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Perception and Adoption Level of Urban Horticulture Technologies, Nairobi County, Kenya

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Abstract: *Recent years have witnessed a significant improvement in the adoption and promotion of horticultural technologies among smallholder farmers world-wide and in particular, developing countries. This study is aimed at evaluating the socio-economic factors that significantly determine farmers' decision to adoption of horticultural practices and how knowledge transfer influences urban horticulture. A sample of 580 respondents was used, 138 in Kasarani, 195 in Mathare and 247 in Kibera. Questionnaires were used to collect data from urban farmers and an interview schedule used to collect information from farmers. Social and economic characteristics, accesses to space, access to information, business management and governance data was collected. Frequencies and percentage were used to analyze the data using Statistical Package for Social Sciences (SPSS). It was found that age is significant and has a positive relationship with technology adoption, women are mainly in charge of urban farming and the farmers are spread over all education level and the source of food is the main reason for urban horticulture. The chi–square was used to differentiate different groups and conclusions. The findings show that there is a positive relationship between occupation in peri-urban and reason for adoption of urban technologies. The study also shows that there is positive relationship between age in peri-urban and technology transfer. More than 65% of the respondents were female. There is a negative relationship between education level and technology transfer. The results from this study will enable technology implementers, policy makers and local leaders to promote appropriate technologies to the residents which will lead to increased food supply, ensure food security for active and healthy life.*

Keywords: *Urban horticulture, food security and technology*

1. INTRODUCTION

Urban Horticulture is the cultivation, processing, and sale of fruits, nuts, vegetables, ornamental plants, and flowers as well as many additional services (Shyr & Reily, 2017). The products of urban horticulture include a large variety of vegetables, cereals, flowers, ornamental trees, aromatic vegetables and mushrooms.

The significance of urban horticulture as an important and growing sector of the urban space economy can be appreciated at individual household, community, and national levels. Urban horticulture is also a source of employment, income and favors both social inclusion and reduction of gender inequalities as 65% of urban farmers are women (Orsini et al. 2013). A key challenge is developing policy, strategies and technical support mechanisms for the sustainable management of urban agricultural systems, addressing production issues and marketing needs within a broader framework of environmental planning and management, water supply and utilization schemes, and food safety assurance (FAO, 2010).

Kenya is one of the countries in East Africa with high population growth rate of 2.11% (World Bank, 2013). Most of the people work within the agricultural sector and their households depend on the harvest (World Bank Group, 2008). However, food insecurity is still a major problem and malnutrition is common in urban areas (Dubbeling, de Zeeuw and van Veenhuizen 2010). Within this reality, urban agriculture/horticulture has become a key component of the survival strategies of poorer sections of the population, while also providing a significant contribution to the urban fresh food supply chain (FAO, 2010). The Government of Kenya has outlined four priority areas for the next five years. These are agricultural and food security, affordable housing, increased share of manufacturing, and universal health coverage (World Bank, 2018).

The world urban population is expected to surpass 8.5 billion by 2030 (UN, 2015). The urban population expansion is more pronounced in developing countries as a result of emigration from rural areas, as people flock to the cities in search of food, employment and security. The trend is accelerating, and by the year 2050, it is expected that about 66% of the world's population will be living in cities (UN, 2014). More than 60 percent of the population of Nairobi lives in the numerous slums located around the city (UNICEF, 2014). Kibera slum is one of "the biggest slum in Africa" (Desgroppes & Taupin, 2011). Around half million people are currently living in Kibera and the population is increasing daily (Gallaher, WinklerPrins, Njenga & Karanja, 2015). In the slum, landslides are frequent and the unemployment rate is very high. Most of the land is dedicated to housing, and agricultural land remains scarce.

Urban dwellers face relatively high living costs of housing, transportation, health care, education, inflated food prices and cash requirements when compared to their rural equivalents (Cohen & Garrett, 2010). Such rapid urbanization and the harsh reality of urban poverty require strategies to ensure adequate food supply and distribution systems to address escalating levels of urban food insecurity. Besides the growing demand for food, malnutrition remains central issues as poverty continues to be prevalent in many cities around the world. Specifically, it is estimated that 40% of urban inhabitants are living on less than US$1 a day, while simultaneously 70% are living on US$2 a day (FAO, 2012). Similarly, impoverished urban households are estimated to spend 60–80 percent of incomes on food, making them more vulnerable to food price volatility (Cohen & Garrett, 2010). Information on the sociological and economic factors and constrains affecting and limiting consumption, production and marketing of vegetables in urban areas is only sparsely or not available at all. Various technologies for vegetable production are available but have to be modified, adapted and tested under the special urban environments. A comprehensive research is therefore needed to address the issues.

2. RESEARCH METHODOLOGY

2.1. Location of the Study

The study was conducted in Nairobi County. The County covers an area of 695.1 kilometres squared (KNBS,2009) and it borders Kiambu, Machakos and Kajiado counties. According to the Kenya National Census that was carried out 2009, the number of people living in the county is approximated to be 3,138,369 making it one of the highly populated counties in the country (KNBS, 2010). Nairobi, the capital city of Kenya, is located 140 kilometres south of the Equator and 480 kilometres from the Indian Ocean, at around latitude 1°S and longitude 36°E (Makokha & Shisanya, 2010). It covers an area of approximately 690 square kilometres and has a diverse physical environment. The altitude of Nairobi ranges from an average of 1500 metres in the East to approximately 1900 metres (Makokha & Shisanya, 2010).

In the eastern, north-eastern and south-eastern parts of the city centre, new residential estates have been constructed (Makokha & Shisanya, 2010). More open and green spaces have diminished, leading to increase in the concrete jungle within the city environment. Further, immigration into the city for employment opportunities has led to growth of spontaneous squatter settlements in many places within the city (Makokha & Shisanya, 2010).

2.2. Research Design

The study adopted a descriptive survey design. Survey design was suitable for this study due to the fact that it allowed to interviewing and asking people about themselves directly as well as getting the primary data.

2.3. Sampling Procedure

Stratified sampling was used. The 247 respondents were selected from the 9 villages (Makina, Mashimoni, Laini Saba, Kianda, Kisumu Ndogo, Soweto East, Soweto West, Gatwekera, and Silanga) in Kibera, 195 respondents were selected from the 8 villages (3A, 4A, Gitathuru, Kiamutisya, Kosovo, KwaKariuki, Mabatini, Mashimoni) in Mathare and 138 respondents were selected from the two areas of Mwiki and Kasarani. The villages/areas acted as strata where an equal number of respondents were selected from each stratum.

2.4. Data Collection

The study relied on primary data of qualitative and quantitative nature. A questionnaire was used to collect social–economic data such as age, gender and occupation. The interview was the supplementary tool to collect information from urban farmers. The farmers were required to fill in the questionnaires by ticking the boxes where appropriate.

2.5. Data Analysis Procedures

After data collection, questions were coded and entered on spreadsheet into the computer for analysis. Frequencies, percentages, tables and means were calculated to give a simple summary of the observations. A Chi-square test for pairs of variables was used to test the significance of the relationship between the independent and dependent variables.

3. RESULTS AND DISCUSSION

3.1. Socio-Demographic Characteristics of Respondents

Table1. The *distribution of the respondents based on their demographic characteristics in urban areas*

	Urban				**Peri-urban**	
	Mathare		***Kibera***		***Kasarani***	
Social-economic characteristics	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Sex						
Male	61	31.3	74	30	34	24.6
Female	134	68.7	173	70	104	75.4
Age						
Young adults	49	25.1	64	25.9	31	22.5
Middle aged	132	67.7	160	64.8	96	69.5
Older adults	14	7.2	23	9.3	11	8
Marital status						
Single	22	11.3	40	16.2	13	9.4
Married	144	73.9	170	68.8	98	71
Divorced/separated	10	5.1	10	4.1	4	2.9
Widowed	19	9.7	27	10.9	23	19.7
Education Level						
Non formal	16	8.2	23	9.3	8	5.8
Primary	26	13.3	48	19.5	16	11.6
Secondary	108	55.4	129	52.2	41	29.7
Tertiary	45	23.1	47	19	73	52.9
Occupation						
Trading	87	44.6	101	40.9	48	34.8
Farming	4	2.1	3	1.2	2	1.5
Driving	4	2.1	8	3.2	3	2.2
Civil Service	25	12.8	30	12.2	30	21.7
Barbing	2	1	5	2	1	0.7
Unemployed	28	14.4	36	14.6	16	11.6
Others	45	23.1	64	25.9	38	27.5
Level of income						
Less than 5,000	11	5.6	20	8.1	3	2.2
5,001-10,000	23	11.8	16	6.5	5	3.6
10,001-15,000	41	21	48	19.4	18	13
15,001-20,000	39	20	42	17	31	22.5
20,001-25,000	19	9.7	38	15.4	28	20.3
25,001-30,000	12	6.2	19	7.7	19	13.8
30,001-35,000	16	8.2	14	5.7	13	9.4
35,001-40,000	14	7.2	17	6.9	9	6.5
40,001-45,000	6	3.1	9	3.6	5	3.6
45,001-50,000	8	4.1	13	5.3	4	2.9
More than 50,000	6	3.1	11	4.5	3	2.2

Source: *Survey, August 2017*

As shown above (Table 1), it is apparent that the majority of respondents were females, for instance, in Kasarani 75.4% were females and the remainder were males (24.6%). In Mathare, 68.7% were females and the males were 31.3%, and in Kibera, 70% were females and males were 30%. The marital status of respondents as shown on the table, varied from single (9.4%), married (71%), separated/divorced (2.9%) to widowed (16.7%) in Kasarani. In Mathare, 11.3% were single, married73.9%, separated/divorced 5.1% to widowed 9.7% and in Kibera, 16.2% were single, married were 68.8%, separated/divorced 4.1% and widowed 10.9%. It is indicated that most respondents were married; Kasarani (71%), Mathare (73.9%) and Kibera (68.8%).

It is clear that the majority of the respondents are middle aged adults with 67.7%, 64.8% and 69.5% for Mathare, Kibera and Kasarani respectively. On the level of education, the majority (52.9%) of the respondents had post-secondary education in the form of certificates, diplomas and degrees, followed by 29.7% with secondary education, 11.6% with primary education and 5.8% had no-formal education in Kasarani area. In Mathare, the majority (55.4%) of the respondents had secondary education, followed by 23.1% with post-secondary education in the form of certificates, diplomas and degrees, 13.3% with primary education and only 8.2% had no-formal education. In Kibera, the majority (52.2%) of the respondents had secondary education, followed by 19.5% with primary education, 19.0% with post-secondary education in theform of certificates, diplomas and degrees and only 8.2% had no-formal education. The average monthly income of the respondents was between Kshs. (10,000-35,000) for most respondents.

3.2. Frequencies of Respondents by Space Identified for Production of Vegetables

Table2 (i). *Frequency for space identified for growing vegetables according to social-demographic groups of respondents in Kasarani*

	Socio-economic characteristics	***Rooftops***	***Balconies***	***Vacant places***	***In containers***	***Along railways***	***Below power lines***	***River banks***	***School gardens***	***Road strips***	***others***
Sex	Male(n=34)	(1) 3%	(2) 6%	(6) 18%	(5) 15%	(2) 6%	(3) 9%	(9) 27%	(0) 0%	(6) 18%	(2) 3%
	Female(n=104)	(4)4%	(4)4%	(27)26%	(9)9%	(14)14%	(4)4%	(12)12%	(3)3%	(18)17%	(9)8%
	Total(n=138)	(5)4%	(6)4%	(33)24%	(14)10%	(16)12%	(7)5%	(21)15%	(3)2%	(24)17%	(11)8%
	P value	0.494									
Age	Young adults(n=31)	(1)3%	(1)3%	(7)23%	(5)16%	(3)10%	(3)10%	(6)19%	(0)0%	(5)16%	(0)0%
	Middle aged adults(n=96)	(3)3%	(5)5%	(21)22%	(9)9%	(13)14%	(4)4%	(13)14%	(3)3%	(17)18%	(8)8%
	Older adults(n=11)	(1)9%	(0)0%	(5)46%	(0)0%	(0)0%)	(0)0%	(2)18%	(0)0%	(2)18%	(1)9%
	P value	0.465									
Marital status	Single(n=13)	(0)0%	(1)8%	(3)23%	(0)0%	(1)8%	(0)0%	(1)8%	(1)8%	(4)31%	(2)15%
	Married(n=98)	(3)3%	(4)4%	(24)25%	(13)13%	(12)12%	(6)6%	(16)16%	(2)2%	(12)12%	(6)6%
	Divorced/separated(n=4)	(1)25%	(0)0%	(1)25%	(0)0%	(1)25%	(0)0%	(1)25%	(0)0%	(0)0%	(0)0%
	Widowed(n=23)	(1)4%	(1)4%	(5)22%	(1)4%	(2)9%	(1)4%	(3)13%	(0)0%	(8)35%	(1)4%
	P value	0.598									
Educational Level	Non formal education(n=8)	(0)0%	(1)13%	(3)38%	(1)13%	(2)25%	(0)0%	(1)13%	(0)0%	(0)0%	(0)0%
	Primary(n=16)	(1)6%	(0)0%	(6)37%	(0)0%	(1)6%	(1)6%	(1)6%	(2)13%	(2)13%	(2)13%
	Secondary(n=41)	(2)5%	(3)7%	(6)15%	(7)17%	(7)17%	(1)2%	(8)20%	(0)0%	(5)12%	(2)5%
	Tertiary(n=73)	(2)3%	(2)3%	(18)25%	(6)8%	(6)8%	(5)7%	(11)15%	(1)1%	(17)23%	(5)7%
	P value	0.232									
Occupation	Trading(n=48)	(4)8%	(1)2%	(9)19%	(4)8%	(6)13%	(3)6%	(7)15%	(1)2%	(10)21%	(3)6%
	Farming(n=2)	(0)0%	(0)0%	(0)0%	(1)50%	(0)0%	(1)50%	(0)0%	(0)0%	(0)0%	(0)0%
	Driving(n=3)	(0)0%	(1)33%	(1)33%	(0)0%	(1)33%	(0)0%	(0)0%	(0)0%	(0)0%	(0)0%
	Civil Service(n=30)	(1)3%	(2)7%	(6)20%	(3)10%	(3)10%	(1)3%	(8)27%	(0)0%	(3)10%	(3)10%
	Barbing(n=1)	(0)0%	(0)0%	(0)0%	(0)0%	(0)0%	(0)0%	(0)0%	(0)0%	(1)100%	(0)0%
	Unemployed(n=16)	(0)0%	(2)13%	(3)19%	(2)13%	(1)6%	(1)6%	(1)6%	(0)0%	(5)31%	(1)6%
	Others(n=38)	(0)0%	(0)0%	(14)37%	(4)11%	(5)13%	(1)3%	(5)13%	(2)5%	(5)13%	(2)5%
	P value	0.243									
Level of Income(kshs)	Less than 5,000(n=3)	(1)33%	(0)0%	(0)0%	(0)0%	(0)0%	(0)0%	(1)33%	(0)0%	(1)33%	(0)0%
	5,001-10,000(n=5)	(0)0%	(0)0%	(1)20%	(0)0%	(0)0%	(0)0%	(1)20%	(1)20%	(2)40%	(0)0%
	10,001-15,000(n=18)	(0)0%	(0)0%	(5)28%	(2)11%	(0)0%	(1)6%	(4)22%	(0)0%	(4)22%	(2)11%
	15,001-20,000(n=31)	(1)3%	(2)7%	(7)23%	(2)7%	(3)10%	(1)3%	(4)13%	(0)0%	(7)23%	(4)13%
	20,001-25,000(n=28)	(0)0%	(1)4%	(8)29%	(2)7%	(4)14%	(2)7%	(6)21%	(0)0%	(4)14%	(1)4%
	25,001-30,000(n=19)	(1)5%	(3)16%	(4)21%	(4)21%	(4)21%	(1)5%	(1)5%	(0)0%	(1)5%	(0)0%
	30,001-35,000(n=13)	(1)8%	(0)0%	(3)23%	(3)23%	(1)8%	(0)0%	(0)0%	(1)8%	(4)31%	(0)0%

	35,001-40,000(n=9)	(0)0%	(0)0%	(4)44%	(1)11%	(2)22%	(0)0%	(1)11%	(0)0%	(1)11%	(0)0%
	40,001-45,000(n=5)	(1)20%	(0)0%	(1)20%	(0)0%	(0)0%	(0)0%	(1)20%	(0)0%	(0)0%	(2)40%
	45,001-50,000(n=4)	(0)0%	(0)0%	(0)0%	(0)0%	(2)50%	(0)0%	(1)25%	(1)25%	(0)0%	(0)0%
	More than 50,000(n=3)	(0)0%	(0)0%	(0)0%	(0)0%	(0)0%	(2)67%	(1) 33%	(0)0%	(0)0%	(0)0%
	P value	0.140									

`*p<0.05

Source: *survey, August 2017*

The respondents were asked about the space where they grow crops. The farmers' responses were varied. The spaces are categorized into; rooftops, balconies, vacant places, in containers, along the railways, below power lines, river banks, school gardens, road strips and others to give us a better understanding on the choice of spaces for farming in Kasarani. About 24% of the respondents did farming along the vacant places, 17% on the road strips and 15% along the water lines such as river banks and sewage lines. There was considerable variation in the choice of space for farming between farmers from different age groups (Table 2(i)). Forty six percent of older adults (>55 years), did farming on vacant spaces compared to 23% of young adults (<35 years). The choice of space also varied significantly amongst different gender groups (p = 0.494), age groups (p = 0.465), marital status (p = 0. 598), education level (p= 0.232), occupation (n= 0.243) and level of income groups (p = 0.140).

Table2(ii). *Frequency of space identified for growing vegetables according to social-demographic groups in Mathare*

	Socio-economic characteristics	Rooftops	Balconies	Vacant places	In containers	Along railways	Below Power lines	River banks	School gardens	Road strips	others
Sex	Male(n=61)	2(3%)	4(7%)	11(18%)	11(18%)	0(0%)	2(3%)	13(21%)	0(0%)	12(20%)	6(10%)
	Female(n=134	2(2%)	7(5%)	25(19%)	21(16%)	0(0%)	2(2%)	32(24%)	2(2%)	31(23%)	12(9%)
	Total(n=195)	4(2%)	11(6%)	36(19%)	32(16%)	0(0%)	4(2%)	45(23%)	2(1%)	43(22%)	18(9%)
	P value	0.942									
Age	Young adults(n=49)	1(2%)	3(6%)	6(12%)	17(35%)	0(0%)	0(0%)	8(16%)	0(0%)	9(18%)	5(10%)
	Middle aged adults(n=132)	3(2%)	7(5%)	29(22%)	14(11%)	0(0%)	3(2%)	33(25%)	2(2%)	31(24%)	10(8%)
	Older adults(n=14)	0(0%)	1(7%)	1(7%)	1(7%)	0(0%)	1(7%)	4(29%)	0(0%)	3(21%)	3(21%)
	P value	0.507									
Marital status	Single(n=22)	0(0%)	1(5%)	7(32%)	2(9%)	0(0%)	0(0%)	2(9%)	0(0%)	7(32%)	3(14%)
	Married(n=144)	4(3%)	9(6%)	23(16%)	23(16%)	0(0%)	4(3%)	35(24%)	2(1%)	31(22%)	13(9%)
	Divorced/separated(n=10)	0(0%)	0(0%)	3(30%)	3(30%)	0(0%)	0(0%)	1(10%)	0(0%)	2(20%)	1(10%)
	Windowed(n=19)	0(0%)	1(5%)	3(16%)	4(21%)	0(0%)	0(0%)	7(37%)	0(0%)	3(16%)	1(5%)
	P value	0.883									
Educational Level	Non formal education(n=16)	0(0%)	1(6%)	4(25%)	2(13%)	0(0%)	0(0%)	5(31%)	0(0%)	3(19%)	1(6%)
	Primary(n=26)	1(4%)	2(8%)	4(15%)	3(12%)	0(0%)	0(0%)	1(4%)	0(0%)	9(35%)	6(23%)
	Secondary(n=108)	1(1%)	7(7%)	21(19%)	16(15%)	0(0%)	2(2%)	31(29%)	2(2%)	20(19%)	8(7%)
	Tertiary(n=45)	2(4%)	1(2%)	7(16%)	11(24%)	0(0%)	2(4%)	8(18%)	0(0%)	11(24%)	3(7%)
	P value	0.328									
Occupation	Trading(n=87)	3(3%)	4(5%)	15(17%)	14(16%)	0(0%)	0(0%)	22(25%)	1(1%)	16(18%)	12(14%)
	Farming(n=4)	0(0%)	2(50%)	1(25%)	0(0%)	0(0%)	0(0%)	1(25%)	0(0%)	0(0%)	0(0%)
	Driving(n=4)	0(0%)	0(0%)	1(25%)	3(75%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)
	Civil Service(n=25)	0(0%)	1(4%)	7(28%)	2(8%)	0(0%)	3(12%)	4(16%)	1(4%)	7(28%)	0(0%)
	Barbing(n=2)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	2(100%)	0(0%)
	Unemployed(n=28)	0(0%)	2(7%)	3(11%)	5(18%)	0(0%)	0(0%)	7(25%)	0(0%)	7(25%)	4(14%)
	Others(n=45)	1(2%)	2(4%)	9(20%)	8(18%)	0(0%)	1(2%)	11(24%)	0(0%)	11(24%)	2(4%)
	P value	0.203									
Level of income (kshs)	Less than 5,000(n=11)	1(9%)	0(0%)	4(36%)	2(18%)	0(0%)	0(0%)	2(18%)	0(0%)	2(18%)	0(0%)
	5,001-10,000(n=23)	0(0%)	1(4%)	5(22%)	1(4%)	0(0%)	0(0%)	9(39%)	0(0%)	3(13%)	4(17%)
	10,001-15,000(n=41)	0(0%)	0(0%)	6(15%)	6(15%)	0(0%)	1(2%)	12(29%)	1(2%)	11(27%)	4(10%)
	15,001-20,000(n=39)	1(3%)	6(15%)	4(10%)	3(8%0	0(0%)	1(3%)	8(21%)	1(3%)	10(26%)	5(13%)
	20,001-25,000(n=19)	2(11%)	1(5%)	4(21%)	8(42%)	0(0%)	0(0%)	2(11%)	0(0%)	1(5%)	1(5%)
	25,001-30,000(n=12)	0(0%)	1(8%)	2(17%)	1(8%)	0(0%)	0(0%)	3(25%)	0(0%)	5(42%)	0(0%)
	30,001-35,000(n=16)	0(0%)	1(6%)	5(31%)	2(13%)	0(0%)	1(6%)	3(19%)	0(0%)	3(19%)	1(6%)

	35,001-40,000(n=14)	0(0%)	0(0%)	5(36%)	5(36%)	0(0%)	0(0%)	4(29%)	0(0%)	0(0%)	0(0%)
	40,001-45,000(n=6)	0(0%)	1(17%)	1(17%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	3(50%)	1(17%)
	45,001-50,000(n=8)	0(0%)	0(0%)	0(0%)	4(50%)	0(0%)	0(0%)	1(13%)	0(0%)	2(25%)	1(13%)
	More than 50,000(n=6)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	1(17%)	1(17%)	0(0%)	3(50%)	1(17%)
	P value	0.089									

*p<0.05

Source: *survey , August 2017*

The respondents were asked about the space where they grow crops. The farmers' responses were varied. The spaces are categorized into; rooftops, balconies, vacant places, in containers, along the railways, below power lines, river banks, school gardens, road strips and others to give us a better understanding on the choice of spaces for farming in Mathare. About 23% of the respondents planted along the water lines such as river banks and sewage lines, 19% did farming along the vacant places and 22% on the road strips. There was considerable variation in the choice of space for farming between farmers from different age groups (Table 2(ii)). Seven percent (7%) of the older adults (>55 years), did farming in containers compared to 35% of young adults (<35 years). The choice of space also varied significantly amongst different gender groups (p = 0.942), age groups (p = 0.507), marital status (p = 0. 883), education level (p= 0.328) occupation (n = 0.203) and level of income groups (p = 0.089).

Table2(iii). *Frequency of space identified for growing vegetables according to social-demographic groups in Kibera*

	Socio-economic characteristics	**Rooftops**	**Balcones**	**Vacant places**	**In containers**	**Along railways**	**Below power lines**	**River banks**	**School gardens**	**Road strips**	**others**
Sex	Male(n=74)	5(7%)	1(1%)	11(15%)	11(15%)	6(8%)	1(1%)	18(24%)	1(1%)	15(20%)	5(7%)
	Female(n=173)	6(4%)	1(1%)	37(21%)	24(14%)	19(11%)	1(1%)	41(24%)	1(1%)	32(19%)	11(6%)
	Total(n=247)	11(5%)	2(1%)	48(19%)	35(14%)	25(10%)	2(1%)	59(24%)	2(1%)	47(19%)	16(7%)
	P value	0.904									
Age	Young adults(n=64)	5(8%)	1(2%)	10(16%)	9(14%)	10(16%)	0(0%)	13(20%)	1(2%)	11(17%)	4(6%)
	Middle aged (n=160)	5(3%)	1(1%)	31(19%)	22(14%)	12(8%)	2(1%)	41(26%)	1(1%)	13(8%)	12(8%)
	Older adults(n=23)	1(4%)	0(0%)	7(30%)	4(17%)	3(13%)	0(0%)	5(22%)	0(0%)	3(13%)	0(0%)
	P value	0.688									
Marital status	Single(n=40)	2(5%)	0(0%)	5(13%)	3(8%)	5(13%)	1(3%)	11(28%)	0(0%)	12(30%)	1(3%)
	Married(n=170)	9(5%)	1(1%)	38(22%)	25(15%)	19(11%)	1(1%)	33(19%)	1(1%)	31(18%)	12(7%)
	Divorced/separated(n=10)	0(0%)	0(0%)	1(10%)	2(20%)	0(0%)	0(0%)	4(40%)	0(0%)	2(20%)	1(10%)
	Widowed(n=27)	0(0%)	1(4%)	4(15%)	5(19%)	1(4%0	0(0%)	11(41%)	1(4%)	2(7%)	2(7%)
	P value	0.361									
Educational Level	Non formal education(n=23)	1(4%)	0(0%)	3(13%)	3(13%)	3(13%)	0(0%)	5(22%)	0(0%)	5(22%)	3(13%)
	Primary(n=48)	1(2%)	0(0%)	9(19%)	7(15%)	5(10%)	1(2%)	9(19%)	1(2%)	11(23%)	4(8%)
	Secondary(n=129)	8(6%)	1(1%)	23(18%)	20(16%)	8(6%)	1(1%)	37(29%)	1(1%)	22(17%)	8(6%)
	Tertiary(n=47)	1(2%)	1(2%)	13(28%)	5(11%)	9(19%)	0(0%)	8(17%)	0(0%)	9(19%)	1(2%)
	P value	0.727									
Occupation	Trading(n=101)	5(5%)	1(1%)	25(25%)	9(9%)	9(9%)	0(0%)	28(28%)	1(1%)	15(15%)	8(8%)
	Farming(n=3)	0(0%)	0(0%)	1(33%)	0(0%)	1(33%)	0(0%)	0(0%)	0(0%)	1(33%)	0(0%)
	Driving(n=8)	1(13%)	0(0%)	1(13%)	3(38%)	0(0%)	0(0%)	1(13%)	0(0%)	2(25%)	0(0%)
	Civil Service(n=30)	2(7%)	1(3%)	3(10%)	5(17%)	3(10%)	0(0%)	9(30%)	1(3%)	5(17%)	1(3%)
	Barbing(n=5)	0(0%)	0(0%)	0(0%)	1(20%)	1(20%)	0(0%)	2(40%)	0(0%)	1(20%)	0(0%)
	Unemployed(n=36)	1(3%)	0(0%)	4(11%)	7(19%)	5(14%)	0(0%)	10(28%)	0(0%)	6(17%)	3(8%)
	Others(n=64)	2(3%)	0(0%)	14(22%)	10(16%)	6(9%0	2(3%)	9(14%0	0(0%)	17(27%)	4(6%)
	P value	0.918									
Level of income (Kshs)	Less than 5,000(n=20)	1(5%)	0(0%)	4(20%)	3(15%)	4(20%)	0(0%)	4(20%)	0(0%)	3(15%)	1(5%)
	5,001-10,000(n=16)	0(0%)	1(6%)	2(13%)	2(13%)	1(6%)	0(0%)	2(13%)	0(0%)	7(44%)	1(6%)
	10,001-15,000(n=48)	2(4%)	0(0%)	11(23%)	7(15%)	5(10%)	0(0%)	14(29%)	0(0%)	6(13%)	3(6%)
	15,001-20,000(n=42)	1(2%)	0(0%)	9(21%)	9(21%)	3(7%)	0(0%)	8(19%)	1(2%)	8(19%)	3(7%)
	20,001-25,000(n=38)	3(8%)	1(3%)	6(16%)	3(8%)	2(5%)	1(3%)	12(32%)	1(3%)	8(21%)	1(3%)
	25,001-30,000(n=19)	0(0%)	0(0%)	5(26%)	3(16%)	4(21%)	0(0%)	5(26%)	0(0%)	1(5%)	1(5%)
	30,001-35,000(n=14)	2(14%)	0(0%)	2(14%)	4(29%)	1(7%)	0(0%)	3(21%)	0(0%)	2(14%)	0(0%)
	35,001-40,000(n=17)	0(0%)	0(0%)	5(29%)	0(0%)	2(12%)	1(6%)	3(18%)	0(0%)	4(24%)	2(12%)
	40,001-45,000(n=9)	1(11%)	0(0%)	0(0%)	1(11%)	0(0%)	0(0%)	3(33%)	0(0%)	4(44%)	0(0%)

	45,001-50,000(n=13)	0(0%)	0(0%)	3(23%)	1(8%)	2(15%)	0(0%)	4(31%)	0(0%)	2(15%)	1(8%)
	More than 50,000(n=11)	1(9%)	0(0%)	1(9%)	2(18%)	1(9%)	0(0%)	1(9%)	0(0%)	2(18%)	3(27%)
	P value	0.820									

*p<0.05

Source: *Servey, August 2017*

The respondents were asked about the space where they grow crops. The farmers' responses were varied. The spaces are categorized into; rooftops, balconies, vacant places, in containers, along the railways, below power lines, river banks, school gardens, road strips and others to give us a better understanding on the choice of spaces for farming in Kibera. About 24% of the respondents planted along the river banks such as water lines and sewage lines and19% on the road strips. There was considerable variation in the choice of space for farming between farmers from different age groups (Table 2(iii)). Thirty (30 %) of the older adults (>55 years), did farming on vacant places to 16% of young adults (<35 years).The choice of space also varied significantly amongst different gender groups (p = 0.904), age groups (p = 0.688), marital status (p = 0. 361), education level (p=0.727) occupation (n=0.918) and level of income groups (p = 0.820).

3.3. Reasons/ Benefits for Adoption of Technology

Table3(i). *Frequency distribution on reasons for adoption of urban-technologies, according to social-demographic groups in urban areas, Kasarani*

	Socio-economic characteristics	***Source of food***	***Source of income***	***Unemployment***	***Use of available water and land***	***High dependency***	***Others***
Sex	Male(n=34)	(20)59%	(7)21%	(3)9%	(1)3%	(2)6%	(1)3%
	Female(n=104)	(81)78%	(11)11%	(2)2%	(1)1%	(6)6%	(3)3%
	Total(n=138)	(101)73%	(18)13%	(5)4%	(2)1%	(8)6%	(4)3%
	P value	0.199					
Age	Young adults(n=31)	(19)61%	(5)16%	(2)7%	(1)3%	(4)13%	(0)0%
	Middle aged adults(n=96)	(73)76%	(12)13%	(3)3%	(1)1%	(4)4%	(3)3%
	Older adults(n=11)	(9)82%	(1)9%	(0)0%	(0)0%	(0)0%	(1)9%
	P value	0.34					
Marital status	Single(n=13)	(9)69%	(3)23%	(1)8%	(0)0%	(0)0%	(0)0%
	Married(n=98)	(70)71%	(12)12%	(4)4%	(2)2%	(8)8%	(2)2%
	Divorced/separated(n=4)	(3)75%	(0)0%	(0)0%	(0)0%	(0)0%	(1)25%
	Widowed(n=23)	(19)83%	(3)13%	(0)0%	(0)0%	(0)0%	(1)4%
	P value	0.439					
Educational Level	Non formal education(n=8)	(6)75%	(1)13%	(0)0%	(0)0%	(0)0%	(1)13%
	Primary(n=16)	(13)81%	(3)19%	(0)0%	(0)0%	(0)0%	(0)0%
	Secondary(n=41)	(32)78%	(2)5%	(2)5%	(1)2%	(4)10%	(0)0%
	Tertiary(n=73)	(50)69%	(12)16%	(3)4%	(1)1%	(4)6%	(3)4%
	P value	0.645					
Occupation	Trading(n=48)	(35)73%	(7)15%	(1)2%	(1)2%	(3)6%	(1)2%
	Farming(n=2)	(0)0%	(0)0%	(1)50%	(0)0%	(0)0%	(1)50%
	Driving(n=3)	(0)0%	(2)67%	(0)0%	(0)0%	(1)33%	(0)0%
	Civil Service(n=30)	(22)73%	(3)10%	(1)3%	(1)3%	(3)10%	(0)0%
	Barbing(n=1)	(1)100%	(0)0%	(0)0%	(0)0%	(0)0%	(0)0%
	Unemployed(n=16)	(13)81%	(0)0%	(2)13%	(0)0%	(0)0%	(1)1%
	Others(n=38)	(30)79%	(6)16%	(0)0%	(0)0%	(1)3%	(1)3%
	P value	P<0.05					
Level of income (Kshs)	Less than 5,000(n=3)	(3)100%	(0)0%	(0)0%	(0)0%	(0)0%	(0)0%
	5,001-10,000(n=5)	(2)40%	(3)60%	(0)0%	(0)0%	(0)0%	(0)0%
	10,001-15,000(n=18)	(14)78%	(1)6%	(1)6%	(0)0%	(1)6%	(1)6%
	15,001-20,000(n=31)	(22)71%	(4)13%	(1)3%	(0)0%	(3)10%	(1)3%
	20,001-25,000(n=28)	(24)86%	(2)7%	(0)0%	(0)0%	(2)7%	(0)0%
	25,001-30,000(n=19)	(11)58%	(3)16%	(1)5%	(2)11%	(1)5%	(1)5%
	30,001-35,000(n=13)	(12)92%	(0)0%	(1)8%	(0)0%	(0)0%	(0)0%
	35,001-40,000(n=9)	(6)67%	(0)0%	(1)11%	(0)0%	(1)11%	(1)11%
	40,001-45,000(n=5)	(3)60%	(2)40%	(0)0%	(0)0%	(0)0%	(0)0%
	45,001-50,000(n=4)	(2)50%	(2)50%	(0)0%	(0)0%	(0)0%	(0)0%
	More than 50,000(n=3)	(2)67%	(1)33%	(0)0%	(0)0%	(0)0%	(0)0%
	P value	0.503					

*p<0.05

Source: *survey, August, 2017*

In the analysis of the main reasons for adoption of urban horticultural technologies, the farmers' responses were varied in Kasarani. They are categorized into a source of food, source of income, unemployment, use of available water and land and high dependence. About 73% respondents said the source of food is the main reason for adoption of urban horticultural technologies, followed by 'source of income' (13%), and about 6% and 4% indicated high dependency and unemployment respectively (Table 3 i). Reason for adoption varied significantly amongst different social demographic groups, sex groups (p = 0.199), age groups (p = 0.34), and occupation groups (p < 0.05).

Table3(ii). *Frequency distribution on reasons for adoption of urban-technologies, according to social-demographic groups in urban areas, Mathare*

	Socio-economic characteristics	Source of food	Source of income	Unemployment	Use of available water and land	High dependency	Others
sex	Male(n=61)	48(79%)	5(8%)	5(8%)	1(2%)	0(0%)	2(3%)
	Female(n=134)	101(75%)	19(14%)	2(2%)	4(3%)	3(2%)	5(4%)
	Total(n=195)	149(76%)	24(12%)	7(4%)	5(3%)	3(2%)	7(4%)
	P value	0.145					
Age	Young adults(n=49)	33(67%)	9(18%)	2(4%)	4(8%)	0(0%)	1(2%)
	Middle aged adults(n=132)	104(49%)	13(10%)	5(4%)	1(1%)	3(2%)	6(5%)
	Older adults(n=14)	12(86%)	2(14%)	0(0%)	0(0%)	0(0%)	0(0%)
	Total(n=195)	149(76%)	24(12%)	7(4%)	5(3%)	3(2%)	7(4%)
	P value	0.043					
Marital status	Single(n=22)	17(77%)	5(23%)	0(0%)	0(0%)	0(0%)	0(0%)
	Married(n=144)	109(76%)	16(11%)	5(4%)	4(3%)	3(2%)	7(5%)
	Divorced/separated(n=10)	9(90%)	0(0%)	1(10%)	0(0%)	0(0%)	0(0%)
	Widowed(n=19)	14(74%)	3(16%)	1(5%)	1(5%)	0(0%)	0(0%)
	P value	0.766					
Education level	Non formal education(n=16)	12(75%)	3(19%)	1(6%)	2(13%)	1(6%)	2(13%)
	Primary(n=26)	20(77%)	6(23%)	2(7%)	1(4%)	0(0%)	1(4%)
	Secondary(n=108)	85(79%)	11(10%)	4(4%)	1(1%)	0(0%)	3(3%)
	Tertiary (n=45)	32(71%)	4(9%)	0(0%)	1(2%)	2(4%)	1(2%)
	P value	0.617					
Occupation	Trading(n=87)	63(72%)	13(15%)	2(2%)	2(2%)	2(2%)	5(6%)
	Farming(n=4)	4(100%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)
	Driving(n=4)	3(75%)	1(25%)	0(0%)	0(0%)	0(0%)	0(0%)
	Civil Service(n=25)	16(64%)	5(20%)	1(4%)	2(8%)	0(0%)	1(4%)
	Barbing(n=2)	1(50%)	1(50%)	0(0%)	0(0%)	0(0%)	0(0%)
	Unemployed(n=28)	24(86%)	2(7%)	1(4%)	0(0%)	0(0%)	1(4%)
	Others(n=45)	38(84%)	2(4%)	3(7%)	1(2%)	1(2%)	0(0%)
	P value	0.984					
Level of income (Kshs)	Less than 5,000(n=11)	8(73%)	2(18%)	0(0%)	1(9%)	0(0%)	0(0%)
	5,001-10,000(n=23)	17(74%)	2(9%)	0(0%)	2(9%)	0(0%)	2(9%)
	10,001-15,000(n=41)	34(83%)	5(12%)	1(2%)	0(0%)	0(0%)	1(2%)
	15,001-20,000(n=39)	31(80%)	3(8%)	2(5%)	1(3%)	0(0%)	2(5%)
	20,001-25,000(n=19)	16(84%)	2(11%)	1(5%)	0(0%)	0(0%)	0(0%)
	25,001-30,000(n=12)	10(8%)	2(17%)	0(0%)	0(0%)	0(0%)	0(0%)
	30,001-35,000(n=16)	10(6%)	4(25%)	0(0%)	1(6%)	0(0%)	1(6%)
	35,001-40,000(n=14)	10(7%)	1(7%)	1(7%)	0(0%)	1(7%)	1(7%)
	40,001-45,000(n=6)	4(67%)	1(17%)	1(17%)	0(0%)	0(0%)	0(0%)
	45,001-50,000(n=8)	6(75%)	2(25%)	0(0%)	0(0%)	0(0%)	0(0%)
	More than 50,000(n=6)	3(50%)	0(0%)	1(17%)	0(0%)	2(33%)	0(0%)
	P value	0.011					

*p<0.05

Source: *Survey, August 2017*

The analysis of the main reasons for adoption of urban horticultural technologies showed that the farmers' responses were varied in Mathare. They are categorized into a source of food, source of income, unemployment, use of available water and land and high dependence. About 76% respondents said the source of food as the main reason for adoption of urban horticultural technologies, followed by 'source of income' (12%), and about 7% indicated unemployment (Table 3 ii). Reason for adoption varied significantly amongst different social demographic groups, sex groups (p = 0.145), age groups (p = 0.043), and level of income (p = 0.011).

Table3(iii). *Frequency distribution on reasons for adoption of urban-technologies ,according to social-demographic groups in urban areas, Kibera*

	Socio-economic characteristics	Source of food	Source of income	Unemployment	Use of available water and land	High dependency	Others
Sex	Male(n=74)	52(70%)	9(12%)	4(5%)	1(1%)	1(1%)	7(10%)
	Female(n=173)	123(71%)	28(16%)	6(4%)	4(2%)	5(3%)	7(4%)
	Total(n=247)	175(71%)	37(15%)	10(4%)	5(2%)	6(2%)	14(6%)
	P value	0.484					
Age	Young adults(n=64)	37(58%)	17(7%)	2(3%)	3(5%)	1(2%)	4(6%)
	Middle aged (n=160)	120(75%)	18(11%)	8(5%)	2(1%)	4(3%)	8(5%)
	Older adults(n=23)	18(78%)	2(9%)	0(0%)	0(0%)	1(4%)	2(9%)
	Total(n=247)	175(71%)	37(15%)	10(4%)	5(2%)	6(2%)	14(6%)
	P value	0.499					
Marital status	Single(n=40)	30(75%)	5(13%)	1(3%)	2(5%)	1(3%)	1(3%)
	Married(n=170)	115(68%)	28(17%)	9(5%)	3(2%)	3(2%)	12(7%)
	Divorced/separated(n=10)	9(90%)	1(10%)	0(0%)	0(0%)	0(0%)	0(0%)
	Windowed(n=27)	21(78%)	3(11%)	0(0%)	0(0%)	2(7%)	1(4%)
	P value	0.665					
Educational Level	Non formal education(n=23)	16(70%)	4(17%)	0(0%)	0(0%)	1(4%)	2(9%)
	Primary(n=48)	34(71%)	9(19%)	1(2%)	2(4%)	0(0%)	2(4%)
	Secondary(n=129)	96(74%)	16(12%)	6(5%)	1(1%)	4(3%)	6(5%)
	Tertiary(n=47)	29(62%)	8(17%)	3(6%)	2(4%)	1(2%)	4(9%)
	P value	0.744					
Occupation	Trading(n=101)	72(71%)	15(15%)	4(4%)	2(2%)	3(3%)	5(5%)
	Farming(n=3)	2(67%)	1(33%)	2(67%)	0(0%)	0(0%)	0(0%)
	Driving(n=8)	7(88%)	0(0%)	0(0%)	1(13%)	0(0%)	0(0%)
	Civil Service(n=30)	18(60%)	6(20%)	1(3%)	0(0%)	0(0%)	5(17%)
	Barbing(n=5)	4(80%)	1(20%)	0(0%)	0(0%)	0(0%)	0(0%)
	Unemployed(n=36)	22(61%)	7(19%)	3(8%)	1(3%)	2(6%)	1(3%)
	Others(n=64)	51(80%)	6(9%)	2(3%)	1(2%)	1(2%)	3(5%)
	P value	0.197					
Level of income (Kshs)	Less than 5,000(n=20)	15(75%)	3(15%)	0(0%)	1(5%)	1(5%)	0(0%)
	5,001-10,000(n=16)	10(63%)	3(19%)	0(0%)	1(6%)	0(0%)	2(13%)
	10,001-15,000(n=48)	33(69%)	9(19%)	4(8%)	0(0%)	0(0%)	2(4%)
	15,001-20,000(n=42)	35(83%)	4(10%)	2(5%)	0(0%)	0(0%)	1(2%)
	20,001-25,000(n=38)	27(71%)	5(13%)	0(0%)	1(3%)	2(5%)	3(8%)
	25,001-30,000(n=19)	13(68%)	4(21%)	0(0%)	0(0%)	1(5%)	1(5%)
	30,001-35,000(n=14)	7(50%)	1(7%)	0(0%)	1(7%)	1(7%)	4(29%)
	35,001-40,000(n=17)	12(71%)	1(6%)	3(18%)	0(0%)	0(0%)	1(6%)
	40,001-45,000(n=9)	4(45%)	4(45%)	0(0%)	0(0%)	1(11%)	0(0%)
	45,001-50,000(n=13)	10(77%)	2(15%)	0(0%)	1(8%)	0(0%)	0(0%)
	More than 50,000(n=11)	9(82%)	1(9%)	1(9%)	0(0%)	0(0%)	0(0%)
	P value	0.065					

***p<0.05**

Source: *Survey, August 2017*

The analysis of the main reasons for adoption of urban horticultural technologies showed that the farmers' responses were varied. They are categorized into a source of food, source of income, unemployment, use of available water and land and high dependence. About 71% of the respondents said the source of food is the main reason for adoption of urban horticultural technologies, followed by 'source of income' 15% , and about 4% indicated unemployment (Table 3 iii). Reason for adoption varied significantly amongst different social demographic groups, sex groups (p = 0.484), age groups (p = 0.499), and level of income (p = 0.065).

3.4. Challenges Farmers Faced in Adoption of Urban Farming Technologies

Table4. *Frequency distribution on challengesfarmers faced in adopting of urban technologies according to social-demographic groups, Kibera*

	Socio-economic characteristics	Pests & Diseases	Inadequate capital	Slashing crops	security	Inadequate inputs	Inadequate Market	Any other
sex	Male(n=74)	18(24%)	6(8%)	6(8%)	46(62%)	0(0%)	0(0%)	4(5%)
	Female(n=173)	0(0%)	17(10%)	34(20%)	83(48%)	20(12%)	4(2%)	25(15%)
	Total(n=247)	18(7%)	23(9%)	40(16%)	129(52%)	20(8%)	4(2%)	29(12%)
Age	Young adults(n=64)	7(11%)	9(14%)	8(13%)	20(31%)	5(8%)	2(3%)	13(20%)

	Middle aged (n=160)	5(3%)	7(4%)	25(16%)	91(57%)	15(9%)	2(1%)	15(9%)
	Older adults(n=23)	6(26%)	7(30%)	7(30%)	18(78%)	0(0%)	0(0%)	1(4%)
Marital status	Single(n=40)	4(10%)	4(10%)	1(3%)	31(78%)	2(5%)	0(0%)	1(3%)
	Married(n=170)	13(8%)	10(6%)	33(19%)	79(47%)	16(9%)	4(2%)	25(15%)
	Divorced/separated(n=10)	1(10%)	5(50%)	0(0%)	4(40%)	0(0%)	0(0%)	0(0%)
	Widowed(n=27)	0(0%)	4(15%)	6(22%)	15(55%)	2(7%)	0(0%)	3(11%)
Education level	Non formal education(n=23)	6(26%)	10(44%)	1(4%)	10(44%)	1(4%)	0(0%)	0(0%)
	Primary(n=48)	1(2%)	5(10%)	7(15%)	19(40%)	3(6%)	2(4%)	12(25%)
	Secondary(n=129)	5(4%)	7(5%)	25(19%)	69(54%)	10(8%)	2(2%)	15(12%)
	Tertiary(n=47)	6(13%)	1(2%)	7(15%)	29(62%)	6(13%)	0(0%)	2(4%)
Occupation	Trading(n=101)	7(7%)	7(7%)	17(17%)	57(56%)	8(8%)	1(1%)	15(15%)
	Farming(n=3)	1(33%)	0(0%)	0(0%)	1(33%)	0(0%)	0(0%)	3(100%)
	Driving(n=8)	1(13%)	0(0%)	2(25%)	3(38%)	0(0%)	0(0%)	3(38%)
	Civil Service(n=30)	1(3%)	3(10%)	5(17%)	17(57%)	1(3%)	1(3%)	2(7%)
	Barbing(n=5)	0(0%)	2(40%)	1(20%)	1(20%)	0(0%)	0(0%)	1(20%)
	Unemployed(n=36)	0(0%)	7(19%)	4(11%)	18(50%)	4(11%)	1(3%)	4(11%)
	Others(n=64)	8(13%)	6(9%)	11(17%)	32(50%)	7(11%)	1(2%)	1(2%)
Level of income (Kshs)	Less than 5,000(n=20)	3(15%)	0(0%)	0(0%)	18(90%)	0(0%)	0(0%)	0(0%)
	5,001-10,000(n=16)	1(6%)	1(6%)	1(6%)	7(44%)	3(19%)	0(0%)	3(19%)
	10,001-15,000(n=51)	3(6%)	6(12%)	11(22%)	21(41%)	4(8%)	0(0%)	6(12%)
	15,001-20,000(n=42)	0(0%)	2(5%)	7(17%)	23(55%)	3(7%)	3(7%)	2(5%)
	20,001-25,000(n=47)	4(9%)	6(13%)	6(13%)	20(43%)	2(4%)	0(0%)	9(19%)
	25,001-30,000(n=20)	1(5%)	0(0%)	4(20%)	10(50%)	2(10%)	0(0%)	2(10%)
	30,001-35,000(n=15)	1(7%)	2(13%)	3(20%)	5(33%)	1(7%)	0(0%)	1(7%)
	35,001-40,000(n=17)	3(18%)	2(12%)	3(18%)	11(65%)	0(0%)	0(0%)	0(0%)
	40,001-45,000(n=9)	0(0%)	1(11%)	3(33%)	4(44%)	2(22%)	0(0%)	1(11%)
	45,001-50,000(n=13)	2(15%)	1(8%)	0(0%)	5(39%)	3(23%)	1(8%)	1(8%)
	More than 50,000(n=11)	0(0%)	2(18%)	2(18%)	5(46%)	0(0%)	0(0%)	1(9%)

N:B These responses may not add to 100%,because some respondents gave more than one response(multiple response)

Source: *Survey, August 2017*

Data on table 4 shows that 52% of the respondents felt that security of land ownership and theft of crops were the most severe challenges for urban horticulture. Other challenges are slashing of crops (16%), pest and diseases (7%), while only 2% mentioned inadequate market for vegetables. Those, whose level of income was less than 5,000, indicated that security and pests as well as diseases as the main challenges at 18% and 15% respectively.

3.5. Kind of Vegetables Grown

Table 5. *Distribution frequency of kind of vegetables grown according to social-demographic groups, Mathare*

	Socio-economic characteristics	Kales	Spinach	Onions	Amaranth	Pumpkin	Green beans	Pepper	others
Sex	Male(n=61)	61(100%)	35(57%)	16(26%)	30(49%)	0(0%)	0(0%)	4(7%)	6(10%)
	Female(n=134)	96(72%)	80(60%)	33(25%)	24(18%)	41(31%)	12(9%)	5(4%)	15(11%)
	Total(n=195)	157(81%)	115(59%)	49(25%)	54(28%)	41(21%)	12(6%)	9(5%)	21(11%)
Age	Young adults(n=49)	49(100%)	29(59%)	10(20%)	12(24%)	0(0%)	0(0%)	4(8%)	9(18%)
	Middle aged adults(n=132)	106(80%)	74(56%)	39(30%)	36(27%)	41(31%)	12(9%)	5(4%)	8(6%)
	Older adults(n=14)	2(14%)	12(86%)	0(0%)	6(43%)	0(0%)	0(0%)	0(0%)	4(29%)
Marital status	Single(n=22)	22(100%)	12(55%)	6(27%)	13(59%)	0(0%)	0(0%)	3(14%)	2(14%)
	Married(n=144)	124(86%)	82(57%)	42(29%)	32(22%)	41(29%)	12(8%)	6(4%)	11(8%)
	Divorced/separated(n=10)	6(60%)	6(60%)	0(0%)	3(30%)	0(0%)	0(0%)	0(0%)	5(50%)
	Widowed(n=19)	5(26%)	15(79%)	1(5%)	6(32%)	0(0%)	0(0%)	0(0%)	3(16%)
Occupation	Trading(n=87)	77(86%)	48(55%)	32(37%)	37(43%)	2(2%)	0(0%)	7(8%)	19(22%)
	Farming(n=4)	2(50%)	1(25%)	1(25%)	2(50%)	1(25%)	0(0%)	0(0%)	0(0%)
	Driving(n=4)	2(50%)	1(25%)	1(25%)	2(50%)	2(50%)	0(0%)	0(0%)	0(0%)
	Civil Service(n=25)	20(80%)	18(72%)	3(12%)	4(16%)	11(44%)	0(0%)	2(8%)	1(4%)
	Barbing(n=2)	2(100%)	1(50%)	1(50%)	0(0%)	1(50%)	0(0%)	0(0%)	0(0%)
	Unemployment(n=28)	28(100%)	17(61%)	7(25%)	1(4%)	13(46%)	6(21%)	0(0%)	0(0%)
	Others(n=45)	26(58%)	29(64%)	4(9%)	8(18%)	11(24%)	6(13%)	0(0%)	17(38%)
Level of education	Non formal education(n=16)	16(100%)	10(63%)	0(0%)	9(56%)	1(6%)	1(6%)	1(6%)	2(13%)
	Primary(n=26)	26(100%)	15(58%)	8(31%)	13(50%)	4(15%)	1(4%)	2(8%)	3(12%)
	Secondary(n=108)	89(82%)	61(57%)	37(34%)	24(22%)	29(27%)	4(4%)	6(6%)	7(7%)
	Tertiary(n=45)	26(58%)	29(64%)	4(9%)	7(16%)	7(16%)	6(13%)	0(0%)	9(20%)

Level of income (Kshs)	Less than 5,000(n=11)	11(100%)	2(18%)	0(0%)	7(64%)	0(0%)	0(0%)	0(0%)	5(46%)
	5,001-10,000(n=23)	23(100%)	12(52%)	5(22%)	11(48%)	0(0%)	0(0%)	3(13%)	3(13%)
	10,001-15,000(n=41)	37(90%)	26(63%)	21(51%)	6(15%)	0(0%)	0(0%)	3(7%)	4(10%)
	15,001-20,000(n=39)	24(62%)	22(56%)	7(18%)	10(26%)	20(51%)	0(0%)	2(5%)	1(3%)
	20,001-25,000(n=19)	12(63%)	15(79%)	6(32%)	3(16%)	15(79%)	0(0%)	1(5%)	2(11%)
	25,001-30,000(n=12)	10(83%)	10(42%)	4(33%)	2(17%)	3(25%)	4(33%)	0(0%)	1(8%)
	30,001-35,000(n=16)	14(88%)	8(50%)	5(31%)	2(13%)	3(19%)	8(50%)	0(0%)	0(0%)
	35,001-40,000(n=14)	12(86%)	2(14%)	0(0%)	4(29%)	0(0%)	0(0%)	0(0%)	1(7%)
	40,001-45,000(n=6)	6(100%)	5(83%)	0(0%)	4(67%)	0(0%)	0(0%)	0(0%)	2(33%)
	45,001-50,000(n=8)	5(63%)	4(50%)	1(13%)	5(63%)	0(0%)	0(0%)	0(0%)	1(13%)
	More than 50,000(n=6)	3(50%)	6(100%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	1(17%)

N:B These responses may not add to 100%,because some respondents gave more than one response(multiple response)

Data from table 5 show that 81% the respondents grow kales as a major vegetable while 59% indicated that they grow spinach, 41% grow onions and 16% grow green beans. Other crops grown by respondents include tomatoes, carrots, spider plant and cabbage at 11%. On gender, majority of the respondents grew kales at 72% for female and male at 100%.

3.6. Method of Technology Transfer of Respondents

Table6. *Distribution frequency on mode of Technology transfer according to social-demographic groups in Kasarani*

	Socio-economic characteristics	***Authority***	***Tenacity***	***Experience***	***Induction***	***Deduction***	***Scientific Method***
Sex	Male(n=34)	(11)32%	(10)29%	(1)3%	(3)9%	(4)12%	(5)15%
	Female(n=104)	(30)29%	(27)26%	(20)19%	(7)7%	(8)7%	(12)12%
	Total(n=138)	(41)30%	(37)27%	(21)15%	(10)7%	(12)9%	(17)12%
Age	Young adults(n=31)	(13)42%	(6)19%	(4)13%	(2)7%	(2)7%	(4)13%
	Middle aged adults(n=96)	(25)26%	(28)29%	(14)15%	(8)8%	(9)9%	(12)39%
	Older adults(n=11)	(3)27%	(3)27%	(3)27%	(0)0%	(1)9%	(1)9%
	Total(n=138)	(41)30%	(37)27%	(21)15%	(10)7%	(12)9%	(17)12%
Marital status	Single(n=13)	(2)15%	(3)23%	(5)39%	(1)7%	(1)7%	(1)7%
	Married(n=98)	(33)34%	(25)26%	(14)14%	(7)7%	(8)8%	(11)11%
	Divorced/separated(n=4)	(0)0%	(3)75%	(1)25%	(0)0%	(0)0%	(0)0%
	Widowed(n=23)	(6)26%	(6)26%	(1)4%	(2)9%	(3)13%	(5)22%
Educational Level	Non formal education(n=8)	(1)12%	(4)25%	(1)12%	(1)12%	(0)0%	(1)12%
	Primary(n=16)	(3)19%	(4)25%	(3)19%	(1)6%	(3)19%	(2)13%
	Secondary(n=41)	(13)32%	(12)29%	(6)15%	(3)7%	(2)5%	(5)12%
	Tertiary(n=73)	(24)33%	(17)23%	(11)15%	(5)7%	(7)10%	(9)12%
Occupation	Trading(n=48)	(15)31%	(15)31%	(4)8%	(3)6%	(6)12%	(5)10%
	Farming(n=2)	(0)0%	(1)50%	(0)0%	(0)0%	(0)0%	(1)50%
	Driving(n=3)	(0)0%	(1)33%	(2)67%	(0)0%	(0)0%	(0)0%
	Civil Service(n=30)	(8)27%	(10)33%	(6)20%	(2)7%	(3)10%	(1)3%
	Barbing(n=1)	(0)0%	(0)0%	(0)0%	(1)100%	(0)0%	(0)0%
	Unemployed(n=16)	(4)25%	(4)25%	(2)13%	(2)13%	(1)6%	(3)19%
	Others(n=38)	(14)37%	(6)16%	(7)18%	(2)5%	(2)5%	(7)18%
Level of Income (Kshs)	Less than 5,000(n=3)	(2)67%	(0)0%	(0)0%	(0)0%	(1)33%	(0)0%
	5,001-10,000(n=5)	(2)40%	(1)20%	(0)0%	(2)40%	(0)0%	(0)0%
	10,001-15,000(n=18)	(3)17%	(8)44%	(3)16%	(1)6%	(2)11%	(1)6%
	15,001-20,000(n=31)	(10)32%	(9)29%	(5)16%	(1)3%	(5)16%	(1)3%
	20,001-25,000(n=28)	(8)29%	(5)18%	(4)14%	(0)0%	(4)14%	(7)25%
	25,001-30,000(n=19)	(7)37%	(5)26%	(4)21%	(2)11%	(0)0%	(1)5%
	30,001-35,000(n=13)	(3)23%	(3)23%	(1)8%	(1)8%	(0)0%	(5)39%
	35,001-40,000(n=9)	(3)33%	(1)11%	(3)33%	(1)11%	(0)0%	(1)11%
	40,001-45,000(n=5)	(0)0%	(3)60%	(0)0%	(1)20%	(0)0%	(1)20%
	45,001-50,000(n=4)	(2)50%	(1)25%	(0)0%	(1)25%	(0)0%	(0)0%
	More than 50,000(n=3)	(1)33%	(1)33%	(1)33%	(0)0%	(0)0%	(0)0%

Source: *Survey, August 2017*

Most of the sampled respondents (41%) acquired knowledge through authority, Tenacity 27%, and induction 7%.The majority of younger adults (42%) acquired knowledge through Authority (Table 6), while the majority of middle aged adults (29%) acquired knowledge through Tenacity. On the level of education, the majority (33%) of those who had attained tertiary as the highest level of education acquired horticultural technology through authority, while those with non-formal education majority (25%) acquired through tenacity.

3.7. Respondentsby Last Place of Residence

Table7. *Distribution frequency of last place of residence before residing on the current place according to social-demographic groups, Kibera*

	Socio-economic characteristics	Other places in Nairobi	Rural areas	Other urban areas
Sex	Male(n=74)	20(3%)	37(50%)	17(23%)
	Female(n=173)	39(23%)	84(49%)	50(29%)
	Total(n=247	59(24%)	121(49%)	67(27%)
Age	Young adults(n=64)	17(27%)	31(48%)	16(25%)
	Middle aged (n=160)	39(24%)	75(47%)	46(29%)
	Older adults(n=23)	3(13%)	15(65%)	5(22%)
Marital status	Single(n=40)	11(28%)	22(55%)	7(18%)
	Married(n=170)	36(21%)	84(49%)	50(29%)
	Divorced/separated(n=10)	2(20%)	4(40%)	4(40%)
	Widowed(n=27)	10(37%)	11(41%)	6(22%)
Education Level	Non formal education(n=23)	7(30%)	10(43%)	6(26%)
	Primary(n=48)	17(35%)	21(44%)	10(21%)
	Secondary(n=129)	26(20%)	68(53%)	35(27%)
	Tertiary(n=47)	9(19%)	22(47%)	16(34%)
Occupation	Trading(n=101)	25(25%)	49(49%)	27(27%)
	Farming(n=3)	2(67%)	0(0%)	1(33%)
	Driving(n=8)	2(25%)	3(38%)	3(38%)
	Civil Service(n=30)	9(30%)	12(40%)	8(27%)
	Barbing(n=5)	1(20%)	3(60%)	1(20%)
	Unemployed(n=36)	6(17%)	22(61%)	9(25%)
	Others(n=64)	14(22%)	6(9%)	5(8%)
Level of income (Kshs)	Less than 5,000(n=20)	4(20%)	14(70%)	2(10%)
	5,001-10,000(n=16)	5(31%)	5(31%)	6(38%)
	10,001-15,000(n=48)	11(23%)	26(54%)	11(23%)
	15,001-20,000(n=42)	11(26%)	21(50%)	10(24%)
	20,001-25,000(n=38)	8(21%)	18(47%)	12(32%)
	25,001-30,000(n=19)	3(16%)	9(47%)	7(37%)
	30,001-35,000(n=14)	6(43%)	6(43%)	2(14%)
	35,001-40,000(n=17)	4(24%)	8(47%)	5(29%)
	40,001-45,000(n=9)	2(22%)	4(44%)	3(33%)
	45,001-50,000(n=13)	2(15%)	7(54%)	4(31%)
	More than 50,000(n=11)	1(9%)	7(64%)	3(27%)

Source: *Survey, August 2017*

As shown in Table 7 above, 49% came from the rural areas, 27% from other locations of urban areas, and 24% from other places within Nairobi. The majority of younger adults and middle aged adults came from rural areas at 48% and 47% respectively, while 13% of older adults came from other places in Nairobi areas.

4. Summary and Conclusions

4.1. Respondents Characteristics

It is apparent that the majority of respondents were females. This suggests that urban horticulture is dominated by females who in most cases are married with household care giving responsibilities. This agrees with (Lee-Smith and Prain., 2010) who indicated that in sub-Saharan Africa, studies of urban agriculture have been limited, but those that have been done generally suggest that approximately one-third of households are engaged in some form of urban agriculture, and that two third of the farmers are women. Urban farming also favors both social inclusion and reduction of gender inequalities in cities as 65% of urban farmers are women (Orsini et al. 2013). It is because of the close proximity to the home, gardening can be much better combined with child care which is still seen as a woman's duty in many countries (Dubbeling, de Zeeuw and van Veenhuizen, 2010). (Barau and Oladeji, 2017) found that 69.4% of the females who were doing farming were married in Sokoto Metropolis, Nigeria.

It is clear that the majority of the respondents are middle aged adults and education level ranging from informal to post-secondary. Accessing land for farming in urban areas requires energy, determination and maturity. The finding agrees with (Barau and Oladeji, 2017) who found that most of the urban women farmers (38.9%) were in the active age range and also (Teig et al., 2009) found that the

majority of community gardeners are seniors. Age is also assumed to be a determinant of adoption of new technology. Older farmers are assumed to have gained knowledge and experience over time and are better able to evaluate technology information than younger farmers (Kariyasa & Dewi, 2013). On the other hand, age has been found to have a negative relationship with adoption of technology. This relationship is explained by Thomas et al., (2017) that as farmers grow older, there is an increase in risk aversion and a decreased interest in long term investment in the farm. While the, younger farmers are typically less risk-averse and are more willing to try new technologies. On education, it is evident from the findings that the farmers are spread all over education level. The findings outlined are in agreement with the observation in Accra, urban farmers interviewed had no particular educational pattern (World Bank, 2013).

4.2. Space Identified for Production of Vegetables

A renovated urban farming arose worldwide as a response to a number of factors (Bohn and Viljoen 2011). In city centres, the inadequate space has been a major challenge in the diffusion of agricultural activities (Christine & Nazim G. 2015). In order to utilize the available vacant urban spaces as efficiently as possible, new cultivation methods are required (Christine & Nazim G. 2015). As a result, the introduction of horticulture activities in available spaces in cities has recently been observed in both land-based and non-land-based vacant spaces. First, non-constructed areas (e.g., abandoned plots, green spaces or interstitial areas) are being converted into urban gardens when available and vacant. Second, innovative methods for turning concrete into urban green infrastructures for vegetable production have been developed in the recent past, ranging from vertical farms (Despommier, 2011) to the most ordinary rooftop gardens. The study carried in Nairobi found that urban agriculture is practiced in backyard farms, on open spaces under power lines, along roadsides, along railway lines and riverbanks as well as on institutional land (World bank, 2013).Vacant spaces in cities should also be considered as possible alternative of reducing pressure from rural agriculture and to decompensate land loss (Christine & Nazim G. 2015), by turning vacant lots into urban vegetable gardens, food security and sustainability are increased.

Fig1. *A farmer watering sukuma wiki at Mwiki*
Source: Survey, August 2017

Fig2. *A farmer attending to cowpeas at Mwiki*
Source: Survey, August 2017 .

Gender, age, marital status, education level, occupation and level of income had non-significant to space where production of vegetables is done. This may suggest that due to limited space in urban areas for farming, farmers have no choice other than using the available space.

4.3. Reason for Adoption of Urban Technologies

Golden (2013) found that urban dwellers can benefit from urban farming through accessing land, community development, cross-generational and cultural integration, job creation, and economic savings on food. Municipal authorities can also benefit from urban agriculture through savings (Chaminuka & Dube 2017). Land for farming is limited in urban areas, urban farming creates access to land by creating space within cities for farming. Urban agriculture can benefit urban dwellers through accessing land for them to call their own, thereby creating some sense of pride through ownership of the land (Chaminuka & Dube 2017).

Food access and availability are important dimensions that constitute food security (Chaminuka & Dube 2017). Urban horticultural has been viewed as an intervention to deal with food security. It has been used as an effective means for improving food security in critical and insecure areas (Corrigan, 2011; Larsen & Gilliland, 2009). Matteson (2007) found that, above 700 community gardens exist in

New York City, which have increased food access and availability to urban dwellers. Apart from improving food access and availability, urban agriculture is also important in job creation. Hagey, Rice, S. & Flournoy (2012) indicates that urban agriculture that offers packaging and processing, to complement crop cultivation is capable of creating many jobs for urban residents. Metcalf and Widener (2011) argues that through Job Creation, many urban agriculture projects will engage youths to manage horticultural farms and this will provides them with income above skills training. Urban agriculture can provide savings for county government. For example, the management of vacant lots by communities in San Francisco turned into urban farming areas benefited the Department of Public Works about US$4,100 through preventing vandalism, dumping, and labor-intensive upkeep (SPUR, 2012).

Out of 6 variables studied, occupation in Kasarani, age and level of income in Mathare were significant ($P<0.05$) on adoption of horticultural technologies. Non-significant of gender, marital status and education level observed in this study may indicate that these socio-economic variables definitely do not have any bearing on the adoption of technologies. Majority of the respondents were traders, which may indicate they have flexible time to attend to their crops.

4.4. Challenges Farmers Face in Adoption of Urban Farming Technologies

Limited access to land, lack of tenure on property, and insufficient infrastructure and services for urban growers are among the main restrictions of urban horticulture according to (Lovell, 2010). Land tenure affects the application of technologies for agricultural (Islam & Tuulikki, 2009), secured land tenure gives sufficient incentives to the farmers to increase their efficiencies in terms of production. Without secured property rights farmers do not feel emotional attachment to the land they cultivate, do not invest in land development and will not use inputs efficiently (Islam & Tuulikki, 2009). Theft of crops by non-farmers and stray animals eating crops, are other problems associated with to urban farming (Chaminuka & Dube, 2017).

Urban agriculture is occasionally practiced in public areas unsuitable for housing, such as road verges, banks of drainage channels, wetlands and contaminated sites such as scrap yards and dumpsites for solid and liquid wastes (Nabulo et al., 2008). As such the farmers' crop has at times been slashed down by authorities (Chaminuka & Dube, 2017).

4.5. Kind of Vegetables Grown

Majority of the respondents mentioned kales and spinach. The producers in urban areasgrow more green leafy vegetables, such as kale and spinach (World Bank, 2013) this also agrees with (Gallaher et al., 2015, who indicated that over the past several years, in urban areas especially, indigenous vegetables have been replaced by kale, swisschard, and cabbage. Kales (Sukuma wiki) literally means "to push the week". As the name suggests, low income earners can survive on it by making it a daily meal. Kales due to its low price, it keeps people going hoping for better tomorrow.

The case study in Kibera, households and other institutions like the eco school cultivate crops such as kale and spinach – leafy vegetables which adapts very well to the conditions of sack farming (Erulkar & Matheka 2007).

4.6. Last Place of Residence

Most respondents came from rural areas as a result most households engaging in urban agriculture could be bringing to the city the rural culture of farming to urban areas. Through urban farming, migrants gets opportunity to grow food for consumption purposes and may even sell surpluses (Beckie & Bogdan, 2010), Migrants have important skills and culture which they can share with urban farmers.(Gallaher et al., 2015) found out that the majority of farmers and non-farmers (85% and 75%, respectively) have had previous experience with mixed farming in rural areas, mostly before they migrated to Kibera. A report by World Bank (2013) indicates that most of the residents engaged in urban farming had stayed in the city the longest or always lived there.

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