

GREEN BALCONIES AND TERRACES: A SOLUTION FOR CLIMATE CHANGE

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TABLE OF CONTENTS

| | |
|---|----|
| SUMMARY | 3 |
| RESEARCH QUESTIONS | 4 |
| INTRODUCTION | 5 |
| Literature review | 5 |
| Description of the problem | 6 |
| Importance of green balconies and terraces..... | 7 |
| Community impact of the project | 8 |
| MATERIALS AND METHODS..... | 9 |
| Survey of study area..... | 9 |
| Designing creative planting pots from recycled plastic containers | 9 |
| Equipment and materials..... | 9 |
| Procedure | 10 |
| RESULTS | 12 |
| Findings on our survey of buildings around Nyali area | 12 |
| Creative design of plant pots from recycled plastic containers | 14 |
| DISCUSSION | 15 |
| CONCLUSIONS..... | 15 |
| REFERENCES..... | 17 |

SUMMARY

Mombasa is the second largest city, located along the Indian Ocean in Kenya. It has a rapidly growing population; hence the increasing demand for housing and infrastructure. Due to this increase in demand, many buildings are being constructed to accommodate the increasing population needs. This has contributed to the clearing of more vegetation cover for construction in order to meet the population rise. Furthermore, most of the modern houses which have been erected do not have vegetation cover in their surroundings since the vegetation has been cleared. This increase in human activity within the city of Mombasa has greatly resulted to Urban Heat Island (UHI) effect. UHI is the increase in temperature within the cities as compared to the surrounding suburbs due to increased human activity.

This project aimed at investigating ways in which we can increase the vegetation cover within the buildings. This will help in purifying air and reducing the levels of temperature, hence contributing to climate change. Within this project, we reused and recycled plastic waste such as empty water and soda bottles, oil and detergents containers, among others. These materials were creatively designed into beautiful containers and were used for growing plants for the balconies and terraces of the many high rise buildings within Nyali area in Mombasa. Some of the plants included air purifying plants such as the snake plant (*Sansevieria laurentii*), spider plant (*Chlorophytum comosum*), English ivy (*Hedera helix*) among others. These plants help in purifying the air and reducing the effect of urban heat island.

We had 150 plants: 30 were used for demonstration and the rest given as donation during community awareness program. Some community members have started embracing green balconies. This will help to purify the air in the atmosphere and the impact of Urban Heat Island which contribute to global warming and climate change. The project also encourages reusing and recycling of plastic waste. This effect caused by clearing of vegetation to build more houses, has had a ripple effect across the county and the world at large. Climate change as a matter of great concern to the world has been aggravated by these human activities. This project is part of the mitigating measures to keep the temperature levels on check which mostly make the lives of Mombasa dwellers uncomfortable.

Key words: *urban heat island, green balconies and terraces, climate change*

RESEARCH QUESTIONS

1. Are there any “green” balconies and terraces in buildings within Nyali area of Mombasa County?
2. Can recycled material be designed to make planting pots to create green balconies and terraces?
3. Do green balconies and terraces help in purifying the air and regulating temperatures?

INTRODUCTION

Literature review

Climate change is one of the greatest concerns in the world today. In the 2021 United Nations Climate Change Conference (COP26) held in Glasgow from 31 October to 13 November 2021, climate change was the priority. The great focus was for all the countries to work together towards maintaining global warming at 1.5 degrees and dealing with climate impacts. The world's main aim to halve emissions and reach net zero carbon emissions will only be achieved if the global temperatures are limited to 1.5 degrees.

Factors that contribute to climate change range from human to natural causes. However, as pointed out by the European Commission Directorate-General for the Environment, (2009), the contributions of humans towards climate change are eminently visible as compared to the natural causes. This is evident all over the world through the various changes that are happening. Furthermore, according to U.S. Global Change Research Program et al., (2017) human activities contribute largely to climate change; approximately over 90% of the climate change has been accelerated by man.

Among these contribution by human toward climate change is the excessive production of greenhouse gases which has adversely brought more harm to the atmosphere. Human activities have in the years increased the concentration of

carbon dioxide (CO₂), methane, nitrous oxide fluorinated gases which are the main cause of the current global warming state.

Description of the problem

As the cities and urban center become more and more populated, the demand for houses has also increased resulting to clearing of more land to create room for construction. Moreover, expansion of industrial activities in the cities to accommodate the demand for jobs is no exception to indirectly contributing to climate change. The buildings in town and other erected structures have thus contributed greatly to the rise in temperatures and the effect of urban heat island which is largely experienced in Mombasa City. Over the years there has been a great concern by the residents of Mombasa on the increase in temperatures hence resulting to a lot of discomfort. Some residents have suffered excessive sweating, heat rashes, uncomfortable sleep among others. To deal with these problems, many buildings are fitted with fans and air conditioners to help ease the discomfort experienced by the residents. However, this does not help in addressing the rise in atmospheric temperatures as a result of global warming that is brought about by clearing of vegetation.

Importance of green balconies and terraces

There has been great initiatives by various institutions and organizations such as schools, public parks, hospitals and offices towards restoring the green spaces through introduction of grass lawns, flower gardens, trees and herbs along the pavement, most of which are aimed at bring the nature back to people (Wolch et al., 2014).

The aim of this research was to investigate whether green balconies contribute to reduction of the UHI. Most of the buildings in Nyali area in Mombasa County are storey and occupy very vast spaces. There are a few patches of trees and grass, however, much of the vegetation has been replaced by the buildings and other constructions. The Nyali area in Mombasa is largely dominated by residential houses, estates, business centers, learning institutions, recreational centres among others.

Our research project as part of mitigating measures to solve the problem of increased temperatures intended to find out how green balconies will contribute to regulating temperatures within the buildings. Moreover, the project contributed to adding aesthetic value to the balconies through reusing beautifully designed plastic materials as plant pots. This process of recycling and reusing plastic materials helps in reducing environmental pollution caused by dumping of such waste which when burnt contributes to production of greenhouse gases.

Community impact of the project

The purpose of this project was to exhibit how the balconies and terraces in the areas of residents and offices can be used to increase vegetation cover in the county. There has been minimal utilization of balconies and terraces, therefore transforming them into green space will be a step ahead towards regulating the temperature in the houses, as well as reducing the concentration of carbon dioxide in the atmosphere.

We intend to exhibit this project at our Junior School Academic Exhibition Day to be held on 12th March, 2022, with the hope of reaching out to our parents and the local community and encourage them to increase vegetation cover in their buildings.

From our survey, we observed that some families are already adopting our idea of green balconies using recycled material to grow their potted plants and flowers and placing them in balconies (Figure 5 in the Results section).

MATERIALS AND METHODS

Survey of study area

We observed the residential buildings around Nyali area in Mombasa to determine if there was any vegetation on them or if any were practicing balcony or terrace gardening. We also measured the atmospheric temperatures of balconies and terraces within some of the buildings that had potted plants and those that did not have plants (Table 1 in the results section). We used the GLOBE protocol (Surface Temperature) to measure the local ambient temperature around the area.

Designing creative planting pots from recycled plastic containers

Equipment and materials

The following materials were used during the project;

- Used plastic containers / bottles
- Used milk cartons
- Wood glue
- Office glue
- Cutting tools (scissors, knife, blades)
- Beads and glitters
- Wall paint (different colours)
- Brushes
- Turpentine
- Camera / Smart phone

Procedure

Step 1: Collection of plastic containers and milk cartons.

We collected the used milk cartons and different plastic containers and bottles.

We sorted the containers according to size and shape in order to get uniform and similar patterns during decoration.

Step 2: Planting and watering of the seedlings

We prepared a space within the school compound where we planted the seedlings in the milk cartons. Here we planted the air purifying plants which are suitable for balconies and terraces. (Figure 1).



Figure 1: Students planting and watering the seedlings in used milk cartons.

Step 3: Cleaning the containers

After sorting out the containers, we cleaned them ready for cutting and decoration (Figure 2).



Figure 2: Students cleaning the containers

Step 4: Marking, cutting and painting the containers

All the sorted containers were cut out into various designs and painted. We left the painted containers for 2 days to dry (Figure 3).



Figure 3: Students marking, cutting out and painting the containers.

Step 5: Decorating the containers

The painted containers were decorated using beads and glitters to improve their aesthetic value.



Figure 4: Students decorating the containers.

Step 6: Transplanting the seedlings into the containers

We later transplanted the seedlings into the decorated containers ready for placement in the balconies and terraces.

RESULTS

Findings on our survey of buildings around Nyali area

Our surveys of the Nyali area revealed that most of the buildings had bare balconies and terraces, and are also very close together (Figure 5). We also found out that some residents had made efforts to place potted plants in their balconies and terraces (Figure 6). We also observed the balconies with potted plants had lower temperatures as compared to those without (Table 1).



Figure 5: One of the apartments in Nyali, Mombasa with bare balconies.



A “green” balcony in a residential building in Nyali area.



Some recycled material used for planting.

Figure 6: “Green” balconies observed in a residential area in Nyali, created by using recycled material as pots for planting.

Table 1: Temperature recordings of some buildings with and without potted plants using the GLOBE Protocol (Atmosphere - Surface Temperature)

| Sample(s) | Temperature for balconies with potted plants. (°C) | Temperature for bare balconies (°C) |
|----------------|--|-------------------------------------|
| Sample 1 | 32.0 | 35.5 |
| Sample 2 | 32.0 | 35.7 |
| Sample 3 | 33.6 | 36.0 |
| Sample 4 | 33.0 | 36.1 |
| Sample 5 | 32.5 | 35.8 |
| Sample 6 | 32.4 | 35.7 |
| Sample 7 | 33.0 | 36.0 |
| Sample 8 | 33.1 | 36.1 |
| Sample 9 | 33.0 | 35.8 |
| Average | 32.7 | 35.80 |

Creative designs of plant pots from recycled plastic containers

We created a variety of plant pots using recycled plastic containers. We had different shapes, sizes and colours and had a lot of fun creating them! (Figure 7).

We created 150 plant pots in which we planted different air purifying and cover plants. Out of these 120 of them were donated to the community during the Green Balconies and Terraces for Climate Change Awareness Program.

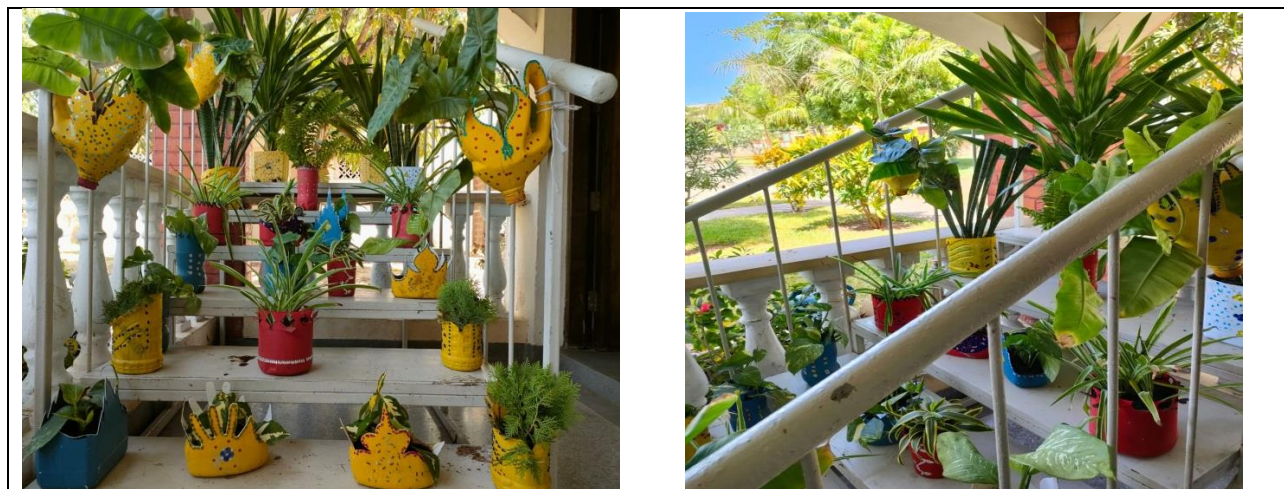


Figure 7: Creatively designed plant pots for balcony and terrace gardening.

DISCUSSION

Many of the balconies and terraces identified by the study were empty and did not have any plants on them. This shows that there is underutilization of the balconies and terraces. The empty balconies and terraces were relatively warmer as compared to those with some plants. This is an indication that increasing the plant cover in the balconies and terraces can help in making the places cooler, hence reducing the impacts of urban heat island.

CONCLUSIONS

The findings of our research have shown that human activities have greatly contributed to the climate change in the world today. The places identified by this study which did not have any vegetation cover had extreme temperatures which brought much discomfort; however, places with some plants around them had good air circulation. This explains why green balconies and terraces are necessary in regulating the temperatures as well as purifying the air.

Our study has also shown that it is possible to transform bare balconies to green balconies (Figure 8). This has been achieved before, in countries like Italy and China, and it is possible to achieve this in Mombasa city. This study will come in handy in creating awareness to the general community of Nyali and the world on the importance of vegetation towards restoring the planet Earth.

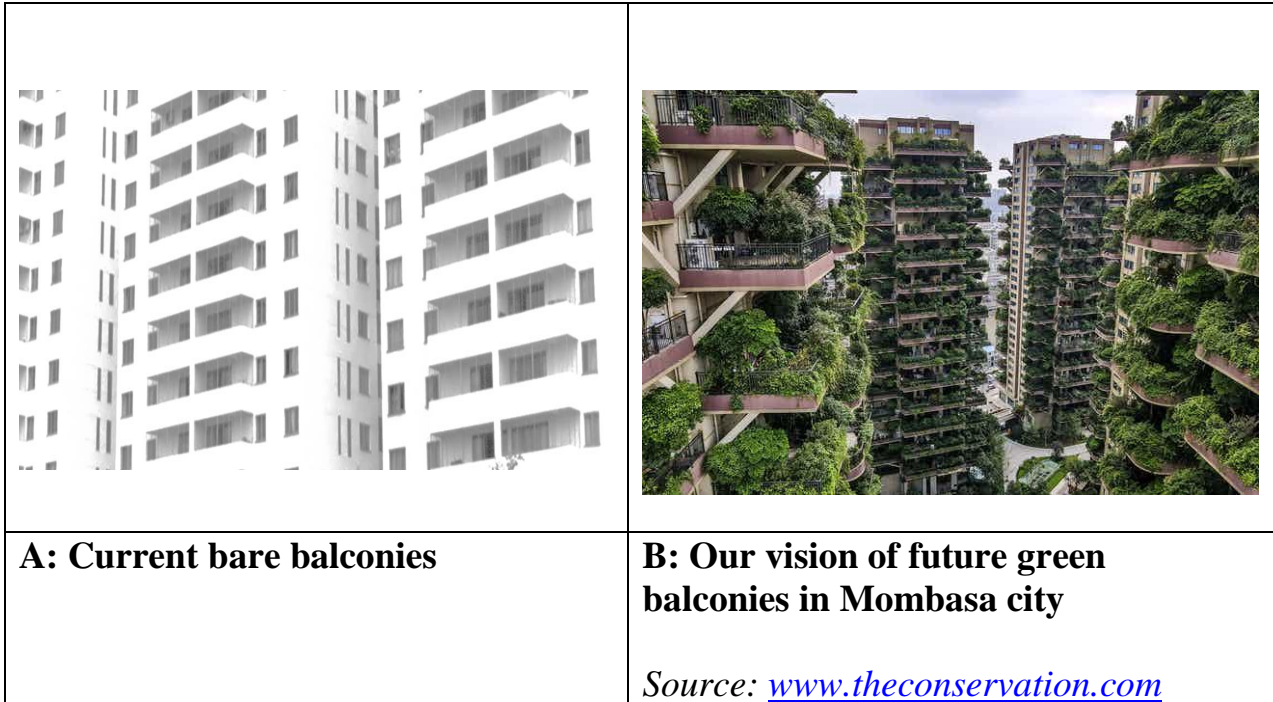


Figure 8: Our vision: engineering green balconies as a solution to global warming and climate change.

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