



## Pollution Absorbing Plant Design in Public Space Using Vertical Garden Method

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**Abstract.** Forest fires, waste smoke from industrial activities, carbon fumes from vehicles become serious problems for the environment and health in modern cities today. This study aims to describe and develop product design that utilize types of pollution-absorbing plants using the vertical garden method. The result of the product has a novelty value that offer great usage value for the problems that exist in the urban environment, especially on the problems of air pollution in big cities. The design process includes the following stages: problem formulation, data analysis, solutions, design development, and solution ideas through product sketches. This product design is expected to be placed in public spaces which accommodate a product with the “Green City” concept to have a significant impact on reducing pollution on urban streets.

**Keywords:** Product Design, Vertical Garden, Public Space

## INTRODUCTION

Air pollution is the introduction into the atmosphere of chemicals, particulates, or biological materials that cause discomfort, disease, or death to humans, damage other living organisms such as food crops, or damage the natural environment or environment (Shyam Bihari Sharma, et al. 2013). It will be a serious threat if we ignore this problem. Therefore, an action should be taken by creating some innovation that support a green and healthy environment. This invention should also help the society to be aware of the problems that are threatening the environment.

In Indonesia, air pollution is one of the main problems in every year. This problem occurs from the massive industrial activities, vehicle exhaust gas, deforestation, and many more. Based on the observation of Air Quality Live Index (AQLI), 91% of Indonesian citizen lives in an area where the air pollution level is above the safety level set by World Health organization with average concentration per year from air pollutant or Particulate Matter (PM 2,5) not more than 10 micron per meter cubic. However, the Coronavirus Pandemic all over the world include Indonesia change the mindset of the people and everyone starting to change into a healthier lifestyle. People tend to stay at their home and doing activities like gardening. A lot of people start planting decorative plants in the pandemic situation.

In this paper, the writer saw that there can be an innovation that can be applied based on the trend of planting decorative plants related to the problem of air pollution. The innovation can be made by using pollution-absorber plants and design it to be able to be placed in a narrow place. As big cities are congested by crowd and buildings, a vertical garden is an option to do this.

Patric Blanc from France was the pioneer of Vertical Garden. It is one of the answers for the air pollution problems. Global warming issues causing environment damage and the way people handle this situation is not good enough because the lack of awareness of this global warming issues. The Design of Vertical Garden could be a solution to build a proper garden in a limited space. Vertical garden is an agricultural method that utilizes vertical space. Vertical space is a potential land when horizontal space (land) is increasingly limited (Nada Radilla, et al. 2020)

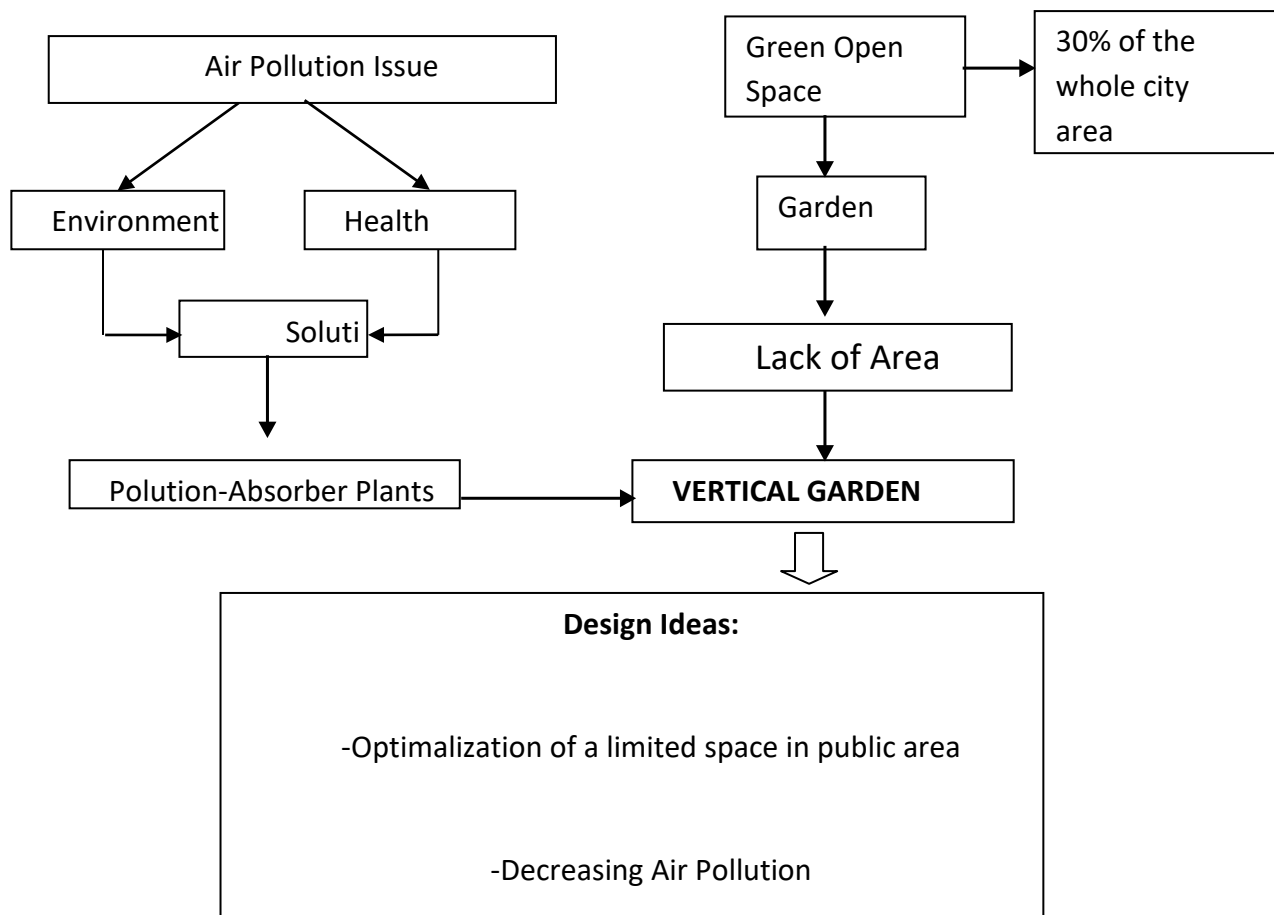
In general, vertical garden focus on the beauty of decorative plants. However, this study was highlighting the functional aspect of the plants as a media for absorbing air pollution. Some plants that can be used to absorb air pollution are Lily Flower, Bamboo Palm, *Aglaonema*, *Sansevieria*, and many others. Every plant has their own uniqueness. For example, *Sansevieria* which is very popular and affordable. It can grow in a lowlight area and only need a little amount of water. Importantly, this plant can absorb air pollution. Therefore, *Sansevieria* is one of the best options to be applied in

vertical garden method. This method is the way to adapt to the congested environment which need a pollution-free area. It is very important to create an innovation as a move to protect the environment. The process of designing Pollution-absorber vertical garden in public places is one of the solutions to protect our environment.

## METHOD

The method used in this study are literature review and survey that used to observe and monitor the needs and solution in the process of designing the product.

## Research Framework



## Ideas

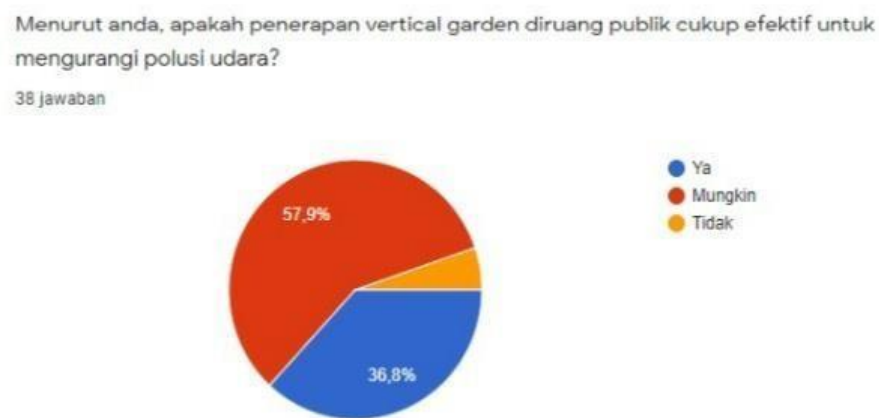
The idea grows based on the observation and experience that happen from some air pollution issues in the environment specifically in the public space around the city like roads, underpass,

offices, and any other public places. A solution then constructed based on the issues by designing pollution-absorber vertical garden.

### Data Collection

The data for the study was obtained by doing a literature review on some articles, journal, and projects. Meanwhile survey was done by doing an interview and discussion with lecturers and students.

To analyze the data collected from both literature review and survey, it can be seen in the diagram attached in the picture 2. From the diagram, it can be seen that the respondents felt the use of vertical garden in public space is effective enough in reducing air pollution. From 38 respondents, 57,9% thought it is possible for vertical garden to reduce the air pollution. 36,8% respondents thought vertical garden can reduce the air pollution while 6,4% of the respondents said that vertical garden did not affect the air pollution level.



**Picture 2.** Survey Result on the effectiveness of Vertical Garden in Public Places

## Analysis

- Problem : Air pollution (CO<sub>2</sub>) piled up the air and causing visibility issue
- Solution : Restoring green area and reducing the use of private vehicle. As shown in the picture 3 we can decrease the vandalism by using vertical garden.



**Picture 3.** Traffic Jam and Vandalism in the Underpass

Source: <https://jakarta.ayoinonesia.com/bodetabek/pr-7615090368/akses-menuju-cilebut-ditutup-lalu-lintas-di-underpass-jalan-sholeh-iskandar-macet>

### Underpass Wall:

- Problem : Vandalism toward underpass wall.
- Solution : Clean the wall and design the vertical garden to increase the artistic value of public place.

### Traffic Jam:

- Problem : Vehicle exhaust create air pollution that affect the air quality in the environment
- Solution : Construct a vertical garden that can absorb the air pollution so that it can increase the air quality of the environment.

## **RESULTS AND DISCUSSION**

### **Green Desain Analysis**

Emphasis the study to the design aspects in order to make the product acceptable both conceptuality and functionality of the product. Green Desain concept has an objective that in line with the government regulations in urban spatial planning which is focusing on restoring open public space in big cities. Green Design concept is an effort to enhance the aesthetic and marketing value of a place that effect to human as the user and also economical and health aspect in the cities (Bhat, V.N. (1993).

### **Sanseveria Analysis**

Sansevieria can absorb air pollutant and visually has an aesthetic value if placed in an area. Based on some study by NASA, this plant can absorb more than 107 dangerous pollutant elements in the air so that this plant is very potential to be applicated in vertical garden design where the product target is to be placed in open space that passed by vehicles. Nasa recommend to plant about 15-18 Sansevierias in a 6–8-inch container every 1800 feet square of an area.

### **Material Analysis**

Material Analysis was done to determine the suitable material to be used in the vertical garden design. In this design, material was focused in the design of bag system for the Sansevieria plant. The material used is geo-textile which has an attribute as a filter that prevent a material to contaminate other material layer so that it can increase the durability of the bag system itself. There also screen material which is used because it can cover the plant media. The dimension of the bag system in this vertical garden design is 180 x 180 cm as the length and height of the entire vertical garden is flexible based on the available area. Compost is also used as a material for the plant to grow from as it is easy to maintain.

## System Analysis

System analysis was conducted to determine suitable system for the component applied in the vertical garden design. The use of bag material and other same process need a good sewing process that can be use to connect and create bag system for the plants. Modular system of the bag can be one of the effective systems that applied in a limited area. The advantage of this modular system is that it can be customized to match the dimension of the area and the plants needed. Picture 4 shows the example of vertical garden.



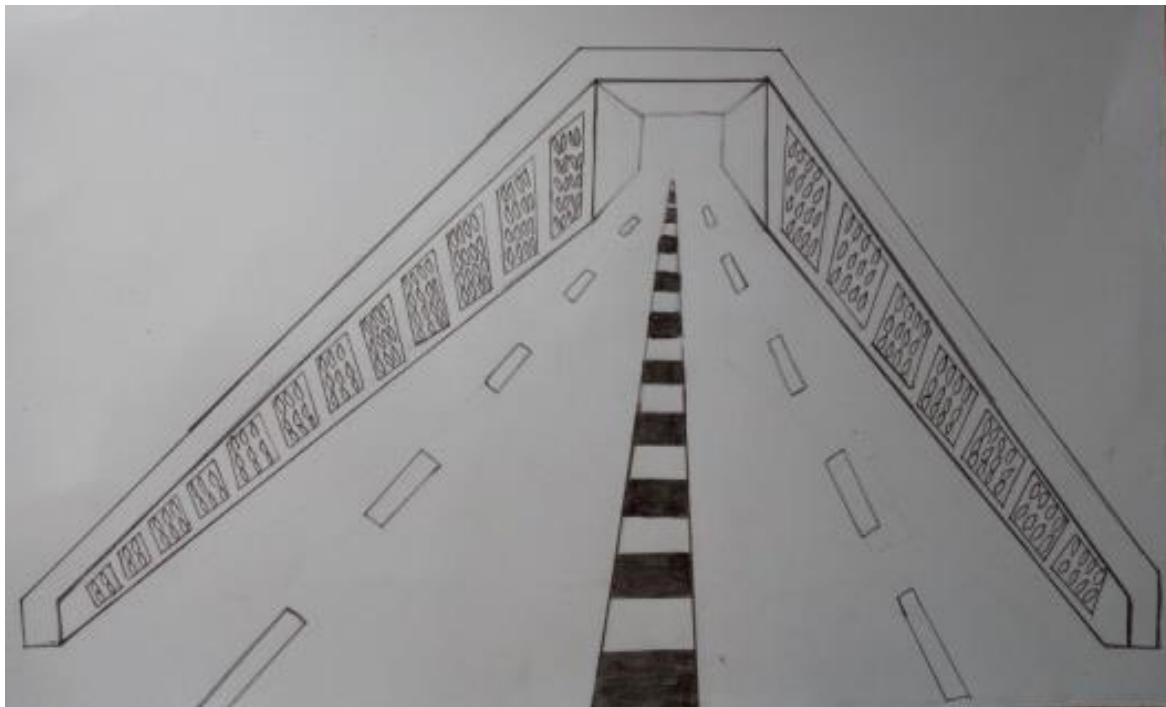
**Picture 4.** Example of Vertical Garden Plant's Bag System Configuration.

The process of Manual Sewing Bag System in the Vertical Garden Design:

1. Calculate the wall or object area where vertical garden design will be built. The bigger the area, the frame construction need to be bigger and stronger
2. Connect the frame of the vertical garden to the wall or object
3. Create a screen filter layer using geotextile to build the bag system with and give every bag some space depends on the size of the area.
4. Sew the bag using string in every reinforcement connection between the bag and the frame.
5. Insert irrigation pipe system and tied strongly to the string.
6. Insert the plants media (soil) to the bag system.
7. Plant the Sansevierias in the bags
8. Add some compost whether directly to the soil or through the irrigation system.
9. Vertical Garden Design is ready to use.

## Design Process

In a process of designing, there is some steps taken until the result is coming. The first step is taking problems research which determine the problems that should be discussed for the study. The situation then become the point where there is a need for an action to solve the problems. The next step is to analyze the needs and solution to solve the problems. Through literature review, observation and monitoring, this study finds out that there is a need to design a pollution-absorber vertical garden in the public place. The next step is decide the suitable plants that can be applied in the design of the vertical garden. Picture 5 shows the final construction of the vertical garden.



**Picture 5.** Final Construction of the Vertical Garden



## **CONCLUSION**

The design of Vertical Garden become one of the solutions to reduce air pollution in public places using the pollution-absorber plants like Sansevieria. Using Green Design Approach, vertical garden design applied modular system method so that it can effectively and efficiently used as an innovative way to support a healthy and pollution-free environment. Modular system design of the vertical design is also one of the solutions to accommodate green open space in a narrow space or area. This vertical configuration gives an efficient use of public space in big cities. It is also a good point because there are a lot of high vertical object in urban area that can be used for a vertical garden design.

There are still a lot of elements that can be improved in this design. Hopefully this design can inspire other researcher to create and improve this design to make it better. This design can be developed based on the need of the user. This design can contribute to the environment by reducing the air pollution and become a filter for the air in the cities that can significantly make a healthier environment.

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