

Greenhouse Farming
Of Vegetables And Its
Contribution To Urban
Food Security And
Farmers' Wellbeing: A
Case Study Of Dar Es
Salaam, Tanzania

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ABSTRACT

The food insecurity facing urban areas in Tanzania has led to the introduction of greenhouse farming in the country. This technology has the potential to contribute to food security and to improve people's wellbeing, particularly in urban areas. This paper examines greenhouse farming and its contribution to some urban dwellers' food security and wellbeing. A total of 50 farmers were selected in Kinondoni District using random sampling techniques. Data were collected using qualitative and quantitative methods. The study found that the farmers generated income from farming vegetables. The income was used to boost the wellbeing of their family members. Indeed, they used to meet educational expenses, business investment; carter meet medical expenses and recreational activities. Greenhouse farming contributes to food security, since it increases the production of food, which is highly needed in urban areas, ensures constant supply of food, improves the nutritional level of family members and generates additional income for household members. Therefore, the study recommends that the government should advocate greenhouse farming in urban areas. Additionally, greenhouse farming is an environmentally-friendly technology which can be used in most urban areas to ensure food security among urban dwellers.

Keywords: Urban agriculture, greenhouse farming technology, food security and wellbeing

1. INTRODUCTION

The term greenhouse refers to a structure which is heated artificially and is covered with transparent material for the purpose of admitting natural light for plant growth (Smitha *et al.*, 2016). Through this technology, crops may be grown under a controlled environment throughout the year. Four to five crops may be grown because of the availability of the requisite environmental conditions. This may increase productivity and ensure that quality products are produced. It also leads to efficient use of various types of input, for example water, fertilizer, seeds and plant-protection chemicals (Wambui, 2015).

The origin of the greenhouse farming (GHF) technology can be traced back to 600 BC. The technology started in the Netherlands and England in the 17th century. It was first developed by Charles Lucien Bonaparte, a French Botanist who constructed the first practical modern greenhouse in Leiden and Holland for the purpose of growing medicinal tropical plants (Bowery, 2017). The technology is now used in more than 130 countries in the world which are commercially involved in vegetable production. The size of the area covered is estimated to be 497,815 hectares. The hydroponic or soilless greenhouse system accounts for about 100,000 hectares of the total world area (Hickman, 2018).

Of the countries which have adopted the technology, Turkey has been recognized as one of the leading greenhouse-producing countries in the world. In Turkey GHF is used to grow vegetables. The technology is influenced by the climatic conditions as well as the socio-economic environment of an area. Jensen (2002)

observed that between 1997 and 1988 GHF was adopted by other developed continents such as Northern Europe. It later spread to other areas such as the Mediterranean region, North America, Oceania, Asia and Africa. In sub-Saharan Africa, the GHF technology has recently been adopted in countries such as Kenya because of the scarcity of land and water (Baudoin *et al.*, 2017). In Tanzania, GHF technology is one of fast growing technologies used in horticulture production in urban and peri-urban areas. As the population continues to grow, then more agricultural land is being taken up by urban development, thus GHF plays an important role in enhancing food security (FAO, 2019).

GHF can contribute the country to achieve Sustainable Development Goal (SDG) seven, which is to eradicate extreme poverty in the country by increasing food security among rural and urban dwellers because greenhouse farming is one of the sustainable agricultural practices. It complies with Tanzania's agricultural policy. GHF has been touted as an activity that could help the country attain food sufficiency by solving its persistent food problems. Food security is critical to economic growth and to the development of a nation (Akanji, 1999). As suggested by Gerald *et al.* (2009), if the current trends in population growth and the distribution of wealth continue, 10-20 percent of people may be at the risk of hunger by 2050. Parry *et al.* (2009) add that climate change will alter the availability of water, affect the spread of pests and disease, shift crop distribution and negatively impact specific crop yields in developing countries. The development of GHF techniques generally resulting in overall food security for the whole world and helping to reduce hunger.

GHF is a sustainable practice that help to meet the current and long-term food needs of the society, while at the same time maximizing the net benefits through the conservation of resources (Rao and Rogers, 2006). However, only a few studies have been conducted on GHF in Tanzania. Most of the studies concentrated on greenhouse gas emissions. Consequently, there is inadequate information on the contribution of GHF to farmers' wellbeing and to food security in urban areas. Therefore, this paper examines the contribution of GHF to farmers' wellbeing and to food security.

2. METHODOLOGY

This study involved farmers from Kinondoni District in Dar es Salaam Region. The district was chosen because it is one of the districts in which the GHF technology is used to produce horticulture. In addition, the region is populated with more than six million people, half of whom live in Kinondoni District (URT, 2012). Kinondoni District has 27 wards, out of which three, which represent 10% of all the wards, were purposefully selected. The selected wards were Makongo Juu and Mikocheni with a total of 58 farmers using greenhouse technology as identified by TARI (2021). Cochran's (1977) correction formula for adjusting the sample size for smaller populations (ones whose 5% is less than 384) was employed to get sample size as follows:

$$n = \frac{\text{sample size for any infinite population size, i.e. 384}}{(1 + (\text{sample size for any infinite population size}/\text{population size}))} = \frac{384}{(1 + (384/N))} =$$

$$n = \frac{384}{(1 + (384/58))} = 50$$

A total of 50 respondents who engaged in greenhouse farming were randomly selected using lottery method where the list of farmers were coded in a paper which sliced into 58 pieces, folded and put into a container and loitered to get 50 farmers from the aforementioned wards. Moreover, the key informants, officers from Tanzania Agricultural Research Institute (TARI), were also purposefully selected, since they were installing the greenhouse technology in the region.

Both qualitative and quantitative data were collected. Quantitative data were collected using a semi-structured questionnaire comprising open- and closed-ended questions. Qualitative data were collected using in-depth interviews with the selected key informants in order to supplement the information which was not captured well using the questionnaire. All in-depth interviews were conducted in Kiswahili, the national language and the language understood by most Tanzanians. The interviews were audio-recorded.

2.1 DATA ANALYSIS AND INTERPRETATION

The collected quantitative and qualitative data were analyzed statistically and contently respectively. The analysis involved checking the data carefully for errors and accuracy, and identifying and handling missing values. Checking the data for accuracy related to the legibility and completeness of the responses. Qualitative data were analysed using deductive and inductive strategies through three main steps; preparing and organising the data, creating categories/themes, and coding, presenting and interpreting the data. Quantitative data were edited, coded and entered into the Statistical Package for Social Sciences (SPSS) software to obtain descriptive statistics such as frequencies, percentages and means.

3. RESULTS AND DISCUSSION OF FINDINGS

3.1 AGE AND EDUCATION OF RESPONDENTS

The findings reveal that 12% of the respondents were aged 41 and above, 36% were aged between 21 and 30, and the rest (52%) were aged between 31 and 40 (Table 1). The findings also show that 76% of the respondents had tertiary education and that 24% had secondary school education (Table 1).

Table 1: Respondents' Profiles

Respondents' profile	Frequency	Percentage
Age:		
21-30	18	36
31-40	26	52
41+	6	12
Total	50	100

Education level		
Secondary	12	24
Tertiary	38	76
Total	50	100

Generally, the findings reveal that the majority of urban farmers who practice GHF are adults with secondary school education and/or higher education. This suggests that the people practicing GHF are well-informed. That is why they have selected a more appropriate farming technology, which is friendly to both the user and the environment. These findings are similar to the findings of studies conducted by Deressa *et al.* (2009), Moges and Taye (2017) and Uaiene *et al.* (2009). These scholars found that a higher level of education was positively associated with the uptake of agricultural technologies.

3.2 CONTRIBUTION OF VEGETABLE PRODUCTION USING GREENHOUSE TECHNOLOGY TO FARMERS' WELLBEING IN URBAN AREAS

In order to find out the contribution of GHF to farmers' wellbeing, the study looked at the amount of money earned from selling vegetables. Most of the respondents (40%) said that they earned between two and three million shillings a month, at the time of harvesting their vegetables. However, 4% of the respondents earned more than four million shillings a month (Table 2).

Table 2: Income Generated from Greenhouse Farming

Monthly Income (TZS)	Frequency	Percentage
100, 000 - 1, 000, 000	5	10.0
1, 100, 000 - 2, 000, 000	15	30.0
2, 100, 000 - 3, 000, 000	20	40.0
3, 100, 000 - 4, 000, 000	8	16.0
≥ 4, 100, 000	2	4.0
Total	50	100.0

Source: Field Data, 2019

Talking about the amount of money earned, one respondent said, "I was earning one million or two million shillings a month by selling tomatoes and bell papers (green & red) to supermarkets and individual clients". This finding echoes the findings of a study conducted by Dutta and Sen (2013). They observed that GHF generated a high income for farmers, which helped them to have food security.

Most of the crops grown are those which are in high demand. This is the result of the fact that the vegetables cultivated grow very fast. This finding is consistent with the findings of Wambui (2012), who found that the crops cultivated using the greenhouse farming technology in Kenya include tomatoes, bell papers and lettuce because they are in high demand.

3.3 USE OF THE INCOME GENERATED FROM VEGETABLES CULTIVATED THROUGH GREENHOUSE FARMING

The income was used to make further investments (25, 50%), pay school fees (18, 36%) and engage in recreational activities (02, 04%), as shown in Figure 1.

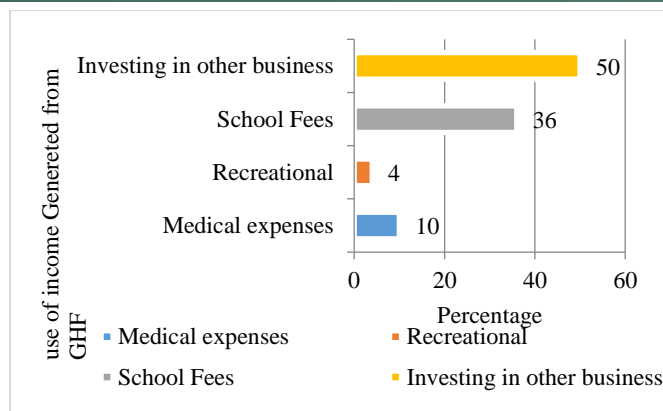


Figure 1: Use of the Money Obtained from Greenhouse Farming

Although Dubbeling *et al.* (2010) observed that the urban agriculture done in a controlled environment is mainly for food production, this study has established that the income earned from greenhouse farming is invested in other businesses and that it is also used to meet educational and medical expenses, and to engage in recreational activities, which improve the farmers' wellbeing. This is supported by Mok *et al.* (2014) and Orsini *et al.* (2013), who note that greenhouse farming improves food supply and health conditions, boosts the local economy and conserves the environment.

3.4 PERCEPTION OF GREENHOUSE FARMING AND FOOD SECURITY

3.4.1 FOOD ACCESSIBILITY

GHF contributes to food accessibility since the vegetables as cultivated increases the physical and economic accessibility to food. GHF increases access to farmers and the surrounding community to fresh and nutritional food. Thus the study found out that the main aim of 78% of the farmers was to obtain food and income (Table 4). Through cultivation of vegetables, farmers could have physical access to food especially the vegetation, at the same time they could get income by selling part of their surplus products and be able to buy other food stuffs which they could not produce and thus ensuring food security. The study is more similar or less to what has been observed by Onyango (2010) in South Africa as he identified that urban agriculture especially using GHF enhances food accessibility to the families which could be consumed at their family level and some of it being sold hence saving money for use on other livelihood obligation.

3.4.2 FOOD AVAILABILITY

The cultivation of vegetables using GHF technology increases the availability of fresh vegetables, health and affordable food to the farmers and the nearby residents who purchased it in the local near supermarkets. When the issue of availability was investigated 70% acknowledged the fact that they were able to consume vegetables which harvested in their greenhouse throughout the year (Table 4). When the study went further in studying the surrounding local super markets they acknowledged that they obtained their vegetables from the green house farmers. The findings obtained are in line with the study conducted by Yihedego *et al.* (2009) who

asserted that the urban farmers who are using GHF are able to satisfy their food needs and supply the market with the surplus.

3.4.3 FOOD STABILITY

The use of GHF in vegetable production in urban area becomes an important for food stability. The findings obtained from this study shows that 78% of the respondents affirmed that the vegetables produced could either be used at household or sold of which the money obtained could be used to purchase other food stuffs (Table 4). During the focus group discussions with the greenhouse farmers it was revealed that greenhouse farming contributes to the availability of the food since it does it ensures constant supply of food since it depends much on from water irrigation from river streams, bore holes thus ensuring constant supply throughout the year as opposed to other farming system.

3.4.4 ABILITY TO GAIN NUTRITIONAL STATUS

The use of GHF enabled the urban farmers to gain to improve their nutritional status by improving the health of urban farmers as it was explained by 90% of the respondents who agreed that the availability of vegetables improves their nutrition status. This fact was also supported through focus discussion where the members acknowledged to have more than two meals per day which has vegetables (Table 4). The findings are similar to the findings of a study conducted by Orsini *et al.* (2013) who found that, the urban production of horticulture using the GHF technology has a significant contribution to nutrition and food security in developing countries as it stimulates the consumption of the crops cultivated, increases the income of individuals and improves the nutritional security of people.

Table 4: Greenhouse Farming and Food Security

Statement	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Farmers produce a variety of vegetables	29 (58) ¹	10 (20) ₁	2 (4) ¹	9 (18) ¹	0 (0) ¹
It increases food production	36 (72) ¹	14 (28) ₁	0 (0) ¹	0 (0) ¹	0 (0) ¹
It improves the health of household members because vegetables are available	17 (34) ¹	23 (46) ₁	2 (4) ¹	3 (6) ¹	5 (10) ¹
The irrigation of plants helps to ensure that there is a constant supply of food	25 (50) ¹	19 (38) ₁	1 (2) ¹	5 (10) ¹	1 (2) ¹
Vegetables are available throughout the year	35 (70) ¹	10 (20) ₁	2 (4) ¹	3 (20) ¹	1 (2) ¹
Money is obtained from selling the vegetables	18 (36) ¹	12 (24) ₁	16 (32) ¹	4 (8) ¹	0 (0) ¹
To get food and income	39 (78) ¹	9 (18) ¹	2 (4) ¹	0 (0) ¹	0 (0) ¹

()¹ = Percentages

Source: Field Data, 2019

The cultivation of a number of crops on a single farm protects farmers from the uncertainties associated with single crop production and increases the quality and quantity of crops so as to meet the demand of the market. The study sought to find out the extent to which GHF influenced food security in the area where it was conducted. When the respondents were asked about the type of crops they cultivated, they said they mostly grew tomatoes (16, 32%), followed by bell papers (14, 28%) and finally cucumbers, vegetables and French beans, which accounted for 20% (Table 5).

Table 5: Types of Crops Cultivated

Types of Crops Cultivated	Frequency	Percentage
Tomatoes	16	32.0
Cucumber	10	20.0
Bell papers	14	28.0
Vegetables	04	08.0
French beans	06	12.0
Total	50	100.0

Source: Field Data, 2019

4. CONCLUSION AND RECOMMENDATIONS

4.1 CONCLUSION

Urban farming using the GHF technology ensures the availability and accessibility of affordable food. The technology also improves food and nutritional security, in addition to improving farmers' livelihoods through the income generated. This means that urban GHF should not be seen as being complimentary to rural agriculture, but rather it should be seen as an important contributor to food security in urban areas. In order to promote GHF effectively in urban areas, there is a need to factor in the needs of farmers when government policies on agricultural activities are being developed.

4.2 RECOMMENDATIONS

In the light of the results presented above, the paper recommends that public and private institutions should provide train to people (especially the unemployed youth) in greenhouse construction and maintenance so that they can use the knowledge to engage in agricultural production. Moreover, the public should be enlightenment on the benefits of GHF so that they can adopt the technology.

Lastly, the Government should provide support and incentives to people so that they can use GHF technology to produce adequate food and thus help ensure food security in the country.

5. COMPLIANCE WITH ETHICAL STANDARDS

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5.2 DISCLOSURE OF CONFLICT OF INTEREST

The author has no any conflict of interest for publishing this paper.

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