

APPLICATION OF DISTANCE DECAY CONCEPT IN THE ASSESSMENT OF FLORA SPECIES LOSS IN ECO - TOURISM HOT SPOTS IN SOUTHERN CROSS RIVERS STATE, NIGERIA.

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Abstract

Different authors have given different interpretation to decay concept” some say deals with the decreasing of occurrences or events, activities and effects with increasing distance from location from which these things emanate or from which they event influence. It is also seen as being concerned about regularity of influences (patterns). It operates within the contexts of gravity model. Its parameters measure the relationship between observed interactions patterns and distance when all other determinants of the interactions are constant. It was on this premise that the study was conducted. The correlation between infrastructural sites and species diversity was positively and statistically significant ($r = 0.657$; $p < 0.001$). This implies that as the distance from infrastructure sites increases, species density and diversity increases. The significant relationship shows that two variables (distance from infrastructure and species diversity) Co-vary. The null hypothesis that there is no significant relationship between the two variables was rejected and the alternate hypothesis accepted. There is therefore need to control the extent at which infrastructures are cited close to the forest to avoid effects on flora diversity.

Keyword: Distance decay concept; Species Diversity, Tourism Hot spot, Eco-Tourism, Cross River State, Southern Nigeria.

1. Introduction

It is no longer strange that anthropogenic activities are actually a gradation the

environment. Such activities amongst other things includes the development of infrastructures in ecotourism hotspot in southern Cross River State selected eco-

tourism sites such as Aqua Vista farms, Tinapa and Qua falls were used for the study.

It is therefore not an overstatement to say that there can be no way that humans will tap from the environment without causing damage no matter how small. It has been observed that that though ecotourism can be both fun and incentives to protect the natural environment, it also leads to their degradation and over use.

Humans have dramatically altered the capacity of ecotourism to deliver goods and services and significantly so in the past century. World Resources institute (2000 - 2001) observed that whether for some goods and services, such as food production, man has greatly increased the capacity of ecotourism to provide the needs of man, while for others such as water purification and flora diversity conservation; we have greatly degraded their capacity.

Spellerberg (1992) is of the opinion that concern about the impact of man on the environment is not new. He observed that since 1864, George Marsh was very perceptive about the way human kind was changing the face of the earth and pointed out the dangers of over exploitation of nature.

The penetration of the unspoiled and fragile environment requires the construction of facilities and infrastructures that will cater for the needs of tourism – who are foreigners.

Tourism product is a package consisting of travel accommodation and activity taking place in a specific environment (social

environment (social, cultural and physical) with all facilities and services laid on (Island Resource Foundation, 1996).

The environment including protected areas is the most fundamental component of the tourist package, because a potential visitor is stimulated and motivated to visit a particular place on the attractions of the area.

Moshi (1992: 34) observed that it is destination and that the successful development of tourism demands the resource – based attractions to be exploited to satisfy customers expectations and to meet the socio- economic and other policy “objectives of the lost country”.

Objectives

The main objectives of this study are therefore to examine how to use the “Distance Decay Concept” to evaluate the extent of damage done to flora species in the course of the development of tourism infrastructure in tourism hot spots of Southern Cross River State.

To do this, the impact of infrastructure development on flora species diversity, the impact assessment of road as an infrastructure in tourism hotspots, the negative impact of tourism infrastructure on the environment, the threat to flora by recreation and tourism as well as the land cover characteristics of the study area will be explained or examined using the distance decay concept.

The Distance Decay Concept

A brief review of the works of some authors will help to explain further the concept and why it is appropriate in the society of the

effect of infrastructure development on flora diversity.

Amedes and Gollidge (1975:5) opines that distance decay deals with the decreasing of occurrences of events, activities and effects with increasing distance from location from which these things emanate or from which they exert influence. It is concerned about spatial regularity of influences (patterns) it is said to be an expansion process used in determining the spatial variations or content of gravity model (Eldridge and Jones, 1991). Fatheringham (1981: 425) opines that “a distance – decay parameters measure the relationship between observed interactions patterns and distance when all other determines of the interactions are constant” The study assume also that all other variables are held constants.

Distance plays a role in the distribution of technology, interaction: ideas and population of various types, underpins a lot of empirical regularities and constitutes the basis for Tobler’s (1970) “first law of geography”

Eldridge and Jones, (1991:500) state that “the formalization of distance decay as a measureable entity can be traced to the “social physics” school of Stewart, Waruts and zip whose work laid the foundations for host of studies on spatial interaction by geographers in the 1960s and beyond”

They went further to state that:

“The gravity model was considered to be the most important tool in defining the concept. The friction of distance parameter became a precise analog for distance decay, while the parallel development of modern computing technology enabled estimation of the effect of distance on an immense variety of

phenomena of the friction of distance for any given origin varies over space, the equivalent distances in different location result in varied effects in interaction. Since variations are conceptualized the property of equivalent distance effect across no longer holds.

This suggests spatial variations in the friction of distance may be cartographically represented as a transformation or “warping” of the space within the interaction that takes place” (p 500).

The Concept of distance decay according to Taverna and Xi (2010:4) “refers to decrease or loss of similarity between two observations when the distance between them increases, in ecology and evolutionary phenomena such as (species turn over along environmental gradients), a negative relationship between distance and similarity. These variations between distance decay rate can be attributed to difference in landscape such as dispersal abilities. The variations observed in the study area cannot be accounted by dispersal abilities of trees but rather to the construction of infrastructure.

Nekola and White (1990) also emphasized the importance of distance decay similarity in ecology and flora conservation by examine the reduction in community similarity as the distance between them increases. He used data from Boreal and Spruce Fir forest of more than 6000km in range. The difference between his study and this research is that while he was looking at the reduction of communities this study looks as the effect on the reduction in flora diversity holistically as the distance from the infrastructure to the flora diversity increases.

According to Nekola and white (1999:4) "the distance decay curves were best fit by a simple negative exponential function and the steepness of these curves was a function of plant growth". They therefore drew conclusion that distance decay of similarity with difference or by limits to dispersal and niche with difference among them.

On the other hand, Hubble (2001:34) in his neutral theory opines that "the distance decay

of similarity in community composition under ecological drift and random dispersal is expected to be compound exponential, and the distance decay rates are also slower of the meta community is limited by high rate of dispersal" they therefore drew similarity with distance decay of similarity could be caused by either a decrease in environmental similarity with distance or by limits to dispersal and niche with differences among them.

On the other hand, Hubble (2001: 34) in his neutral theory opinions that "the distance decay of similarity in community composition under ecological drift and random dispersal is expected to be compound exponential, and then distance decay rates are also slower of dispersal". The prediction of Neutral theory according to Hubble (2001) provides a null model for ecologists who are interested in finding out why distance decay is also used in urban planning. According to Sekar (2010) this could not hold in the spread of cities because of the advancement in transportation technology and telecommunications and many other factors alongside the size and spatial distribution of urban areas and through the zoning of time and space. This

situation has resulted in the concept of "Cyber city" which have the potential of turning tangible city into intangible city, hard city to soft city and materialistic to eternal one. This gives a food for thought on how city grows through distance decay of similarity can easily be bridged with advancement in technology, this may not be very easy in ecological especially as it relates to the effects of tourism infrastructure development.

Generally, the principles of distance decay states that the amount of interaction between two places decreases as the distance between them increases, so that the amount of contact between people living in two towns of similar size five kilometers apart will be much greater than two towns fifty kilometers apart. It has been discovered that measurement of this relationship have shown that it is difficult to be precise about the way in which contact decrease with distances expect that the general pattern is that contact fall rapidly over a short distance and the much more scatter points which indicates the relation between distance and species/ Density will be considered appropriately linear when both variables are logarithmically transformed. The average trend will be calculated as:

$$\text{Log}(S) - x \log(D)$$

Where S= number of species per square meter, D= distance of midpoint of each quadratic from the location of tourism infrastructure to the bush.

This is in line with GLOBIO – model which uses "distance to road to measure the decline in impact of infrastructure" (p310) (UNEP 2001, Forman and Newton, Vistnes, Jordhoy, Strand and Newton, 2003). Distance decay

suggests that spatial variations are amplified with increasing distance between their

origins and the destination (Tiefelsdorf, 2003).

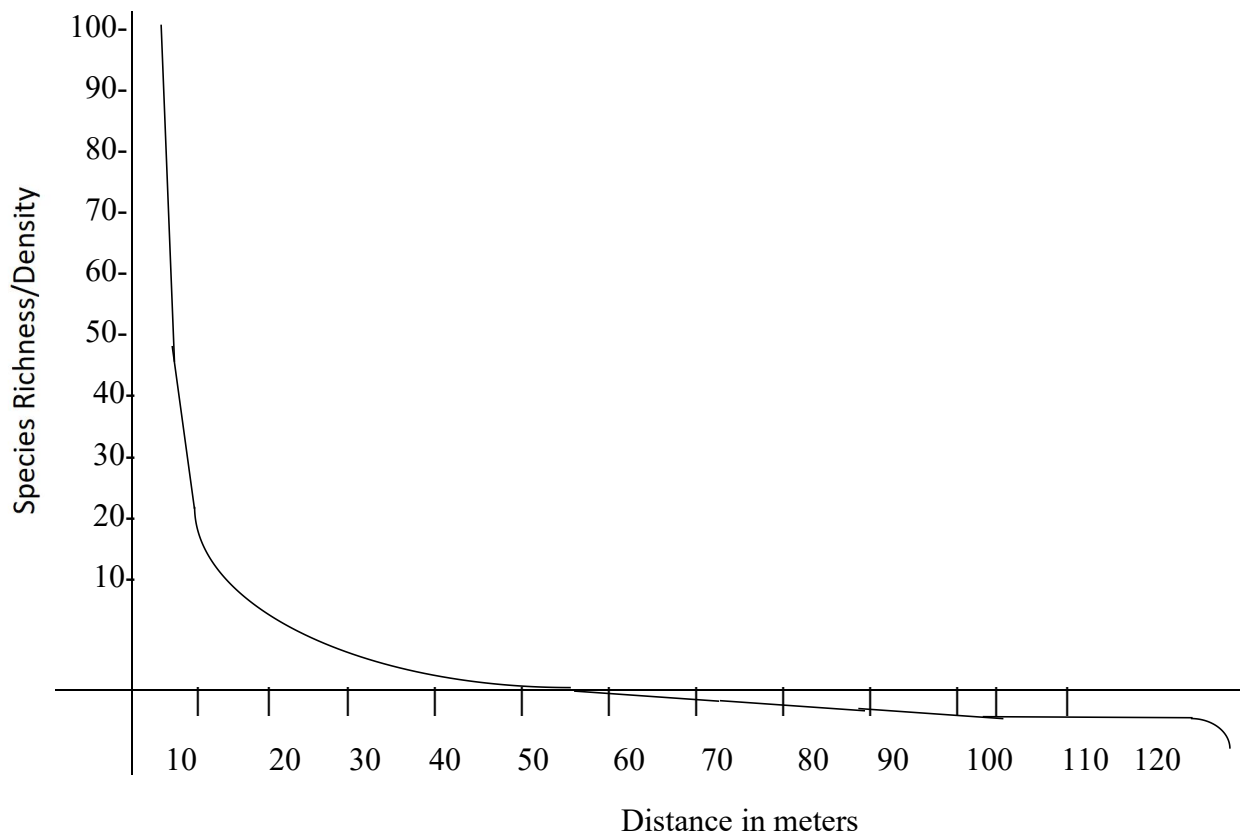


Fig 1: Diagram showing variations in species richness/ Density with increase in distance.

It is important in this study because it shows the extent at which infrastructure destroys ecological diversity close to it compared to those far from it. Distance decay plays a role in processes that produces the decay effect.

It is use as an independent variable by social scientist other than geographers, economists employ it as it relates to transport cost to their economic theories. Sociologists employ it as a general determinant of

friendship patterns and other social relationship patterns. In certain situations, political scientists use it to explain voting pattern. It is used as a model in surface interpretation. However, despite its wide spread application, distance is not a dynamic process variable but remains a simple structural characteristic of a situation (Taylor, 1983). Distance decay is said to play an important role in all spatial relationship that it has been identified as the

first law of geography (Mekkercher, 2008). Distance decay functions are central to determining accessibility measures (Iacono, 2008).

According to Iacono (2008), this model is constrained in so many ways:

- (i) By limiting the maximum range to be included in computations
- (ii) By limiting the maximum number of locations to be considered
- (iii) By restricting the range of values the parameters may take and by explicitly taking account of barriers (e.g. inaccessible regions.)

Nevertheless, as a structural element, it directly influences many of the dynamic processes. It is seen by Taylor (1983) as a very general surrogate that has the basic advantage that it can easily be measured and incorporated into our analysis as regards the process at work result in this very useful surrogate variable.

2. Material and Method

The data gathered for this work included data on species diversity and density of tress

(flora), data on distance away from the location of infrastructure facilities in the destination of the species quadrant.

Data were collected directly by the research from field, through random sampling from the quadrants. The tress in tourism hotspot areas of Calabar and Odukpani wetland in the rainforest of Akamkpa were used for the study. Only tress regardless of their species was used for the study. What was regarded as tress is any perennial plant with an elongated wooden stem or trunk, supporting leafs or branches transect – based methods were used to survey the changes in the vegetation's in each of the sites. This is in line with transecting method adopted by Sutherland (1997). A hundred meters transect was used and measured from the closest infrastructure facility in the hot into the bush (flora diversity). This hundred meters transect was divided into ten different quadrant of 10×10 meters plots for woody species (Xu, Louis & Janet, 2009) each. This 10×10 meters frame quadrant was the local frequency of species in each quadrant and their variations was calculated along the transected and correlated with Shannon- Weiner index in each site. The advantage of this method is that it traverses a wide spectrum of floristic variation in the study area.

Table I

Number of trees at different distance from facilities at tourism sites.

Study Area	Distance From Facilities (meters)	Number of trees (frequency)
Aqua Vista		
Plot 1	20	15
Plot 2	60	21
Plot 3	100	24
Tinapa		
Plot 1	20	9
Plot 2	60	17
Plot 3	100	20
Kwa Falls		
Plot 1	20	25
Plot 2	60	17
Plot 3	100	22

Sources: Resource field work.

Table I Showing number of trees at different distance from facilities at tourism sites is graphically represented by figure 5.

Table 1 Shows the various distance (20cm; 60m; and 100m) away from facility. It also reflects the number of trees in each plot at different locations in each of the tourist site respectively. A negative relative relationship between distance and similarity is explicit in several ecological and evolutionary

phenomena on species turn over along environmental gradient.

It is evident that in some cases distance away from tourist facility has not obeyed the distance decay concept in which it was expected, that there should be more species

composition as one moves away from the facility. This is probably due to the fact that the flora diversity forms the main source of attraction to tourist. It is equally indicative of the fact that since logging is prohibited in this area, then loggers of timber move away from the facility further into the forest where they will not be seen by eyed of the law (anti- deforestation law). This is why a distance from the facility of 20 meters has much as 25trees whereas 60 meters away has 17 trees and 100 meters away has 22 trees. This is the only site anthropogenic activities do not follow the location of the tourism facility. Rather, the species composition is based in absence or presence of other anthropogenic factors such as logging and agriculture/ farming. In other words, the deforestation or flora diversity distraction does not diminish with increase with in distance rather it is vice versa (i.e., increase with increase in distance).

Fig.2 is a graphical illustration of the extent of damage to flora diversity as a result of infrastructural development on the sites from the graph, in the entire site, the less the number of trees, the higher the effect, the more the number of trees the lesser the effects. This is depended on the distance from facility, except for Kwa falls where anthropogenic activities moves rather from the facility so as to hide from the eyes of the law (Cross River State anti-deforestation law) which task force forbids the cutting down of tress in the forest without permission from the government.

From the researcher's point of view, the Cross River State Anti-deforestation task force was only to check the extent of deforestation by individuals or private projects. This opinion is borne out of the

fact that while the task force came into existence in 2011 to halt further deforestation, the same government was embarking on the contraction of an international conference centre project directly opposite TINAPA business and leisure resort, where large portion of law has already been destroyed. The 2010 Cross River State forestry commission law, expected to regulate the impact of the government project on forest recourses, was equally observed to be effected on loggers only, otherwise how Iyata farm (not part of this study) sprang up directly across the Calabar River, directly opposite TINAPA.

Generally, of all the tourist sites considered for this research, Tinapa is more developed than others. Various infrastructures that occupy the large portions of land are fund in this site. Among them are four international standard wholesale emporiums of 10,000m shop space each, four warehouse of 18,000m each, trailer parks for the wading of trucks, administrative centre, parking for 3,000 cars and coaches, children's pool and play area, tennis courts, volley ball courts, swimming pools. A golf course, Nollywood movie studio &, two international standard casino and cinema halls for 1,915 viewers and road network and structures and super structures that brings about deforestation and destruction of trees (reducing their types about densities). Besides the influences of these infrastructure impacts seriously on the types of species and flora diversity. This is why the infrastructures mentioned occupies as much as 2.81 KM²I Tinapa making it the largest in size amongst the other sites (Aqua Vista, Iyata farms and Kwa falls).

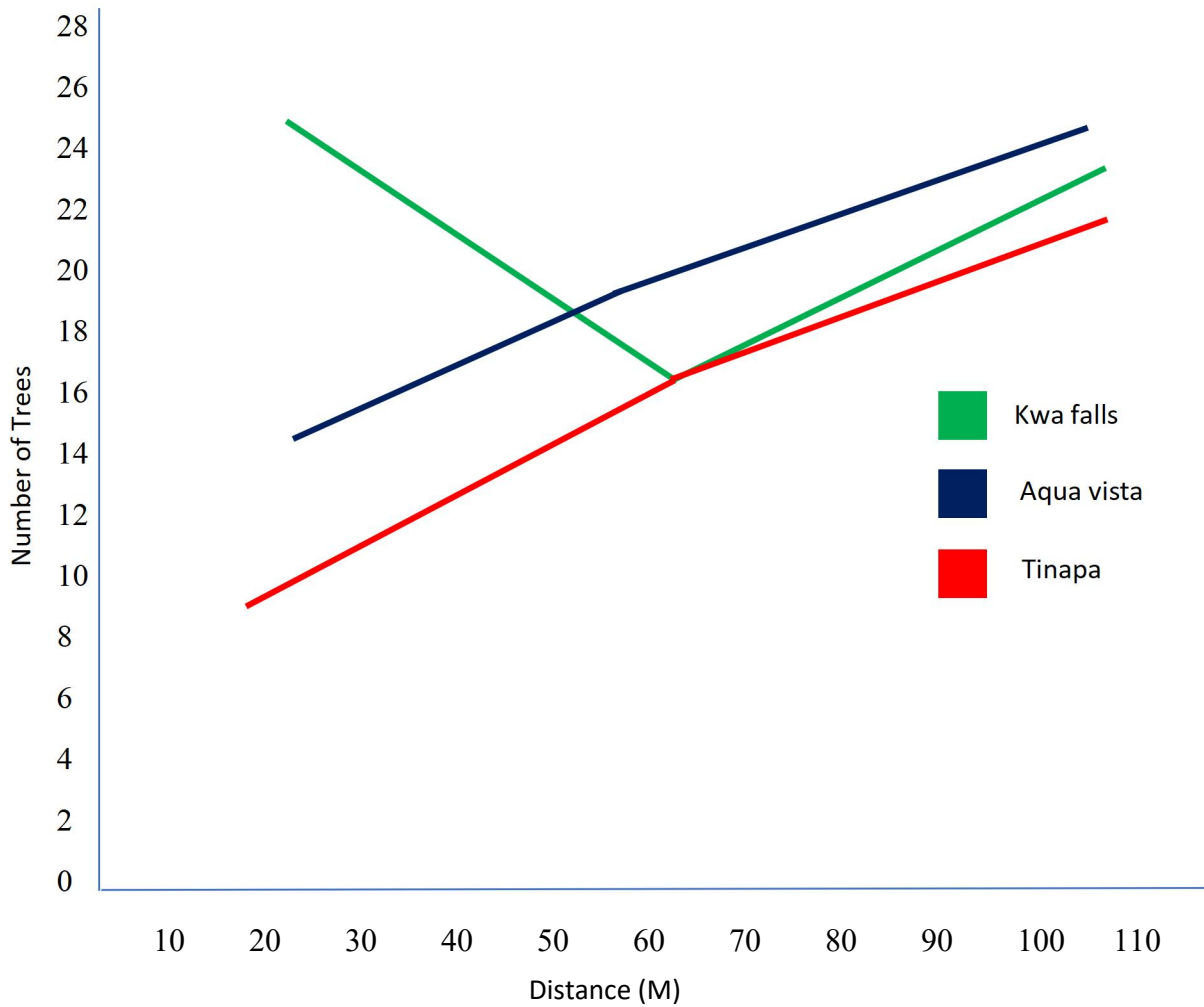


Figure 2: Distance decay concept explained by impact of Tourism Infrastructure on flora diversity in eco-tourism sites.

Table 2

Shannon Weiner species Diversity as Distance increases in each tourism site.

Location	Distance X (m)	Species Diversity (Shannon Weiner)
Aqua Vista Farms		
	10	0.300
	20	0.330
	30	0.360
	40	0.390
	50	0.420
	60	0.430
	70	0.443
	80	0.456
	90	0.469
	100	0.470
Tinapa Business and Leisure Resort		
	10	0.323
	20	0.260
	30	0.323
	40	0.386
	50	0.449
	60	0.450
	70	0.463
	80	0.476
	90	0.489
	100	0.490
Iyata Farms		
	10	0.170
	20	0.240
	30	0.310
	40	0.380
	50	0.450
	60	0.450

	70	0.467
	80	0.484
	90	0.501
	100	0.500
Kwa Falls		
	10	0.470
	20	0.470
	30	0.475
	40	0.473
	50	0.471
	60	0.350
	70	0.377
	80	0.404
	90	0.431
	100	0.430

Source: Researcher's field work

Table 3

Result of correlation analysis between distance and species diversity

Correlations	Distance (x)	Species Diversity (y)
Pearson's Correlation	1	.657
Sig. (2-tailed)		.000
Sum of square and cross products	3.300 E4	58.930
N	40	40
Species diversity Pearson's correlation	.657	1
Sig (2-tailed)	.000	
Sum of square and cross products	58.930	.244
Covariance	1.511	.006
N	40	40

** Correlation is significant at 0.01 level (2-tailed)

Table 4

Result of the analysis of T-test

N	Df	R	Tc	tx	Sig.	P < 1
4	30	0.65	5.27	2.04	0.05	0.001

T calculated (5.27) > t – tabulated (2.04) = reject Ho

Therefore, since the calculated value is greater than the tabulated value, the null

hypothesis that there is no significant relationship between infrastructural

development and species loss on tourism site is rejected while the alternate that a significant relationship between infrastructural development and species loss is upheld. The hypothesis was tested using variables from Shannon Weiner species indices of every quadrat (plot size 10 m x 10 m) as dependent variables and distance away from the tourist sites as independent variables.

The data in table 2 were used in testing the hypothesis while Pearson's Product Moment Correlation (PPMC) was used in the analysis to find out the relationship between distance from tourism infrastructures site and species diversity.

3. Result

The correlation between distance from infrastructural sites and species diversity is positive and statistically significant ($r = 0.657$; $P < 0.001$). The implication of this is that as the distance away from the tourism infrastructure increases, species diversity increases. The significant relationship indicates that the two variables (distance from infrastructure and species diversity) co-vary. That is, the increase in species diversity as distance increases from tourism infrastructure sites. The result from the analysis was subjected to a t-test using this formula thus shown in table 3 and 4 above.

Decision

From the analysis and the data in table 4, the data was significant at 0.05 level of

confidence for this research, ($r = 0.657$; $P < 0.001$). Therefore, $t - tab = 2.04$.

Therefore, since the calculated value is greater than the tabulated value, the null hypothesis is rejected, while the alternate is upheld. This implies that there exists a positive relationship between distance from tourism infrastructure and species diversity, meaning that there is a significant relationship between tourism infrastructure development and species loss. In other words, the further away from tourism infrastructure, the more species diversity. ($R^2 = 0.65^2 = 0.4225$ or 42.25 percent).

The hypothesis has taken care of the objective of the study which seeks to examine the impact of tourism infrastructure development (construction) on flora diversity. It has also confirmed the concept of distance decay as stated by Taverna and Xi (2010) that "there is decrease or loss of similarity between observations as the distance between them increases" and the Hubble (2000) Neutral theory predictions that in ecology, similarity changes with distance across landscapes.

4. Conclusion

Eco-tourism and generally tourism infrastructure development has caused the depletion of the terrestrial and wetland flora diversity in the study area. It was observed by this study that adopting distance decay concept as a methodology helps to explain better the effects of damage done to flora diversity as the distance from the facility increases, the effects of the infrastructure damage on biodiversity becomes less as distance increases. This was evident by the

flora diversity which increases with the increase in the distance from the facility.

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