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INFLUENCE OF DRAINAGE DENSITY AND RELIEF ON CULTURAL VEGETATION IN RIMINGADO-TOFA AREAS, KANO STATE, NIGERIA

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ABSTRACT

The aim of the study was to determine the influence of relief and drainage density in the study area for improvements. Quadrats of 100m by 100m each were laid in two local government areas based on topography. Data on relief and altitudes of the area was collected from sampled points of each quadrat using GPS and slope was determined from Digital Elevation Model (DEM). Drainage density map of the study area was developed using GIS techniques. Drainage density of each location was calculated from drainage density map of the study area. Different types of cultural vegetation species were determined and counted at each sampling point within each quadrant. Distribution and changes in cultural vegetation was determined based on relief and drainage density. Data on changes of indigenous cultural vegetation in the area was counted in each quadrat unit. Data was analysed using simple statistics. Data on distribution and changes of cultural vegetation with drainage systems and relief was analysed using ANOVA single factor. Result of the research shows that higher areas of Rimingado and Tofa recorded the least number of cultural vegetation whereby Doka recorded 19 trees Yango 25 and Butu-butu 30 trees. Lower areas recorded the highest number of cultural vegetation, Karofinyashi recoded 69 trees. Result shows that highest number of shrubs were recorded in Yango with 40. Findings also shows that more saplings are recorded in the lower areas than in the higher areas. Result shows that areas with drainage density 157.5km/km², slope 7.5° recoded highest number of trees. The result shows that there is a significant difference at 0.05 level between relief and cultural vegetation and between drainage density and cultural vegetation among the study locations since P values are 0.0002 and 0,040 respectively which are all < 0.05 and there is no significant differences between slope and the distribution of cultural vegetation in the areas with P 0.13. It was deduced that the cultural vegetation in the area was greatly influenced by drainage density and relief. Based on findings it is recommended that practice of afforestation and preservation of cultural vegetation should be given serious attention by governments, NGOs and individuals particularly in the higher areas of Rimingado-Tofa.

INTRODUCTION

Surface topography of any portion on earth is not uniform, it varies from place to place and it is in constant state of change over time. This change is possible through erosion, deposition and other forms of denudation. Relief of an

area also determined drainage density and drainage patterns of that area.

Relief and drainage orientation of any geographical area on the planet earth determined the nature, distribution and character of vegetation cover in that area.

Any organised system of tributaries exhibits spatial characteristics that provide important information about the nature of the drainage basin. That is why areas of higher drainage density will have higher surface runoff, less infiltration, least moderately erodible surface material which also affects vegetation character and distribution (Istanbulluoglu and Bras, 2005). Drainage density and drainage systems behaviour depend on nature of watershed. Watershed is a geohydrological unit draining at a common point. Such natural unit has evolved through rain water interaction with land mass, typically comprising arable land, non-arable land and natural drainage lines in rain-fed areas (Rymbai, Dey and Jha, 2012).

Slope and drainage density of an area can affect vegetation, areas of steep slope and sparse vegetation cover are having less drainage density (Istanbulluoglu and Bras, 2005). Research findings in southern Dakota Badlands by Istanbulluoglu and Bras (2005) indicated that easily eroded parts are located in a steppe climate, an area with extremely high drainage density of over 125km/km² and very resistant granitic hills in a humid climate may have a drainage density of only 5km/km² and at hill sides the natural vegetation is scarce.

Cultural vegetation is defined as vegetation with a distinctive structure, composition, and development determined by regular human activity. Cultural vegetation has typically been planted or treated, and has relatively distinctive physiognomic, floristic, or site features when compared to natural vegetation (United States Natural Vegetation Classification (USNVC, 2008). Also Kuchler (2010) Define cultural vegetation as all types of vegetation that have been altered by man directly or indirectly. Floristic and physiognomic criteria are the primary properties of cultural vegetation used to define all units of the classification, but assessed in light of human activities that govern these properties. Some types are difficult to place in terms of natural versus cultural vegetation (e.g., forest plantation, pastures), and the user may need to look in both parts of the hierarchy to determine the

type's location (Federal Government Data Committee (FGDC), 2008). The most precise understanding of the character of natural vegetation type is important because it represent the integration of all physical biotic features of their respective biotopes (Kuchler, 2010). USNVC (2015) classify cultural vegetation in to upper hierarchy as cultural class, cultural subclass and cultural formation, middle hierarchy consist of cultural group and subcultural group and lower hierarchy as cultural types and cultural subtypes. This classification is based on combination of growth form, as those respond to climate, elevation, slope, drainage systems and substrates among others.

In the study areas there are different forms of cultural vegetation that varies spatially from one part to another. This variation may be attributed to differences in terms of altitude, slope and drainage systems. Over the years some cultural vegetation is changing and some species are disappearing in some parts of the study area and no available data on the issue for development and planning. For example *Rimi* one of the historic trees in Rimingado-Tofa areas is disappearing, shrubs and saplings displayed different pattern and changes in the area and no justifiable reasons for that spatial distribution that is why the study is necessary.

Recent studies conducted outside the study area that are having relation with this include that of Silva *et al* (2008) in parts of Brazil in which they investigated relief influence on tree species using 61 plots of 0.30ha. The relief was characterised by mean and variance of slope, elevation, aspect and slope location, result shows that no sight relationship between relief heterogeneity and tree species richness and species richness increases with increase in elevation at such higher areas have high vegetation cover and lower areas have low vegetation cover.

This study considered only relief with no drainage density or systems. Helder *et al*, (2014) conducted an integrated analysis of climate, soil, topography and vegetative growth in the Iberian Viticultural Regions (IVR), using state-of-the-art datasets.

For climatic assessment, a categorized index, accounting for phenological/thermal development, water availability and grape ripening conditions were computed. The results showed that the integrated climate-soil-topography influence on vine performance is evident. Most Iberian vineyards are grown in temperate dry climates with loamy soils, presenting low vegetative growth. Vineyards in temperate humid conditions tend to show higher vegetative growth. Jayakumar and Nair (2013) studied species diversity and tree regeneration patterns of different vegetation types of Western Ghats, India in which different vegetation types were estimated using rarefaction. One-way ANOVA was used to test for differences with relief. Results shows that species heterogeneity was higher in vegetation types at mid elevations while their abundance was higher in vegetation types at higher elevations.

Moreover Istanbuloglu and Bras (2005) investigated the effects of vegetation on thresholds for channel initiation and landform evolution using both analytical and numerical approaches. Vegetation is assumed to form a uniform ground cover. Runoff erosion is modelled based on a power function of excess shear stress, in which shear stress efficiency is inversely proportional to vegetation cover. This approach is validated using data. Plant effect on slope stability is represented by additional cohesion provided by plant roots. Their results suggest that in an equilibrium basin with a fixed vegetation cover, plants may cause a transition in the dominant erosion process at the channel head. A runoff erosion-dominated landscape, under none or poor vegetation cover, may become landslide dominated under a denser vegetation cover. The sign of the predicted relationship between drainage density and vegetation cover depends on the relative influence of vegetation on different erosion phenomena. Rymbai, Dey and Jha (2012) undertook study on the geomorphology, land-use systems and their impact on water resource management

on the Meghalaya Umbaniun micro-watershed and vegetation. Findings revealed that sustainable production depends on the health, vitality and purity of a particular environment in which land, water and vegetation are important constituents.

Related studies conducted in Nigeria includes that of Phil-Eze(2012) who investigated forest ecosystem species habitats and vegetation resources in Sagbama oilfield axis of Niger Delta using Normalise difference Vegetation Index (NDVI) and maximum Likelihood Classifier (MLC) geospatial techniques were used. Results indicates severe decline of healthy forests and vegetation resources as revealed by 0.23 deviation in NDVI of 0.55 (41.98%) in 1987 to 24.43% in 2002 and 15.76% in 2013. This indicates that the vegetation reduced significantly due to some other factors like relief, drainage density and topography. Also Uchenna Ochege *et al.* (2017) studied diversity of tree species in Nsukka Plateau in which 100 plots of 20m by 20m quadrats were selected for trees counting, aspects and slopes were determined at the field, Binary Discriminant Analysis (BDA) and Principle Component Analysis (PCA) were used. The result of their findings shows that elevation and aspect significantly influences plant species diversity and species distribution even at lower altitudes. So also Aigbe, Akindele and Onyekwelu (2014) assessed tree species diversity and density pattern along Afi River Forest Reserves in Cross River State. The method adopted was counting using quadrats. Multistage (3 stage) sampling technique was adopted for data collection. 10 tertiary plots were randomly established within the secondary plots and trees randomly selected. The results indicate that an average number of trees per hectare of 323 (68 species) were encountered in the study area. The high species diversity and the relative richness in timber species of the forest reserve does not correlate well with the abundance because the abundance of each of the species was quite low and density poor.

None of these studies conducted in the study area and also none of them considered influence of relief and drainage on vegetation that is why the major objective of the study is to determine how relief and drainage systems influences the distribution and changes of cultural vegetation for planning and development.

MATERIALS AND METHODS

The Study area

The study areas Rimin gado and Tofa fall under old Rimin gado Local Government area (Rimin gado District) created out of old Dawakin-Tofa Local Government Area. The areas are located between latitude 11°50'00"11N, 12°60'00"11N and longitude 8°7'30"11E, 8°3'00"11E with a total land area of 427km² (Rimin gado 225km² and Tofa 202km²). (Rilwanu, 2017). The study areas fall within high plains of Northern Nigeria, highest point in the area is 564m around Danisa hills (Rilwanu, 1996). Geologically the area is underlain by migmatite

gneiss, metasediments (Quartzite and Schist), granite and porphyritic granites all of older granitic origin (Garba, 2009 and Rilwanu, 2014). In terms of climate the study area is within tropical wet climate coded Aw according to Koppen’s Climatic Classification. Regarding temperature the annual temperature is 25°C, mean annual 61-21°C in coolest month i.e December to January, with rainfall of 800mm – 1000mm (Olofin, 1987). Vegetation of the area is Sudan savanna type characterised by scattered trees and tall grasses. The soil of the study area is sandy to sandy loamy type or what is referred to as ferruginous tropical soils. In terms of drainage and hydrology the study area is drained by the following rivers Takwami, Guzu-Guzu, Dawaza that drains their water into Chalawa, Janguza, Taba and Yasanya that drains their water into Watari then to Chalawa (Garba, 2009 and Rilwanu, 2014). Map of the study area is presented in (Figure 1).

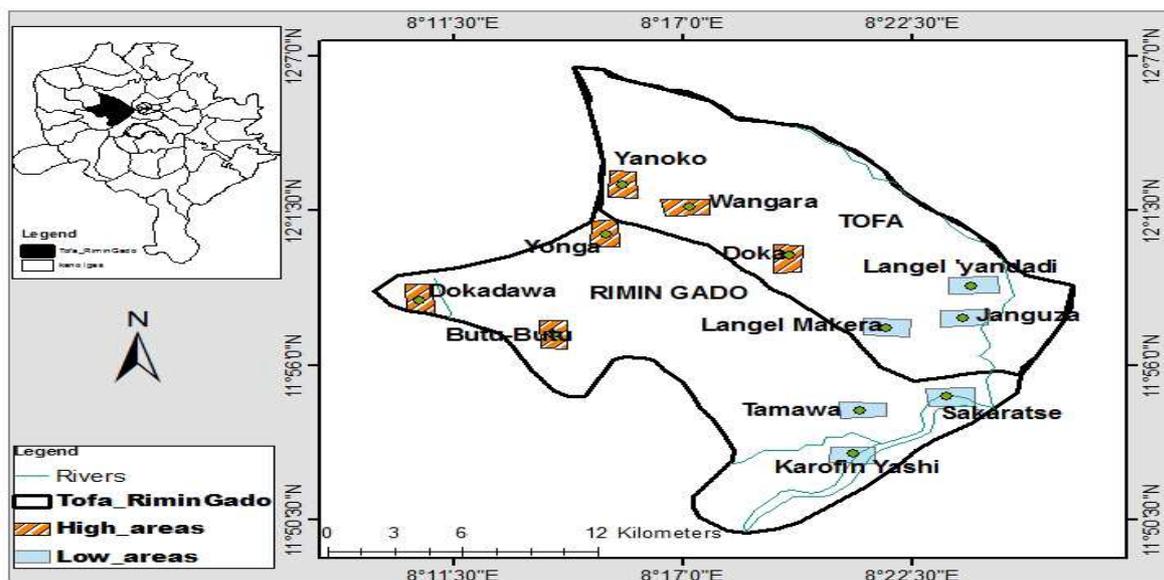


Figure 1: The study area with the selected Quadrats
Source: Geography Department, Bayero University, Kano

Sampling Procedures

For the purpose of this study a total of twelve quadrats of 100m by 100m were selected based on relief i.e. 3 from higher areas of Rimingado and 3 from higher areas of Tofa (areas with a relief of 509m to 555m and above) and 3 from lower areas of Rimin gado and 3 from lower areas of Tofa (areas with a relief of 469m to 485m and below).

Methods of Data Collection

Data on relief was obtained using Global Positioning system (GPS) and Digital Elevation Model (DEM). GPS was used to obtained data for altitudes of the selected locations. Quadrats were demarcated using measuring wheel.

Number of trees, shrubs and saplings were obtained through counting in each quadrat. Slope values of each quadrat in the study locations were obtained from DEM. Slope map was generated from DEM which was developed from Shuttle Radar Topography Mission (SRTM) of the study areas as adopted from Siva *et al.*, (2008) and Rymbai, Dey and Jha, (2012). Drainage density map was developed from Landsat Earth Thematic Mapper (ETM) 2017 with 2.8m resolution downloaded from USGS GLOVIS.

Methods of Data Analysis

The data was summarised and analysed using simple statistics to calculate totals, mean and tabulation methods. Inferential statistics such as one way ANOVA was used to determine level of influence between relief drainage density and distribution of cultural vegetation in the area as adopted from Jayakumar and Nair (2013). Slope map, contour map and drainage density maps were analysed using Arc GIS software.

RESULTS AND DISCUSSION

Spatial Distribution of the cultural Trees in the area

Findings of the study shows that higher areas of Rimingado and Tofa recorded the least number of cultural trees in every 100 by 100m²

whereby Doka recorded 19 trees Yango 25 and Butu-butu 30 trees while moderate to lower areas of Rimingado Tofa recorded the highest number of cultural trees. In every 100 by 100m² Karofinyashi recorded 69 followed by Sakaratsa with 59 (Table 1). Result also indicates that *Ararrabi (Bosovellia dalziekii)* very scarce in the study areas only two trees are located at the lower areas around Sakaratsa and Karofinyasi in Rimingado. *Darbejiya (azadirachita indica)* (A is the tree with highest number (88). With 14 and 16 in Karofinyashi and Janguza respectively all in the lower areas of Rimingado-Tofa. *Kuka (Adasonia digitata)* is higher in the lower areas in which Tamawa recorded 6, Sakaratsa 9, Karofin Yashi 12 and Langel-yandadi with 8 all in every 100 by 100m². *Marke (Anogeissus leiocarpus)* is also higher in the lower areas whereby Sakaratsa is having 10, Langel Yandadi 6 and Langel-Makera 10 all in 100 by 100m². *Rimi (Ceiba pentandra)* which is a well-known tree in the areas is no longer in abundance now with only 10 in the lower areas (Table 1). This indicates that altitude of the areas influences the distribution of the cultural trees in the area which might be due to more moisture in the lower areas. Riverine lower areas have more vegetation due to the influence of moisture and water (Uchenna Ochege *et al.*, 2017).

Table 1 Number of Tree species in each Quadrat

S/ N	Tree species Hausa Name	Tree species Botanical Name	Yango	Dokadawa	Butubutu	Wangara	Doka	Yanoko	Tamawa	Sakaratsa	K/Yashi	L/Yandadi	L/Makera	Janguza
1	Ararrabi	<i>Bosovelladalzieki</i>								1	1			
2	Bagaruwa	<i>Acacia nilotica</i>			2			1					7	
3	Baure	<i>Ficussyeomorus</i>			1				2	1			7	
4	Chediya	<i>Ficusthonningii</i>				1					5			
5	Kashu	<i>Anacacadiumaccidentale</i>									8			
6	Danya	<i>Schlorocaryabiviana</i>		4		1					1		9	1
7	Darbejiya	<i>Azadrachiaindica</i>	8		8	8	3	6	8	8	14	9		16
8	Dashi	<i>CommiphoraAfricana</i>			3					3	5			
9	Dorawa	<i>Perkiabiglabosa</i>	4	2	5	8	2		3	4		10		2
10	Farar kaya	<i>Acacia Sieberiana</i>		5	2			5						
11	Gamji	<i>Ficusplatyphylla</i>								2				
12	Gatsari	<i>Acacia maciostachya</i>	2									2		
13	Gawo	<i>Fadaliaticalbidda</i>				1		2			3		7	
14	Hada-fada	<i>CaesalpiniaSieberiana</i>						2						
15	Hano	<i>MenotesKerstingii</i>							1	1		1		
16	Kadanya	<i>Vitellariaparadoxa</i>	2	1	1			1	3	2				
17	Kanya	<i>Diospyrosmespiliferus</i>	1	2	1	5	4		9		1	6	16	1
18	Kalgo	<i>Piliotigmaretialatrim</i>		10		3		5		7		4	3	
19	Kirya	<i>Prosopis Africana</i>												2
20	Kokiya	<i>Stryohnnesspinesa</i>												1
21	Kuka	<i>Adansoniadigitate</i>			2		8	1	6	9	12	8		2
22	Kurna	<i>zizophusspinaschristi</i>	3			1		2	2		1			
23	Kwandari	<i>Terminalis macioptera</i>			1					1				
24	Magaryar Kura	<i>ZizophusAbssinica</i>	2											
25	Magarya	<i>Zizophusmauritaiana</i>	3	4				2	1					1
26	Mangoro	<i>Mangiferaindica</i>									11			
27	Marke	<i>Anaogerssusleiocapus</i>		5	3	1	2		3	20		6	10	11
28	Rimi	<i>Ceibapentendra</i>									6	3		1
29	Tawatsa	<i>Entado Africana</i>						2						
30	Tsamiya	<i>Tamarindusindica</i>			1	3					1			2
	TOTAL		25	33	30	32	19	29	38	59	69	49	59	40

Source Field Survey, 2018

Spatial Distribution of the cultural Shrubs in the area

Result from field survey shows that highest number of shrubs were recorded in Yango with 40 followed by Yanoko 39, Langelmakera 32 and the least was recorded in sakaratsa. The shrubs with highest number is Hanne (*Lawsonia inermis*) with 73Geza (*Combretum micranthum*) with 50 while

shrubs with lowest number is *Giginya (Borassus aethopium)* with only 1 shrub. (Table 2). This shows that the shrubs distribution is not determined by the nature of relief in the area. The shrubs are more in the higher areas than in the lower, may be because the lower areas are more into use in terms of crops cultivation.

Table 2 Number Shrubs in each Quadrat

S/N	Shrubs Hausa Name	Shrubs Botanical Name	Yango	Dokadawa	Butubutu	Wangara	Doka	Yanoko	Tamawa	Sakaratsa	K/Yashi	L/Yandadi	L/Makera	Janguza
1	Giginya	<i>Borassusaethipium</i>						1						
2	Kaba	<i>Hyphaenethebaica</i>							4					
3	Goriba	<i>Hyphaenethebaica</i>	1	1				1						
4	Binidazugu	<i>Euphorbiaceae</i>		1	13								13	
5	Geza	<i>Combretummicranthum</i>	30	2		4	14							
6	Hada-fada	<i>CaesalpiniaSieberiana</i>						1	3	1				
7	Lalle	<i>Lawsoniainermis</i>	8	1	3		2	24			20	9	6	
8	Sabara	<i>Guierasenegalensis</i>				3		10						
9	Sarkakiya	<i>Acacia ataxacantha</i>		1				2	15		15		1	1
10	Tunfafiya	<i>Calotropisprocera</i>	1							2			12	7
	TOTAL		40	6	16	7	16	39	22	3	35	9	32	8

Source Field Survey, 2018

Spatial Distribution of the cultural Saplings in the area

For the saplings quadrats survey results shows that there are more saplings than trees in the study areas and more saplings are recorded in the lower areas than in the higher areas. Sakaratsa, Langel-yandadi and Tamawa recorded 127, 113 and 106 saplings in every 100 by 100m² respectively (Table 3). Among the saplings *Kanya (Diospyros mesipiliforms)* is the highest with 180 followed by *Kuka (Adansonia digitate)* with 133 *Darbejiya (azadracha indica)* with 91 and *Dorawa (Parkia clappertonia)* with 69. *Kanya (Diospyros mesipiliforms)* is higher in Sakaratsa, tamawa and Karofinyashi with 35,

28 and and 25 respect all in the lower areas. *Kuka (Adansonia digitata)* saplings are higher at Tamawa, Sakaratsa and Langel Yandadi with 32, 30 and 25 respectively also in the lower areas of the study areas (Table 3). This indicates that saplings are more common in the lower areas than in the higher parts of the study area. This might be due to the fact that higher areas are more disturbed through activities of man like farming and deforestation. This is contrary to the findings of Silva et al (2008) in parts of Brazil that species richness increases with increase in elevation

Table 3 Number of Saplings in each Quadrat

S/N	Sampling s Hausa Names	Saplings Botanical Name as	Yango	Dokadawa	Butubutu	Wangara	Doka	Yanoko	Tamawa	Sakaratsa	K/Yashi	L/Yandadi	L/Makera	Janguza
1	Aduwa	<i>Balanite aegyptica</i>		1										
2	Ararrabi	<i>Bosovellia dalzieki</i>												2
3	Bagaruwa	<i>Acacia nilotica</i>		22								12		
4	Baure	<i>Ficus syeomorus</i>										3		1
5	Chediya	<i>Ficus thonningii</i>							6			4		5
6	Darbejiya	<i>Azadracha indica</i>	1	5	6	1	6	4		14	20	18		16
7	Dashi	<i>Commiphera Africana</i>			5			1	5					
8	Dorawa	<i>Perkia biglabosa</i>			2			1		23	25			18
9	Dundu	<i>Dichrostachusciner ea</i>	8	24	2									
10	Farar kaya	<i>Acacia Sieberiana</i>	2	10			1					4		2
11	Gamji	<i>Ficus platyphylla</i>	1											
12	Gatsari	<i>Acacia maciostachya</i>	8											
13	Gawo	<i>Fadaliaticalbidda</i>	2	1		6	3	1	15	3	5	5	20	12
14	Giginya	<i>Borassusaethippum</i>	2	1										
15	Goriba	<i>Hyphaenethebiaca</i>	13	8				1	5					
16	Kaba	<i>Hyphaenethebiaca</i>			5					3		2	3	3
17	Kadanya	<i>Vitellariaparadoxa</i>	1											
18	Kanya	<i>Diospyrosmesipilife rus</i>	8	10			5	16	30	32	25	18	19	17
19	Kalgo	<i>Piliotigma retialatrim</i>		9		3	1	25		10		19	6	8
20	Kuka	<i>Adansonia digitate</i>	7		3	9	1	8	28	35		19	10	13
21	Kurna	<i>Ziziphus spinaschristi</i>						4		3		2	9	3
22	Magarya	<i>Ziziphus mauritaiana</i>	9	8	5		6							
23	Mangoro	<i>Mangifera indica</i>							1		10			
24	Marga	<i>Cassia arereh</i>		1										
25	Marke	<i>Anaogerssusleiocap us</i>			2				3	4		7	8	2
26	Rimi	<i>Ceiba pentendra</i>							1		3		1	
27	Tawatsa	<i>Entado africana</i>		2					10					
28	Tsamiya	<i>Tamarindus indica</i>							2				1	
	TOTAL		62	102	30	19	23	61	106	127	88	113	77	102

Source Field Survey, 2018

Influence of drainage density and relief on cultural vegetation in the higher areas

It can be seen from the results and mapping that trees and saplings are more in the lower areas of Rimingado-Tofa than in the higher parts. Results shows that in the higher areas Doka-dawa with relief of 555m, average

drainage density 34.5km/km², slope 19.5^o recoded 33 trees, 6 shrubs and 102 sapling. Yango which is the next highest point with an elevation of 548m, average drainage density of 9km/km² and an average slope of 42.5^o has 25 trees, 40 shrubs and 62 saplings (Table 4, Figure 2, 3 and 4). This result indicates that

these are the highest points of the study area, areas with low to moderate drainage density and higher average slope value and at the same time are areas with lowest number of trees and saplings as compared to the lower areas. The shrubs does not follow either relief or drainage density of the area. It can also be noticed from the result that even within the higher areas cultural vegetation varies with relief and drainage density. This may be attributed to the fact that higher areas are

more likely to have less vegetation than the lower areas because of differences in water availability and soil moisture content among other factors. This finding is contrary to that of Siva *et al* (2008) that vegetation increase with altitude and vice versa. But it coincided with assertion of Istanbuluoglu and Bras (2005) that slope and drainage density of an area can affect vegetation, areas of steep slope and sparse vegetation cover are having less drainage density.

Table 4 Tree, Shrubs and Saplings based on relief and drainage in the higher areas

Villages	Location of Quadrats	Altitudes (m)	Average Drainage Density (Km/Km ²)	Average Slope(°)	No of Trees	No of Shrubs	No of saplings
Yango (RMG)	11° 58' 53.66" N 8° 14' 29.85" E	548	9	42.5	25	40	62
Dokodawa (RMG)	11° 58' 53.99" N 8° 20' 10.67" E	555	34.5	19.5	33	6	102
Butubutu (RMG)	11° 58' 7.60" N 8° 13' 18.60" E	550	34.5	42.5	30	16	30
Wangara (TFA)	12° 1' 29.76" N 8° 16' 37.49" E	530	67	19.5	32	7	19
Doka (TFA)	11° 59' 23.70" N 8° 18' 21.81" E	523	34.5	8	19	16	23
Yanoko (TFA)	12° 4' 2.60" N 8° 17' 47.80" E	509	9	13	29	39	61
	Total	3215	188.5	145	168	124	297
	Mean	536	31	24	28	21	50

Source Field Survey and data Analysis, 2018

Influence of drainage density and relief on cultural vegetation in the Lower areas

Results from data analysis and mapping shows that trees and saplings are more in the lower areas than in the higher parts of the study areas. It can be seen that in the lower areas Karofinyashi is the lowest in terms of relief with 469m, average drainage density 157.5km/km², slope 7.5° recoded highest number of trees 69, 35 shrubs and 58 sapling.

Langel-yandadi which is the next lowest point with an elevation of 473m, average drainage density of 67km/km² and an average slope of 7.5° recorded 49 trees, 9 shrubs and 113 saplings. Also Sakaratsa with an average relief of 482m, average drainage density 157.5k m/km², slope 2.5° number of trees were found to be 59, shrubs 3 and 127 saplings which is the highest of all. (Table 5, Figure 2, 3 and 4).

This result indicates that these are the lowest points of the study area, areas with high to very high drainage density and lower slope value and at the same time are areas with highest number of trees and saplings as compared to the higher points.

The shrubs recorded low value and does not follow either relief or drainage density of the area. It can also be observed from the result that even within the lower areas cultural vegetation varies with relief and drainage density. This may be attributed to the fact that areas of high density, low relief, lower slope value are most likely to have recorded more vegetation due to presence more surface water, more groundwater and flat or almost

flat terrain for soil accumulation. This result is substantiated by the findings of Jayakumar and Nair (2013) in Western Ghats, India in which it was discovered that species heterogeneity was higher in vegetation types at mid elevations while their abundance was higher in vegetation types at higher elevations. It is also in line with findings of Istanbuluoglu and Bras (2005) in southern Dakota Badlands which indicates that area with extremely high drainage density of over 125km/km² and very resistant granitic hills may have more vegetation while in a humid climate may have a drainage density of only 5km/km² and at hill sides the natural vegetation is scares.

Table 5: Tree, Shrubs and Saplings based on relief and drainage in the lower areas

Villages	Location of Quadrats	Altitudes (m)	Average Drainage Density(Km/Km ²)	Average Slope (°)	No of Trees	No of Shrubs	No of samplings
Tamawa (RMG)	11° 53' 32.87"N 8° 20' 40.62"E	470	67	2.5	38	22	106
Sakaratsa (RMG)	11° 55' 16.95"N 8° 22' 57.12"E	482	157.5	2.5	59	3	127
Korofin Yashi (RMG)	11° 53' 11'.14"N 8° 22' 4.55"E	469	157.5	7.5	69	35	88
Lange lyandadi (TFA)	11° 59' 14.20" N 8° 24' 31.20"E	473	67	7.5	49	9	113
Langel Makera (TFA)	11° 58' 31.30" N 8° 24' 15.70"E	474	67	7.5	59	32	77
Janguza (TFA)	11° 57' 45.80" N 8° 22' 22.40"E	485	102	7.5	40	8	102
	Total	2853	618	35	314	109	613
	Mean	475.5	103	5.8	52	18	102

Source Field Survey and data Analysis, 2018

Variation of cultural vegetation with altitude in the study locations

One way ANOVA test was conducted between relief or altitude of the whole locations to test for variation in the cultural vegetation types (Trees, Shrubs and saplings). The result revealed that there is a significant difference at 0.05 level between the variation in relief and cultural vegetation among the study locations since P value is 0.0002 which is <0.05 and F calculated value is 123.36 which is greater than the F critical 6.59 (Table 6). This reveals that the number of tree, shrubs and saplings in each location varies significantly with relief of

the areas that is even why low areas are having more trees and saplings than the higher areas. It also indicates that density and occurrence of some tree species is attributed to differences in altitude or relief of the area. This result is supported by that of Jayakumar and Nair (2013) Western Ghats, India in which One-way ANOVA was used to test for differences with relief. Results shows that species heterogeneity was higher in vegetation types at mid elevations while their abundance was higher in vegetation types at higher elevations.

Table 6 ANOVA test result between altitude and cultural vegetation the study locations

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	321477.8	3	107159.3	123.3621	0.000214	6.591382
Within Groups	3474.625	4	868.6563			
Total	324952.5	7				

Source Data Analysis, 2018

Variation of cultural vegetation with Drainage density in the study locations

One way ANOVA was conducted to test between average drainage density of the whole locations and number of cultural vegetation types (Trees, Shrubs and saplings) shows that there is significant difference at 0.05 level between the variation in the average drainage density and cultural vegetation among the study locations since P value is 0.040 which is <0.05 (Table 7). This indicates that the number of tree, shrubs and saplings in each location are dependent on

drainage density of the areas. This means that there are more species in areas with high to moderate drainage density. Also some tree species like mango (*Mangifera indica*), *kuka* (*Adansonia digitata*) are more in abundant in areas with higher drainage density than areas of low drainage density for example in Karofinyashi which is close to river Chalawa there are many mangoes as compared to all areas studied. This result is contrary to that of Istanbuluoglu and Bras (2005) that drainage density of over 125km/km² attract more tree that an area with about 5km/km².

Table 7 ANOVA test result between Drainage density and cultural vegetation the study locations

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	3987.375	3	1329.125	1.254927	0.401511	6.591382
Within Groups	4236.5	4	1059.125			
Total	8223.875	7				

Source Data Analysis, 2018

Variation of cultural vegetation with slope in the study locations

Result for ANOVA test between average slope values of the study areas and number of cultural vegetation types (Trees, Shrubs and saplings) revealed that there is no significant difference at 0.05 level between the variation in the average slope value and cultural vegetation among the study locations since P value is 0.13 which is >0.05 and F stat value is 3.425 which is less than the F critical 6.59 (Table 8). This indicates that the number of

tree, shrubs and saplings in each location are not necessarily dependent on slope of the areas. This is a clear indication that even in areas of higher slopes, shrubs and saplings can be located but despite this there are more species in areas of low to moderate slope. But some cultural vegetation are more adopted to areas of higher slope values examples of them include all acacia species like *aduwa*(*Balanite aegyptica*), others include *kaba* (*Hyphaenethebaica*).

Table 8 ANOVA test result between slope and cultural vegetation among the study locations

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	4646.44	3	1548.813	3.422565	0.13278	6.591382
Within Groups	1810.12	4	452.53			
Total	6456.56	7				

Source Data Analysis, 2018

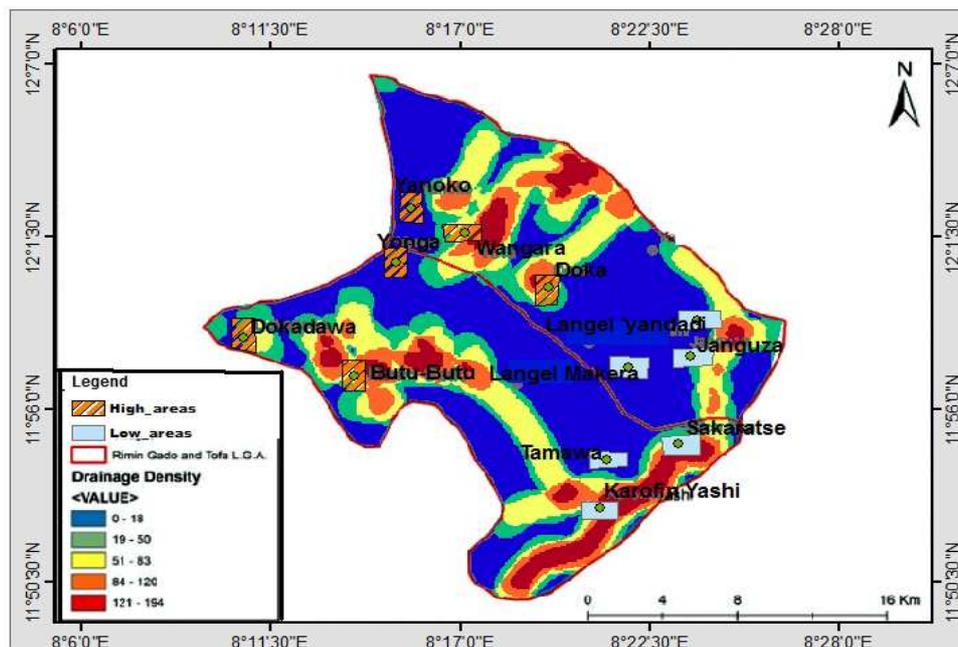


Figure 2 Drainage Density of the study locations
Source Data analysis, 2018

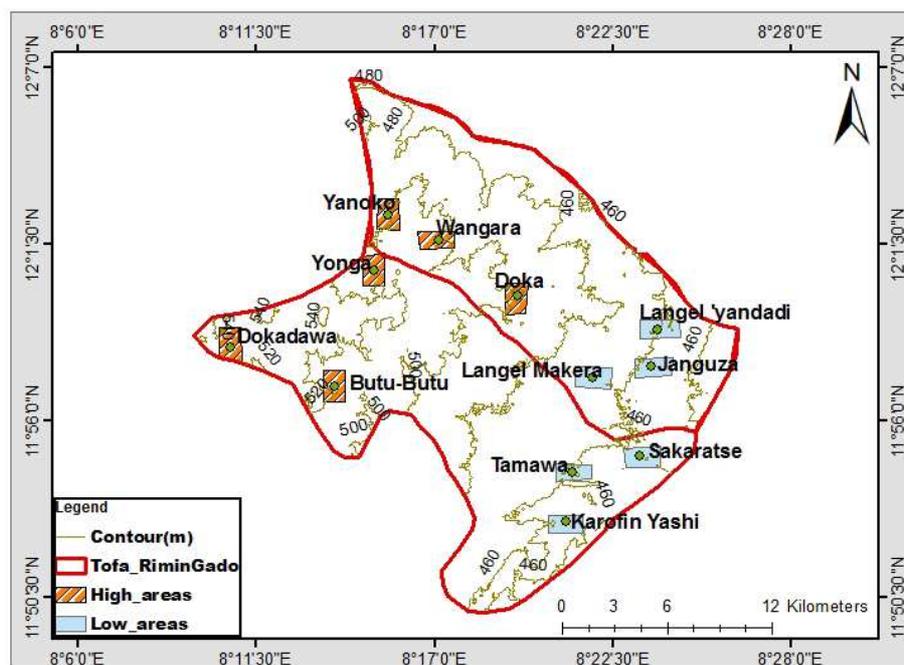


Figure 3 Contour map of the study area
Source Data analysis, 2018

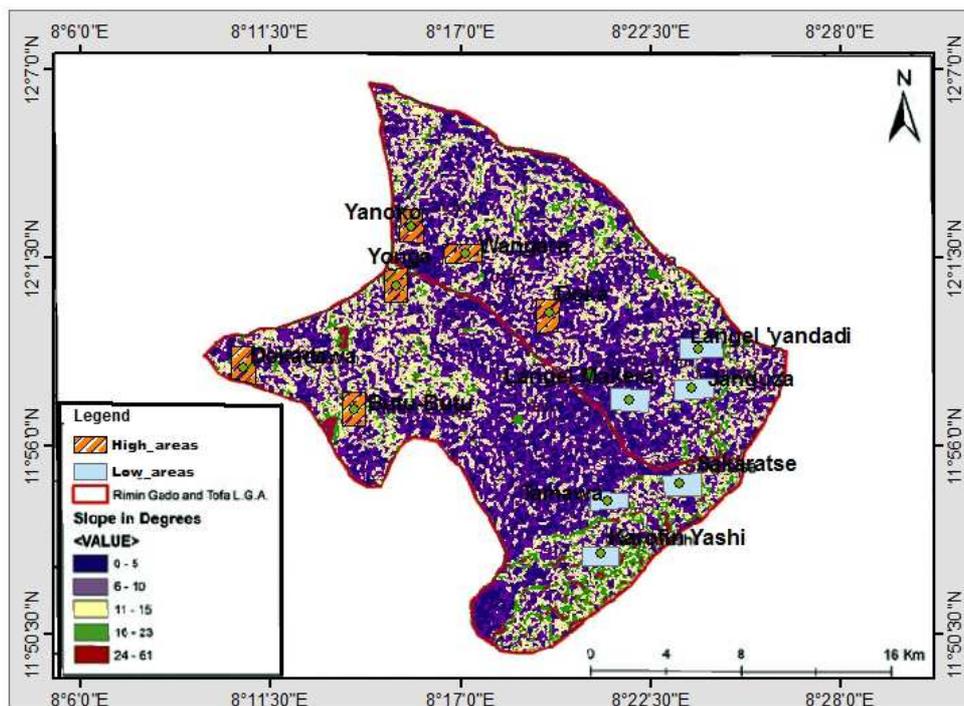


Figure 4 Slope map of the study areas
Source Data analysis, 2018

CONCLUSION

Influence of relief and drainage parameters on cultural vegetation in Rimingado-Tofa areas was examined and it is concluded that lower areas of Rimingado-Tofa are having more trees and more saplings, but shrubs are distributed everywhere. It can be concluded that distribution of cultural vegetation in the areas depend largely on relief rather than on drainage even though human activities might change the pattern. Cultural vegetation are also more in areas with higher drainage density and areas with low slope values. It can also be concluded that *Darbejiya* (*Azadirachitaindica*), *dorawa* (*Parkia biglobosa*), *kuka* (*Adasonia digitata*), *gawo* and *acacia* trees are the dominant cultural trees in the areas. *Geza*(*Combretum micranthum*) and *Henna`* (*Lawsonia inermis*) are the dominant shrubs in the area. It was also proved that mango is more common in lower areas that is areas with higher drainage density and low slope values. It was also deduced that *Rimi* (*Ceiba pentendra*) tree which even Rimingado got its name from it is more common in the lower areas and its disappearing may be due to high level of its demand by local lumbermen in the area. Study proved that there is significant difference between relief and

cultural vegetation diversity and distribution among the study location. Also part of the conclusion study determined that there is no significant differences between drainage density, slope and the distribution of cultural vegetation in the areas. It was established as well that shrubs are more in the higher areas as a result of more agricultural activities in the lower areas.

Recommendations

Reference to the major findings of the study it can be recommended that practice of afforestation and preservation of cultural vegetation should be given serious attention particularly in the higher areas of Rimingado-Tofa. In areas of lower drainage densities and high slope values alternative means of raising and watering seedlings of cultural indigenous vegetation should be adopted and saplings should be left on lands.

It can also be recommended that local lumbering of some valuable tree species like *Rimi* (*Ceiba pentendra*) should be arrested to avoid extinction of the tree species in the areas. It will also be good if research will be conducted on disappearing of tree species in the area for effective preservation of cultural vegetation in the area for development.

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