Increasing Nutrition Security with Vertical Gardens – Testing Different Systems for Vegetable Production

Sahrah Fischer[1], Saskia Grünwasser[2], Bastian Winkler[3], Thomas Pircher[4], Christine Lambert[5], Thomas Hilger[1], Georg Cadisch[1]

1: Institute for Institute of Agricultural Sciences in the Tropics (Hans-Ruthenberg-Institute), University of Hohenheim; 2: Nürtingen Geislingen University (HfWU), Nürtingen, Germany; 3: Institute of Crop Sciences, University of Hohenheim, Stuttgart, Germany; 4: Research Centre for Global Food Security and Ecosystems (GFE), University of Hohenheim Stuttgart, Germany; 5: Institute of Biological Chemistry and Nutritional Science, University of Hohenheim, Stuttgart, Germany

INTRODUCTION

- Producing and consuming nutrient rich foods is vital for food and nutrition security, as well as human health.
- The hotspot of vegetable production for households in smallholder farming systems of Sub-Saharan Africa are home gardens
- Home gardens are often limited in size and may feature soils of poor fertility
- Vertical garden systems are tested in their ability to produce local green leafy vegetables in Kapchorwa, Uganda to expand the surface area of the home garden and increase vegetable production

Figure 2: Bucket system consisting of four buckets per tower, one filled with water followed by one filled with soils. Drip irrigation possible through small holes in the bottom of the water buckets. Source: Saskia Grünwasser

RESULTS

- Both the planting tower and the second wall showed significantly higher vegetable yields (g) than the bucket system for all vegetables cultivated
- The wall was the most efficient when regarding yield/m^2
- No significant differences could be found between north and south direction
- Field peas did not yield due to a lack of rain, but all green leafy vegetables produced a yield (trial was during a drought season)

Table 1: Mean Yield ± Standard Deviation in grams per m^2 growing space per species and total grams leaves harvested for consumption.

	Nightshade		African Spinage		Collards	
Type	Yield (g/m^2)	Yield (g)	Yield (g/m^2)	Yield (g)	Yield (g/m^2)	Yield (g)
Wall	70.5 ± 34	22.5 ± 11	52.3 ± 47	25.2 ± 11	100.9 ± 64	32.3 ± 21
Tower	21.6 ± 5	30.4 ± 7	50.6 ± 51	28.6 ± 11	22.9 ± 15	32.3 ± 21
Bucket	33.9 ± 18	8.8 ± 5	60.8 ± 41	22.8 ± 13	58.1 ± 39	15.1 ± 10

CONCLUSIONS

- **Vertical Gardens are a viable possibility to improve food and nutrition security in rural households**
- **Focus on recyclable materials worked well**
- **More research can be done on irrigation techniques to extend the season**
- **More research needed on multiple season cultivation effects on yield**

Figure 1: Second wall, built emulating a house wall. The main materials are sticks and sacking. Moisture is distributed evenly through a cotton cloth stretched through the centre of the system. Source: Saskia Grünwasser

METHODS

- Three systems developed using recyclable materials: the second wall (Fig.1), bucket system (Fig.2) and planting tower (Fig.3) with different irrigation systems: cotton cloth, plastic tubes, and drip irrigation
- Six systems (two of each of the three) were set up in each location with three facing north and three facing south
- Soil temperature and moisture was measured using Meter EM50 sensors
- Four local vegetables were tested field peas (*Pisum sativum* L.; Fabaceae), African spinach (*Beta vulgaris* spp.; Amaranthaceae), black nightshade (*Solanum nigrum* L.; Solanaceae) and collard greens (*Brassica oleraceae* L.; Brassicaceae)

Figure 3: Planting tower, built emulating a granary in the area. The main materials are sticks and sacking. Water distribution is provided through three large plastic tubes with holes filled with cotton cloth and gravel in the middle of the system. Source: Saskia Grünwasser

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727715

Gefördert durch: Bundesministerium für Ernährung und Landwirtschaft aufgrund eines Beschlusses des Deutschen Bundestages