



Status and scope of kitchen gardening of green leafy vegetables in rural Tanzania: implications for nutrition interventions

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Abstract

Kitchen gardens in Tanzania are currently facing a variety of threats. However, many households depend on basic farming activities to meet household food needs. The objective of this study was to describe the current status and scope of kitchen gardening for improving the food security situation in the Morogoro and Dodoma regions of Tanzania. A cluster sampling method was used to select 383 households. The main respondents were mothers or caregivers responsible for food preparation. Techniques for data collection were observations, focus group discussions and face to face interviews. A small proportion (2.6%) of residents in the semi-arid Dodoma region had a kitchen garden as compared to the sub-humid Morogoro region (9.9%). Sweet potato leaves, cassava leaves, pumpkin leaves, cowpea leaves and African egg plant were the principal vegetables grown in the two areas. The market provided vegetables to 87% of the surveyed households. Vegetables sold at the market were mostly in the dried form, fresh vegetables in the market being those cultivated near ponds, especially during dry seasons. About 90% and 55% of the kitchen garden produce was used for home consumption in Dodoma and Morogoro, respectively. Women contributed 80% and 75% of the total labor for managing kitchen gardens in Dodoma and Morogoro, respectively. Socio-cultural factors (food habit and demand and supply of food materials), environmental factors (climatic factors, water availability), types of soils and farmers' local knowledge and understanding (traditional knowledge and practices, formal and non-formal education) were the key determinants of vegetables grown in the traditional kitchen garden. Kitchen gardening was practised by few of the surveyed households and the diversity of the planted vegetables was low. Factors that influenced the presence of a kitchen gardens at household level were: sex of the household head ($p = 0.002$), literacy status of the mother/caregiver ($p = 0.001$) and the education level ($p = 0.001$) of the respondent.

Keywords Kitchen gardening · Vegetables · Climate change adaptation · Coping strategies · Agricultural innovations

1 Introduction

Hunger has remained at the top of the global agenda for decades, despite many global, regional and country level strategic efforts to eradicate it (Ki-Moon 2013; Roosevelt 2001; UN

2009). The global population is growing at a rapid rate and is expected to reach over 9 billion by 2050 (Ghanem 2010). The need to feed the continually growing population is crucial. It has been projected that average daily energy need could reach 3050 kcal per person by 2050 requiring global food production to increase by 70% (Grofova and Srnec 2012). Among all people, those of developing countries are suffering from chronic food insecurity at a higher rate than others (FAO 2014). Developing countries, where hunger and food scarcity is endemic, are trying various counter strategies to meet the growing demand and to avert food insecurity and famine (Galhena et al. 2013).

Currently, nutrition improvement initiatives are giving priority to interventions that support introduction and scaling up of nutritionally sensitive interventions (Ruel and Alderman 2013). The need for interventions and innovations in agriculture is further stressed by constraints in available resources for food production, such as land,

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water, health, education and credit, as they are increasingly scarce and costly. Growing issues of climate change and natural resource degradation further drive the agenda for agricultural innovation that will help to address these challenges (Somers and Stapleton 2014).

There is a growing interest by governments and international organizations in strengthening and intensifying local food production in order to mitigate the adverse effects of global food shocks and volatility of food prices (Galhena et al. 2013). This has resulted in increasing interest in kitchen gardens as a strategy to enhance household food security and to improve nutrition. A kitchen garden is an integrated system which comprises the family house, a recreational area and a garden, producing a variety of foods including vegetables, fruits and medicinal plants for home consumption or sale (Galhena et al. 2013).

The greatest struggles related to kitchen gardening in other countries have been a low appreciation of their role, climate adversities, water scarcity and limited knowledge of their management (SDSN 2013). However, kitchen gardens are a feature of local food systems and the agricultural landscape of developing countries all over the world. They have stood the test of time and may help to alleviate malnutrition (Galhena et al. 2013). Essentially, kitchen gardens are an important factor in improving food security, nutritional status and household income (SDSN 2013). Kitchen gardens have been associated with improved dietary diversity scores, greater consumption of vitamin A rich fruits and vegetables, pulses, other fruits and vegetables, and improved complementary food availability (Girard et al. 2012).

Kitchen gardens affect nutrition through changes in household food production and consumption, maternal and child intake of target foods and micronutrients, and increase overall dietary diversity of rural low-income households (Ruel and Alderman 2013). In addition, although kitchen gardens may not directly supply cereals to the family, they may do so indirectly by using the savings achieved by not having to buy fruits and vegetables (Njuguna 2013). One study showed a 40% increase in the number of households with an improved Food Consumption Score (FCS), and a 30% increase in the number of households with an improved Household Dietary Diversity Score (HDDS) following a 3 year intervention in kitchen gardens for people living with HIV in Zimbabwe (Puett et al. 2014). Kitchen/home gardens have been found to play an important role in improving food security for the resource poor rural households in developing countries such as Bangladesh (Commission on Sustainable Agriculture and Climate Change 2012). In addition to supporting dietary needs, kitchen gardens help to conserve biodiversity as well as integrate the younger generation into community norms (Njuguna 2013).

Positive factors that influence the presence of a kitchen garden at a household include: proper care of the garden area, use of fertilizer and irrigation with enough water (Mohsin et al.

2017). Others are support from local government (staff, gardening specialists, extension officers and local organizations), integration within the school curriculum, a supportive and inclusive environment (i.e. all children can participate), connection with cultural heritage and local foods, a garden committee, and links with the wider community (Ohly et al. 2016). However, positive outcomes of kitchen gardening can only be achieved by successful implementation and when main participants and children are motivated to engage in school garden activities. Reported socio-economic factors influencing kitchen gardening ownership are age category, in that older people are more likely to own a kitchen garden than younger ones; gender in that females are more likely to own kitchen gardens compared to males; education level in that educated people are more likely to own a kitchen garden compared to uneducated ones; and the main economic activity of a household, in that households with agriculture as the main economic activity are more likely to own a kitchen garden than households whose main activity is not agriculture related (Gbedomon et al. 2015).

Diversity of a kitchen garden is determined by socio-cultural and economic factors such as food patterns and traditions, gender, ethnicity, markets, religious values and norms, gender role, structure of society, access and distance to market, demand and supply of other available food items (Gbedomon et al. 2015). Ecological factors also determine kitchen garden diversity due to agro-ecological and climatic features such as availability of indigenous and exotic species, altitude and the management and ecological functions of soils, water and forests (Gautam et al. 2009). Lastly, knowledge and awareness determine the presence and diversity of a kitchen garden. For example, traditional knowledge and practices, formal and non-formal education, delivery of extension services, involvement of government and private sectors, relationship with other community members can all influence ownership of a kitchen garden (Gautam et al. 2009; Mohsin et al. 2017).

Despite the fact that in Tanzania many households depend on farming activities to meet household food needs, more than two-thirds of households in some rural communities still experience food insecurity (Ntwenya et al. 2015). According to the Tanzania Demographic Health Survey (TDHS) 2015–2016, micronutrient deficiencies are high among women of child bearing age, with 45% being anemic and 33% being iodine deficient (Ministry of Health (MoH) et al. 2016). Although kitchen gardens appear to have potential to improve food security, according to the literature they have attracted little research and in Tanzania few attempts have been made to document the use of kitchen gardens. Also, very little attention has been devoted to the promotion of kitchen gardening activities in order to improve dietary diversity and overall nutritional status.

This study describes the current status and scope of kitchen gardening regarding key determinants for growing vegetables. The aims were (a) to provide a framework to guide the process

of building kitchen gardens by highlighting determinants that drive or hinder success and (b) to explain factors that support or hinder production of vegetables in kitchen gardens for household consumption.

2 Methods

2.1 Case study sites

The study was carried out in the Dodoma and Morogoro regions of Central Tanzania (see Kissoly et al. 2017) (Fig. 1). These regions were selected as case study sites for Trans-SEC activities (Kissoly et al. 2017), and included an assessment of the implementation of kitchen gardens in areas with different social and environmental conditions. Due to low annual

precipitation, the Dodoma region is particularly susceptible to food insecurity, while Morogoro has both food-insecure and food-secure areas.

Six main components were targeted: natural resources, food production, processing, waste management, markets and consumption. Four Case Study Sites (CSS) were selected consisting of two villages from the sub-humid areas of the Morogoro region and two from the semi-arid areas of the Dodoma region (Graef et al. 2016). Data were obtained from a total of 383 randomly selected households, the number of households being proportional to the size of the villages. The two regions have diverse environmental and socio-economic conditions for investigating causative factors related to food and nutrition insecurity thus allowing for the transfer of results to other regions with characteristics similar to those of Tanzania.

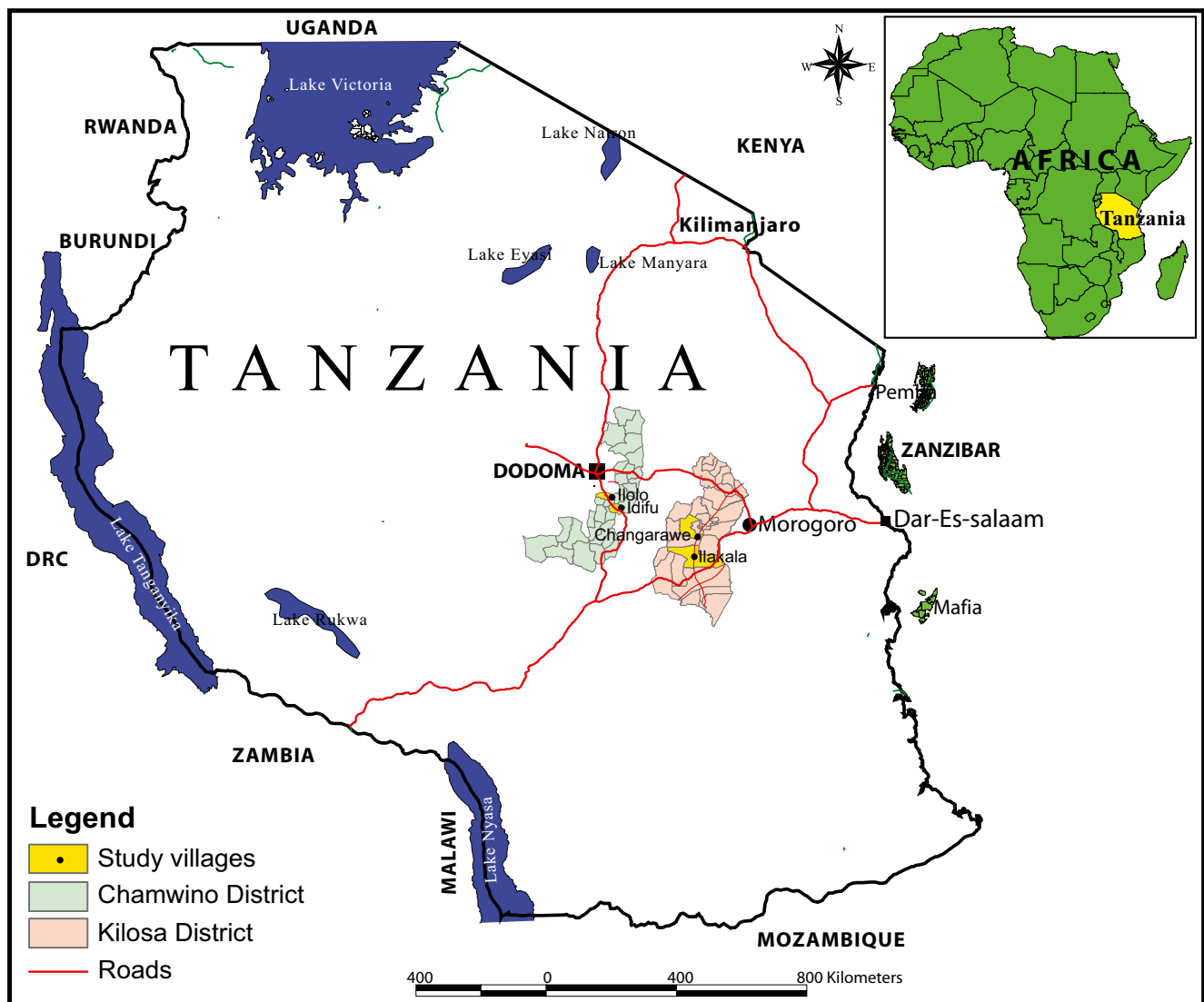


Fig. 1 Map showing the locations of the study villages

2.2 Data collection

This was a cross sectional study and data were collected from January to May 2015 among selected households in Dodoma and Morogoro regions to capture the kitchen gardening practices taking place. A kitchen garden, in this context, is the traditional land use system around a homestead, where several species of vegetables and fruits are grown and maintained by household members. The produce is primarily intended for family consumption. In the selected households, participants were the mothers or caregivers.

Face to face interviews with the mothers or caregivers of the 383 households, using a questionnaire, were conducted to collect demographic and socioeconomic information and other relevant information regarding the practice of kitchen gardening. Other approaches applied were observations and focus group discussions. Observation is a qualitative method of data collection in which events, behaviours, and artefacts in the social setting chosen for study are systematically described (Kawulich 2005). Observations provided researchers with the opportunity to evaluate existing kitchen gardens.

Four focus group discussions were conducted. Each focus group comprised 8–9 participants. Participants were selected on the basis of age, geographic location of residence, self-identified ethnicity, and knowledge of the village as well as changes that have been happening in the village. All the participants were over 30 years of age and identified by a village leader as people who were both cultural experts and effective communicators.

The focus group in Ilakala village consisted of eight people, four women and four men and that in Changarawe village was composed of nine people, five women and four men who resided within the village. In Iloilo and Idifu both focus groups consisted of eight people, four women and four men. Each focus group discussion lasted approximately 1 hour and consisted of questions about kitchen gardening. There were two investigators for the focus groups; one who took notes while the other person led the discussion. The proceedings were digitally recorded, transcribed in Kiswahili and translated into English.

Ethics approval for the study was granted by the National Institute for Medical Research ethical committee (NIMR/HQ/R.8a/Vol.IX/2226). Household heads and spouses were informed of the purpose, objectives and activities of the study and requested to participate. The household representatives were requested to sign the consent form or apply a thumb print (in ink) as a proof of agreement to participate in the study.

2.3 Data analysis

SPSS software version 17 (SPSS Inc., Chicago, IL, USA) and Microsoft Excel application 2007 were used to

analyze the collected data. All categorical variables were described by using frequencies and percentages. Aspects analyzed included demographic characteristics of households, proportion of households practising kitchen gardening, fruits and vegetables consumed, farmers' perspectives on the advantages of vegetable kitchen gardening, drivers of vegetable growing in kitchen gardens, most important problems in vegetable production and utilization of surplus produce. Focus groups discussion data were analyzed to obtain farmers' perspectives on the advantages of vegetable kitchen gardening and drivers for the type of vegetables grown. The Pearson Chi-squared test was used to assess differences in gardening aspects between Dodoma and Morogoro. Significance was considered when $p < 0.05$. Logit regression analysis was performed to identify factors that contributed to presence of a kitchen garden at a household level. The dependent variable was presence of a kitchen garden and explanatory variables were the household demographic characteristics (sex of household head, marital status of household head, literacy level of mother or caregiver, household size and education level of respondent).

3 Results

3.1 Demographic characteristics of households ($n = 383$)

Characteristics of the study population are shown in Table 1. Of all surveyed households 91.1% and 84.9% were male headed in Morogoro and Dodoma, respectively. The remaining households were female headed. Polygamy and divorce rate were 3.4% and 9.8% and 1.7% and 3.3% in Morogoro and Dodoma, respectively. Almost 40% and 48% of household heads had no formal education, and 59.4% and 51% had only primary school education in Morogoro and Dodoma, respectively. The proportion of household caregivers who could read and write effectively was 55.9% and 42.6% in Morogoro and Dodoma, respectively; those who could not read or write at all were 23.7% and 42.6%, respectively. Farming was the main occupation for all households in Morogoro and for 95.1% of the households in Dodoma. The proportion of household with 6 to 8 members was 28.8% in Morogoro and 27.8% in Dodoma. Literacy of caregivers was significantly better in Morogoro than in Dodoma ($p = 0.001$).

3.2 Affirmative response to kitchen gardening practice among the CSS in sub-humid and semi-arid regions of Tanzania ($n = 383$)

The proportion of households practising kitchen gardening was 12.5%. About 10% of the surveyed households in the

Table 1 Demographic characteristics of participating households (n = 383)

Characteristics	Morogoro (n = 200) %	Dodoma (n = 183) %	p value
Village of origin			
Changarawe	50		
Ilakala	50		
Ilo		53.6	
Idifu		46.4	
Sex of household head			0.006*
Male	91.1	84.9	
Female	8.9	15.1	
Marital status of household head			0.061
Married-monogamous	88.1	73.8	
Married-polygamous	3.4	9.8	
Widowed	1.7	6.6	
Divorced	1.7	3.3	
Single	1.7	1.6	
Cohabitation	3.4	4.9	
Level of literacy of caregiver/mother			0.001*
Not able to read or write	23.7	42.6	
Can read and write to some extent	20.3	14.8	
Can read and write	55.9	42.6	
Occupation of respondent			0.071
Farmer	100	95.1	
Self employed	0.0	1.6	
Other	0.0	3.3	
Total number of people living in the household			0.021*
2 to 5	62.7	59.5	
6 to 8	28.8	27.8	
9 to 13	8.5	12.7	
Education level of respondent			0.023*
No education	40.0	48.0	
Primary education	59.4	51.0	
Secondary education	0.6	1.0	

*Chi-square test significant at $p < 0.05$

sub-humid region (Morogoro) had a kitchen garden compared to 2.6% in the semi-arid region (Dodoma; Table 2).

3.3 Characteristics of kitchen gardening in the CSS

The largest source of vegetable consumption in most households was from market purchases (Table 3). Households with kitchen gardens in Morogoro consumed 55% of their produce while those in Dodoma consumed 90% of their produce. Gender roles show that 75% and 80% of women and 20% and 18% of other relatives and children participated in caring for the kitchen gardens in Morogoro and Dodoma, respectively. Family labor was common among kitchen garden practitioners (98% in Morogoro and 100% in Dodoma, respectively). There were significant differences between Morogoro and Dodoma in the proportions of vegetables sold and consumed ($p = 0.047$; Table 3).

Table 2 Affirmative response to practising kitchen gardening among the Case Study Sites (CSS) in sub-humid and semi-arid regions of Tanzania (n = 48)

Place	Climatic zone	Villages surveyed	Yes	
			n	%
Morogoro	Sub-humid	Changarawe	20	5.2
		Ilakala	18	4.7
Total			38	9.9
Dodoma	Semi-arid	Ilo	6	1.6
		Idifu	4	1.0
Total			10	2.6
Grand total			48	12.5

The bold letters are just thought to highlight the total of households using kitchen gardens in individual case study regions (Dodoma and Morogoro) and in total (Morogoro +Dodoma region)

Table 3 Characteristics of kitchen gardening in the CSS

Major indicator	Dodoma (n = 10)	Morogoro (n = 38)	p value*
Main sources of vegetables consumed in the household	%	%	
Own garden	82	25	0.083
Market	18	75	
Main purpose of vegetables produced			
Consumption	90	55	0.047*
Sale	10	45	
Person responsible for caring the garden			
Husband	2	5	0.075
Wife	80	75	
Other (Children, relatives etc)	18	20	
Use of labour by the kitchen garden practitioners			
Family	100	98	0.062
Hired	0	2	

*Chi-square test significant at $p < 0.05$

3.4 Common vegetables found in the local kitchen gardens

About five common vegetable types were grown in the study areas. These included sweet potato leaves, cassava leaves, pumpkin leaves, cowpea leaves and African egg plants (Table 4).

3.5 Drivers for vegetables grown in traditional kitchen gardens

Focus group discussions with 33 farmers identified three items: socio-cultural factors, environment factors and farmers' knowledge and understanding of local systems (Table 5). The socio-cultural factors include food habits and demand at home. Environmental factors were water availability, type of soil and climate. Traditional knowledge and level of formal education also impacted one's decision to participate in kitchen gardening.

3.6 Fruit and vegetable consumption by women and children under 5 years of age in households (n = 383) in the surveyed areas

Green leafy vegetables were consumed by 49% and 45% of women and children, respectively, in Dodoma while in

Table 4 Common vegetables found in local kitchen gardens in the surveyed CCS in Morogoro and Dodoma region –Tanzania

English name	Scientific name
Sweet potato leaves	<i>Ipomoea batatas</i>
Cassava leaves	<i>Manihot esculenta Crantz</i>
Pumpkin leaves	<i>Cucurbita pepo</i>
Cowpea leaves	<i>Vigna unguiculata</i>
African egg plant	<i>Solanum melongena</i>

Morogoro they were consumed by 28% and 30% of women and children, respectively (Table 6). Red/orange/yellow vegetables were consumed by only 9% and 11% of women and children, respectively in Dodoma while these vegetables were consumed by 16% and 17% of women and children in Morogoro, respectively. Households with kitchen gardens consumed more green leafy vegetables compared to households without kitchen gardens ($p = 0.001$).

Table 7 indicates that the likelihood ratio (LR) chi-square of 43.64 with a p value of 0.001 shows that the model as a whole fits significantly better than a model with no predictors. Factors that influenced the presence of a kitchen garden at household level were: sex of the household head ($p = 0.002$), literacy status of the mother/caregiver ($p = 0.001$) and the education level of the respondent ($p = 0.001$).

3.7 Most important problems in vegetable production

Water scarcity was the main hindrance to kitchen gardening (Fig. 2). The other challenges were fencing, tools for farming, pesticides and limited access to seeds. Lack of fences held back most of the households from establishing kitchen gardens. Significant differences in responses to problems between Dodoma and Morogoro were found in mentioning water scarcity ($p = 0.003$) and limited access to seeds ($p = 0.039$).

3.8 Surplus produce use

Respondents were asked what they would do with any excess vegetables and fruit production in their garden. The majority stated that they would sell additional produce rather than giving to neighbors or increasing their personal household consumption (Fig. 3). The only aspect that was

Table 5 Drivers for vegetables grown in traditional kitchen gardens among households in Dodoma and Morogoro

Drivers for vegetables grown in the traditional kitchen gardens	Items Dodoma	Items Morogoro
Social cultural factors	Food habit, demand and supply of food materials	Food habit
Environmental factors	Climatic factors, water availability, type of soils	Climatic factors, type of soils
Farmers' local knowledge and understanding	Traditional knowledge and practices, formal and non- formal education	Traditional knowledge and practices, formal and non- formal education

Results from Focus Group Discussions

found to be statistically significant between Dodoma and Morogoro was selling additional produce to neighbors ($p = 0.001$) with Morogoro selling more surplus produce to neighbors than Dodoma.

3.9 Farmers perspectives on the advantages of vegetable kitchen gardening

Focus group discussions demonstrated that farmers perceived kitchen gardening as an opportunity to utilize waste water effectively. Others described it as an opportunity to have access to vegetables during dry seasons when they were scarce. The perceived benefit was belief in the positive contribution of kitchen gardens to household nutrition and health improvement. Some described it as an opportunity to create household income diversity through selling produce. Others found that through kitchen gardening they could save the money that would otherwise have been used to purchase vegetables. Kitchen gardening was also described as an opportunity to utilize the available land areas around the homestead and to beautify the environment. There was also a perception that this practice improved soil nutrient levels.

4 Discussion

Our results show that kitchen gardening households not only have a higher chance of producing and consuming

micronutrient rich foods but this produce also serves as the most important source of relishes within these homes. In a study conducted in Cambodia, intervention households were found to have produced and consumed a greater amount of vegetables, had higher dietary diversity and lower prevalence of fever among children under 5 years of age (Olney et al. 2009). Therefore prevalence of stunting could be reduced by improving access to kitchen gardens (Bloss et al. 2004). Talukder et al. (2010) also observed an increase in variety and volume of vegetables produced being three and four times higher among households which practised improved kitchen gardening compared to those who did not.

Our results indicate that individuals living in households with kitchen gardens consume significantly more green leafy vegetables, which are rich in pro vitamin A carotenoids. The results are in line with a review article by Webb and Kennedy (2014) which reported positive impacts on dietary vitamin A intake of participants in kitchen gardening activities.

Other available data suggest that, compared with control households, kitchen-gardening is associated with 1) higher nutritional knowledge, 2) increased likelihood of food preservation and 3) nutrition supporting behaviors such as feeding complementary foods to infants and 4) greater consumption of home-produced micronutrient rich vegetables and fruits (Jones et al. 2005). In our case study regions, a very small proportion of the surveyed households in

Table 6 Fruits and vegetables consumption by women and children under 5 years in households in the surveyed areas (n = 383)

Food group	Dodoma (% Consumption)		Morogoro (% Consumption)		p value
	Women	Children	Women	Children	
Green leafy vegetables	49	45	28	30	0.001*
Yes					
Red/orange/yellow vegetables	7	10	14	16	0.064
Yes					
Red/orange/yellow fruits	9	11	16	17	0.057
Yes					

*Chi-square test significant at $p < 0.05$

Table 7 Results of regression analysis

Independent variables	Coefficients	SE	P	LR chi 2	Pseudo R2
Sex_of the household head	2.816841	0.860462	0.002		
Marital status of the household head	3.593327	1.386257	0.203	43.64 with <i>p</i> value 0.001	0.4564
Literacy	4.623202	1.477262	0.001		
Occupation_Res	1.333715	1.245757	0.246		
Household_size	0.757382	0.579415	0.312		
Education_level	3.821832	1.347391	0.001		
Constant	-20.28376	4.917827	0.001		

Dodoma and Morogoro owned a kitchen garden. In addition, recent data published by the Tanzanian government on nutritional status showed that 45.2% and 36.9% of children in Dodoma and Morogoro regions, respectively are stunted, suggestive of low benefit accrued from kitchen gardens (TFNC 2014).

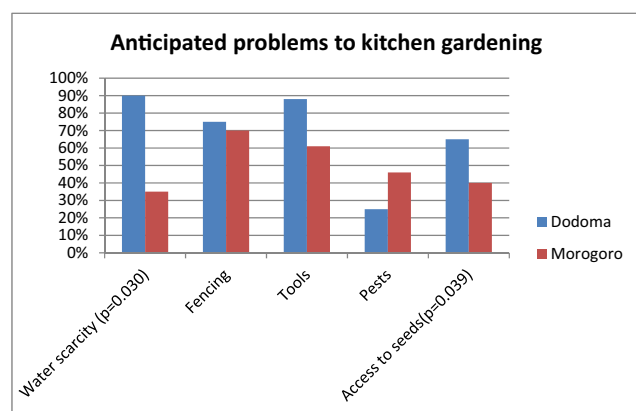
The surveyed community in both regions considered kitchen gardening as a promising opportunity for their households to generate income through either selling kitchen garden produce or saving money that otherwise would be used to buy fruits and vegetables. Our observations are in line with a review paper that has documented a positive impact of kitchen gardens on household income (Girard et al. 2012). Households participating in kitchen gardening activities had not only generated increased household income but, in particular, women were more likely to control production decisions, receive and control funds earned from produce sales and spend this income on food as compared to those women in households without kitchen gardens (Herforth et al. 2012).

Despite the positive effects of kitchen gardening on household welfare, several limitations to this practice were documented during field research with frequent shortages

of water being the most important. Similar challenges have been reported where participants claimed that the lack of water was the most difficult aspect of kitchen gardening (Begay et al. 2011). Sethy et al. 2010 reported water scarcity to be the second most important constraint (76.5%) among kitchen gardeners. Only 3% of households in the semi-arid areas of Dodoma region own a kitchen garden – an expected finding as it is an area where water supply is inadequate. Another frequently mentioned limitation was a lack of a proper fencing to protect kitchen gardens against grazing of small ruminants.

We further observed that 1) sex of household head, 2) literacy level of mother/caregiver and 3) education level of respondent have significant impacts on the presence of a vegetable garden in the household. For an educated versus a non-educated person the log odds of having a vegetable garden increased by 3.8. One explanation is that the knowledge gained through education included the importance of vegetables for well-being. Similarly, the log odds of having a vegetable garden increased by 2.8 for a female household head rather than a male. Where decisions concerning food preparation and cooking are made by women, it is more likely for them to include greater amounts of vegetables in meals compared to such decisions made by men. This underlines the need for nutrition education for all members of households, including men.

The low incidence of kitchen gardens in both Morogoro and Dodoma show that there is an opportunity for households to invest in this activity. There is also an urgent need to address social cultural factors, farmers' local knowledge and environmental factors. Farmers' knowledge and training should include emphasis on the health benefits associated with vegetable gardening and consumption.

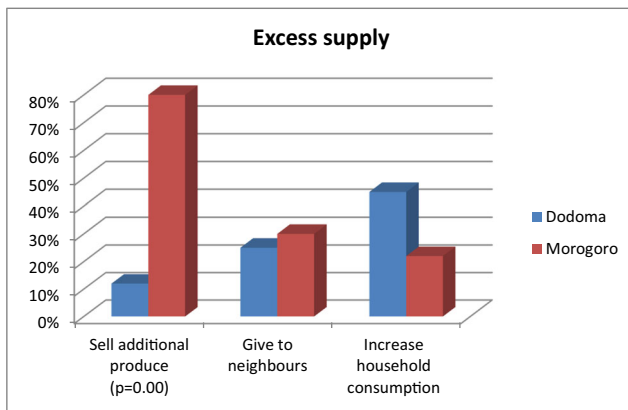


*Mann Whitney test; significant at $p < 0.05$

Fig. 2 Anticipated problems for kitchen gardening among the 383 surveyed households in Dodoma and Morogoro region-Tanzania. *Mann Whitney test; significant at $p < 0.05$

5 Conclusion

Kitchen gardens present a promising opportunity to produce fruits and vegetables high in micronutrients and to address food insecurity and malnutrition issues. Our data



*Mann Whitney test; significant at $p < 0.05$

Fig. 3 Surplus kitchen garden produce use among the producing households in Dodoma and Morogoro ($n = 383$) *Mann Whitney test; significant at $p < 0.05$

indicate that successful implementation of kitchen gardens is associated with specific framing conditions such as environmental factors (water availability), nutritional knowledge and gender aspects (sex of household heads). To address these conditions for kitchen garden implementation, water saving and nutrition education strategies should be designed, developed and tested under field conditions. To support the implementation of kitchen gardens at a national level, the cultivation of vegetables in households and especially households affected by food and nutrition insecurity has to be included in the curriculum of extension workers' education and should also be in their work scope or job description. Furthermore, the establishment of nutrition education structures (e.g. nutrition education in schools and trainings for nutrition facilitators at local level) are recommended. Kitchen gardening interventions can be progressed further by selecting plants rich in vitamin A and other micronutrients for cultivation in order to increase the dietary quality of households.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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