory vegetation have 69.5 effective species. These are the number of species that are equally common and giving the area its diversity value. The Simpson’s D index is commonly used to record dominance or diversity values, where lower values typically indicate higher diversity (Bhatti et al., 2021). Within the river basin, lowest Simpson’s D is 0.35 indicating 1.5 species as dominant. The highest value is 0.92 with 12.5 dominant species. However, the average number of dominant species is 5.26 with a D index of 0.81.

Table 2: Diversity Indices for vegetation in the river basin

| | Tree | Shrub | All Vegetation |
|---|---|---|---|
| Samples | 183 | 183 | 183 |
| Individuals (computed) | 2841 | 5936 | 8777 |
| Chao 1 | 188 | 233.13 | 351.82 |
| Chao 1 SD (analytical) | 9.18 | 10 | 11.04 |
| Chao 2 | 198.93 | 297.11 | 407.6 |

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| | | | |
|---|---|---|---|
| Chao 2 SD (analytical) | 12 | 25.54 | 22.72 |
| Shannon Mean | 4.24 | 4.24 | 4.79 |
| Simpson Inv Mean | 41.89 | 37.73 | 66.44 |

The terrain is characterised by undulations spread over the area. Average height is 242 m with a range from 56 m to 685 m above sea level as shown in Figure 3. Most of the lowest lying areas are at the southern part of the area with height values of between 56 m to 161 m above sea level. This is characteristic as these areas are closest to the Shasha river channel. The upper eastern parts of the river basin have the highest topographic elevations of between 328 m and 685 m and are farthest from the river channel. The upper eastern areas are characterized by few scattered hills making the elevation up to 685 m. The percentage increase in slope for most of the area (Figure 4) is between 0% to 9%, making up 77.5%. 18% of the area have a slope of between 9% and 16% with only 4.5% of the area having a rise of 16% to 112%. Similarly, measuring slope rise in degree show that 76.5% of the area have a rise of below 5.51°, 17.5% have a rise of between 5.51° and 9.32° and 6% of the area have a rise of between 9.32° and 48°.

Aspect is the compass direction of the slope, measured from 0° to 360°, given the north, south, east and west directions. The direction of the slope gives an indication on the illumination available for vegetal growth (Bayat et al., 2022). Most of the Shasha river basin have east to west slope southwards (64.7%) between 112° to 292° as shown in Table 3. The other 35.3% are slopes facing northwards from west to east (337° to 67°).

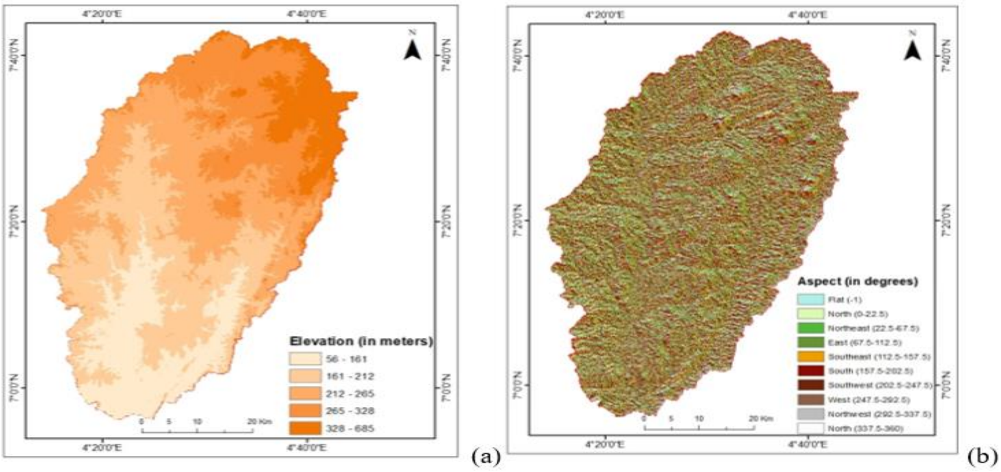


Figure 3: Elevation and Aspect in the River Shasha basin

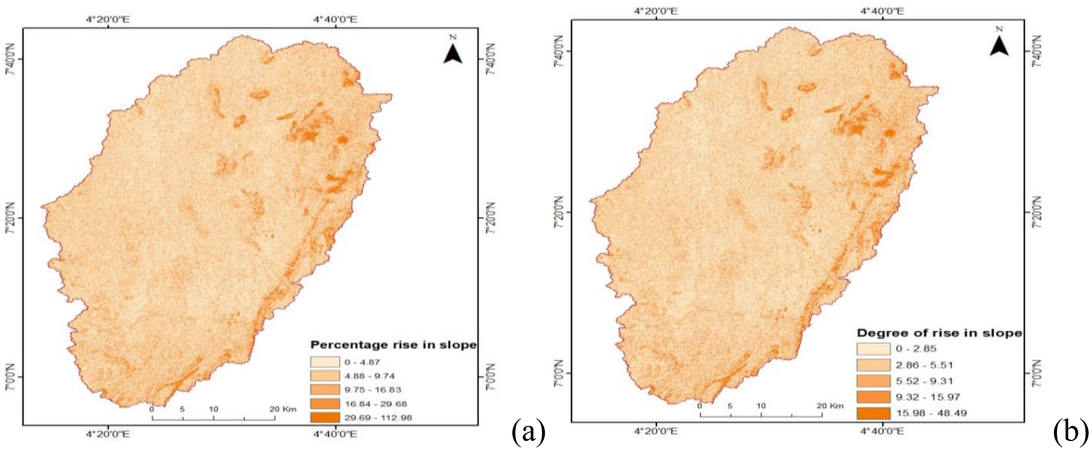


Figure 4: Slope of the River Shasha basin showing (a) the percentage rise in slope and (b) the degree of slope rise

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PCA carried out of vegetation data show that the Principal Component 1 and 2 accounted for 93.75% of the variance. Chao1 index had the highest loading of 0.98 in the first principal component while Average Diameter at Breast Height had 0.96 loading in the second principal component (Table 3). Chao1 index has a high positive variation in the first component. The PCA for slope using the elevation, slope and aspect as input variables have components 1 and 2 accounting for 99.8 percent of the variance (Table 4). Aspect has a significant loading of 0.99 in component 1. Other variables had positive loadings with Slope being closest to 0 variation. On the second component, elevation has 0.99 loading with only Aspect being negative but still very close to 0 with Slope.

Table 3: PCA loadings for vegetation variables

| | PC 1 | PC 2 | PC 3 | PC 4 | PC 5 | PC 6 | PC 7 | PC 8 | PC 9 | PC 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Average DBH | -0.10 | **0.96** | 0.05 | -0.27 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average Height | -0.06 | 0.26 | 0.07 | 0.96 | -0.01 | -0.01 | -0.01 | 0.00 | 0.00 | 0.00 |
| Simpson_1-D | 0.00 | 0.00 | 0.02 | 0.00 | 0.11 | 0.25 | -0.10 | 0.24 | -0.30 | 0.88 |
| Shannon_H | 0.01 | -0.01 | 0.08 | 0.00 | 0.45 | 0.54 | -0.30 | 0.50 | 0.28 | -0.29 |
| Chao-1 | **0.98** | 0.13 | -0.16 | 0.04 | -0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |

Table 4: PCA loadings for slope variable

| | PC 1 | PC 2 | PC 3 | PC 4 |
|---|---|---|---|---|
| H | 0.068642 | **0.99756** | -0.01303 | 0.000189 |
| Slope (Percent) | 0.010758 | 0.010714 | 0.87003 | -0.49276 |
| Slope (Degree) | 0.006116 | 0.005848 | 0.49269 | 0.87017 |
| Aspect | **0.99756** | -0.06879 | -0.01151 | -3.42E-05 |

Correlation matrix of topography and vegetation properties indicate a significant but low relationships (Table 5). Correlation coefficient ranged from -0.13 to +0.21. The highest positive relationship is between Height and number of species. The p-value of the relationship between Height and number of species is 0.004, which is well below the threshold of 0.01. This show that though variations in topography influences the vegetation characteristics, the strength of the influence is low. The variance (r2) indicates only about 4.4% is explained by the relationship between height and number of species. The implication is that species that can be found on low lying areas may also be present at higher altitudes.

Table 5: Correlation matrix for vegetation and slope variables

| | H | Slope (Percent) | Aspect |
|---|---|---|---|
| No. Veg Individuals | 0.16 | 0.10 | 0.01 |
| No. of Species | **0.21** | -0.05 | 0.09 |
| Average DBH | 0.08 | -0.02 | -0.11 |
| Average Height | 0.01 | 0.04 | -0.09 |

| | | | |
|---|---|---|---|
| Simpson_1-D | 0.10 | 0.00 | 0.05 |
| Shannon_H | 0.13 | -0.04 | 0.10 |
| Chao-1 | 0.00 | -0.11 | 0.04 |

## 4.DISCUSSION

Land use/cover studies of the Shasha area by Olokeogun et al. (2014) and Adedeji and Adeofun (2014) reported that forest cover within the forest reserve was over 60%, with most of the forest areas remaining unchanged since the 1980s. This is mostly because a substantial portion of the area is protected as a national forest reserve. Though findings in this study indicate more forest vegetation, it is consistent with previous studies. The study by Adepoju and Salami (2017) suggest that the forest area within the reserve may have increased, though there are indications of forest fragmentation, as areas that were previously forested may have become farmlands or even grasslands due to Anthropogenic activities in the area, especially logging and clearing of lands for cocoa, plantain and oil palm plantations (Bukoye et al., 2023; Olatoye et al., 2026). The forests in this area have been largely exploited for its resources, especially for wood, food, accommodation/settlements and medicine (Gbadegesin, 1996; Adekunle et al., 2010). Salami (1998) found that vegetation systems have been affected by anthropogenic activities. Within the forest reserve, pockets of farmlands could be observed, especially in areas where small settlements have sprung up (Olokeogun et al., 2014). The built up areas within the basin is consistent with similar studies by Adepoju and Salami (2017) who found 2% of the forest reserve area to be built.

The river basin is characterized by floral diversity that is characteristic of the African tropical rainforest (Sosef et al., 2017). Many of the species were identified using Hutchinson et al. (1963). The study reported about 324 species belonging to 81 families. This was more than that reported in Akinyemi and Oke (2014), though that study was carried out within the forest reserve alone. However, the Biodiversity inventory report of nearby Omo forest reserve indicated over 500 plant species (Ola-Adams, 2014). Some of the dominant species found were consistent with similar studies by Hall and Okali (1979) and Oke and Isichei (1997) but quite different from those found to be common in the Omo forest reserve (Ola-Adams, 2014).

The topography in the river basin ranges from 56m in the lowest lying areas to 685m in the hilly eastern parts of the area (local topographic survey). This is characteristic of terrain in many parts of western Nigeria. Osinowo et al. (2014) found their study area in south western Nigeria to be undulating with values between 125m and 1812m ASL. However, Shasha river basin has a gentler topographical range. Assessing the relationship between the topography and vegetation in the river basin shows that height can be a determinant in vegetation distribution (O'Brien & Escudero, 2021). Wu and Archer (2005) noted that topography is an important determinant of vegetation as it affects factors such as water retention and soil nutrient accumulation. Correlating topographical characteristics with vegetation attributes show mostly positive correlation. However, considering the relatively gentle slopes found in the study area, it appears that the influence of topography on most of the vegetation characteristics is not high. Studies such as Asuk et al., (2023) on similar Nigerian forests indicate that topography often influences species distribution indirectly by regulating human access to different parts of the landscape for foraging and logging. Human disturbance, known to be high in this basin, may be a confounding variable that masks natural topographical drivers (Asuk et al., 2025). In gentle terrain, if access is uniform across elevations, this could mask the expected topographic influence. Furthermore, the low correlation coefficients found here may be partly due to a scale mismatch between the 10m x 10m field plots and the 30m resolution of the SRTM DEM used. Research by Guillaume et al., (2024) suggests that a 30m grain size often 'smooths' over the micro-topographic features (local ridges, gullies) that drive vegetation patterns at the 10m scale.

Further studies may consider this phenomenon in areas within the region using compound indices like the Topographic Wetness Index and Topographic Position Index as this has been found to be useful in assessing vegetation slope relationships (Maduako et al., 2017; Adelabu & Wang, 2025). Also, analyzing other factors such as soil nutrients (Ajah et al., 2022) and moisture, anthropogenic activities and agriculture may give better indication of topographical influences on vegetation characteristics in the area.

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## 5.CONCLUSION AND RECOMMENDATION

This study evaluated the relationship between vegetation and topography in the Shasha river basin in South western Nigeria. the area was found to be predominantly forest, with other land uses being farmland, built-up areas, bare-lands and water body. Vegetation characteristics of the area indicate a high vegetation biodiversity and species richness. The terrain is undulating with most areas lying in low slopes. The Chao 1 index and the elevation Height were found to be the most important factors of variation the study. Correlating these factors indicate positive relationships, though the correlation is low. The study provides information that is useful in managing biodiversity especially within the protected area of the forest reserve. It is recommended that topographical studies be included in vegetation analysis for conservation and management as it help provide a holistic environmental analysis for understanding plant species distribution. Further studies may consider much broader topographical variation, as well as include other environmental factors to aid in understand species environment relationship for better biodiversity conservation and management.

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