A TERM PAPER

On

THE IMPACT OF SOFT LANDSCAPING ON THE MICROCLIMATE OF A TYPICAL BUNGALOW IN AKURE

By

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ABSTRACT

The paper examines the need for soft landscape and its impact on the microclimatic environment using a typical residential bungalow in Akure as a case study. It explains what is meant by microclimatic and climatic condition of the area. It identifies hard and soft landscape element as a different type of landscape but mainly focuses on soft landscape elements such as trees and shrubs, lawn and flower, mulches as well as ponds extensively. The paper also examines opinions of various scholars on the issue of soft landscape. It further discusses the impact of soft landscape elements on the typical bungalow examined. It then concludes by highlighting the importance of soft landscape which involves the improvement of indoor air quality, human comfort and brings about cooling to the occupants and recommends the practice of soft landscape.

Keywords: microclimate, Akure, bungalow, impact, soft landscape
INTRODUCTION

A microclimate is a local atmospheric zone where the climate differs from the surrounding area. The term may refer to areas as small as a few square feet (for example a garden bed) or as large as many square miles. Microclimates exist, for example, near bodies of water which may cool the local atmosphere, or in heavily urban areas where brick, concrete, and asphalt absorb the sun's energy, heat up, and reradiate that heat to the ambient air: the resulting urban heat island is a kind of microclimate.

The residential building envelope is a place where a lot of time is spent for rest. The rest is attained only when there is thermal comfort within the building. Nigeria which is in the tropics has a major problem of excessive heat from the sun. The use of external sun shading devices such as vertical, horizontal and egg-crates have been found to be expensive and also do not necessarily provide complete shade to the entire building envelope (Mohammad, 2011).

This has overtime resulted into the use of mechanical means to cool the buildings. The use of such mechanical conditioners however consumes a lot of energy and the more energy consumed by this equipment, the more the ecological footprint on the environment. Air conditioners are the single most expensive equipment to run in term of energy consumptions in residential buildings.

Microclimates can also refer to purpose made environments, such as those in a room or other enclosure. Microclimates are commonly created and carefully maintained in museum display and storage environments. This can be done using passive methods, such as silica gel, or with active microclimate control devices.
A microclimate can offer an opportunity as a small growing region for crops that cannot thrive in the broader area; this concept is often used in permaculture practiced in northern temperate climates. Microclimates can be used to the advantage of gardeners who carefully choose and position their plants. Cities often raise the average temperature by zoning, and a sheltered position can reduce the severity of winter. Roof gardening, however, exposes plants to more extreme temperatures in both summer and winter.

STUDY AREA
The study area utilized for this paper is Akure, the capital city of Ondo State, Southwest, Nigeria. Akure has a population of 360,268 (National Population Census, 2006). Using 2% yearly increase, it is expected that by 2015 it would rise to 430, 553 and 475,365 by the year 2020. It is located some 311km North East of Lagos, about 370m above sea level and lies on longitude 5° 18' East and Latitude 7° 17' North of the Equator. The rapidity of the city’s development within the last twenty-five years stemmed from the political status of the town which was initially a provisional headquarter and later a state capital thus serving as the seat of both the local and State Governments since 1976. Akure has been classified as a Millennium Development City.

The climatic condition of Akure follows the pattern of south western Nigeria where the climate is influenced mainly by the rain-bearing southwest monsoon winds from the ocean and the dry northwest winds from the Sahara Desert. High temperatures and high humidity also characterize the climate. There are two distinct seasons, the rainy and dry seasons. The rainy season lasts for about seven months (April to October). The rainfall is about 1524mm per year. The atmospheric temperature ranges between 28°C and 31°C and a mean annual relative humidity of about 80 per cent (Nigeria Metrological Agency, 2010).
The soil is made up of ferruginous tropical soils. Crystalline acid rocks constitute the main parent material of these soils. The main features include a sandy surface horizon underlain by a weakly developed clayey, mottled and occasionally concretionary sub-soil. The soil is however sensitive to erosion and occasional water logging as a result of the clay sub-soil. The soils have an exceptional clayey texture, but combine good drainage and aeration with good properties of moisture and nutrient retention.

**LITERATURE REVIEW**

Microclimatic design requires a conceptual understanding on how microclimatic components such as wind and solar radiation, can be significantly affected from landscape elements (Brown and Gillespie, 1995). Plants have a strong effect on microclimate. Trees and green spaces can help to cool our cities and save energy. Trees can provide solar protection to individual houses during summer and evapo-transpiration from trees can reduce urban temperatures. Trees also help mitigate the greenhouse effect, filter pollutants, mask noise, prevent soil erosion, and calm their human observers. Shading from trees is an effective way to significantly reduce energy for cooling purposes. According to Brown and Gillespie (1995) and Torre (1999) microclimatic design involves a precise analysis of all the elements present on the studied site like:

- Location: Geographic position, topography, position related to water masses, urban form.
- Shape: Orientation, volume, dimension, proportion.
- Limits: Vertical and horizontal limits.
- Material characteristics.
- Vegetation: Species, age, soil, oxygen, water and mineral resources available, foliage form, colour, type (evergreen or seasonal).
- Field measures of a typical day of the period studied (air and radiant temperature, wind speed and direction, solar radiation and relative humidity).
- Growth hypothesis based on site parameters.

The thermal behaviour of each building affects to a great extents the demand of energy a building requires, as such it is the architect’s responsibility to control that right from planning and design stage (Steve, 2004).

THE OBJECTIVES OF MICROCLIMATE CONTROL THROUGH LANDSCAPING

Landscaping can be used to control several aspects of the microclimate. The climatic variables that can be regulated include solar radiation (sol-air temperature), air temperature, wind speed and direction, relative humidity and glare.

Sol-Air Temperature Control

The use of ventilated shading provided by trees, shrubs and climbers for the control of radiant temperature, and reduction of air, ground and surface temperature is a primary objective of microclimate control through landscaping. Air temperature is measured in the shade (in a Stevenson’s screen), whereas the globe temperature is measured without shade and it indicates the effect of solar radiation on air temperature. Ventilated shading reduces the amount of solar radiation reaching ground and wall surfaces, thereby reducing the sol-air temperature, which is an indication of the globe temperature. Climbers with or without trellis can be used to cover surfaces exposed to the sun.
Air Temperature Control

The air temperature control achieved through landscaping is a direct result of reduction in solar air temperatures caused by ventilated shading. Ventilated shading is accompanied by evapotranspiration, a process whereby plants take water from the soil and lose the water by evaporation through the leaves. This causes cooling just like sweating causes cooling in humans, with the latent heat of evaporation taken from the surrounding air.

Humidity Control

Plants in general increase the humidity of the site. They can therefore increase the thermal comfort during hot, dry seasons, although the plants have to be watered. The plants take water from the soil, and when this water evaporates from the leaves it increases the relative humidity while lowering the air temperature. Pools and ponds behave in a similar manner. Water evaporating from the surface increases relative humidity while reducing air temperature.

Control of Air Velocity and Wind Speed

Plants are used to reduce wind speed and to increase the velocity of stagnant and slow moving air. Windbreakers in the form of rows of trees are a very effective way of reducing wind speed and filtering dust. The almond tree effect induces air movement under and around trees even when there is relative calm in unplanted areas.

Control of Wind Direction

Landscaping can be used to direct wind away from the building, or towards the building. Fences, walls, hedges and trees can be combined to form an obstruction that will deflect the wind above the building. This can be useful when protecting the building from the cold harmattan wind. The more common use of trees however is to channel air flow towards living space. While trees
allow a portion of the wind to pass through them, some wind is deflected above and below the trees. The wind forced to flow beneath the trees increases air movement in living space. On larger plots groups of trees can also be used to channel the wind in a particular direction.

**Control of Surface Absorptivity and Reflectance (Albedo)**

Landscaping can be used to control the rate at which surfaces absorb and reflect solar radiation. The use of lawns, plants, colour and careful selection of pavement materials can control the proportion of solar radiation absorbed to that reflected.

**Seasonal shading**

The choice of plants can be used to control the amount of shading in different seasons. There are two types of climate in Nigeria: the warm humid and the composite climates. The composite climates have warm humid, hot dry and cold seasons. Seasonal shading usually involves full shading in hot, wet season. In the dry, cold season trees are used to block the cold northern wind while allowing the sun in from the south. The cold season wind can be blocked by plant material, especially thick evergreens and plants with heavy foliage. A good design will have planting with deciduous trees on the South, which cool the air in the hot season and drop their leaves to let in precious sunlight in the cold season (Caudill et al 1974).

**Pollution control**

Plants are very effective in controlling levels of pollution. They absorb dangerous gases like carbon dioxide that are associated with the urban heat island. They also reduce the levels of other pollutants, especially from automobiles. Buffer zones planted with trees are used for separating industrial areas from residential areas. The tree belts in Northern Nigeria help reduce the dust content of the harmattan winds.
Glare Control

Direct glare can be prevented by using trees to block off the relevant portions of the sky while indirect glare can be prevented by planting flowers, shrubs and grass on surfaces that would normally reflect light into the building.

Fresh Air and Fragrance

Plants produce oxygen and fragrances, which combined with the almond tree effect, create the refreshing atmosphere of gardens. While the freshness of the air and fragrance may not be measurable by climatic variables, the improvement in the microclimate is unquestionable.

SOFT LANDSCAPING ELEMENTS

The term soft landscape is used by practitioners of landscape design, landscape architecture, and garden design; and gardeners to describe the vegetative materials which are used to improve a landscape by design. The corresponding term hard landscape is used to describe construction materials. The range of soft landscape materials includes each layer of the ecological sequence: aquatic plants, semi-aquatic plants, field layer plants (including grasses and herbaceous plants) shrubs and trees.

- Trees and shrubs

Trees and shrubs are the most significant in the provision of shade and the control of relative humidity and air movement. They contribute more to the attainment of thermal comfort than any other element. Ventilation is affected by plant materials. Air crossing hard reflective or absorptive surfaces like parking lots and sidewalks is warmed, but air passing through trees and plants will be cooled (Caudill et al 1974).
- **Lawns and flowerbeds**

Lawns and flowerbeds are used to reduce ground temperature and to prevent glare. Vegetation generally improves air freshness and fragrance.

- **Pools and ponds**

These water bodies are used for humidification and evaporative cooling.

- **Mulches**

Mulch is a protective covering over the roots of trees and bushes to retain moisture and kill weeds. Mulches include straw, fallen leaves or plastic sheeting. Others are gravel, wood chipping, rotting leaves and grass. Mulches can be used to reduce surface and air temperatures by reducing the heat absorbed by the ground.

- **Trellis and climbers**

A trellis is a light framework of crossing strips of wood, plastic, et cetera used to support climbing plants and it is often fastened to a wall. This can be used to provide shade on western walls.

- **Outdoor Living space**

Outdoor living spaces occupy that region between the house and the garden. These are conditioned outdoor spaces. They are partly garden, partly house. They are partially protected from harsh climatic element, yet open to nature. They include courtyard, patios, corridors, balconies and porches (verandas). Outdoor living space can be considered a part of the landscape and its design can significantly impact on the indoor comfort conditions.
• **Plants Selection and Landscaping**

Most of what makes a landscape unsustainable is the amount of inputs required to grow a non-native plant on it. A local plant, which has adapted to local climate conditions, will require less work on the part of some other agents to flourish. Also, by choosing native plants, certain problems with insects and pests can be avoided because these plants will be adapted to deal with any local invaders.

**IMPACT OF SOFT LANDSCAPE ON MICROCLIMATE OF A TYPICAL BUNGALOW**

**Typical Bungalow:** The typical bungalow to be studied is Apelegan Villa.

Plate 1: Picture showing a typical bungalow in Akure

Source: Author’s field survey, 2011.
Location: The building under study is located opposite Elizade Motors along Oyemekun road besides Okuta Elerinla Police Station in Akure, Ondo State.

Soft Landscaping Elements and Their Impacts on the Building

1. Trees and Shrubs:
   
i. It prevents the building from external features and forces such as dusts, heavy wind velocity etc. which affects the building during stormy winds.

   ii. It prevents direct glare from entering the building.

   iii. It brings about thermal comfort to the occupants through the direct supply of ventilation.

Plate 2: Picture showing trees and shrubs within the building

Source: Author’s field survey, 2011.
2. **Lawns and flowerbeds**
   
i. It prevents the building from being heated when the temperature rises.

   ii. It prevents penetration of indirect glare into the building.

Plate 3: Picture showing the lawn within the building

Source: Author’s field survey, 2011.

3. **Outdoor living spaces**

   i. It encourages ventilation within the building.

   ii. It brings about supply of fresh air within the building.

   iii. It allows free flow of air and accommodates all forms of climatic conditions.
Plate 4: Picture showing the outdoor living space  
Source: Author’s field survey, 2011.

RECOMMENDATIONS

1. The government should encourage the use of soft landscape element in a residential building in microclimatic region by making tree and shrub seed available at a cheaper rate.

2. Adequate set back should be provided all round the building in the area so that the elements can be planted around the building.

3. There should be adequate and proper maintenance of these soft landscaping elements by house owner since it enhances supply of fresh air and brings about peasant environment.
CONCLUSION

The use of soft landscaping elements especially the planting of trees and shrubs, mulches, lawns and flower beds on residential buildings in microclimatic conditions cannot be overemphasized. The end users of these buildings should not be left with sole responsibility of using the landscape elements since most of them will not put into considerations the technicality involved in it as this may result into creating an unplanned landscape. However, the incorporation of such landscape elements as part of external work in a residential building will contribute positively towards the improvement of the environment and also providing a thermally comfortable microclimate of any given residential building.
REFERENCES


WEBSITE REFERENCES

