

**ADOPTION STATUS OF MULTI-STOREY GARDENS AND OPPORTUNITIES FOR
VEGETABLES PRODUCTION IN PUMWANI DIVISION, NAIROBI.**

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N50/CE/11928/07

A Research Project submitted in partial fulfilment of the Degree of Masters of Environmental
Studies (Community Development) in the School of Environmental Studies of Kenyatta
University

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*Adoption Status of
multi-storey gardens*



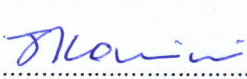
2011/351106

November 2010

DECLARATION

This research project is my original work and has not been presented for a degree in any other university.

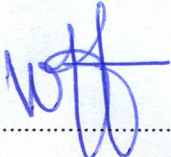
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DEDICATION

This thesis is dedicated to my husband, Mr. Karimi for the many life sacrifices he made to ensure that I achieve my academic excellence. My dear husband you are the source of my inspiration.

This paper is also dedicated to my Children Mercy, Moris, Paul and Evelyne who were always assisting me in my studies encouraging and praying for me. May the Lord continue to bless you all and may He give me strength to be there for you as you have been for me.

ACKNOWLEDGEMENT

First and foremost I thank God for His blessings and giving me the strength and endurance in this process of writing this thesis. I also thank profoundly my supervisors Dr Waswa and Mr. Abwao who gave me remarkable assistance and guidance in the course of my study. To all the respondents who took time out of their busy schedules to answer the questionnaires thank you as without your responses this research would not have been possible to conduct.

To the lecturers, library staff, security and all other Kenyatta University staff and faculty members, am deeply grateful for you assisted me in one way or another during my studies at the University and during my research. May God Bless you abundantly.

My sincere appreciation to my husband who sponsored me for this course and for his encouragement and prayers To my children Maurice, Mercy Paul and Evalyne, am so grateful for always being there for me especially helping me in domestic chores so that I could concentrate with my studies and for your prayers. I also say thank you to my friends who made my student life pleasant. To Carol and Francis, thank you for your encouragement and guidance on tackling exam questions always reminding me to take a break once in a while. My sincere appreciation goes to all my relatives, friends, and colleagues who made my student life pleasant.

May the Lord bless you abundantly

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ACRONYMS AND ABBREVIATIONS

AID	Acquired Immune Deficiency syndrome
CAN	Calcium Ammonium Nitrate fertilizer used for top dressing
DAP	Di Ammonium Phosphate fertilizer used for planting horticultural crops
DESA	Department of Economics and Social Affairs
FAO	Food Agriculture Organization
HIV	Human Immunodeficiency Virus
IFPRI	International food and policy research institute
MOA	Ministry of Agriculture
MSG	Multi-storey garden
UA	Urban Agriculture
UNDP	United Nations Development Programs
UNRISD	United Nations Research Institute for Social Development

ABSTRACT

Pumwani division is one of the areas that have been affected by the high rate of urbanization in Nairobi. Land for agricultural production has greatly reduced posing a threat to food security among the urban poor. The contribution of urban agriculture to food security and nutrition is critical. In the recent past, the government and other stakeholders have enhanced the growth of vegetables by using multi-storey gardens. However the adoption rate among potential users remains low. This research focused on the adoption status of multi-storey gardens in the division with the aim of contributing to scaling-out this technology for increasing vegetable production. A descriptive survey with both quantitative and qualitative aspects was adopted as the research design. Data were gathered using questionnaires, observation and photography from 90 households who live in both formal and informal settlements. Data collected were analyzed using descriptive statistics. The results showed that 80% of the respondents were aware of multi-storey garden farming system but the adoption rate was 60%. This was attributed to the various challenges faced by respondents such as inadequate land size, income and lack of technical skills. It further revealed that those who adopted the technology 65% grew exotic vegetables where 40% used no organic fertilizers. Social factors such as education, age, attitude and customs played a major role in the consumption of the indigenous vegetables in the division. The conclusion drawn from the results of the study was that multi-storey gardens systems were not fully adopted by the community. Most of the farmers grew exotic vegetables and organic fertilizers were not utilized to increase production. Scaling-up and out the multi-storey gardens by planting indigenous vegetables and use of organic fertilizers to increase vegetable production. This would contribute to better health and achieve food security in the division. The researcher recommends that the extension staff on the ground should continue to educate the community on the nutritive importance of indigenous vegetable and need to increase production and consumption. Further they should sensitize and train the community on the available resources that can be utilized to make organic fertilizers locally. City by-laws that do not allow farming should be revised to incorporate urban farming as a mean of improving food security in the urban setting. There is need for further study to assess the effectiveness of extension services in improving food security in the division. More should be done on vegetable value addition to ensure continuous supply throughout the year.

CHAPTER 1: INTRODUCTION

1.1 Background:

High population due to migration into big towns is a common feature in urban areas as people seek for alternative livelihoods due to environmental degradation. They cause pressure on the existing infrastructure and cause an increased in the rate of unemployment. Most of the migrants end up living in informal settlements causing more negative effects on the environment and a decline on people's health. This further limits their productive potentials and end up living in a vicious cycle of extreme poverty and environmental degradation (Roland, 2003).

In Kenya, most people living in big towns are unemployed and poverty levels are alarming with 56% of the population surviving on less than one dollar per day (UN, 2007). Malnutrition in its many forms persists in virtually all parts of the country despite there being a general improvement in food supplies and health conditions, and the increased availability of educational and social services. The gap between the poor and the rich is very wide especially for those communities living in big cities making them to be more disadvantaged (UNDP, 2000). They cannot afford the basic needs and majority live in the slum areas.

Pumwani division is one of the areas that have been affected by the high rate of urbanization. This has reduced land available for food production for the growing population. The resulting intensive farming is widely acknowledged to have negative environmental impacts that are a threat to occupation human systems and are disproportionately felt. The poor are more affected as they rely on natural resources such as land and water to meet their basic needs. The households put too much of their income on purchasing food thus affecting their investment capability.

The contribution of urban agriculture to food security and healthy nutrition is an important asset. It can be considered by the urban poor who are faced by the challenges of inadequate, unreliable and irregular access to food, and the lack of purchasing power. It has been considered an important source of income for a substantial number of urban households when they grow their own food and sell the surplus. (Argenti, 2000 and Mougeot, 2005).

The use of multi-storey gardens is an important technology in urban agriculture as it utilizes the vertical dimension to increase the cropping area. The gardens are made from

sacks, tyres and crates among others where the crops are grown in stairs (plate 1-4). This technology may function as an important strategy for poverty alleviation and social integration of disadvantaged groups such as immigrants, HIV-AIDS affected households, disabled people, female-headed households with children, elderly people without pension and youngsters without a job by integrating them more strongly into the urban network, providing them with a decent livelihood and preventing social problems (Gonzalez and Murphy, 2000).



Plate 1: Kales grown on multi-storey for gardens



Plate 2: Different containers used multi-storey gardens



Plate 3: Indigenous vegetables in a Multi-storey garden



Plate 4: Spinach in a multi-storey garden

According to FAO, 2000 most developing countries consume mainly cereals and root crops for their carbohydrates and very little of meat and vegetables. This has been brought about by over reliance on natural rain for food production by most of the communities. In Pumwani division the price of meats is quite high and ranges between KSH140 - 200 depending on the area, while legumes and vegetables are sourced from the market for the daily food requirement. Urban agriculture can be used to promote vegetable production to enhance on their health as well as uplifting their livelihoods.

In the recent past, the government together with other stakeholders has enhanced the consumption of vegetables through community capacity building on the various methods of production and preservation. However this has been limited by the frequent harsh weather and the reduction of arable land due to other competitive uses. Also the continued production of exotic vegetables such as kale and spinach that require high inputs and have less harvest period further limits the poor farmer's economic and food security status.

According to Chweya, (1999) indigenous vegetables have been accepted by most of the people in their daily meals due to their high nutritive value compared with the exotic ones. They are well adapted to various agro-ecological climatic conditions and production is easy as the local community requires minimum skills and inputs. These plants were gathered in the wild by the women and they could meet their daily vegetable requirements a few weeks after the onset of rains after which only stored roots, cereals and legumes were used for food (IFPRI, 2001). To meet the swelling demand for home consumption and for commercial purpose, the vegetables have been domesticated and are grown just like other subsistence crops using natural rains and irrigation for continuous supply.

Most of the land in the urban areas has been put on building and farming is done as a part time activity on kitchen gardens, along the river banks and on any available space to subsidize on the household income and food availability. According to a recent observation done in the division, there is intensive farming done to meet the high demand where the exotic vegetables such as kales and spinach are mostly grown with only a few farmers growing indigenous ones. The promotion of indigenous vegetable production on multi-storey gardens as a means of increasing the cropping area and having sustainable vegetable production will improve on the community's livelihood.

The adoption of new technologies is an important move towards any positive development. The adoption rate depends on the various characteristics among, which the cost, better benefits and social cultural norms is very important as it determines

acceptability of the innovation. This should be well assessed before a new innovation is introduced to the community. The proper communication channels should be used for the diffusion of information about the new innovation in every community. There are various category/stage of adopters through which an innovation undergoes before it acquires a critical mass for its sustainability (Rogers, 2005).

1.2 Problem Statement and Justification

Pumwani division is experiencing increased population growth due to rapid urbanization resulting in increased demand for vegetables. In their effort to meet their daily food demands households have cultivated on any available space where exotic vegetables have taken an upper arm despite their low nutritive value, high cost of production, less drought resistant and less harvest period. Land for agricultural purpose is also threatened by other alternative uses mainly infrastructure development. In the recent past, new innovations such as multi-storey gardens have been introduced in the division to increase production in order to solve the food problem in the area within the constraints of diminishing land. Adoption of this new technology is quite low despite its potential to increase vegetable production. There is need to identify factors responsible for this scenario.

1.3 Objectives of the Study

The main objective of this study was to assess the status of multi-storey garden systems for intensive production of indigenous vegetables in Pumwani, as a contribution to food security planning among the urban poor. The specific objectives were:

- i) To assess the adoption status of multi-storey gardens in Pumwani division
- ii) To assess factors influencing the adoption of multi-storey garden technologies
- iii) To determine scaling out factors for multi-storey gardening technologies

1.4 Research Questions

This study was guided by the following questions:

- i. What was the adoption status of multi-storey gardens in the division?
- ii. What were the factors influencing adoption of multi-storey garden technologies?
- iii. How could multi-storey gardens be scaled out to increase food production and improve household livelihood?
- iv. What were the social cultural factors affecting consumption of indigenous vegetables?

1.5 Conceptual Framework

To improve on the community's livelihood, various factors have to be considered so that people have enough and balanced diet throughout all seasons. To achieve this, new technologies of farming have to be adopted in order to increase production or the up scaling of the old ones. It is also necessary to conceptualize how the different independent variables (adoption status, scaling-out of multi-storey gardens, sustainable farming and socio-culture) interact to have an effect on the dependant variable (production and consumption of vegetables). In this study various independent variables were considered and their effects on sustainable production and consumption as shown in Figure 1.1 below.

The use of multi-storey gardens for vegetable production in the division has been in place for a number of years. Farmers have been using any container available to grow exotic vegetables such as kales and spinach near their residential houses. Despite the knowledge on this system of farming few farmers have adopted to the technology and hence the need to assess the factors hindering adoption for more food production so as to achieve the millennium goal of alleviating hunger and improved health. The people in the division have very small areas to use as kitchen gardens where they grow vegetables for their home consumption and the excess is sold in the local markets. By promoting production of indigenous vegetables using the multi-storey garden production will increase to meet the increased demand. The vegetables have high nutritive value and better market price hence people's health will improve as well as their economic status.

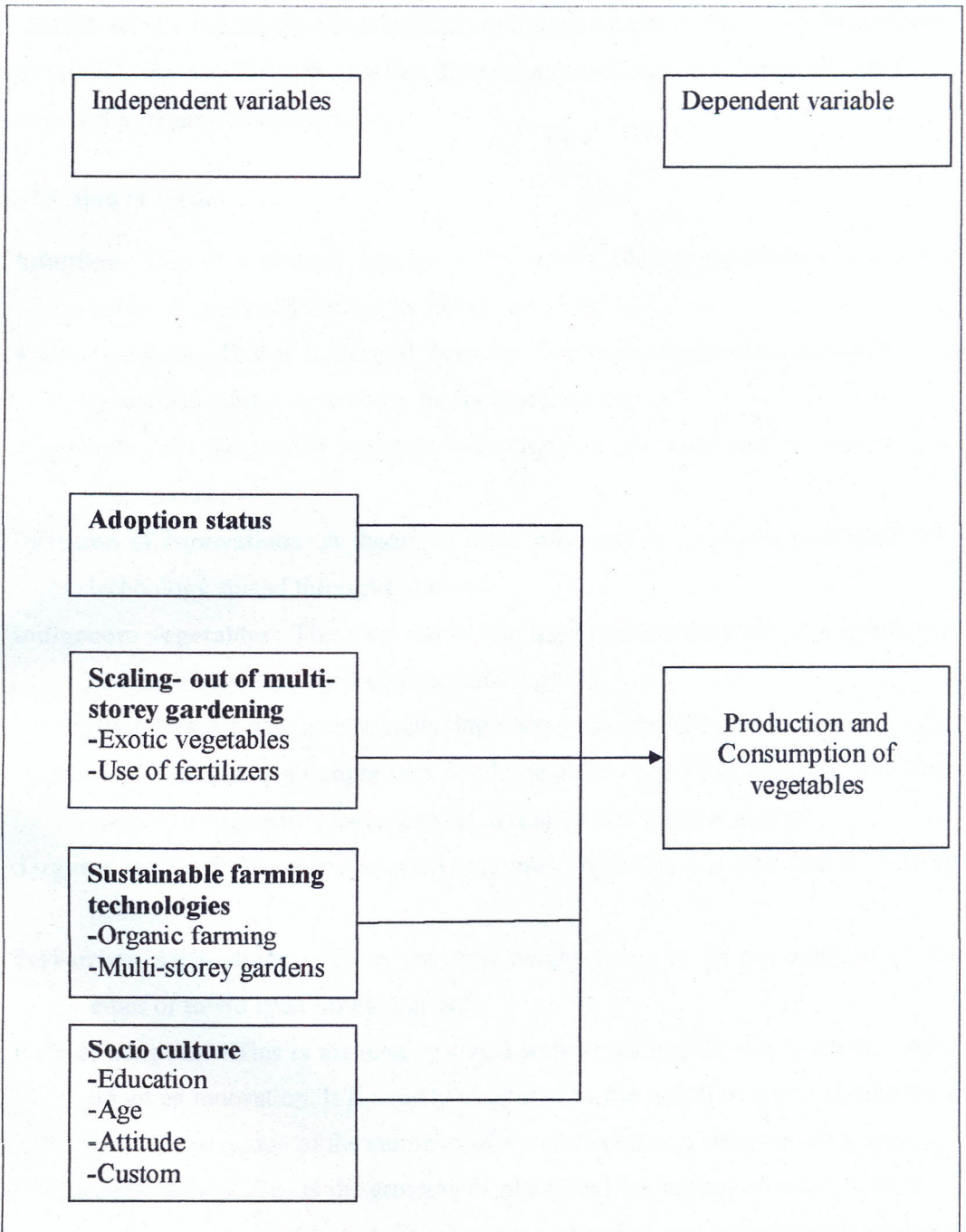


Figure 1.1 Factors influencing production and consumption of indigenous vegetables (Source: Karimi, (2010))

There is need to identify the various resources that are available in the locality that can be utilized to achieve sustainable production for the current generation and that of posterity. These resources can be used to enhance soil fertility and conserve the environment and achieve sustainable livelihood. People’s choices on the vegetable they use in their meals

are affected by various social cultural aspects such as age, economic status, education level, beliefs etc. By identifying the social culture difference that exists, it will be possible to come up with the way forward such that diversity in consumption is achieved and alleviate food insecurity in the division.

1.6 Definition of terms

Adoption- This is a process through which a new idea or technology undergoes before it can be utilized for its fullest potential.

Agro-chemicals- This is a general term for fertilizers, fungicides, pesticides and herbicides used in agriculture for food production.

Amaranth - An Indigenous vegetable with high nutrient value and compatible with other foods.

Diffusion of Innovations- A theory of how, why, and at what rate new ideas and technology spread through cultures.

Indigenous vegetables –These are plants that have evolved naturally in a given area and have been used for a considerable time.

Innovation-This is a new idea or technology being introduced in the society

Multi-storey garden -An upright sack or a large plastic bag filled with soil, with food crops like vegetables, kales, carrots, or onions etc, planted in tiers.

Organic fertilizer -Decomposed plant or animal matter that has nutrients for healthy plant growth.

Peri-urban Agriculture – These are areas neighbouring or on the outskirts of the cities or towns used for agriculture

Rate of adoption - This is the relative speed with which members of a social system adopt an innovation. It is usually measured by the length of time required for a certain percentage of the members of a social system to adopt an innovation

Urban agriculture- This is the growing of plants and the raising of animals for food and other uses within and around cities and towns, and related activities such as the production and delivery of inputs, and the processing and marketing of products

CHAPTER 2: LITERATURE REVIEW

2.1 Role of Food Security in Sustainable urban Livelihoods

Urbanization is the migration of people from the rural areas to the big towns or cities. Migration plays a major role in urban population growth which is driven by the push factors such as decline in agricultural commodity prices, livelihood opportunities and insufficient rural land to confer social standing. Also the pull factors that include prospects for a cash employment in the government and in the available public services in town and the intrinsic excitement of urban areas as well as non-manual employment. This causes an increase in population at the place they migrate to (DESA, 2005).

The human population depends environmental components such as land and water resource for their livelihoods and the maintenance of the carrying capacity of a given area is very crucial to retain the mutual relationship (UNRISD, 1994). The land for agricultural production in the urban areas has reduced considerably due to the changes in land use and farming is no longer an economic livelihood. The little land on farming is highly degraded due to the poor farming methods and the high use of agrochemical. Water which used to supplement natural rain in times of bad weather is little and heavily polluted by both home and industrial wastes emptied into the few rivers in the locality. The food produced is not enough to meet the daily food requirement for the households and supplement is required from the market to meet the deficit. The surplus which used to be stored for future use is no more leaving the community with no safety nets and becoming food insecure, hence no investment for any development.

Most of the community members have lost their livelihoods and poverty levels have increased thus hindering development in the area. According to the government statistic the national poverty seems to have increased from 44% in 1992 to 56% in the year 2002. Nairobi alone registered the highest rate of urbanization (4.5%) with a population of 2.2 million in the year 2000. About 50% of the people living in Nairobi live below the absolute poverty line of less than Kshs. 2648 per month. They are not able to afford the basic needs that are enjoyed by other people; therefore they have to involve themselves with other means of putting food on the table (UN, 2007).

Urban farming though still undervalued and resisted by the public officials is a viable intervention that can be integrated in the small scale projects aimed at achieving food security for the vulnerable groups (UNDP, 2000). Most of the urban poor are

concentrated in the informal settlements (slum areas) where there is no infrastructure and other services that address environmental issues. The families are involved in urban agriculture where 29% grow crops on kitchen gardens 17% keep livestock with maximum utilization of any available space (MOA, 2005). This has resulted in intensive farming which has its own impacts on the environment and human wellbeing.

Despite the healthy and environmental hazards associated with urban agriculture due to the agrochemicals used the advantages outweigh the disadvantages. It provides cheap, fresh and nutritious food, reduces the cost of waste collection, treatment and disposal, and creates agriculture jobs and incomes, non market access to food for the poor consumers. Banning UA is not a solution to the potential problems but there is need to integrate UA into urban management and planning policy. More local policies are needed on the type of crops to be grown and the location.

2.2 Importance of Indigenous Vegetables for Sustainable Livelihoods

Indigenous vegetables are plants that have evolved naturally in a given area and have been used for a considerable time. They have long been considered an important source of human nutrients in their diets and are regarded as food security crops as well as commercial crops (Chweya, 1999). They are considered to be of higher nutritive value compared to other exotic varieties grown by the household as indicated in table 2.1

The vegetable are used to add value to other foods e.g. amaranth which has a high nutritive value with high levels of micronutrients which are required in small amounts but very essential for human health. Its protein content based on dry matter content lies between 20-38% and is rich in lysine which is an essential amino-acid but lacking in most cereals and root based diets (Chweya and Eyzaguirre, 1998). This makes the crop a good remedy for malnutrition cases when incorporated in the other foods. Indigenous vegetables have the following positive qualities:-long harvesting period, easily available, good taste, high yielding, early maturing, resistance to drought and resistance to pests. However they also have a few negative qualities such as stinging hairs, bitter, long preparation process and odour which could limit consumption.

Table 2.1 Mean composition per 100gms edible portion of selected traditional leafy vegetables compared with cabbage and Kales

	Amaranth	African nightshade	Spider plant	Cabbage	kales
Moisture	84	87.2	86.6	91.4	84
Iron(mg)	8.9	1.0	6.0	0.7	1.3
Protein(g)	4.6	4.3	4.8	1.7	3.5
Calories	42	38	34	26	43
Carbohydrates(g)	8.2	5.7	5.2	6.0	0.8
Fibre (g)	1.8	1.3	1.4	1.2	1.6
Vit.c(mg)	64	20	13	54	110
calcium	410	442	288	47	132
phosphorus	103	75	111	40	77
B-carotene(mg)	5716	3660	10452	100	900
Vit-B1	0.05	-	-	0.04	-
Vit-B2	0.42	0.59	-	0.1	-

Source; resource centre for indigenous knowledge (KENRIK), National Museums of Kenya.

Indigenous vegetables have several social economic importance such as income generation, provides employment especially to those in the informal employment in the urban and the peri-urban areas and also the social cultural aspects of the various communities and religions such as in marriages and circumcision ceremonies (Chweya, 1999). The vegetables require less management compared with the exotic vegetables since agrochemicals are not used. They require fertile soils and this is achieved through use of organic manures from any source hence more environment friendly and sustainable.

According to the current market survey done in Pumwani division the indigenous vegetables have a better selling price compared to exotic ones e.g. a kilo of black nightshade costs between Kshs 50-70 while that of kales is between Kshs 10-20. Through increased production and consumption these crops can promote food security and

improve health of the poor as well as promoting the economic value of the vegetables for improved livelihoods (Anonymous, 2000).

2.3 Intensive Sustainable Agricultural Technologies

Modern conventional agriculture can be very expensive for farmers. The cost of inputs such as chemical fertilizers and pesticides continues to rise beyond the ability of the poor smallholders trying to meet their daily food requirement. Furthermore, these inputs can be dangerous to people's health when mishandled and cause environmental pollution. The agrochemicals alter the chemical composition of the soil especially when used intensively leading to poor crop nutrient uptake and hence low yields. In order to alleviate this situation, farmers need to practice alternatives farming technologies which are more environmentally friendly and sustains the present generation's food requirement without compromising that of posterity (Mihindo, 2002).

The application of manures to soil provides potential benefits including improving the fertility, regulates the soil PH, structure, water holding capacity of soil, increasing soil organic matter and reducing the amount of synthetic fertilizer needed(Pham et al, 2002). This enhance better crop production and improve on the environment and hence the achievement of sustainable farming for better livelihoods. There are various sources of organic manure and their nutrient levers depend on the source and the storage conditions as shown in the table 2.2. Poultry manure which has rapid N release is used for crops with high N demands (Mununa and Lekei, 2004).Indigenous vegetables grown for leaf production do very well with poultry manure.

Table 2.2 Major nutrient composition of organic manure (g/kg DM)

Organic manure	N	P	K
Compost (6X)	40.00	11.73	29.10
Chicken Manure	22.61	15.21	28.97
Cow dung	32.55	6.05	56.06
Horse Manure	13.60	64.15	24.68
Sheep Manure	19.26	5.70	22.51
Chicken Manure Pellet	40.00	25.00	23.00

Source: (Mununa and Lekei, 2004)

Use of organic manure in farming provides long-term benefits to people and the environment. This includes increase long-term soil fertility, control pests and diseases without harming the environment, ensure that water stays clean and safe, use resources which the farmer already have in their immediate locality, so the farmer needs less money

to buy farm inputs and produce nutritious and high quality vegetables for the family use and for sale.

2.4 Emerging role of Multi-storey Gardens in food security management

Crop production in smallholdings adjacent to human settlements is the oldest and most enduring form of cultivation. The mid-1980s witnessed a revival of interest in small-scale food production at the farm and household levels. This involves different land use systems around the dwelling units that cater to the subsistence needs of the family. The homestead was defined as the home and its adjoining land owned and occupied by the members of the dwelling unit, including the immediate area surrounding the dwelling unit used for cultivation of trees and vegetables, and unused space, if any (Shehana *et al* ,1992).

The home gardens evolved in response to the pressure of a shrinking land resource base coupled with a high population density .It is mainly a need-oriented, self-provisioning system with minimal chemical use, and the emphasis is more on homemade formulations of biological origin, such as tobacco decoction, Neem extracts, and so on. This helps to minimize pesticide pollution of the agricultural environment. The system is, by and large, environmentally clean and sustainable (Harwood, 1979).

Addressing food insecurity in resource-poor settings is difficult in any context especially in slum areas where land for agriculture is not available and people cannot meet their daily food requirement. This is a big challenge for the government and the other stakeholders and requires new technique/ innovations and strategies to boost food production. The use of intensive multi-storey gardening and at the home level can improve on food security (Zaide, 2005).

The development and adaptation of multi-storey gardens is a new technology that has been tried in various countries to increase food production with success. According to Mary, (2006) Multi-Storey Gardens can be made using any locally available containers. This technology increases the cropping area (one bag hold 200 plants) and yields thereby reducing food insecurity among the landless poor living in urban settings.

In Nairobi North district the adoption of multi-storey gardens in the slum areas as well as in the middle and upper class households is an opportunity which if well utilized would

solve the problem of food insecurity and improve the community's economic status. It uses less water and increases the area under crop. Through promotion of local vegetable production that requires minimum and affordable inputs malnutrition cases will be solved to a big extent which is common in the slums where there is limited or no land for any farming.

Along with benefits already mentioned (dietary diversification, inexpensive and income generation), the approach encourages self reliance and empowers women. Produce can be grown all year round ensuring food security. The concept of micro agriculture using a small amount of space and water remains the central element. This is a low input garden activity that could be targeted at households where labour is constrained, e.g. households with people living with HIV/AIDS or orphans, and should be considered in areas where HIV/ AIDS prevalence is particularly high due to their need of vegetables to boost their immunity

2.5 The Adoption Process

Diffusion of an innovation occurs through a five-step process. It occurs through a series of communication channels over a period of time among the members of a similar social system. This involves knowledge, persuasion, decision, implementation, and confirmation. After the diffusion process the rate at which the community adapts to the new technology is determined by the individual's category of adopters. Individuals who first adopt an innovation require a shorter adoption period (adoption process) than late adopters. Within the rate of adoption there is a point at which an innovation reaches critical mass. This is a point in time within the adoption curve when enough individuals have adopted an innovation. After this the continued adoption of the innovation is self-sustaining (Rogers, 2005). For a new innovation to be adopted it should have the following characteristics:- a relative advantage over the already existing ones, Compatible, not complex, triable and observable. This influences an individual's decision to adopt or reject.

2.6 Social Cultural Factors Affecting Food Consumption

The food habits for different people are as a result of their cultures and traditions. It may be said that cultures and traditional practices are the foundations on which all food choice decisions are built. Some of the largest variations in food choice are due to the boundaries laid down by cultures and traditions because they give us values and beliefs in different

foods and eating patterns. However there are still many differences in food choices, and in food likes and dislikes, among members of the same culture (Khan, 1981).

According to Cox, 1998 the way some types of food are perceived significantly affects procurement and consumption by households. Certain dishes are perceived as “poor people’s food” or “rich people’s food”. In Kenya indigenous vegetable have for long been gathered in the wild by the poor, they never used to be grown for commercial purpose and were not found in the shopping malls where the rich do their shopping, they were branded as food for the poor. Even where such dishes are more nutritious as argued by nutritionists, there is strong resistance to their consumption because of the social class perceptions attached to them. At the opposite end of the spectrum, exotic vegetables based dishes are considered rich people’s food and have for long been in the shopping malls hence more market promotion and consumption. Education can make a person change from lower social strata to a high one. Using the influence theory this can influence a person’s consumption behaviour where certain foods are regarded as poor people’s food. This can have negative influence on choice of vegetables.

Availability of the indigenous vegetables in the local shops, green grocer or super markets for the buyers determines consumption. For individuals depending on public transport or walking to shops, vegetables are heavy and bulky to carry so the expected consumptions are low and higher prices can be expected thus not only affecting the poor but the entire consumers (Cox, 1998). The time available for preparation and consumption of vegetables will determine the choice made by the household for convenience. Exotic vegetables have large size leaves and require less time to prepare and hence more convenient for the working mothers. Most of the local vegetables have small leafs and require more time for preparation explaining the low consumption (Kilcast *et al*, 1996).

2.7 Future of multi-storey gardens in Urban Agriculture

Land for agricultural activities continues to diminish day by day due to the increased rural-urban migration. Also the increased rate of construction which is a more paying enterprise is leaving the poor without space for any farming activities. The use of multi-storey gardens will remain the only option for the poor farmer. Due to the limitation on space the households have to grow crops of high value with a long harvest period such as indigenous vegetables.

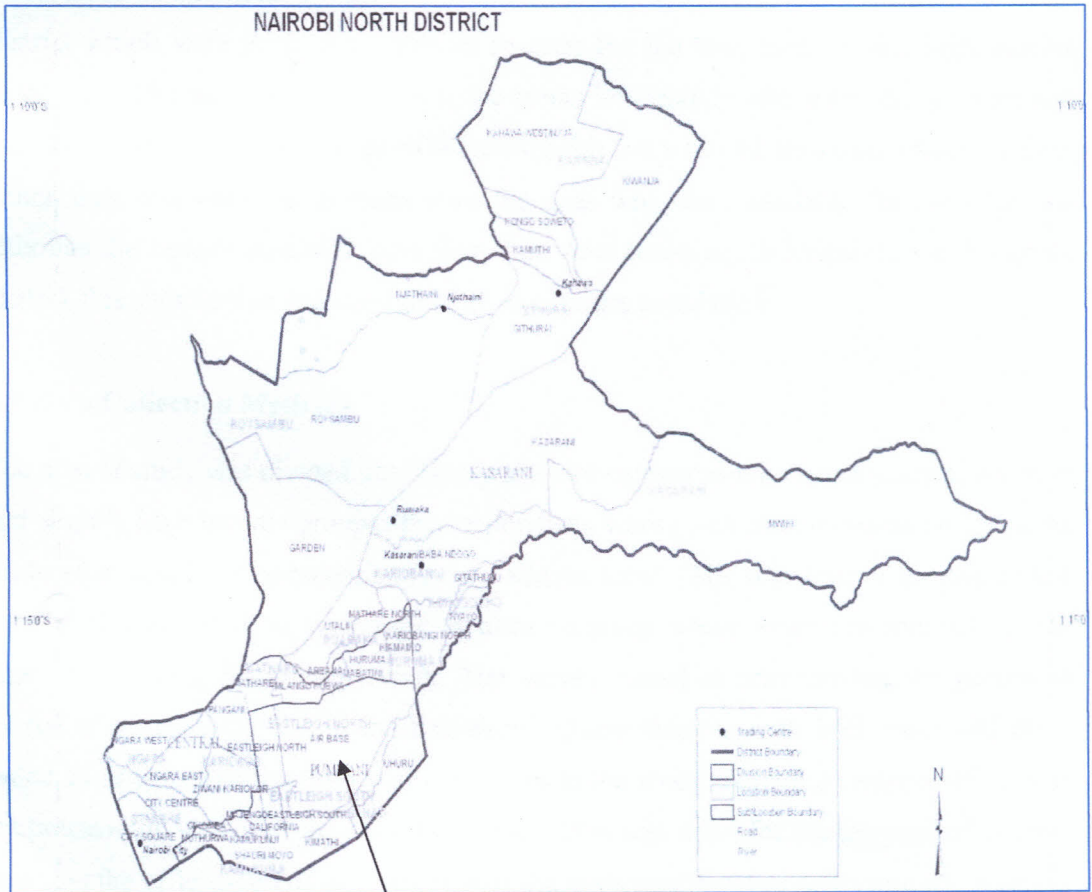
Urban agriculture has multiple roles and functions such as enhancing urban food security, nutrition and health, creating job opportunities and generation of income especially for the urban poor. It also contribute to increased recycling of nutrients (turning urban organic wastes into a resource) and facilitating social inclusion of disadvantaged groups in community development such as urban greening and maintenance of green open spaces.

Although urban agriculture takes place under varying socio-political conditions and policy regimes, urban policy makers and support institutions can substantially contribute to the development of safe and sustainable urban agriculture. This can be achieved through creating a conducive policy environment and formal acceptance of urban agriculture as an urban land use, enhancing access to vacant open urban spaces and the security of agricultural land use, enhancing the productivity and economic viability of urban agriculture by improving access of urban farmers to training, technical advice, and credit, supporting the establishment and strengthening of urban farmer organizations and taking measures that prevent or reduce health and environmental risks associated with urban agriculture through farmer training on health risks and related management practices (Allen, 2001).

CHAPTER 3: METHODOLOGY

3.1 Study Area

The study was conducted in Pumwani division of Nairobi North district in Kenya (Figure 3.1). The division covers an area of 11.7 km² and is on the eastern side of the city. The division has five locations, Bahati, Eastleigh N&S Pumwani and Kamukunji with a total population of 201,783, this poses a big challenge to meet the family's daily food requirement as majority relies on the market supply which does not meet the high demand and other sources apart from the market have to be considered. The area experiences an average daily temperature of 22°C throughout the 24hrs. However this drops to 1 in the month of July and August and 20°C in the month of March. The soils are well drained, deep dark brown to very dark grey friable to firm with a PH range of 5.5-6.8. (Thiang'au and Kibe,1982). This makes the area appropriate for the growth of most of the indigenous vegetables which have a wide range of ecological requirements.



Pumwani

Figure 3.1 Location of Pumwani Division

3.2 The Research Design

The study was carried out using a survey design approach which entails use of broad and reasonably accurate view over a large sample (Mugenda and Mugenda, 1999). It involved planning, organizing, collecting and analyzing data to produce the information the researcher was looking for.

The survey also aimed at carrying out a survey to gather information from the representative sample of the population from which the researcher would be able to generalize findings of larger population as a whole (Bell, 1993).

3.3 Target Population and Sampling Procedure

A target population is the large group to which one wishes to generalize or apply his/her research findings to represent the entire population and a population refers to all the members in the target study (Fraenkel and Wallen, 1993). The study was drawn in the three areas of Kiambiu, Bahati and Kamukunji in Pumwani division of Nairobi North district which were purposively chosen to cater for the low, medium and high income categories. The target population was the urban households who were the growers and consumers of vegetables. A total of 90 households were served with questionnaires from which data was gathered as these were the ones who were available for the interview although the sample size was more than that. And according to Mugenda and Mugenda (1999), this sample size was enough to generalize the population.

3.4 Data Collection Methods

The area of study was divided into three purposive categories which had the low, medium and slightly high income groups. The respondents were given brief explanation about the study after which the questionnaires were administered. The selection of the respondent household was based on systematic random sampling where every 5th respondent was interviewed along the transect walk. The survey aimed at interviewing the person in charge of purchasing food in the household. Questionnaires were both open and close ended so as to get all the information requires in the study. A random sample of 10% of the households was used for the pilot survey. This was done for the purpose of counter checking the efficiency and effectiveness of the tools used for data collection and changes made appropriately.

3.5 Data Analysis Methods

The information gathered based on the study objectives included: the adoption status and factors influence adoption of multi-storey garden, factors to be considered for the scaling up and out, and socio-cultural factors affecting production and consumption. This information was cleaned, coded and entered into Microsoft excel sheet and imported into the statistical package for social sciences (SPSS) program for analysis. This gave descriptive information in form of frequencies distributions, percentages and means which was presented as tables and graphs. The descriptive information gathered which was answering question on what, why, who and how together with the general observation were used to explain further the information gathered quantitatively. All this information gathered was used in the discussion and coming up with conclusion and recommendations based on the study objectives.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results of the study based on the study objectives. It gives an overview of the social-economic characteristics of the community in the study area. The community's adoption of multi-storey gardens as a technology in urban farming and the vegetables grown is assessed by the study. The study further identifies scaling out factors to increase production to improve food security in the division. The chapter also discusses the results of the various items considered linking them with other study section and the literature review based on the study objectives.

4.2 Socio-Demographic Information of the Respondents

This section of study formed the first part of the questionnaire. Socio-demographic information of the respondents gave insightful background information that would help in the interpretation of the findings on their views about multi-storey garden in the right context. Level of education is a vital tool for development. The level of education of respondents in the study was investigated under this section. The results were as indicated in table 4.1

Table 4.1: Level of education of respondents in the division

Level of education	Frequency	Percentage
Primary	54	60
Secondary	29	32
Tertiary	10	11
Others	7	8
Total	90	100

Study findings indicated that 60% of the respondents had attained primary level of education. Those with secondary education were 32% and only 11% had tertiary education while 8% did not attend school. This showed that most of the respondents were employed in the informal sector and there was a high level of unemployment. This could mean that poverty level in the division was very high and most of the households cannot meet their daily food needs.

Monthly income plays a significant role in determining the food security status of the community. This section of the study sought to assess the level of income of the study

respondents. To achieve this, the respondents were asked to approximate their monthly income and indicate accordingly within the income bracket provided. Results were as presented in table 4.2.

Table 4.2 Distribution of respondents Monthly Income

Income level	Frequency	Percentage
Below 2,000	27	30
2001-5,000	42	46.67
5001-10,000	13	14.44
Above 10,000	8	8.89
Total	90	100

The results revealed that most of the respondents were in the low income bracket of between 2000-5000 (46.7%) indicating their dire need to substitute their income so as to meet their daily food requirement. It can be interpreted that income level is an important factor determining the adoption rate of an innovation especially where the immediate needs of the community are met. This was also indicated in the figure 4.8 on multi-storey garden construction where the highest percent of adoption was in the low income level who earned 5000 and below. The mode of employment is an important factor that determines poverty levels and food security status of any community. It also determines how fast an innovation is adopted more so if it requires some initial capital.

The results showed that about three quarters of the total population were employed in the informal sector and a quarter not employed at all (Figure 4.1). The interpretation drawn from the results was that most of the households in the division did not have a reliable source of income and poverty levels were quite high. Most households could not meet the basic needs and promotion and development of multi-storey technology was of great relief to the community in meeting its daily food requirement.

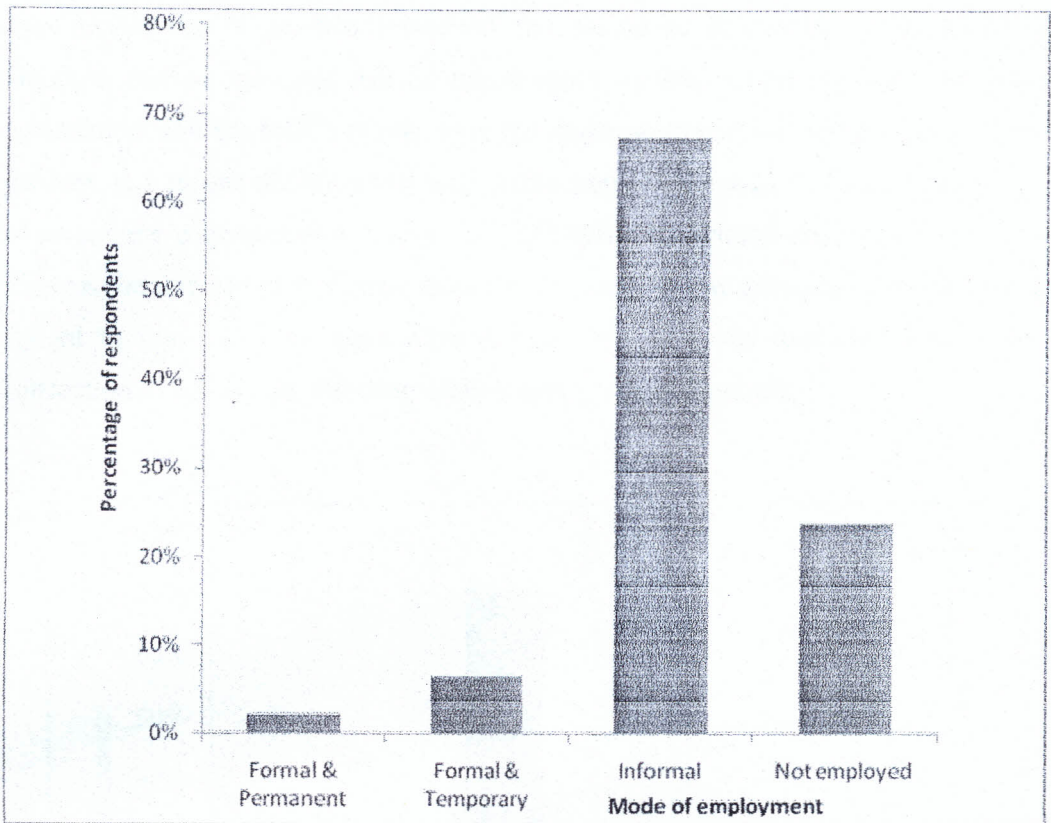


Figure 4.1 Percent mode of employment in the division

4.3 Community Awareness about Multi-storey Gardens

Awareness is a factor that makes an individual to make a decision towards any innovation. The researcher sought to gather this information as it would pave way to identifying other factors affecting the adopting of multi-storey gardens in the division, a technology that could be utilized to boost food production in the urban settings.

Multi-storey awareness was high in the division with 80% of the respondents in the sample being aware. This was associated with the presence of extension staff from both the government and the NGOs currently working in the division as shown in figure 4.2. The awareness was also achieved from friends who had implemented the technology, shows, field days and the media. According to the data collected and the observation made in the division, adoption of the technology was not as high. This showed that other factors influenced the adoption rate of the new innovation in the community. It also depended on what level the respondents were in the adoption process and whether it had the characteristics that influenced the decision of the individual acceptance or rejection of the technology (Rogers, 2005).

The respondents were interviewed on the source of knowledge about Multi-storey Gardens. Results indicated that extension staff working in the division both from the government and the NGOs (80%) were the major source of information on multi-storey gardens as a means of increasing food production (Figure 4.2). The other minor sources of awareness were acquired through friends (18%), agricultural show and own initiative. This can be interpreted that other factors contributed to low adoption rate. The researcher sought to find out what these other factors were and was discussed later under the subsection of constraints affecting multi-storey gardens adoption.

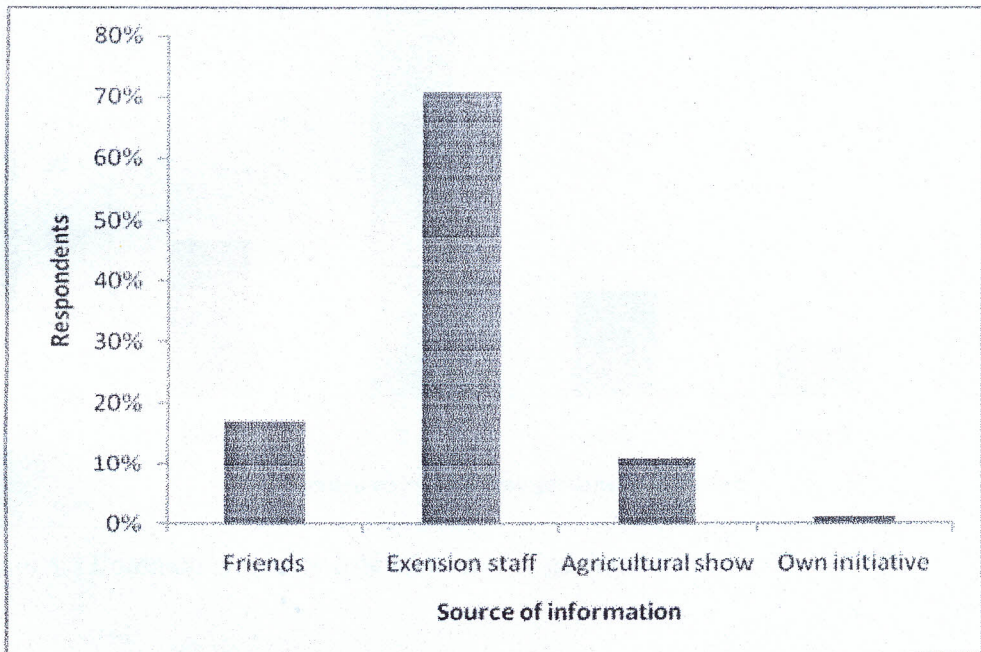


Figure 4.2 Community source of knowledge on multi-storey gardens

This section of the study was to assess the adoption status of the innovation in the division upon which more promotion and development would be made. The information gathered from the respondents is indicated in the figure 4.3. The respondents' that were aware of the multi-storey gardens and constructed 1-3 was quite high about 60% compared to the others who implemented the new technology. This was due to individual level of adoption process and the fact that immediate results were realized. The respondents could sustainably feed their families with fresh vegetables from within their own home made gardens. Those with five and above five were 15% and 10% respectively as they had gone a step further from mere subsistence to commercial production. It was also observed that very few farmers had constructed the gardens the right way resulting in

low plant population per garden, low yields and a short lifespan. This could be attributed to lack of income to buy the proper construction materials due to the low financial status of majority of the respondents (Table 4.2) and lack of technical skills. Majority of the people in the community had acceptance the vegetables grown through the technology (80%) thus improving their financial status as well as eliminating hunger

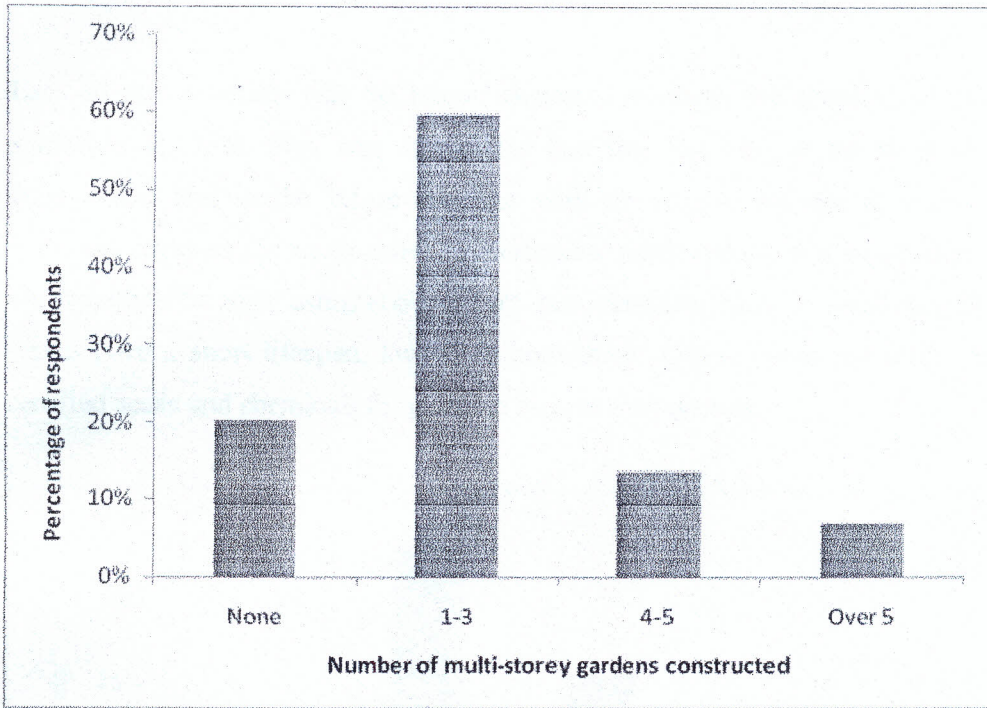


Figure 4.3 Community adoption of multi-storey gardens

The acceptance of a new innovation and utilization of its product is a crucial step in food security and poverty reduction. From the data gathered it showed that there was a general acceptance of vegetables grown in the multi-storey gardens (80%). They confessed that the vegetables were more fresh and clean than those bought from the market whose crop husbandry, quality and health precautions were not known. This showed that the low adoption rate in some of the areas such as Bahati and Kamukunji was due to other factors and not vegetable rejection. The respondents who did not accept the vegetable gave reasons such as they were not as tasty as those planted on open land where there is enough air, they also doubted their nutritive status due to their confinement in one place.

4.4 Factors Affecting Adoption of Multi-Storey Gardens

The study also aimed at identifying the factors that reduced the adoption of the technology despite been earmarked as a potential tool towards achievement of food security in the urban settings (Mary, 2006). The researcher first sought to find out what challenges the respondents were facing during the implementation of the new technology. From the information gathered the key challenges were as indicated in figure 4.4.

Lack of raw materials was the major constraint affecting the adoption of multi-storey gardens with 34%. This was due to the fact that majority of the respondents were unemployed and in the informal sector with no reliable income to source the raw materials required for multi-storey construction, production and maintenance. Some of the respondents were using sub-standard raw materials such as small polythene bags which have a short lifespan, low plant population. Others could not afford fertilizers, certified seeds and chemicals for pest and disease management

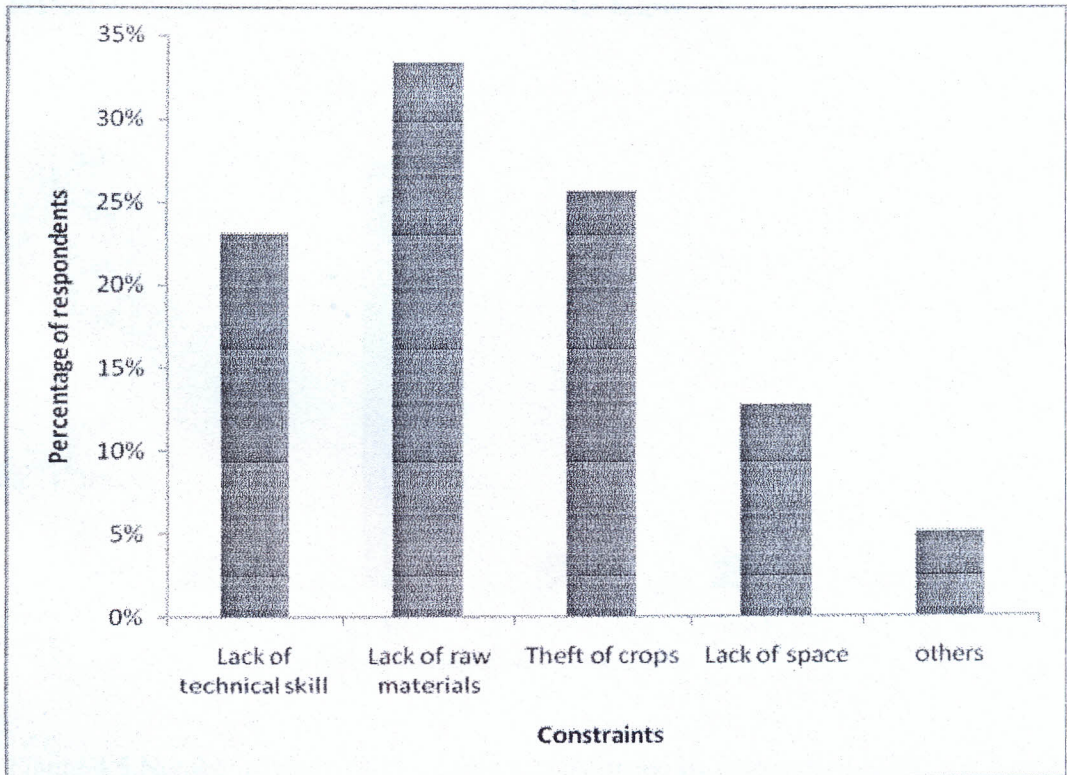


Figure 4.4 Constraints in multi-storey garden construction

Theft factor was notably high at 27% and this could have been attributed to the high population growth rate and increased poverty in the division and the fact that not all people had constructed the gardens to cater for their vegetable needs. The social morals

were no longer respected and people were using any means to have food at the table. Out of the 90 respondents interviewed 24% lacked the technical skills on multi-storey construction as the division is served by only two government staff and could not reach all the farmers some 12% of the respondents had no space to construct the multi-storey gardens though they were aware about its importance and the role it plays in alleviating hunger. This was associated to the poor urban planning, the high rate of unemployment and the mushrooming informal settlements in the division. There were other minor challenges such as destruction of the crops by livestock such as poultry, goats and pigs left on free range. All the discussed constraints above contributed to low implementation of the technology resulting to low vegetable production and food insecurity in the division..

The study gathered the information on the land size where the respondents grew their vegetables and how it affected adoption rate. The study compared the respondents land sizes and the number of the multi-storey gardens they constructed . The results revealed the following information as shown in Figure 4.5 below.

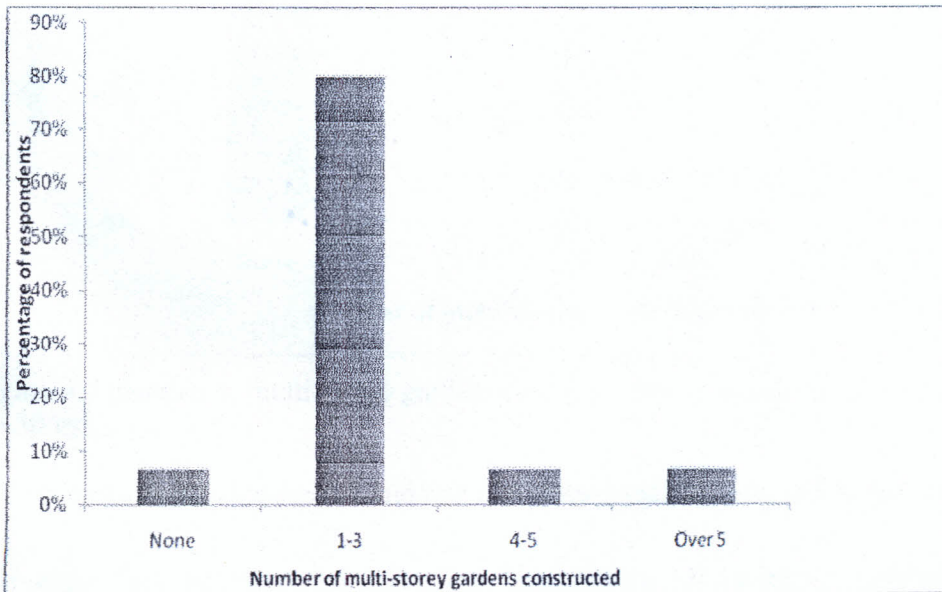


Figure 4.5 Number of multi-storey gardens constructed by respondents with land size of less than 10M²

Respondents who did not adopt the technology were 6% while those who had 1-3 (80%),4-5 (7%)and >5 7%

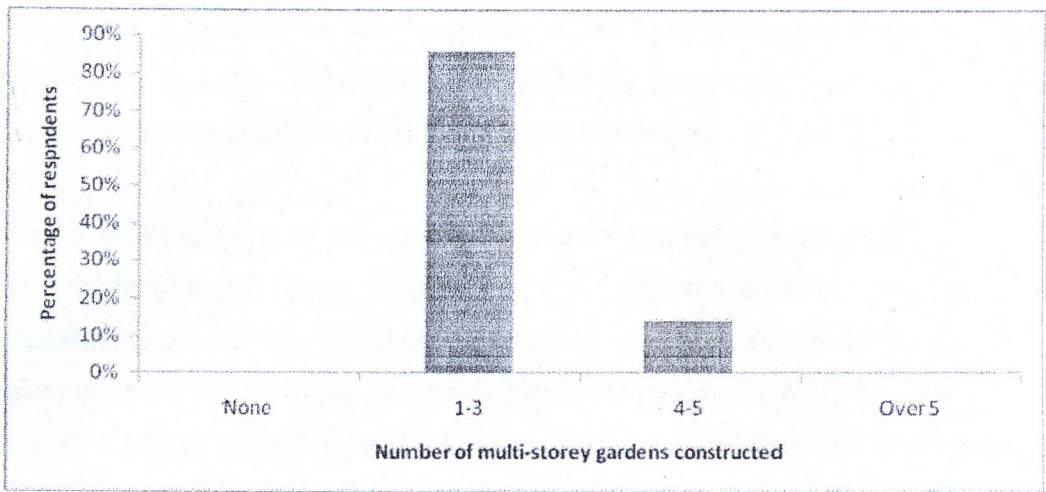


Figure 4.6 Number of multi-storey gardens constructed by respondents with land size of 10-20M²

Respondents who constructed 1-3 were 85% while 13% had 4-5 multi-storey gardens

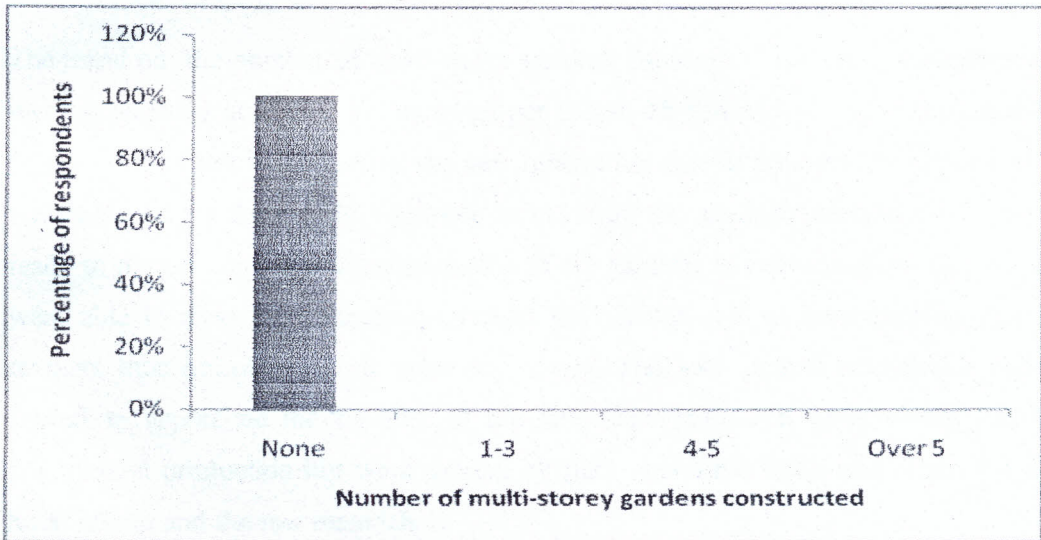


Figure 4.7 Number of multi-storey gardens constructed by respondents with land size of 20-30 m²

The respondent with big size of land had not constructed the multi-storey gardens.

The respondents with land size below 20M² had constructed the highest number of multi-storey gardens, compared to those with the bigger size of the land (>20M²) The interpretation drawn from this information is that the households had no land where they could grow vegetable on a kitchen garden. Instead they had opted to effective use of the little available land by constructing multi-storey gardens which takes advantage of the vertical dimension to increase the area under crop and increase production. According to Mary, (2006) one multi-storey garden is able to support a family of three with sufficient vegetables throughout the year with proper management. From the above results it shows

that the more the land the less the number of the multi-stories constructed. Households with bigger land size of 30-40 M² preferred having their vegetable on a kitchen gardens hence the low adoption rate of the multi-storey technology.

The level of income is an important factor that determines the adoption status of any new innovation where the early adopters are those who can afford (Rogers 2002). If an innovation requires some initial capital its adoption may be slowed down by the lever of income of the beneficiaries. The researcher sought to assess how the level of income related to the adoption rate in the division. The results in Figure 4.8 showed that those with higher income had the lowest number of multi-storey gardens constructed. They mainly depended on the market for their vegetable needs because they could afford and only 2% had constructed 1-3. They had other means of achieving their daily vegetable needs hence the low adoption rate.

The trend on the number of multi-storey gardens constructed increased with decrease in income whereby at 2000-5000 earnings per month 18 respondent had constructed MSG (Figure 4.8) .They had accepted the new innovation due to the benefits realized as they were able to get their daily vegetable needs from the gardens constructed. They were ready to pay labour for more construction of the gardens to increase on production. They were able to meet their family needs and the surplus sold at farm gate and the local markets thus improving their economic status. The low income households had also started to appreciate the benefits of the new innovation and gone a step further to commercial production but were limited by their economic status and could not afford hired labour and the raw materials.

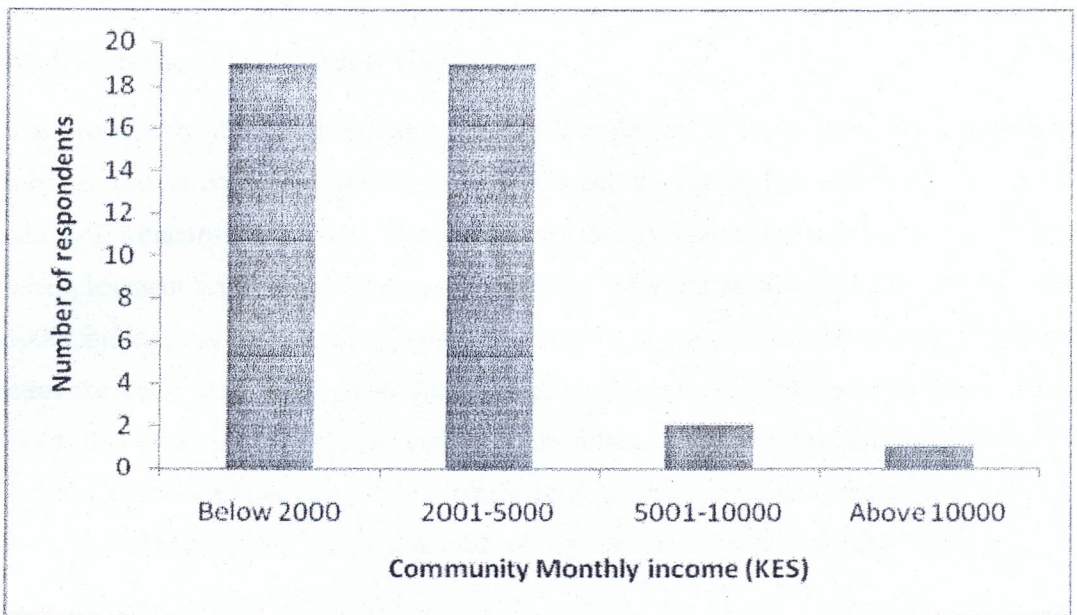


Figure 4.8 Respondents who constructed between 1-3 multi-storey gardens vs monthly income

The visit of households by extension staff during the implementation of a new innovation plays a role in influencing the decision making by the beneficiaries (Rogers, 2002). The respondents were asked how often they were visited by the extension staff in the division in order to assess the impact it had on adoption rate. From the summary results (Figure 4.9) it shows that those visited once per week and constructed multi-storey gardens were 10. Those visited once per month constructed 38 MTG. Those visited once per year 7 constructed MTGs while those not visited at all constructed 17 MTGs. This means that despite the frequent visits by the extension staff the adoption rate was very low contrary to what is expected. This meant that other factors influenced decision making and implementation by the respondent as highlighted in the previous discussion.

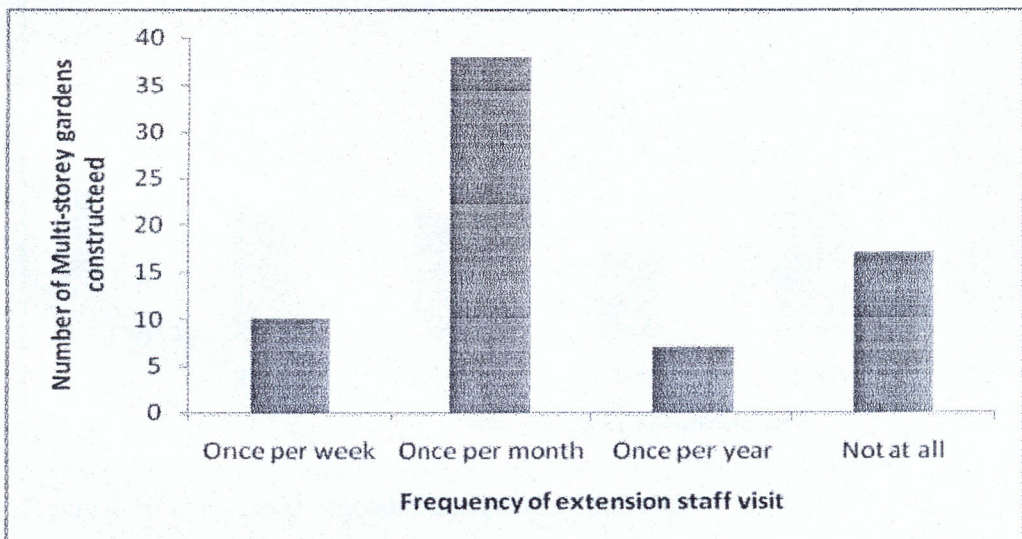


Figure 4.9 Extension visits versus multi-storey construction

4.5 Up-scaling of Multi-storey Gardens

The production of vegetables using multi-storey garden in the division has been on the increase due to continued decline in land size and the increasing demand for vegetables and food insecurity in general. The community is very vulnerable due to the high level of unemployment with about three quarters in the informal sector where they earn below 5000 shillings per month. This explains their need to supplement the income in order to meet the daily food requirement for most of the households. The need to improve crop yields and attain sustainable production is important so that the community become food secure. The researcher sought to identify how production of the vegetables would be increased to improve the living standards of the community and attain food security.

From the previous results and discussion MSG have been used for the production of the vegetables and the trend seems to increase with the increase in population and the rate of unemployment as well as poverty levels in the division. According to Chweya, (1999) indigenous vegetables are of high nutritive value compared to the exotic ones (kales, cabbage and spinach) ones as indicated in table 2.1. They can be used to upscale the multi-storey gardens to achieve food security in future which is a major challenge in the division. The researcher sought to assess whether the community accepted consumption of indigenous vegetables which have longer harvest period and hence more production per unit area. This was compared with the age factor of the respondent and the information gathered was as indicated in figure 4.10.

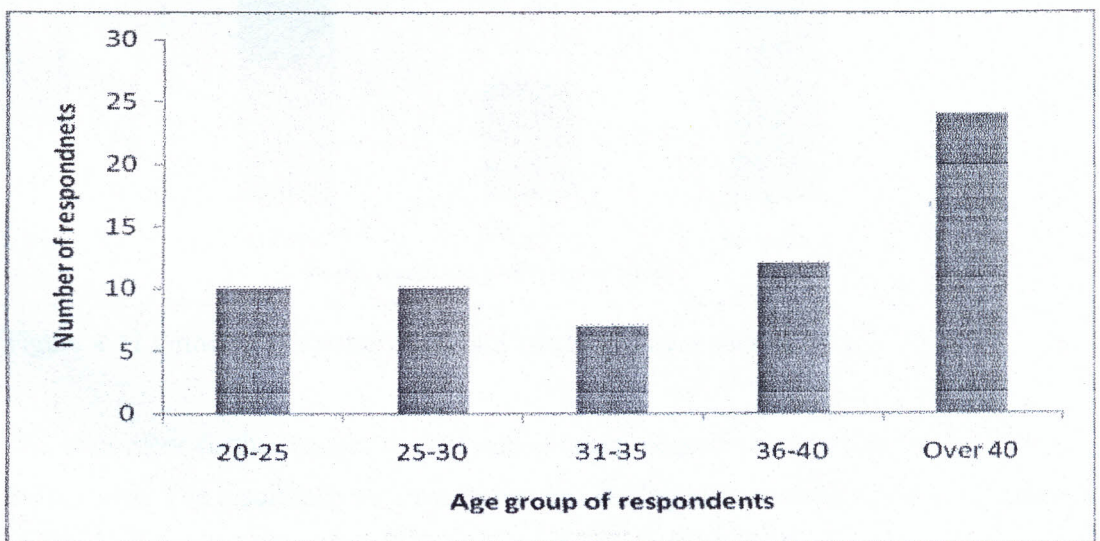


Figure 4.10 Indigenous vegetable acceptance versus age

The respondents who were over 40 years of age had the highest acceptance. This could be interpreted that these are the settled people who have time to prepare the vegetables; they are also attached to their culture and knew the nutritive value of vegetables. The respondents who were 31-35 years of age had the lowest acceptance (7%). This could be interpreted that these are the young brought up in the city and have no cultural attachment to the vegetables. They are also busy and would prefer the exotic vegetables which are easy to grow and prepare. They also gave reasons that some of the indigenous vegetables had bitter, bad odour and slippery. Never the less the results showed a general upward trend of acceptance of the vegetables throughout all the ages. This showed the community's need for food disregarding the type and source. This was due to the poverty levels in the division which is quite high as shown in figure 4.1 where majority of the respondents are unemployed and in the informal sector.

The researcher sought to assess whether indigenous vegetables were been grown in the area and this was compared with exotic ones. This information was necessary as it would give the status in the division for consideration in the up scaling of multi-storey gardens. The information collected was as indicated in figure 4.11.

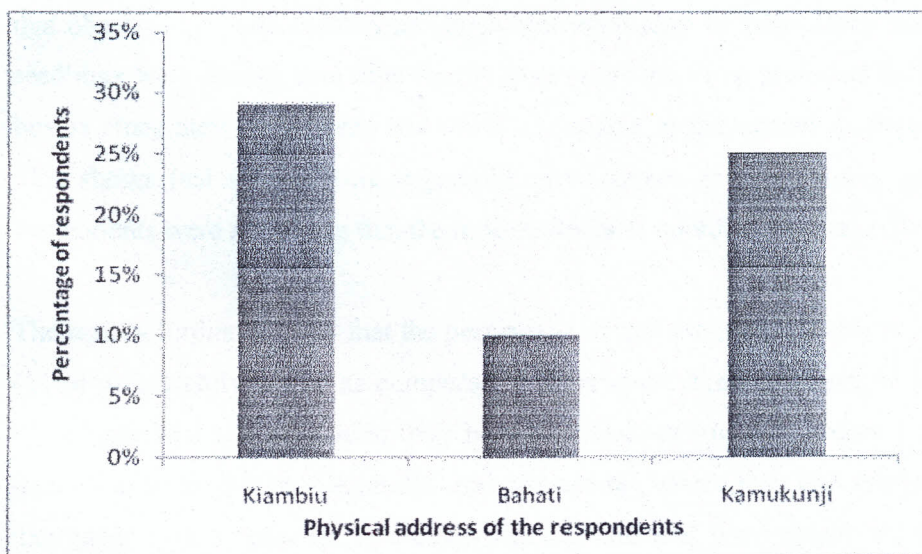


Figure 4.11 Growing of exotic vegetables verses physical address

The researcher further sought to find out whether indigenous vegetables were grown in the division. The results showed that Bahati had the highest percentage (22%) in Kiambiu and Kamukunji had 8% and 5% respectively this is as shown in figure 4.12 below.

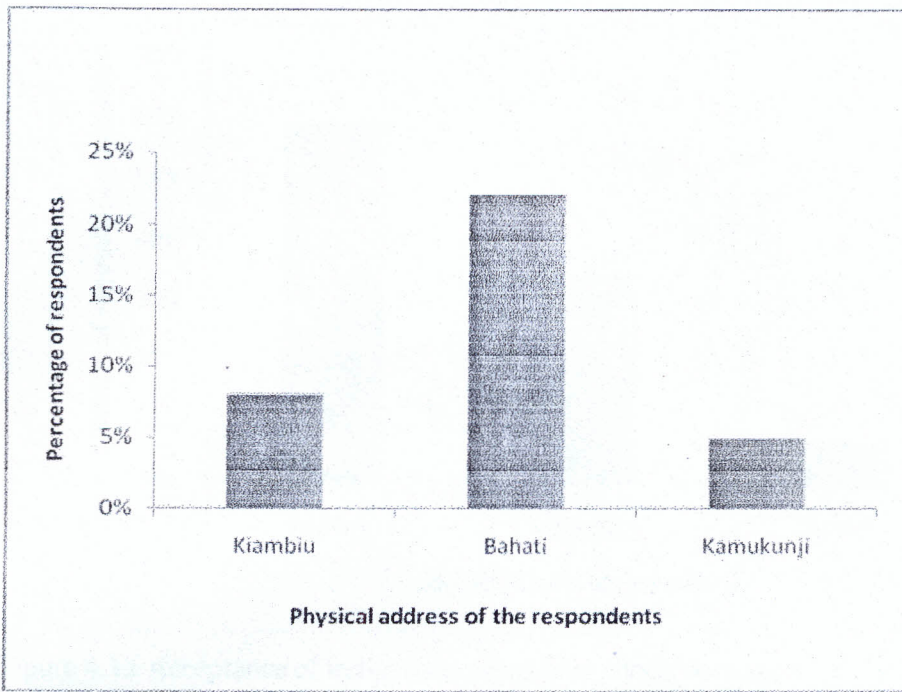


Figure 4.12 Growing of indigenous vegetables verses physical address

Comparing figures 4.11 and 4.12 it is evident that exotic vegetables were grown more in multi-storey gardens as compared to indigenous vegetables. The main reasons given to that observation were that exotic vegetables were easy to grow since the seeds and the seedlings were readily available locally, they were the most preferred by majority of the buyers since they were cheap and readily available in the market as shown in table 4.3. This shows that more exotic vegetables were grown in multi-storey gardens and the respondents were not aware that the indigenous ones could perform equally well.

The results further showed that the percentage of indigenous vegetable growing in Bahati (21%) was slightly higher as compared to other areas. This was because the respondents had bigger size of land behind their houses in form of kitchen gardens where they grew their vegetables. While in Kiambiu and Kamukunji, where they had smaller sizes of land they grew their vegetables in multi-storey gardens and were not aware that indigenous vegetables could also be grown in multi-storey gardens. The acceptance of food and its consumption is usually affected by education level of the individuals (Cox, 1998). This information was necessary before considering indigenous vegetables as a means of up scaling multi-storey gardens. The information gathered was as shown in figure 4.13.

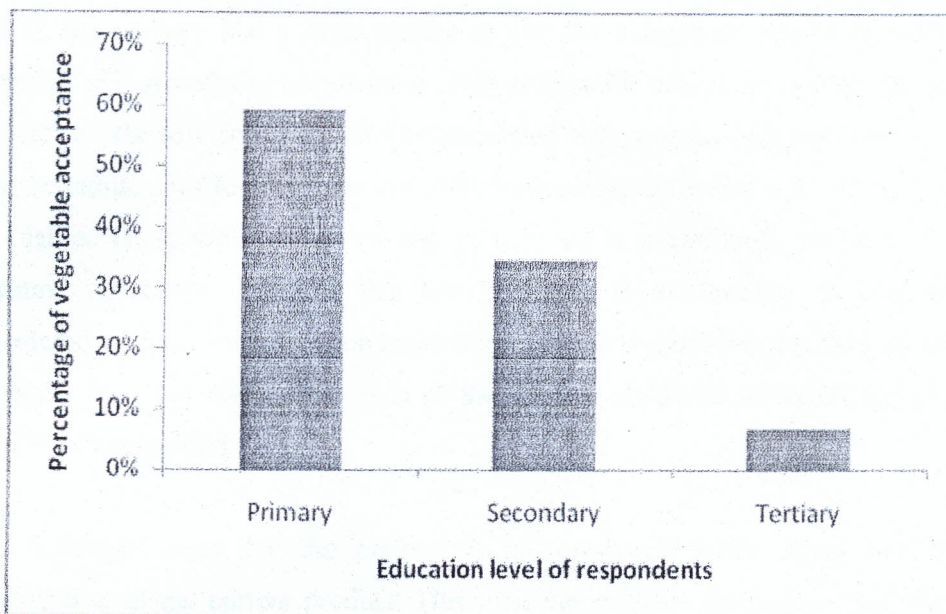


Figure 4.13 Acceptance of indigenous vegetables verses education

From the data collected on education and acceptance of indigenous vegetable in the community, it was found out that education level played a major role. The lower the educations level the more the acceptance. Where those who had attained primary education had the highest acceptance of 58%, secondary education 35% and tertiary only 7% (figure 4.13). Various reasons were given for non-acceptance of the indigenous vegetables which included the following:

- Some of the vegetables are bitter and slippery thus not accepted by all members of the family
- Need more time for preparation
- Unavailability in the market
- The vegetables' are considered as weeds and not food
- Food gathered by the poor from the wild

It was observed that those people with low education also had low income levels and were willing to accept any food to boast their food security status. Apart from education level being a limiting factor on consumption and acceptance of indigenous vegetables high prices remained the biggest hindrance.

The culture of the people has some influence on how well certain foods are accepted by the community (Khan, 1981). The respondents in the study area gave various reasons for

lack or low consumption of indigenous vegetables. People who came from the western part of the country had a high preference for the indigenous vegetables and did not complain of bitterness or slipperiness. This is because they were brought up taking the vegetables. The low consumption was associated with scarcity and high prices compared with the exotic ones forcing them to opt for exotic vegetables that were much cheaper and affordable. Those who were born and brought up in urban areas said that they could consume whichever vegetable that was available in the locality as long as it was considered as food by the community. Some of the respondents brought up in Central province, were not aware that some of the plants considered as weeds were good and nutritious human food.

The customers need for the product is an important factor when one thinks of development of the current product. This indicates whether the product will have better market and improve the economic status of the community. The information gathered on the frequent customers of indigenous vegetables was as shown in figure 4.14. From the survey done in the division to identify the frequent customers of indigenous vegetables the results showed that people who were over 40 and over 50 years of age composed the highest (30% and 35% respectively) percentage. These are the people who still recognize the nutritive importance of the vegetables and can withstand their tastes. They have the patience in preparation since they are a bit settled in life as compared to the younger people. Also they embrace their cultural values of the vegetables unlike the young most of who are born and brought up in the urban setup. The young preferred exotic vegetables such as kales, spinach and cabbage that are easy to prepare and cook despite the fact that they are inferior nutritionally.

Although there was lower percentage of customers of indigenous vegetables there was a general upward trend on the consumption calling for an increase in production of indigenous vegetables to meet the future demand and have the produce affordable to all. The households would become food secure, better health and improved economic status as the produce has a better market price than the exotic vegetables as shown in table 4.3.

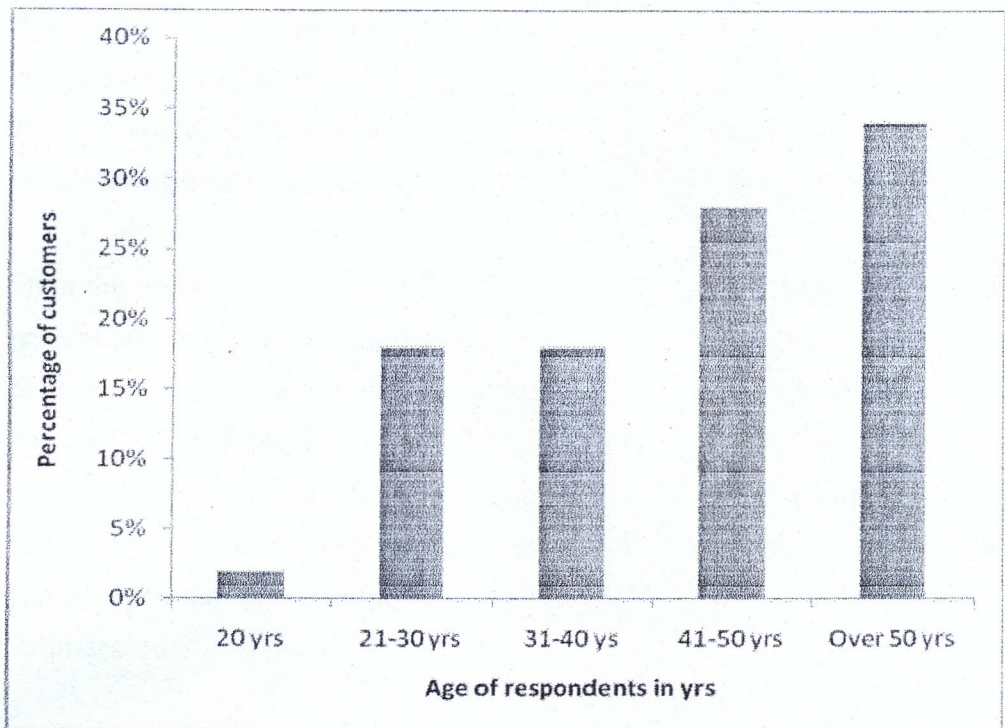


Figure 4.14 Age of frequent customers of indigenous vegetables

The researcher sought to assess the prices of some of the common vegetables in the markets within the division. This would help in coming up with the future recommendations on the vegetables which would improve the economic status of the community. Also it would help in addressing the issue of scarcity of these vegetables in the market. The information gathered was as shown in table 4.3.

Table.4.3. Selected vegetables market prices

Vegetable	Unit of measure	Price
Kales	1kg	10-20
Cabbage	1kg	15-20
Spinach	1kg	20-30
Amaranth	1kg	30-40
Black nightshade	1kg	40-50
Spider plant	1kg	40-50
Cowpeas	1kg	30-40

From the results it shows that indigenous vegetables fetch a higher market price compared to exotic ones. Further information gathered from the respondents indicated that indigenous vegetables were scarce and seasonal and only available during the wet

seasons unlike the exotic ones that are available in the market throughout. This was due to the fact that most farmers grew the exotic vegetables in their gardens both on the ground and in the multi-storey gardens resulting in less supply and more demand (Figure 4.11). The few vendors of the indigenous vegetables knew that the consumers highly valued them due to the nutritional and cultural status attached to them hence the high prices.

From the observation made in the study area the vegetables grown in the multi-storey gardens had very small leaves, others had yellow or purple leaves an indication of lack of primary nutrients. Soil fertility is a prerequisite to good plant growth and sustainable leaf production Muhindo, (2002). The researcher sought to find out whether the respondents were using any of the fertilizers during vegetable production or when constructing the multi-storey gardens. Results showed that those with 1-3 multi-storey gardens 75% did not use organic or inorganic fertilizers and only 25% used organic fertilizers

The results showed that 17% of the farmers did not use neither the organic nor the inorganic fertilizers, those who used inorganic fertilizer were 17% while 66% used organic fertilizer (Figure 4.15). This caused reduced soil nutrients as well as other soil properties necessary for healthy crop growth thus explaining why the leaves were small with yellow and purple coloration in most of the vegetables grown in the division. This was reflected in the division's inability to produce enough vegetables to meet its food needs. This shows that there is need to promote use of organic fertilizers in the multi-storey gardens as well as in the kitchen gardens for sustainable production to improve the food security status in the division.

Vegetables make an important component in achieving a balanced diet and according to FAO, (2000) this is a major challenge in many families especially those in the urban setting where they rely on the market to meet their daily needs. From the previous discussion the community in the study area is very vulnerable as majority are in the low income level. The researcher sought to find from where the families sourced their vegetables to meet their daily vegetable needs. The results showed that about 78% of the respondents met their family's vegetable needs from the farm and the market and only 2% from the farm (Figure 4.16). The households depended on home production during favourable weather and supplemented with the market supply in time of poor weather. This implies that there is need to come up with technologies and crop varieties which enhance continuous production throughout the seasons.

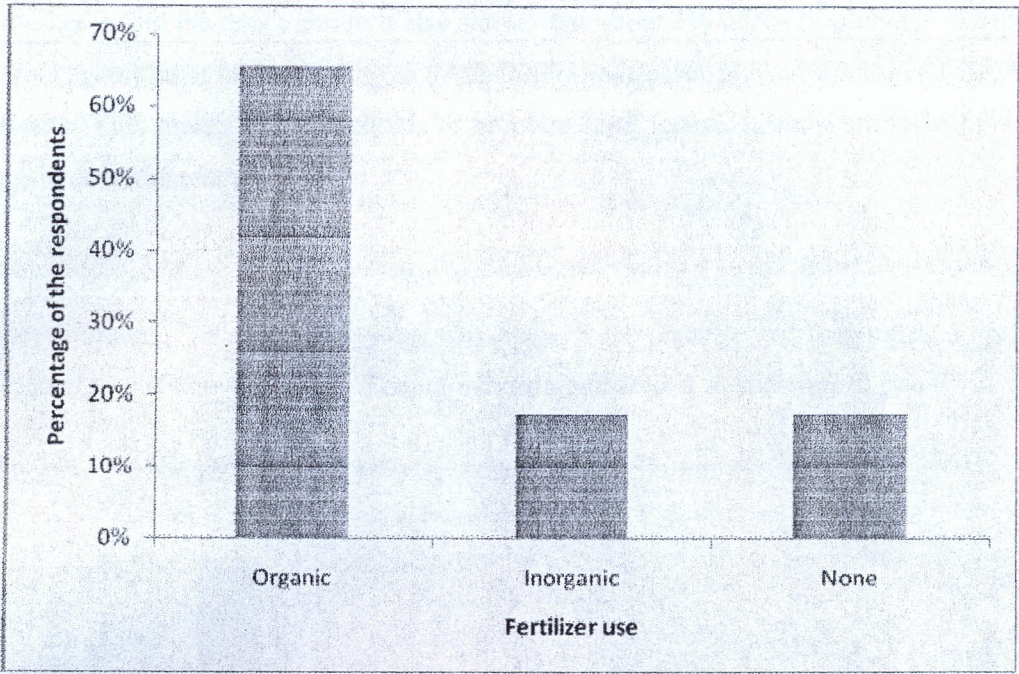


Figure 4.15 Use of fertilizers in the multi-storey gardens constructed

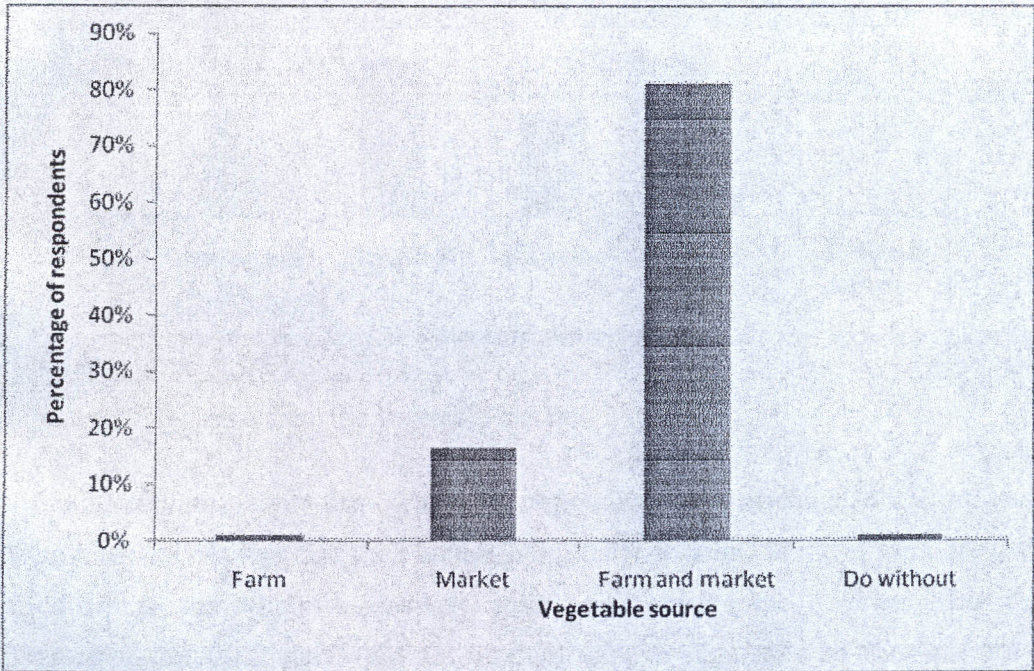


Figure 4.16 How family meet their vegetable needs in the division

By developing the multi-storey garden which uses minimal amounts of irrigation water and incorporation of organic fertilizers sustainable production would be achieved. The introduction of indigenous vegetable which have a longer harvest period can increase on production (Chweya, 1999). This would increase the percent (2%) of families able to

meet their vegetable needs from within the household without having to buy from the market. From the result above it also shows that about 2% of the households did not take any vegetables at all, according to FAO (2000) vegetables play an important role in body health. This makes the households to be more food secure, healthy and save money for other development purposes

Time is an important factor and should be well managed to realize any positive development. The researcher sought to find out the distance the respondent took to the market to buy the vegetables. The information gathered is as shown in figure 4.17.

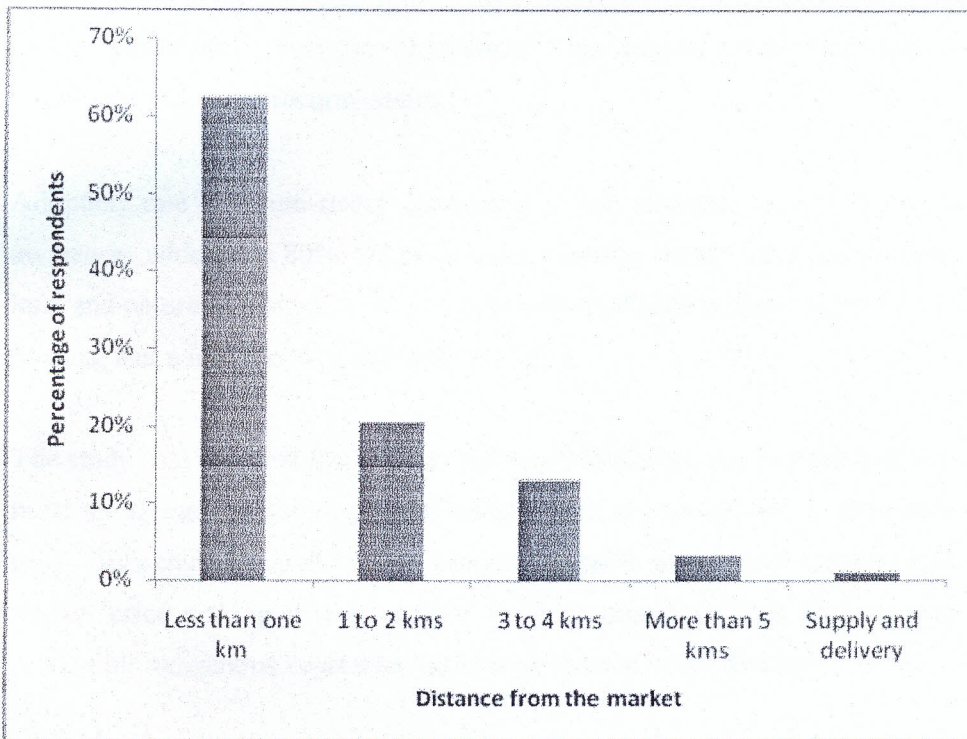


Figure 4.17 Distance from the vegetable markets

From the results it shows that 62% of the respondents got their vegetables from less than 1Km from the retailers near their homes. The others 48% had to travel for more than one kilometre to the wholesale markets within and outside the division. This can be interpreted that the farmers did not produce enough vegetables to cater for the daily demand of the community. This also can be interpreted that time is wasted searching for the vegetables which if production was increased would have been used for other development activities.

CHAPTER 5: SUMMARY CONCLUSION AND RECOMMENDATIONS

5.1 Summary.

That majority of the population in the division was of low income since they were either unemployed or employed in the informal sector. They were not food secure prompting for the need to farm on any available space to get their daily food needs.

The community was aware of Multi-storey garden as a method of increasing food production in the urban setup through increasing farming area, saving on water as well as having continuous vegetable production. This supplemented their low income thus improving their food security status.

Adoption rate of multi-storey gardening in the division was 60% compared to the awareness which was 80%. Other adoption limiting factors were low income, little or no land and nature of residence. The respondents with high income, more land and on rental housing had a low adoption rate and vice versa

The study also revealed that indigenous vegetables were not popular in the division. And most the farmers preferred production of exotic vegetables which were easy to sell and grow. This caused scarcity of indigenous vegetable in the local market resulting in high market price making it unaffordable to the community. This explains why the target market for indigenous vegetables is the high income urban dwellers

Majority of the respondents did not produce enough vegetable to meet their daily needs. They had to supplement from the markets within and outside the division. This points out the need to invest in scaling up and out options to increase production.

The study revealed that there 60% of the respondents did not use organic fertilizers in both the multi-storey and kitchen gardens hence the low yields. This shows there was need to upscale the multi-storey gardens by incorporating organic fertilizers during construction to improve the soil fertility.

The community was also faced by some challenges that deterred their efforts in achieving food security such as lack of technical skills and raw materials, theft and destruction of

crops by roaming livestock. Further the escalating population growth is reducing land available for farming expanded infrastructure. The city by-laws also do not allow any farming thus pushing the people into more poverty and food insecurity.

5.2 Conclusions

The adoption of multi-storey garden was still low in the division despite the high rate of awareness and that increasing the extension services alone could not increase the adoption rate. This means that there were other factors affecting the adoption of the technology in the division.

The study revealed that land sizes and income levels had an effect on the adoption rate of the new technology. Respondents with smaller sizes of land and low income had the highest adoption rate of the technology as it increased the farming area vertically and increase production to meet their daily vegetable needs from within the household. Those with bigger land sizes had kitchen garden where they grew their vegetables.

There was low consumption and production of indigenous vegetables which was due to low production, education, age and cultural difference. This pointed out the need to educate the community on the nutritional importance of the indigenous vegetable and their potential in improving their economic status.

The results of the study also showed that use of organic fertilizers in farming was minimal (40%). This indicated that there was no sustainable production with the majority of the respondents relying on the market supply to meet their daily vegetable needs while those who could not afford staying without. This resulted to increased poverty and vulnerability to hunger and malnutrition diseases.

The community encountered various challenges such as lack of technical skills and raw materials, theft and destruction of crops, infrastructure and the city bylaws. These issues have to be addressed when considering multi-storey garden system in urban agriculture.

5.3 Recommendations

- There is need for more promotion of multi-storey gardens an urban farming technology to increasing food production in the division for both home consumption and commercial purpose. This will avert food security problem in the division by having continuous food supply throughout all seasons.

- There is need for the technical staff to go down to the community and empower them with the technical skills on multi-storey construction, give them knowledge on the high nutritive value of indigenous vegetable, the need to use organic fertilizers in crop production and how to prepare the fertilizers locally . This will increase production and consumption of vegetables a step towards achieving food security in the division.
- The seed companies should embark on indigenous vegetable seed production and multiplication. Do proper packing to maintain viability and have the seeds available to the farmers at affordable prices to increase on production.
- The government should have better planning of the urban areas to improve on the infrastructure. This would create space for multi-storey gardening and increase food production. It would also reduce the social problems facing the community such as insecurity of both crops and the people and reduce the poverty level of the community.
- The city bylaws should be revised to incorporate urban farming an opportunity which can be utilized to increase food production. This can reduce food insecurity and improve the living standards of the vulnerable groups living in the urban setups.

5.4 Suggestion for further study

There is need for further study to assess the effectiveness of extension services in improving food security in the division. More should be done on vegetable value-addition to ensure continuous supply throughout the year.

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7. APPENDICES

7.1 Questionnaire

Introduction

I am a student at Kenyatta University pursuing a masters degree in Environmental studies and doing a project that seeks to identify factors that affects the adoption of multi-storey gardens, and how they can be up scaled to achieve increase production of indigenous vegetables. The results will assist in environmental conservation and sustainable intensive vegetable production to alleviate hunger and improve livelihoods which a major challenge to the community. Your answers will be highly appreciated and will be handled with utmost confidentiality.

Instructions: Kindly tick against your preference or write on the space provided.

Section A. Back ground information

1. Respondent number
2. Physical address
 - a) Kiambiu
 - b) Bahati
 - c) Kamukunji
3. Under what age group do you fall (tick against your age group)
 - a) 20-25 years
 - b) 26-30years
 - c) 31-35 years
 - d) 36-40 years
 - e) Over 40 years
4. What is your marital status?
 - a) Married
 - b) Unmarried
5. Level of education
 - a) Primary
 - b) Secondary
 - c) Tertiary (college or university)
 - d) Others
6. What is your income per month?
 - a) Below 2,000

- b) 2001-5,000
- c) 5001-10,000
- d) Above 10,000

Section B: General information

Part I

1. Are you aware of multi-storey gardening Yes.....No.....

If yes where did you get the knowledge?

- a) When you visited a friend in another region
- b) From extension staff
- c) Agricultural show
- d) Own initiative
- e) Other sources not mentioned above

2. How many multi-storey have you constructed in your area of residence

- a) None
- b) 1-3
- c) 1-5
- d) Over 5

What materials have you used when constructing a multi-storey garden

.....

3) What are the constrains do you encounter in multi-storey gardening

- a) Lack of technical skills
- b) Lack of raw materials
- c) Theft of crops
- d) Lack of space.
- e) Others.....

4) Is manual labour available in the locality Yes... No.....

If yes what are the charges per man day

- a) Less than Sh 100
- b) Sh150
- c) Sh200
- d) More than Sh200

5) How often are you visited by extension staff from either the government or other development agents

- a) Once per week....

b) Once per month...

c) Twice per year...

d) Once per year.....

e) Not at all.....

6) Does the family accept vegetables grown on a multi-storey garden. YES....NO.....

Give reasons for your answer above.....

.....

7) According to your cultural beliefs which local vegetable should not be consumed by the whole family.....

.....

.....

.....

What are the reasons given for the above

answer.....

.....

.....

Part II

1. Do you practice any farming Yes..... No.....

If yes above what is the land size

a) Less than 10M².....

b) 10-20 M².....

c) 20-30M².....

d) 30-40M².....

e) More than 40M².....

2. What is the distance from where you buy the vegetables for family use

a) Less than a Kilometre

b) 1-2kms

c) 3-4kms

d) More than 5kms

e) Supplier delivers

3. What is the mode of vegetable supply

a) Continuous

b) At intervals

Give reasons for the answer chosen above

.....

.....

4. How much money do you spend on vegetable per week

- a) Less than Sh 50
- b) Sh100
- c) Sh150
- d) Sh200
- e) More than Sh 200

5. Do you always get the vegetables of your choice whenever you visit the market.....Yes.....No

If No above what are the

reasons.....
.....
.....

6. What is the mode of employment

- a) Formal and permanent
- b) Formal and temporally
- c) Informal
- d) Not employed

Part III

1. Among the listed vegetables which one do you grow often?

- a) Amaranths (terere)
- b) Sukuma Wiki
- c) Spinach
- d) Black nightshade (managu)
- e) Other (Specify).....

2. According to your choice in question one above give reasons for your preference

.....
.....

3. When growing the vegetable crops which fertilizers do you use

- a) Organic
- b) Inorganic
- c) None

Give reasons for the above

.....
.....
.....

4. How do you meet the family's vegetable needs?

- A) Farm..... b) Market..... c) Farm and marketd) Do without.....

5. If from the market list the vegetables available in your local market

.....

6. What is the price per kilo of the vegetables you listed above in question 5

.....

7. Among the local vegetable listed tick the one you use often in your cooking and indicate how many times per week

Name of vegetable	Number of days cooked per week
Spider plant (saget).....
Amaranth (terere).....
Black nightshade (managu).....
Cowpeas.....
Others.....

8.If you do not use any of the local vegetable listed in question six above give reasons

.....

9. Are you involved in the business of local vegetable? Yes.....No.....

If yes above who are your frequent customers

- a) Below 20years
- b) 20-30 years
- c) 30-40years
- d) 40-50 years
- e) Over 50 years

Give reasons for the above trend

.....

10. How much do you earn from the business per day

.....

11. Comparing indigenous vegetable and exotic ones which ones sells at a higher price

.....

Give reasons to your answer above

.....

.....

Thank you for participating.

End