Q&A: Growing African vegetables on buildings can save space and feed cities—new study

November 6 2023, by Karen Botes

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As cities grow, more people need food. However, space for farming is limited in cities. Building facades can offer a solution for growing food.

We asked landscape architect Karen Botes to tell us about her research—cultivating traditional African vegetables on walls.

What are 'living wall systems' and why did you study them?

Living wall systems are vertical growing platforms which usually form part of a building façade. Some are continuous, others modular.

Continuous systems are lightweight screens with pockets that can contain wet felted substrate layers, or rock wool, for the plants to grow in, or the plants' exposed roots are kept wet with nutrient-rich fluids. An example of a continuous system is hydroponics.

Modular living wall systems are irrigated plant trays or pots containing soil and fixed onto a supporting structure on the building's vertical surface. Modular systems are widely used because they make an immediate aesthetic impact. The plants are pre-grown offsite and individual plants are easily replaced.

To learn more about which modular living wall systems work best, I compared two during the 2021/2022 growing season in Pretoria, South Africa. My six-month study also compared traditional African vegetable crops with a mainstream crop.

What are the benefits of living walls?

Benefits of living walls include food production, biodiversity, cooling, air purification and noise reduction. They also have aesthetic value and are known to reduce stress and improve productivity and well-being.

When households grow edible crops in living walls, it reduces the

environmental impact of food because it doesn't have to come from far away. And it reduces waste. Growing vegetables has also been found to encourage urban gardeners to eat a more balanced diet in Honduras, Japan, Australia and elsewhere.

I'm interested in whether living walls with traditional African vegetables could improve local household food production and contribute to dealing with climate change, urban heat islands and urban microclimates.

What did you discover in your study in Pretoria?

The study compared the performance of traditional African vegetable crops in two types of living wall system, the Vicinity wall and the Eco Green Wall, in terms of crop yields and health.

The Vicinity wall is an all-in-one system, with water tanks at the bottom, a pump and a filter. The top row of pots is drip irrigated and the water gravitates into each row, before circulating back to the top row. The Vicinity pots are clipped onto an aluminum rail fixed to the building.

The Eco Green Wall comprises interlocking, lightweight blocks made out of recycled polystyrene aggregate-and-cement mixture, and plant pots with a soil volume of roughly 1.5 liters. It is designed with economic feasibility and sustainability in mind.

I compared the living wall systems' performance to traditional soil-based agriculture. Variables included minimum and maximum daily temperatures, relative humidity, precipitation, soil temperature, water content and electrical conductivity, leaf biomass yield and plant stress.

The study found that local production of the living wall components reduced their cost and carbon footprint.

Low technology that requires basic assembly, and a basic irrigation system to limit dependency on electricity and water, can enhance performance.

An appropriate plant selection can further improve the living wall's resilience, feasibility and sustainability. The study identified seven traditional African vegetable species suitable for household food production in living wall systems: creeping foxglove, Indian borage, jute plant, pink ribbons, water mint, dwarf elephant's food and black-eyed pea.

How feasible is it? What are the biggest barriers?

Building facades make up roughly double the area of building footprints in urban areas. This means that walls have more potential for local food production than traditional soil-based urban agriculture. They also have environmental benefits.

But the efficiency, resilience and sustainability of current living wall systems have been questioned globally and need improvement.

- They are costly to install and maintain.
- They seldom provide optimal conditions for plants to flourish.
- They rely on electricity and water.
- Some systems require specialized skills and technology.

What could make it work for cities on the continent?

Sun exposure of plant pots should be limited so that the soil doesn't get too hot. The Eco Green Wall system is an example where sun exposure is limited and the structure protects the crops.

Pots need to have at least three liters of soil with a depth of 200mm. This increases yield and reduces plant stress. The soil must be lightweight and meet the plant's requirements. Aeration, texture and drainage must be right. The pots' drainage holes must limit blockages.

A drip or wick irrigation system for each plant level reduces maintenance and increases resilience.

Selecting traditional African vegetables increases the feasibility and resilience of crop performance. These crops can tolerate sub-Saharan Africa's harsh climate conditions.

Traditional African vegetables also have a high nutritional value, don't need much irrigation or chemicals, and are resistant to disease.

These vegetables prefer full sun and no frost. Well-drained, aerated potting soil that allows for movement of air, water and nutrients works well for them. They require moderate irrigation.

The system should be positioned to avoid possible contamination of crops by polluted environments. It must be orientated to provide efficient sun exposure for the selected plants.

So, are living wall systems worth considering to grow vegetables?

I concluded from my research that growing traditional African vegetables in modular living walls saves space compared to standard soil-based food production on a household scale. Considering the horizontal footprint area occupied in terms of yield per square meter, living wall systems with larger pot volumes produced over four times the yield of conventional soil-based agriculture. And they use space that would

otherwise not have been used productively.

I also concluded that outdoor modular living wall systems with selected traditional African vegetable crops might be one way of improving food security and urban environments in sub-Saharan Africa.

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