

Research Article

Influence of *Mangifera Indica* (mango tree) on the landscape and environment of Federal University of Education Kontagora, Niger state

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Abstract

The study investigated the influence of *Mangifera indica* (mango tree) on the landscape and environment of Federal University of Education Kontagora, Niger State. Among the many tropical fruits, mango has been identified as the most important and considered to be the king of fruits from a socio-cultural, commercial and environmental point of view and grown in over 100 countries. 4 research questions were addressed. Purposeful sampling technique was adopted to cover all faculties where all the 33 mango trees existed. Measurements using some instruments, observations and records were taking for data collection. The analysis of data obtained from the measurements and observations made were addressed qualitatively through descriptive statistics. Results showed that the trees provided notable shading that indicated protective effect on the surrounding vegetation, soil stability improvement with their deep, wide and spread root system, contributed aesthetic beauty and created recreational location for staff and students which further enhanced visual appeal and usability of the university landscape, and the trees were valued for their economic benefits. It was concluded that by harnessing the benefits of Mango trees on campus, they created sustainable ecosystem; it was therefore recommended that more Mango trees should be planted on the campus to enhance environmental soil protection and to provide economic and dietary opportunities as well as make environmental education a content in general course curriculum for all students to have a share of the benefits.

Keywords: Aesthetic Value, Campus Landscape, Ecological Impact, Environmental Sustainability, *Mangifera indica*, Soil Stability.

1. Introduction

It is rare to observe a campus devoid of well-planned and mature trees in most institutions of higher learning in Nigeria. Such mature trees which may range from Mango, Neem, Locust bean, Palms to Conifers are usually included in construction site plans. The motive behind standing mature trees on campus is numerous ranging from cooling effect, wind/storm breaker, aesthetics, environmental oxygen-carbon (iv) oxide balance among other benefits as the case may be.

Mango (*Mangifera indica*) is a fleshy stone fruit belonging to the genus *Mangifera* in the family Anacardiaceae. It is a large fruit tree, capable of growing to a height of 30 metres (100 feet). There are two distinct genetic populations in modern mangoes – the "Indian type" and the

"Southeast Asian type". Among the many tropical fruits, mango has been identified as the most important and considered to be the king of fruits from a socio-cultural, commercial and environmental point of view and grown in over 100 countries. The leaves of mango tree are simple, shiny and dark green. Red-yellow flowers appear at the end of dry season, and also at the beginning of raining season. Both male and female flowers are borne on same tree. Climatic conditions have a significant influence on the time of flowering.

Mangifera indica occupies a unique position among edible fruit crops in Nigeria as it grows in all ecological zones of the country (Aguoru, Okoli, & Olasan, 2016). Trees of mango cultivars in Nigeria are distinguished by their fruit

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characteristics and therefore assigned common names. In the North-Central part of the country, the common cultivars are the Big-no-fibre, small-fibre, julie and Opiopo whereas saigon, kent, julie, sherry, palalaa, Opioro, amongst others are mainly found in South-Western Nigeria (Ilioh & Olorode, 1991; Aguoru *et al.* 2016). According to the FAO report of 2004, Nigeria is the largest mango producing country in Africa and seventh in the world, but on the contrary not listed among the 10 leading mango fruit exporters (Ugese, Iyango & Swem, 2012).

The character of a landscape helps define the self-image of the people who inhabit it and a sense of place that differentiates one region from another. It is the dynamic backdrop to people's lives. Landscape can be as varied as farmland, a landscape park or wilderness. The Earth has a vast range of landscapes including the icy landscapes of polar regions, mountainous landscapes, vast arid desert landscapes, islands, and coastal landscapes, densely forested or wooded landscapes including past boreal forests and tropical rainforests and agricultural landscapes of temperate and tropical regions. The activity of modifying the visible features of an area of land is referred to as landscaping (Takase *et al.* 2015).

However, there is the growing problem of "color pollution" - through bright, solid-colored buildings, billboards, and lighting clusters -that adversely affects people physically and psychologically (Bohre *et al.* 2016). The homogenization of colors between cities is causing a loss of cultural identity, as many modern buildings share similar palettes, diluting local characteristics. Researchers have proposed more unified cityscape approaches to address these color landscape issues and help cities preserve their distinctive identities and create vibrant, emotionally engaging urban environments. The landscape of Niger State consists mostly of wooded savannas and includes the floodplains of the Kaduna River.

Some of the challenges of landscape have been known to include: landscape drainage problems which can lead to serious issues, such as: water damage to buildings, dying plants, and unusable lawn areas. Sometimes the natural conditions of a site - such as poor soil, extreme pH levels, or hard ground - make it difficult to grow healthy plants. Similarly, shady landscapes in the neighborhood of mango trees can be particularly challenging, as they may be responsible for poor vegetation under them in addition to possible pockets of soil degradation potentials.

Information on the exact number of cultivars in Nigeria has not been accurately documented leading to a lack of accurate names of germplasm and cultivars. This has been a major limitation on the effective study and communication regarding the general biology of cultivars. The common names used are often misleading, confusing and taxonomically inconsistent. Research to date has mainly focused on the relative food crop value and time of maturity of mango fruits. The Study therefore examined the influence

of Mango trees on campus; advanced the means through which Mango trees could improve soil quality and enhance erosion control; determined the aesthetic and proposed the socio-economic impact associated with Mango trees on the landscape and environment of Federal University of Education Kontagora Niger State.

The following research questions were considered in this study:

1. What are the ecological influence of *Mangnifera indica* (Mango tree) on the landscape and environment of Federal University of Education Kontagora?
2. How could mango trees improve soil quality and enhance erosion control on the landscape of Federal University of Education Kontagora?
3. What are the aesthetic impact associated with Mango trees on the landscape of Federal University of Education Kontagora?
4. What could be the socio-economic impact associated with Mango trees on the landscape of Federal University of Education Kontagora?

2. Methodology

A descriptive survey research design was employed to systematically collect and analyze data related to the influence of *Mangifera indica* (Mango trees) on the landscape and environment of Federal University of Education (FUE) Kontagora, Niger State. This design allows for an in-depth exploration of various factors influencing the environment and local faculties at Federal University of Education Kontagora, Niger State.

2.1. Study Area

The study area covered the grounds of Federal University of Education Kontagora, Niger State. Kontagora (fig 1), in Niger State is located with a global positioning system (GPS) coordinates of 10.407°N (Latitude) 5.47°E (Longitude) (<https://www.geocountries.com>) or of 10°24' 11.484" N and 5°28' 14.88" E (<https://latlong.info>). The University comprises diverse landscape with standing populations of mango trees. Thus, the environment provides an ideal setting for evaluating the ecological, aesthetic and socio-economic impacts of the plant species.

The entire 33 Mango trees existing on the campus of Federal University of Education Kontagora constituted the population of the plants for this study. Hence, a purposive sampling technique was used to ensure adequate coverage of all the faculties where the mango trees existed. The existing 33 mango trees on campus as distributed on the premises of the faculties range from: 3 in Art and social sciences, 4 in sciences, and 21 and 5 each in vocational and General Education with varying levels of soil erosion and land degradation.

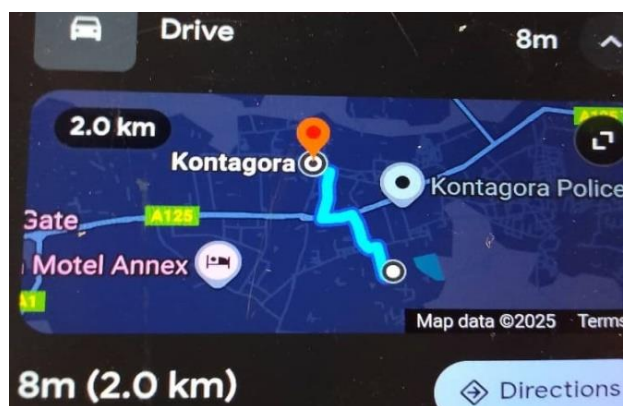


Figure 1. GPS of Kontagora

2.2 Data Collection

Data were obtained through observation and notes taking on Mango trees canopy size as well as on the presence of other plants and grasses in the vicinity of the canopy of the trees to determine if Mango trees affected the growth of other species. Similarly, the observation of the soil nature and root formation or pattern of the trees provided other means of data collection.

2.3 Procedures

1. Site selection: Any location within the premises of the faculties in FUEK on coordinates of 10.407°N (Latitude) 5.47°E (Longitude) where mature *Mangifera indica* (Mango) trees are existed were selected and marked as representative of the overall tree distribution on campus.
2. Materials and Equipment: necessary measuring tools such as measuring tape was used to determine the length (diameter) of the canopy and root spread; while soil auger was used to drill hole into the soil under the mango trees to

ascertain the depth of the fibrous roots with a ruler down to 60cm into the profile that provided data that were analysed in the study.

- 3) Vegetation: all plant species existing under the Mango trees were considered and recorded, noting their abundance and growth stage and especially determined their density using quadrat.

3. Results

The data obtained in the study were analysed using a descriptive statistic and presented accordingly in tables

3.1. Field Observation Summary

Data were collected from all the faculties on campus: Art and Social Sciences, Science, vocational and General Education. Key parameters observed included canopy size, soil condition, presence of under-canopy vegetation, and signs of soil erosion. These observations influenced the evaluating parameters adopted on the effects of Mango trees on the landscape and biodiversity of FUE Kontagora.

3.2. Answers to research Questions

3.2.1 Research Question 1

*Research Question 1: What is the ecological impact of *Mangifera indica* (Mango tree) on the landscape and environment of Federal University of Education Kontagora?*

Table 1 shows the number of Mango trees on campus, the area covered by their canopy, the mean and standard deviation of area covered by their canopy, as well as the percentage of vegetation present under the canopy. It was observed that Mango trees created significant shading which had a noticeable impact on the surrounding vegetation.

Table 1: Canopy (area, mean and standard deviation) and percentage of vegetation present under canopy

Faculty	Existing Mango Trees	Mango Tree Canopy			Vegetation present under canopy
		Average Area (m ²)	$\bar{X}$	Std dev	
Art and Social	3	22.0	13.17	.764	3
Science	4	40.86	13.50	.817	8
Vocation	21	116.29	10.91	2.390	60
General Education	5	69.14	11.96	1.638	46

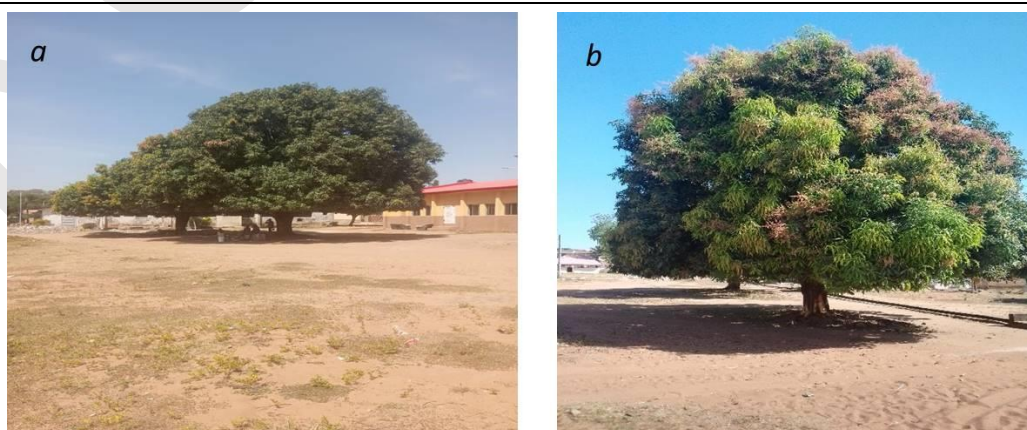


Figure 2 (a) and (b). Tree Canopy covered area and under canopy vegetation

Table 1 shows that Mango trees typically possess broader canopy area with average range of 22.00m², 40.86m², 69.14m² to 116.29m² within the premises of Arts and social sciences, Sciences, General education to Vocational education respectively. The density of vegetation under the canopies followed a distribution pattern of the mean values according to faculties: Sciences ($\bar{X}$ = 13.50 std dev = .817); Arts and social sciences ($\bar{X}$ = 13.17 std dev = .764); General education ($\bar{X}$ = 11.96 std dev = 1.638) and vocational education ($\bar{X}$ = 10.91 std dev = 2.390) with percentage of vegetation under canopy as: 8%, 3%, 46% and 60%

Table 2: Soil quality, root spread and erosion signs

Faculty	Soil Quality	Root spread (depth in cm)	Erosion sign [1(mild)- 3 (severe)]
Art and Social	Stoning	.764	3
Science	loose	.817	8
Vocation	compacted	2.390	60
General Education	compacted	1.638	46

As observed on table 2, Mango trees improved soil stability and quality with a degree of regulating erosion due to their deep and widespread root systems. Observation showed that the soil within the premises of Arts and social science was stoning with a root spread depth of 35cm, that of Science was loose with a root spread depth of 30cm, while those of vocational and General education were compacted with a root spread depth of 60cm and 55cm respectively. A severe signs of soil erosion was reflected at the faculty of Arts and social sciences as well as science premises, attributed to their stoning and loose soil nature as well as shallow root spread depth, whereas a mild erosion sign occurred in the neighbourhood of mango trees in the vocational and General education premises due to the influence of their compacted soil and broader root spread depth.

3.2.3 Research Question 3

Research Question 3: *What are the aesthetic impact associated with Mango trees on the landscape of Federal University of Education Kontagora?*

Table 1 revealed that larger canopies of Mango trees provided ample shade and contributed to the aesthetic beauty of the University campus. The arrangement of the mango

respectively, indicating that the lesser the mean value of canopy cover, the higher the percentage of vegetation under the mango tree. This implied that canopy cover affected the growth of grasses and smaller plants beneath the mango tree and thus influenced the landscape of the area as depicted by figure 2.

3.2.2 Research Question 2

Research Question 2: *How could mango trees improve soil quality and enhance erosion control on the landscape of Federal University of Education Kontagora?*

Table 2 presents observations on soil quality, mango tree root spread and erosion signs. This analysis influenced how Mango trees contribution to soil stability was evaluated

trees in strategic locations influenced the construction of

recreational sites (leisure parks) for students and staff and hawkers of seasonal crops or snacks under most of the trees, enhancing the visual appeal and usability of the University landscape (Figure 3).



Figure 3. Aesthetic background of tree

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3.2.4 Research Question 4

Research Question 4: *What could be the socio-economic impact associated with Mango trees on the landscape of Federal University of Education Kontagora?*

Field observations laid to bare the fact that Mango trees were treasured for their socio-economic values: Mango trees provided seasonal fruits which contributed to both nutritional and micro economic activities on FUE Kontagora campus. This implied that while some individuals were engaged in harnessing the opportunity endowed by nature via harvesting exercises and selling of mangoes fruits on campus, some others benefited from the vitamins and mineral contents of the fruits through buying and consumption.

4. Discussion

The findings of this study has shown from an ecological perspective that the presence of Mango trees on FUE Kontagora ground has a notable impact on the local microclimate and soil quality. The large and dense canopies of mango trees provided extensive shade, which cools the surrounding spaces and reduced heat stress on the campus. The shading effect, while reducing under-canopy vegetation, also lessened soil moisture evaporation, which is beneficial in maintaining soil hydration in an environment prone to dryness. These findings align with other researches who worked on tree canopies in arid and semi-arid regions, where large trees were known to create cooler microhabitats and contribute to localized moisture retention (Tandon, Jaiswal, & Bhandari, 2008).

In terms of soil quality, the observations in this present study confirmed that Mango trees played a crucial role in stabilizing the soil as well as mitigating erosion. Mango trees, while also contributing to soil stability, had a comparatively lesser effect due to their less expansive root systems, particularly in compacted soils where erosion signs were mild. These results are consistent with the general understanding of how deep-rooted trees can enhance soil structure and reduce erosion by holding soil in place and facilitating water infiltration (Dhadse, Gajghate, Ghaudhari, Satapathy, & Wate, 2011).

Another important ecological consideration is the suppression of vegetation beneath the tree canopies. The lower percentage of under-canopy vegetation observed was primarily due to the shade intensity of the mango trees which limits light penetration and consequently, the growth of grasses and smaller plants. While this reduction in plant diversity might seem detrimental, it can also be viewed as a form of natural weed control, reducing competition for resources among desirable plant species. Furthermore, the shading provided by mango trees reduced the spread of invasive species that thrive in direct sunlight, thus playing a protective role in maintaining the ecological balance of the landscape (Oke, & Aiyelari, 2010).

The aesthetic contribution of Mango trees to the campus landscape cannot be overelaborated. Their towering

presence, broad canopies, and seasonal characteristics add both visual appeal and functional beauty to the University grounds. The mango trees served as landmarks and gathering points, offering shaded areas where students and staff did relax and socialized. It has been recorded that in campus settings, large trees are often valued not only for their ecological services but also for their psychological and social benefits. Studies have shown that green spaces with mature trees contributed to improved mental well-being, stress reduction, and overall satisfaction within academic environments and in urban heat mitigation (Sirisena, Jayasinghe, & Rathnayake, 2016). The Federal University of Education Kontagora is no exception, as the strategic placement of mango trees enhances the campus's ambiance, making it more inviting and conducive to learning.

In addition to their ecological and aesthetic functions, Mango trees as found in this study also offered socio-economic benefits. Mango trees in this regard contributed to the local economy through the sale of their fruits, which were harvested during the fruiting season. Although the number of Mango trees on the campus was few, their economic impact was notable, especially among students and local vendors who relied on the seasonal sale of the fruits for supplementary income. This finding corroborated findings in other parts of Nigeria, where Mango cultivation played key roles and contributed to local economies and food security (Fajinmi & Fajinmi, 2006). Furthermore, Mango fruits as found in the present study are dependable source of nutrition, providing vitamins and other essential nutrients to the University community, which enhanced the overall health and well-being of students and staff.

5. Conclusion

This study has established the multifaceted contributions of Mango trees to the landscape and environment of Federal University of Education Kontagora. Ecologically, Mango trees play a critical role in soil stabilization, erosion control, and the creation of favorable microclimates. Aesthetically, they enhance the beauty and functionality of the campus environment, providing shaded areas that improve the social and recreational experience for the University community. Socio-economically, the trees offer medicinal, nutritional, and economic benefits, making them invaluable assets to both the University and the surrounding community.

By supporting ecological balance, enhancing landscape aesthetics, and contributing to local livelihoods, they have a profound and positive influence on the landscape and overall environment of the Federal University of Education Kontagora. Thus, the presence of Mango trees on the Federal University of Education campus has numerous environmental, economic, and agricultural benefits. By harnessing these benefits, the University can create a sustainable and thriving ecosystem.

Recommendations:

Based on the findings in this study, the following recommendations were put forward:

- Plant more Mango trees on the University campus to enhance environmental benefits and provide economic opportunities.
- The university authority should endeavor to provide a working document and culture for tree management and maintenance programs
- There is need to conduct comparative study on other native plant species for biodiversity.
- The curriculum planners should as a matter of necessity provide content for environmental education in general courses for all students to benefit
- Conduct further research on the specific impact of Mango and other trees on the University landscape.

Abbreviations

GPS Global Positioning System

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Author Contributions

Arowolo, Jacob Gbemiga: Conceptualization, methodology, writing- original draft and Formal Analysis.

Iwalaiye, Elizabeth Mayokun: Methodology, Writing- Review and Editing.

Daramola, Olamide Temitope: Writing- Review and Editing

John, Mercy: Conceptualization, Writing-Original draft and Fieldwork

Conflicts of Interest

The author(s) declare that they have no known competing financial interests, professional affiliations or personal relationships that could have appeared to influence the work reported in this paper.

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