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Architectural Determination of Effects of Plants on Market Environment with Regard to Fire Outbreaks in Wuse of the Federal Capital Territory of Nigeria

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Abstract

Fire outbreaks in Nigerian markets are mostly attributed to problems with the use of electrical appliances such as fans and air conditioning systems. For this reason, research was conducted on the market environments in Wuse of the Federal Capital Territory of Nigeria, and it was aimed at the architectural determination of the effects of plants on the market environments, so as to provide guidelines to improve the use of plants at the design stages of Nigerian markets in conjunction with the reduction of the related negative fire implications. The environments of 419 (20.04%) sales points were studied out of 2,091 (100%) sales points in the market using a systematic sampling method at every 5th sales point. Questionnaires, a schedule of observations, and discussions from focus groups are the instruments that were employed for the gathering of research data from the primary sources. Research data from the secondary sources was gotten from the review of the related materials to this research. Amidst the findings of the research are: 92.12% of the buildings in the study area have no plants for landscape architecture; the reliance on using electricity from personal generators for non-natural cooling and ventilation appliances is a result of insufficient plants for natural cooling and ventilation in the market, and among the causes of outbreaks of market fires is using generators of electricity for non-natural cooling and ventilation. Amidst the provided guidelines are: Architects should make sure that the design of market buildings contains adequate plants for landscape architecture, so as to gain natural cooling and ventilation. They should also make sure that there are general electric power houses in the design of markets where there will be general generators to power appliances for artificial cooling and ventilation in times of failure from public power supply, in order to supplement the natural cooling and ventilation from plants and to also reduce fire outbreaks in the markets as a result of indiscriminate use of personal electricity generators.

Keywords: Guidelines, landscape architecture, markets, Nigeria, plants

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INTRODUCTION

Plants are among the living organisms; they cover a significant portion of the land on planet Earth. They include trees, grasses, shrubs, and herbs. Plant cells are made up of rigid walls that comprise the nucleus, chloroplasts, cellulose, and large vacuoles filled with water [1]. The importance of plants, especially in buildings, cannot be overemphasised. According to Daniel and Chris (2017), plants reduce energy usage, extend roof lives, and moderate temperatures during the hot season [2]. From their extra explanation, healthier internal spaces for building occupants are attributed to plants, as

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related to both physical and mental health. Thus, it became necessary that the use of plants in market environments be taken very seriously.

From the information obtained from Chabbi-Chemrouk (2007) and Ngugi (2015), market environments are authorised public places with the gathering of people to transact businesses; they are where the majority of all the fundamental human needs are bought or sold [3, 4]. For this reason, the use of plants to enhance conducive environments for trading in markets is very important. However, the Federal Fire Service of Nigeria (2016) and the National Association of Nigerian Traders (2016) revealed that fire outbreaks in Nigerian markets are significantly high and they are mostly attributed to problems from the use of electrical appliances such as fans and air conditioning systems for artificial cooling and ventilation [5, 6]. This is because emphasis has not been given to the use of plants for natural cooling and ventilation. The Federal Fire Service of Nigeria (2016) and the National Association of Nigerian Traders (2016) further revealed that lives and millions of Naira worth of properties are always lost in the process of market fires [5, 6].

Hence, this research was aimed at the architectural determination of effects of plants on market environments so as to provide guidelines to improve plant usage at the stages of the design of markets in Nigeria in conjunction with the reduction of the related negative fire implications. This research was conducted with very crucial objectives and they are: to have an investigation of the amount of satisfaction acquired by the market people (traders) regarding the comfort from market building usages as connected to non-artificial cooling and ventilation being released by plants; to have an ascertainment of the amount of satisfaction of the traders regarding the comfort from market building usages as connected to non-artificial cooling and ventilation being released by plants; to find out the dependence levels of traders on the employment of generators of electricity for non-natural market cooling and ventilation; to have an assessment of the amount of reliance of traders regarding the non-artificial cooling and ventilation that are gotten from the market plants.

MATERIALS AND METHODS

Description of the Study Area

The study area was the Wuse Market, and the entire external environs of the market were the scope of the study. Wuse Market is found on the street of Herbert Macaulay around Premium Times of Wuse 1 in the aged Wuse [7]. Figure 1 reveals the Wuse district street map showing Wuse market. The Federal Capital Territory (FCT) of Nigeria, particularly in its Municipal Area Council of Abuja, is exactly where this studied market is situated.

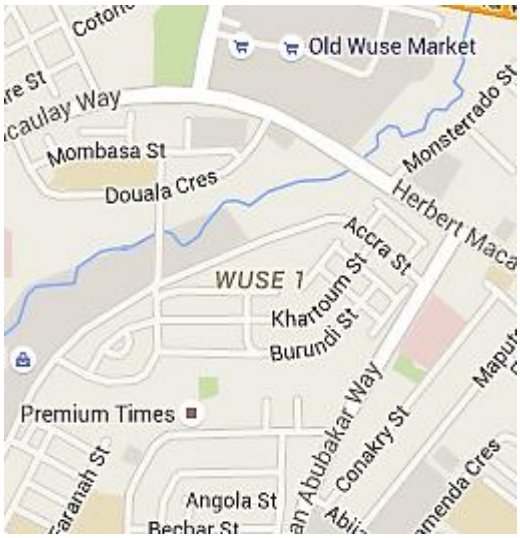

Figure 1. Wuse District street map showing Wuse Market [Source: Pinterest Map Data, 2018 (https://www.pinterest.com/pin/293930313162114274/)].

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Sampling Technique

The research utilised the descriptive survey method in order to give a detailed description of the characteristics of the research population or phenomenon that is being studied. Quantitative and qualitative research data were generated [8, 9]. The management committee of markets in the FCT is responsible for the control of seven existing markets that were regionally built in the territory [10]. It was further stated by this immediately cited authority that these regionally built-up markets are:

1. Wuse Market
2. Maitama Farmers Market
3. Kado Market
4. Nyanya Informal Market
5. Dei-Dei Regional and Building Material Market
6. Garki Model Market
7. Gudu Market

From these seven markets, Wuse Market was chosen by the purposive method of sampling due to the fact that it is the biggest market in the Nigerian FCT [11].

From the information obtained from the company that manages Wuse Market (Abuja Markets Management Limited, 2016), there are 2,091 sales points in Wuse Market [11]. In a study, 20% of the sample size of the target population is a good suggested size of the sample [12, 13]. Hence, systematic sampling was employed at every 5th sales point, and 419 questionnaires were distributed to the salespeople and buyers owing to the large market size for this research via the application of an arithmetic sequence equation with correct consideration of the number of terms and common difference. This implies that one questionnaire was administered to one salesperson and one buyer in the first chosen sales point, and the questionnaire distribution continued at 5th sales point intervals throughout the entire exercise in the study area. The 419 sales points that were chosen for questionnaire distribution are a little bit above 20% of the whole number of market sales points, and this has led to the acceptance of the size of the sample.

Other research instruments that were employed to collect the primary data were direct observation schedules and focus group discussions. The direct observations of the chosen buildings were related to the general plant usage around the buildings in the market. According to Morgan, Gibbs, Maxwell, and Britten (2002) and Masadeh (2012), in research, the actual standard number of participants in focus group is 10 to 12 [14, 15]. For this reason, focus group discussions of five numbers that are comprised of 10 participants (traders) were formed in the study area by randomly getting one participant from some of the chosen buildings for this research. Data from the secondary sources was obtained from the review of reports, guides, blogs, historical documents, journals, books, theses, and maps as related to this study. Tables and photographs were employed for the presentation of the data.

RESULTS AND DISCUSSION

The satisfaction levels of users of the market as related to the buildings with regard to the ventilation derived from plants, and the plants' consequences on the environment of the market were discussed.

Satisfaction Levels of the Users of the Market as Related to the Buildings with Regard to the Ventilation Derived from Plants

Out of 419 questionnaires distributed to the buyers in the market, 3 (0.7%) buyers replied that they are extremely satisfied with the buildings in the market with regards to the ventilation derived from plants. The implication of this was that, this buyers' group possesses an extremely sufficient number of trees for non-artificial ventilation in their shop environments. Andy (2016) opined that an adequate number of plants around buildings is an important factor to consider in achieving natural ventilation in built environments [16]. 11 (2.6%) respondents indicated that they have satisfaction with the market buildings regarding plant ventilations. The meaning of this is that this buyers' group is in possession of

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sufficient trees for non-artificial ventilation in their shop environments. Don, William, and Sherwood (2015) also opined that an adequate number of trees around buildings can greatly affect air flow in built environments.

54 (12.9%) buyers gave responses that neither they have satisfaction nor dissatisfaction with market buildings regarding plant ventilations. The meaning of this is that trees for non-artificial ventilation in shop environments were averagely available in this traders' group location. However, the study of Moncef (2018) revealed that the number of trees around the buildings should be above average level for proper natural ventilation as one of the most fundamental techniques to reduce energy usage in buildings [17]. 152 (36.3%) buyers gave responses that they have dissatisfaction with the market buildings regarding plant ventilations. The meaning of this is that, this buyers' group have no possession of sufficient trees for non-artificial ventilation in their shop environments. 199 (47.5%) buyers gave responses that they possessed extreme dissatisfaction with market buildings regarding plant ventilations. The meaning of this is that, this buyers' group is in possession of extremely few or no trees for non-artificial ventilation in their shop environments. Table 1 shows the different levels of how buyers are satisfied and dissatisfied regarding market buildings in terms of plant ventilation.

Table 1. Levels of satisfaction of buyers with regard to the market buildings in terms of ventilation from plants.

Response (Level of satisfaction)	Frequency	Percent
Very satisfied	3	0.7
Satisfied	11	2.6
Neither satisfied nor dissatisfied	54	12.9
Dissatisfied	152	36.3
Very dissatisfied	199	47.5
Total	419	100.0

Source: Researcher's field work, 2018.

From 419 questionnaires administered to the traders in the market, five (1.1%) traders replied that they are extremely satisfied with the buildings in the market as related to the ventilation derived from plants. The meaning of this is that, this traders' group is in possession of extremely sufficient trees for non-artificial ventilation in their shop environments. Andy (2016) opined that adequate number of plants around the buildings is an important factor to consider when achieving natural ventilation in the built environments [16]. 16 (3.9%) traders gave responses that they have satisfaction with market buildings regarding plant ventilations. This implies that this group of traders possesses adequate trees for natural ventilation in the vicinity of their shops. Likewise, Don et al. (2015) opined that adequate number of trees around buildings can greatly affect air flow in built environments [18].

69 (16.5%) traders gave responses that they have neither satisfaction, nor dissatisfaction with market buildings regarding plant ventilations. This means that there is an average level of trees for natural ventilation in the vicinity of the shops of this set of traders. However, the study of Moncef (2018) revealed that the number of trees around the buildings should be above average level for proper natural ventilation as one of the most fundamental techniques to reduce energy usage in buildings [17]. 148 (35.2%) traders gave responses that they have dissatisfaction with market buildings regarding plant ventilations. The meaning of this is that, this traders' group have no possession of sufficient trees for non-artificial ventilation in their shop environments. 181 (43.3%) traders gave responses that they have extreme dissatisfaction with market buildings regarding plant ventilations. The meaning of this is that this traders' group is in possession of extremely few or no trees for non-artificial ventilation in their shop environments. Table 2 shows the different levels of how traders are satisfied and dissatisfied regarding market buildings in terms of plant ventilations.

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Table 2. Levels of satisfaction of traders with regard to the market buildings in terms of ventilation from plants.

Response (Level of satisfaction)	Frequency	Percent
Very satisfied	5	1.1
Satisfied	16	3.9
Neither satisfied nor dissatisfied	69	16.5
Dissatisfied	148	35.2
Very dissatisfied	181	43.3
Total	419	100.0

Source: Researcher's field work, 2018.

Consequences of Plants in Market Environments

According to Daniel and Chris (2017), plants reduce energy usage, extend roof lives, and moderate temperatures during the hot season [2]. Yet, observation revealed that 92.12% of buildings in the market do not possess plants for landscape architecture but plants usage for landscape architecture was seen in the vicinity of the majority areas of the market fence. This means that most of the market buildings do not have plants for landscape architecture. It implies that there is increase of energy usage; reduction of roof lives, and natural moderation of temperatures in hot season in the market. Likewise, by rationalising the 2,091 sales points in the study area as provided by Abuja Markets Management Limited (2016) as related to the percentage of the plants usage in the market, it means that the significant number of plants in the environments of market where people of substantial numbers gather at the same time to transact businesses were not emphasised at the stage of the design of the market. Plate I reveals the market buildings without plants for landscape architecture.

Plate I. Buildings in Wuse Market without plants for landscape architecture.
(Source: Researcher's field work, 2018).

Also, most of the participants in focus group discussions revealed that there are no adequate plants to moderate temperatures during the hot season. This problem has resulted to the dependence on the personal electricity generators usage for powering appliances for artificial cooling and ventilation as

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alternative to moderate temperatures by natural means when there is no supply of public electricity. Furthermore, few participants of the discussions from focus group stated that among the causes of outbreak of market fires is the employment of the generators of electricity for non-natural cooling and ventilation. Plate II reveals the haphazard employment of generators of electricity to emit power for market non-natural cooling and ventilation appliances. It was observed that due to inadequate car parking spaces in the market and inadequate plants to improve natural ventilation and thereby reduce the use of electricity generators to power fans and air-conditioning system, people park cars very close to the personal electricity generators that are working. This can lead to the fast spread of fire through the cars in times of fire outbreaks from the use of electricity generators. Plate III shows the cars that are parked very close to the electricity generators in the market.

Plate II. Indiscriminate use of electricity generators to power appliances for artificial cooling and ventilation in Wuse Market.
(Source: Researcher's field work, 2018).

Plate III. Cars that are parked very close to the electricity generators in Wuse Market.
***(Source:** Researcher's field work, 2018).*

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Furthermore, the people that participated in the discussions of the focus group stated that, owing to the insufficient plants for temperature moderation, traders are now involved in the selling and storing of petrol in the market, which is being used by the generators of electricity, so as to power non-natural cooling and ventilation appliances. The storage of petrol has led to the outbreak of market fires. Plate IV indicates a market area where people sell petrol.

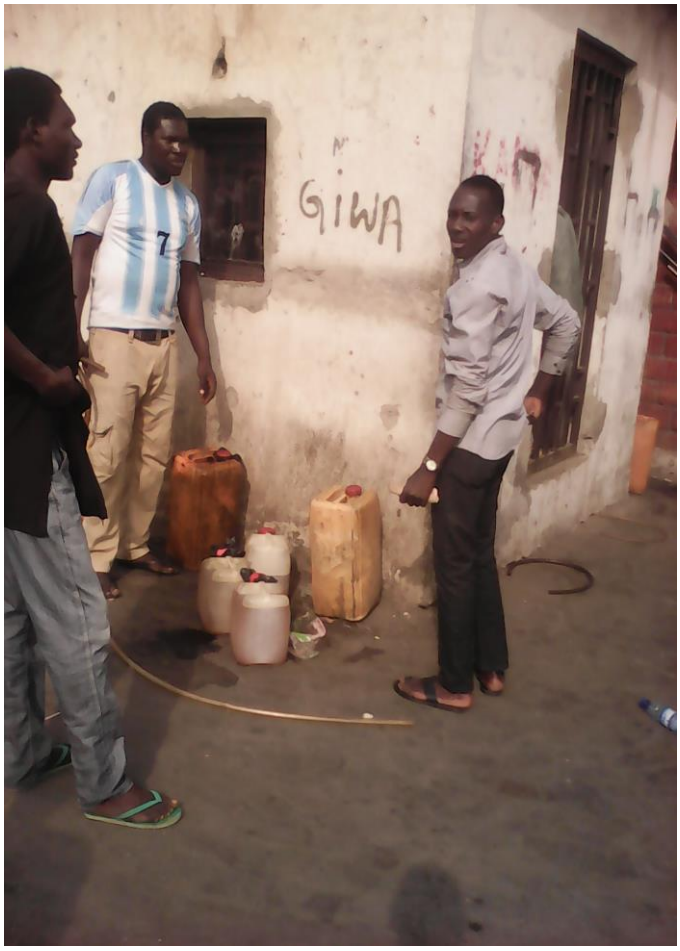

Plate IV. Area for the sale of petrol in Wuse Market.
(Source: Researcher's Field Work, 2018).

CONCLUSION AND RECOMMENDATIONS

The effects of plants on the environments of Wuse Market in Abuja, Federal Capital Territory of Nigeria, were architecturally determined to generate guidelines to improve the use of plants at the design stages of Nigerian markets in conjunction with the reduction of the related negative fire implications. The general results of this study indicated that most (92.12%) of the buildings in the market are not in possession of plants for landscaping as related to architecture; inadequate market plants have led to the reliance on the employment of personal generators of electricity for non-natural cooling and ventilation appliances, and one of the causes of fire outbreaks in the market is the use of electric power generators for artificial cooling and ventilation; people park cars very close to the personal electricity generators that are working due to inadequate car parking spaces in the market and inadequate plants to improve natural ventilation and thereby reduce the use of electricity generators to power fans and air-condition system, and this can lead to the fast spread of fire through the cars in times of fire outbreaks from the use of electricity generators; as a result of inadequate plants to moderate temperatures, people now sell and store petrol in the market to be used by electricity generators, in order to power appliances for artificial cooling and ventilation; the majority of market users (43.3% of traders and 47.5% of buyers) are very dissatisfied with market buildings in terms of the ventilation from plants.

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Thus, the guidelines as follows are provided to give an improvement to the use of plants at the stages of the design of markets in Nigeria in conjunction with the reduction of the related negative fire implications:

i. Architects should make sure that the design of buildings in the markets should possess adequate plants for landscape architecture, so as to gain natural cooling and ventilation, and to make sure that the users of markets are well satisfied with buildings in the market regarding ventilation from plants.
ii. It should be ensured by the architects that there are general power houses in the design of markets, where there will be general generators to power appliances for artificial cooling and ventilation in times of failure from public power supply, in order to supplement the natural cooling and ventilation from plants and to also reduce fire outbreaks in the markets as a result of indiscriminate use of personal electricity generators.
iii. It should be ensured by the architects that there are adequate car parking spaces in markets with respect to the expected human flow or capacity to stop people from parking cars close to the areas of electricity generators, in order to avoid possible fire outbreaks that can be generated from the generators and be transferred through the cars to the market buildings.
iv. Having ensured the general use of power houses in the design of markets by the architects, the management authorities of markets in Nigeria should ban the use of personal electricity generators to power appliances for artificial cooling and ventilation, in order to reduce fire outbreaks in the markets. This will also eliminate the selling and storing of petrol in the market to power personal electricity generators.
v. The management authorities of markets in Nigeria should ensure that people do not park cars very close to any designed power house to avoid the fast spread of fire through the cars, in case of fire outbreaks from the use of electricity generators in power houses.

RESEARCH GAP

Different types of plants and their spacing in the vicinity of buildings in the market to aid natural cooling and ventilation were not considered in this research; this is a gap in knowledge. Thus, in subsequent research of this kind, this gap should be filled or considered.

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