INFLUENCE OF TECHNOLOGY TRANSFER METHODS AND EXTENSION WORKER CHARACTERISTICS ON SUSTAINABILITY OF URBAN AND PERI-URBAN AGRICULTURE IN NAIROBI CITY COUNTY, KENYA

MARY NJOKI MWAURA

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DECLARATION

This thesis is my original work and has not been submitted for award of a degree in any other University.

Signature _____ Date_____

Mary Njoki Mwaura

REG: NO A80/99988/2015

This thesis has been submitted with our approval as university supervisors

Signature _____ Date_____

Dr. Sabina Mukova -Wangia

Department of Agricultural Economics

University of Nairobi

Signature _____ Date_____

Dr. Japheth Ododa Origa

Department of Education, Communication and Technology

University of Nairobi

Signature _____ Date_____

Professor Oliver L. E. Mbatia

Department of Agricultural Economics

University of Nairobi

DECLARATION OF ORIGINALITY

DEDICATION

To My Sons, Sammy and Steve.

For your Love, Inspiration, Patience and Support. May JEHOVAH give you FAVOUR and GRACE in your journey to his Destiny and Purpose for you.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

ADP:	Agricultural Development Programme
AGAH:	Animal Health Service
AGAP:	Animal Production Service
AGPC:	Crop and Grassland service
AGSM:	Marketing and Rural Finance Service.
AGUILA:	Latin American Research Network on Urban Agriculture
ASDS:	Agriculture Sector Development Strategy
CARE:	Care International
CFSP:	County Fiscal Strategy Paper
CGIAR:	International Agricultural Research Centers
CADP:	County Annual Development Plan
CIDP:	County Integrated Development Plan
DALF:	Departments of Agriculture, Livestock and Fisheries Development
FAO:	Food and Agriculture Organization
FESLM:	Framework for Evaluating Sustainable Land Management
FFS:	Farmer Field School
FORC:	Research and Education Service
FV:	Farm Visits
GNP:	Gross National Product
GTZ:	German Technical Cooperation (Deutsche Gesellschaft für Technische Zusammenarbeit,
HIV/AIDS:	Human Immuno Deficiency Virus / Acquired Immuno Deficiency Syndrome.
ICT:	Information and Communication Technology
IDRC:	International Development Research Centre.
IWMI:	International Water Management Institute, Colombo
MSPND:	Ministry of State for planning and National Development and Vision 2030
MPND:	Ministry of Planning and National Development
NALEP-SIDA	National Agriculture and Livestock Extension programme-Swedish International Development Agency

NCC: Nairobi City County

NCE: Nigerian Certificate of Education.

NCWSC: Nairobi City Water and Sewerage Company

NGOS: Non-Governmental Organizations

NRI: Natural Resources Institute

NUPAL: National Urban and Peri-Urban Agriculture and Livestock Policy

OECD: Organization for Economic Cooperation and Development

OV: Office Visits

POLIS: Project on Ecological Governance

RUAF: International Network of Resource Centers on Urban Agriculture and Food Security.

SAVE: Save the Children

SCAO: Sub County Agricultural Officers

SDGs: Sustainable Development Goals

SMEs: Small Microfinance Enterprises

SPSS: Statistical Package for Social Sciences

SRA: Strategy for Revitalizing Agriculture

SSF: Sustainable Society Foundation

SSI: Sustainable Society Index

TEAL: Teaching Excellence in Adult Literacy

UA: Urban Agriculture

UN: United Nations

UNCED: United Nations Conference on Environment and Development

UNCHS: United Nations Centre for Human Settlements (Habitat)

UNDP: United Nations Development Programme

UNESCO: United Nations Organisation for Education, Science and Culture.

UNFPA: United Nations Population fund.

UNHCR: United Nations High Commissioner for Refugees;

UNICEF: United Nations Children's Fund;

UNWHO: United Nations World Health Organization.

UoN: University of Nairobi

UPA: Urban and Peri-urban Agriculture.

UPAP: Urban and Peri - Urban Project

WAEOs: Ward Agricultural Extension Officers

WEF: World Economic Forum

OPERATIONAL DEFINITIONS OF KEY TERMS

Urban and Peri-Urban Agriculture (UPA);

UPA comprised the production, processing or value addition and marketing of produce, in order to meet growing demand of consumers within the boundaries of Nairobi County area of 696.1 square Kilometres. UPA is expected to compete for resources such as land, water, finances and labour. Urban areas are approximately within 7 Km of the Central Business District while peri-urban areas are approximately 8 to 20 km of the Central Business District.

Sustainability of Urban and Peri- Urban Agriculture;

Sustainability of UPA implies the continuity into the future of UPA and its ability to continue to operate profitably at increased levels taking into account its economic, environmental, social and political viability.

Technology Transfer Methods: These will refer to; **mass media** methods of (field days, shows, print **(**Fliers, posters) which help extension agents to pass messages to a large group of farmers. **Group methods** (demonstrations/ trainings, group tours and visits), **individual methods** (farm visits, office visits, ICT (telephone calls and internet) consists of communication between extension worker and farmer.

Extension workers: Agricultural workers who disseminate information and technology on farming practices along the value chain that may positively impact local farmers/clients. They may use one of the several methods of technology dissemination depending on the situation.

Extension Workers Characteristics: These included gender, age, educational level and years of farming experiences in UPA activities.

Urban farmer/Client: A person who practices any activity on urban and peri urban agriculture (UPA).

ABSTRACT

Urban and Peri urban agriculture contributes substantially to food and nutritional security to approximately 60 percent of Nairobi residents directly or indirectly. The current study was necessitated by the emerging and dynamic challenges affecting the sustainability of urban and peri urban agriculture such as the competition of resources, inadequate policies and a declining extension system. The purpose of the study was to gather information and provide an understanding on the influence of technology transfer methods and extension worker characteristics on the empowerment of farmers for sustainability of urban and peri urban agriculture. The study utilised a cross-sectional survey method and used questionnaires to collect data. The study sampled 149 farmers and 64 extension workers. Descriptive and Multiple Linear Regressions were used to analyse data. The characteristics of urban and peri-urban farmers indicated that most farmers (58.4 percent) were male, 30.2 percent middle aged between 41-50 years, having over secondary education and over 15 years of farming experience. Analysis of farmer resources indicated that 42 percent of the farmers farmed on less than 0.5 acres while 30 percent did not own the land they farmed on. Water for irrigation was not adequate and most farmers had no access to credit. The characteristics of extension staff indicated most workers were female with over 50 years of age, well-educated most had a first degree and above. The extension staff had inadequate knowledge on adult learning principles which affected their choice of technology transfer methods for empowerment of farmers. The use of mobile phones and internet (ICT) was found to consider most of the adult learning principles but it was not a popular technology transfer method. The influence of technology transfer methods on the sustainability of urban and peri urban agriculture indicated that ICT, farm visits, office visits, trainings and demonstrations and field days had a positive and significant ($P<.05$) influence on the sustainability of urban and peri urban agriculture. Extension worker characteristics of age, gender, educational levels and work experiences were found to positively and significantly influence the empowerment of the urban and peri urban farmers. The study concluded that the choice of technology transfer methods and extension worker characteristics influenced empowerment and sustainability of urban and peri urban agriculture. The study recommended empowerment of extension workers on the adult learning principles for farmer empowerment and the transformation of the extension system to a more "integrated digitized and individualized method." The Institutionalization of the extension system is recommended for further research.

Key Words: Extension Workers Characteristics, Multiple Linear Regressions, Nairobi County, Sustainability, Technology Transfer Methods, Urban and Peri-urban Agricultur

CHAPTER ONE: INTRODUCTION

1.1 Background Information on Urban and Peri urban Agriculture

Sustainability is the assurance of a continuous availability of resources to protect human activities and the environment. Survival basics dictate that what humans need for their well-being depends, directly or indirectly, on the ecosystem (United Nations (UN), 2005). It maintains a productive balance between the economic, social, and ecological needs of present and future generations for improving livelihoods (UN, 2005).

Statistics state that in 2010, 50.46 percent of the population in the world lived in cities and states a projection of 56.62 percent by 2025 and 68.70 percent by 2050 (UN, 2009). In Kenya approximately 30 percent of 38.6 million Kenyans were living in urban areas in 2009, according to (Republic of Kenya (RoK), 2014). In 2009, the county population was 3,138,369 and this is expected to rise 5,958,338 in 2022 respectively (Nairobi County Integrated Development Plan (NCIDP), 2018). Nairobi's population grew by about 260 percent which is high when compared to 160 percent for the whole of Kenya between 1980 and 2010 (RoK, 2014).

Nairobi City migrants come to search for employment to provide for their dependants but most end up without an income due to the high unemployment rates in the cities. Approximately 60 percent of persons in Nairobi reside in the slum areas (Pascal & Mwende, 2009).

Rapid urbanisation in Nairobi City County has contributed to increased challenges for the urban people. These challenges include high unemployment levels, air and water pollution, increased crime rate and a congested infrastructure. These has led to increase in poverty, various diseases, food and nutrition insecurity and consumption of unsafe food, to approximately 60 percent of Nairobi residents who live in the informal areas according to Ohito (2013). Nairobi's informal areas house approximately 2 million people which were approximately 5 percent of Kenya's population whereby women and children are vulnerable (Oxfam, 2017).

The high population has increased household food demand in the city where it is estimated that 10-30 percent (Mwangi & Foeken 1996) of households engage in urban agriculture for subsistence and sale depending on location. Urban and peri urban agriculture has grown tremendously since the 1970s and this is a response to escalating poverty and rising food prices and shortages. Urban and peri urban agriculture (UPA) can reduce hunger and poverty by enhancing access to food in urban areas.

1.1.1 Characteristics of Urban and Peri Urban Agriculture in the Cities

Urban and peri-urban agriculture is the production of crops, rearing of animals, fish farming, planting of trees, value addition and sale of products within the city (Bareja, 2010). Production of crops may be done in the cities (urban) or in the peripheries (peri-urban). Farming may be done inside the home compounds or away from the place of residence. Off-plot farming may be carried out on private, leased or public land (Bareja, 2010). Crop production techniques that are used include open field farming, tissue culture banana farming, hydroponics, drip, furrow and bucket irrigation, greenhouse farming, multi-storey gardens, moist beds and shade net farming. These are technologies that maximise production per unit area. Farming activities also include tree and vegetable nurseries.

Nairobi farmers cultivate various horticultural crops such as local, exotic and asian vegetables, bananas and various fruits. Field crops include coffee, flowers, maize, beans and various root crops. They also keep dairy cows, goats, pigs and poultry. Rearing of fish has picked up well especially in the outskirts of the cities and institutions (NCIDP 2018). Nairobi County has 14 percent of total land use area under urban agriculture with an average farm size of 0.53 acres in urban areas and 1.44 acres in peri-urban areas covering approximately 1900 hectares (NCIDP, 2018).

Urban and peri urban agriculture contributes towards improving the livelihoods of the urban poor, by cultivating various crops and rearing of livestock with significant yields. (World Economic Forum (WEF), 2015) states that poor people in poor countries spend 50-70% of their income on food. Poverty in the cities has led city dwellers to adopt increased

agricultural activities as a livelihood strategy for survival (RoK 2014). Urban and peri urban agriculture has been ignored by city planners as it was perceived to be a practice from rural life (RoK 2014) even though it contributed to the security of food and nutrition and improved livelihoods for the city poor. Recommendations by Njenga and Karanja (2013) indicated a systems approach of incorporating other technologies to UPA such as waste management and energy production.

There have been several surveys conducted in slum areas of Nairobi which indicated high malnutrition levels of children with prevalence of wasting, chronic diarrhoea and nutrient deficiencies among children of 6–60 months (Ayaga *et al*., 2005). The study also established a link between lack of adequate food with Human Immune Deficiency Virus (HIV-AIDS) in both adults and children. Urban and peri urban agriculture therefore plays an importance role in alleviating these challenges by providing food and income (Ayaga *et al.*, 2005). Crop production and value addition is one component of urban agriculture in Nairobi that has addressed food and nutrition insecurity in addition to supplementing household incomes (NCIDP, 2018). Urban and peri urban agriculture has also supplemented the school feeding lunch programmes in schools and institutions such as homes for the old and children's homes.

1.1.2 Status of Food insecurity in Nairobi City County

Nairobi City County has been ranked second at 22.5 percent poverty levels in the country according to Ogendi, Mukundi, and Orege, (2014). Studies conducted in Nairobi by Faye, Baschieri, Falkingham and Muindi, (2011) on the prevalence of hunger and food insecurity indicated that food insecurity was highest among slum dwellers. One household in five was found to be food secure while most of other households were found to survive on less than one meal a day. Food insecurity in the city has continued to worsen and was reported to require urgent intervention (Oxfam, 2017). The city periodically experiences food crises caused by food shortages and high food prices.

1.1.3 Challenges to the Sustainability of Urban and Peri-Urban Agriculture

Urban and peri urban agriculture activities in the county are diminishing due to escalating built environment inadequate resources and lack of specific policies to address issues on competition of resources such as land, water, finances and labour in the city. The County Government of Nairobi provides limited extension services to UPA farmers (Mwirigi, 2018). This has resulted from the decreasing number of extension workers due to a freeze in employment and limited availability of resources. The devolution of extension services to the county governments has not stabilized the services.

Farmers receive information on crops, livestock, fisheries production and value addition along the value chain. Extension services are also provided by the private sector, community-based organisations, non-governmental organisations and the civil society. A study was conducted by Muyanga and Jayne, (2008) on the policy lessons learnt from private agricultural extension systems in Kenya. The purpose of the study was to understand the efficiency of public and private sectors in terms of service delivery. The findings indicated that private extension was skewed towards certain regions or certain products with a purpose of achieving high profits or quick results. The authors recommended that public and private extension should complement each other than compete or overlap in activities.

The Tegemeo Institute of Egerton University carried out a study in 2006 on private extension services. The study revealed some companies had spent approximately five million Kenya shillings in one year in extension services. These services included marketing of their products, free research samples, advertisements, meetings and conferences (Mwirigi, 2018).

1.1.4 The Decline and Challenges of Extension Services and Methodologies

During the late 1980s, public extension was well staffed and facilitated and subject matter specialists covered up to the sub location level. Farm visits were made regularly while field days and farmers meetings popularly known as" barazas" were well facilitated. Farmers training centres located in most districts were active in farmer's residential trainings which

would take up to one week and most agricultural technologies were practically taught (Mbugua, 2018). However, extension staffing and facilitation has continued to decline due to a government freeze in public employment leading to a high staff farmer ratio which has affected spatial coverage and effectiveness. This situation was aggravated by devolution of agriculture services in 2013 whereby the extension services are yet to stabilise (Mbugua, 2018).

The current extension approaches and methods used include, demand driven and beneficiary led, clientele focus groups, indigenous knowledge and technologies sharing, cost sharing with beneficiaries to reduce dependency syndrome, pluralism and networking (NCIDP, 2018). Clientele are reached through various extension methods such as group trainings, on-farm demonstrations, field-days, trade fairs/exhibitions, exchange visits/tours and farm-visits. Monitoring and evaluation were usually carried out to get feedback and to assess impact. Demonstration plot establishments at Jamhuri showground serves as a demonstration farm for the sector where various farming technologies are show-cased during the Nairobi International Trade Fair (NCIDP, 2018).

These methodologies have portrayed several challenges since the purpose of the methodology is to transfer the technology to the farmers regardless of the consequences (Cho & Boland, 2004). These top-down methodologies do not provide for feedback of information. Farmers and field staff work independently from researchers and these causes' delays in uptake of technologies (Cho & Boland, 2004) and which empowers a farmer to make decisions on sustainability. These technology transfer methods reflect a top-down technology transfer paradigm which therefore necessitates the need for a renewed integrated approach.

According to Garforth and Lawrence (1997), extension can support sustainable agriculture through indicating concerns on the environment. Sustainable technologies were included in the content of extension programmes but the extension methods in the public sector continued to use a paradigm of technology transfer (Garforth & Lawrence, 1997) popularly known as pedagogy.

1.1.5 Extension Worker Characteristics on Job performance.

Extension personnel were expected to be well trained in disciplines of planning, development and management processes since they were important factors to sustainable agricultural development according to Omar, Abu Bakar, Jais, and Shalloof, (2011a).

A study carried out in Nigeria by Adefila, (2012), examined the impact of extension workers to agricultural development in Kaduna State. The purpose of the study was to assess the attitudes of the workers on job performance and to identify the factors that improve performance. Primary data was collected from a sample of 60 agricultural extension workers.

Results indicated that 38 percent had Ordinary National Diploma or Nigeria Certificate of Education and this positively influenced job performance. Analysis on income indicated that only 20 percent were satisfied with the income and job performance was high at 75 percent. Factors that negatively influenced job performance were poor working conditions, irregular wages and inadequate materials and equipment.

The study indicated that there is a significant influence of extension worker characteristics on the job performance of the extension workers. Extension worker job performance is influenced by the personality of the extension worker as a result of influence of genetic and environmental aspects according (Ijioma & Adescope, 2015). Among the environmental aspects were the influence of experience. Mishra et al., (2006 in Debnath, Saravanan, and Datta, 2014) indicated that more female officers in extension performed better than their male counterparts which was as a result of women joining the service much later than men which made gender issues a characteristic of discussion. Understanding the extension worker characteristics are important issues in the achieving the sustainability of UPA in Nairobi City County.

Kotur and Anhazhagan (2014), conducted a study in South India on the influence of age and gender on work performance. Results indicated that workers on the medium age performed better than older and very young workers. The study also indicated that female

workers performed better than male workers and that educational level and experiences affect the leadership abilities of an extension worker (Kotur & Anhazhagan 2014).

These studies indicate the importance of extension worker characteristics on job performance. However, the influence of extension worker characteristics of age, educational levels, gender and years of work experience on the choice of extension methods for empowerment of urban and peri-urban farmers in Nairobi City County has not been fully understood.

The Nairobi City County Governments Department of Food, Agriculture and Forestry objectives in the (NCIDP, 2018) include creating an enabling environment for urban agricultural development, promoting urban food security and safety, increasing dissemination of agricultural information, and promoting output and productivity of crops, livestock and fisheries. The objective also includes enhancing investment in value addition and value chain development of farm produce for local, regional and international markets, (NCIDP, 2018). There is therefore need for an improved dissemination of agricultural information strategy in order to meet these objectives and increase the level of information flow to the farmers.

1.2 Statement of the Problem

Urban and peri urban agriculture contributes to food security and income to approximately 60% (Ohito, 2013), of Nairobi residents directly or indirectly. Urban and peri urban agriculture in Nairobi City County has been declining due several challenges such as inadequate resources of land, water, non-specific policies and a declining extension system. Farmers are not well empowered to make decisions to contribute to its sustainability. Nairobi City County Government provides limited extension services to the city farmers at which 77.5 percent do not receive adequate extension services (Mwasi *et al*, 2017). Most of the studies conducted in UPA indicate that a lot of research has been done on productivity, waste management, income and effects of socio-economic factors on UPA. The contribution of technology transfer methods and extension workers characteristics on sustainability of UPA in Kenya has not been fully understood. The desire in adults to solve problems, become independent and responsible is a great motivation to seek information.

This empowers adults and contributes to making logical decisions to their farming systems which may contribute to sustainability of UPA (Papageorgiou, 2004). Extension workers lack awareness in the considerations of adult learning principles that assist in the choice of technology transfer methods which can contribute to farmer empowerments for sustainability of UPA in Nairobi County.

1.3 Justification

A lot of research has been conducted on the impact of UPA economically and findings indicated that there is increased involvement of people from low-income countries to UPA according to the World Economic Forum (2012). However, these findings do not provide sufficient information on the sustainability of UPA despite its contribution to food and nutrition security to a growing urban population. In the World Economic Forum of 2012, food security was ranked third among factors with the worst impact on global risks (WEF, 2012). The forum recommended more research to assess the influence of behavioural characteristics of farmers and the characteristics of aggregated development systems of which urban agriculture falls.

The Kenya Vision 2030 outlines the key role of the Agriculture sector under the Economic Pillar with the guidelines of the Agriculture Sector Development Strategy (ASDS) 2009-2020. These policy papers aim to improve food and nutrition security and the livelihoods of Kenyans. In the National Urban and Peri-Urban Agriculture and Livestock Policy (NUPAL) released by the Nairobi City County (NCC) in 2015, several constraints were highlighted for interventions. Among them were technology development, technology dissemination and inadequate support services along the value chain framework.

This study will contribute to the data base and information towards an improved understanding on the current technology transfer methods and extension workers characteristics on the sustainability of UPA in Nairobi County. This data can be used in the development of a capacity building model for agricultural extension workers in the design concept of a renewable and integrated extension design. A design that can be updated to

meet the dynamics of present day UPA sustainability challenges. The farmers may be able to seek individualised information and also be able to provide feedback.

Researchers may be able to receive new researchable areas while educational institutions will provide new training courses to their students. These results may be useful to donors and policy makers as information dissemination was identified as gap by the National Urban and Peri-Urban Agriculture and Livestock Policy (NUPAL) released by the Nairobi City County in 2015.

The data will contribute to the Global Sustainable Development Goals (SDGs). According to Davis (2017), the first SDG is related to ending poverty everywhere, while the second SDG is related to ending hunger and to achieve food and nutrition security and promoting sustainable agriculture. The eleventh SDG is concerned with making cities and human settlements safe, resilient and sustainable. SDG twelve is concerned ensuring sustainable consumption and food production patterns.

It may also contribute to the achievement of the University of Nairobi's Department of Agricultural Economics Strategic Objective 4 whose aim is to contribute to sustainable development of society through creation, storage, application and dissemination of knowledge in agriculture, agribusiness, extension education, veterinary medicine and environmental studies (University of Nairobi (UoN), 2013). The results may contribute towards the vision and mission of Nairobi County which is geared towards an innovative, commercially-oriented and modern urban Agriculture and provision of sustainable quality services for Nairobi County residents according to the (Nairobi County Annual Development Plan (NCADP), 2017). Ultimately the data may contribute towards the President's Agenda 4 on food security and the Vision 2030 for Kenya.

1.4 Objectives

1.4.1 Broad Objective

The study purposed to evaluate the influence of technology transfer methods on the sustainability of urban and peri-urban agriculture and the influence of extension worker

characteristics on empowerment of farmers to make decisions on the sustainability of urban and peri urban agriculture in Nairobi City County.

1.4.2 Specific Objectives

i. Characterize the socio economic characteristics of urban and peri urban farmers in Nairobi County.
ii. Describe the availability of resources and considerations of adult learning principles by the extension workers for farmer empowerment in Nairobi City County.
iii. Investigate the influence of technology transfer methods on the sustainability of urban and peri-urban agriculture in Nairobi City County.
iv. Assess the influence of extension worker characteristics on the Empowerment urban and peri urban farmers in Nairobi City County.

1.5 Hypotheses

Based on the above objectives two hypotheses were tested.

H_{01}: There is no significant influence of technology transfer methods on the sustainability of urban and peri-urban agriculture in Nairobi City County.

H_{01}: There is no significant influence of extension worker characteristics on the Empowerment of UPA farmers for the sustainability of UPA in Nairobi City County.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This section reviews related literature that is related to understanding the importance of urban and peri urban agriculture, the challenges that contribute to its decline and the consequences expected. The section also draws insight into the complex dynamics of sustainability, and the importance of the contribution of the extension system towards sustainability of urban and peri urban agriculture. It exposes the deficit of the current extension systems towards empowerment of farmers to make logical decisions to their farming system such as the sustainability of urban and peri urban agriculture in Nairobi City County.

2.1.1 General UPA Overview

Global rapid urbanisation and population explosion has negatively contributed to poor living conditions, inadequate and unsafe food, water pollution and poor sanitation facilities. This has caused major challenges to the environment according to United Nations Population Fund (UNFPA, 2007). Factors such as unemployment, inflation, insecurity, and natural disasters, are leading to greater challenges in the cities. World cities continue to experience challenges of solid and liquid wastes disposal and water and air pollution.

Food and Agriculture Organization's (FAO) has assisted urban populations by contributing to access of adequate nutritious foods as a mandate of the organisation. Developing countries can enhance this assistance by efficiently integrating UPA with rural agriculture in order to play a complementary role. This integration will ensure development of policies and technology that may contribute to sustainability of (Veenhuizen, 2003). Sustainable development is an indication that UPA can potentially contribute in making cities sustainable (Waser, 1997).

The role of UPA in sustainable development has been recognized by international organizations such as FAO, CGIAR (International Agricultural Research Centres, United

Nations Conference on Environment and Development (UNCED) and United Nations Centre for Human Settlements (UNCHS- Habitat), (RUAF, 2000). A United Nations Development Programme (UNDP) survey conducted in 1996 indicated that approximately 800 million people globally participated in UPA (Lee-Smith, 2010).

2.1.2 Global UPA Situation

Food and Agriculture Organization (FAO) has facilitated UPA by supporting international forums for technical enhancements. These forums have upgraded UPA through Animal Production, Health, Veterinary and Public Health (AGAP/AGAH), Food supply and distribution to cities (AGSM), UPA Horticulture (AGPC), and UPA Forestry (FORC). FAO has also conducted research on UPA that has contributed to support in policy and technical competence. The organisation has built an information base on the characteristics of UPA (UN, 2005).

The major international donors for UPA are the World Bank, German Technical Cooperation (GTZ), International Development Research Centre, (IDRC), Natural Resources Institute (NRI) and United Nations Development Programme (UNDP). Other agencies include United Nations World Health Organization (UNWHO), United Nations High Commissioner for Refugees (UNHCR), United Nations Centre for Human Settlements (Habitat), United Nations Children's Fund (UNICEF) and Latin American Research Network on Urban Agriculture (UNCHS- AGUILA). Several networks do exist for Europe, West Africa, and Southeast Asia, (UN, 2005).

The Urban Agriculture Network created in the United States in 1993 has promoted and conducted research on UPA throughout the world. Other organisations that have made major contributions to UPA are Save the Children (SAVE), Care International (CARE), and Oxfam Heifer Institute. Several universities worldwide offer graduate degrees in UPA studies (Veenhuizen, 2003).

2.1.3 The African UPA Situation

Towards the end of the 20th century there was increased interest in UPA, especially in developing countries. This was due to high urban population growth as compared to rural

population, according to the UN Centre for Human Settlements (Waser, 1997). UPA contributes to food and nutrition security by enhancing food availability, access and distribution and therefore contributing to stable food prices and minimizing the number of hungry people in Africa (Lee-Smith, 2010).

A research carried out in Dar- es- Salaam, Tanzania by Jacobi, Drescher, and Amend, (2000) on the contribution by the urban people to the sustainability of the cities. The authors highlighted on the strategy used by the urban people themselves to attain sustainable urban development and this was by involving themselves in urban Agriculture (UA). The study also found out that planned and guided support to UA could contribute to the hardships experienced by urban people and provide a better livelihood. The study recommended three major areas of improving UA would be to conduct more research that would contribute to policy and action-oriented plans to improve UA (Jacobi, Drescher, & Amend, 2000).

Studies were carried out on the characteristics of UPA in Freetown, Dar es Salaam and Khartoum. The studies indicated that farmers relocated as land was put to different uses and new areas were open especially those unsuitable for built environment. UPA has been practiced in the cities between 20-50 years in East and West Africa (Drechsel, Graefe, Sonou, & Olufunke, 2006). Results also indicated that UPA is a profitable activity that provides income and food to the city's residents, due to the availability of ready market and demand for fresh farm produce.

A desk study was carried out in Africa to find out the scope and extent of UPA in the cities (Dima, Ogunmokun & Nantanga, 2002). The study was carried out in Kisangati, Harare, Addis Ababa, Dar es Salaam, Kampala, Nairobi, Ghana, Nigeria Khartoum, Botswana, Bolivia and South Africa. Results indicated that urban farmers and their families benefited from UPA by having better meals and higher income than those of similar socio-economic levels who did not practice UPA. The study found out that UPA was a natural response for survival by middle- and lower-class urban dwellers. The study also concluded that UPA is not sufficiently recognised, is discriminated and does not receive enough funding (Dima,Ogunmokun & Nantanga, 2002).

2.1.4 The Kenyan UPA Situation

Rural urban migration in Kenya is increasing rapidly. Persons migrate to the urban areas in search of employment and income. However, most migrants find the situation worse off economically in the urban areas than they were in their rural homes. A report by Tegemeo Institute (Muthaka, 2013) indicated that a fifth of Nairobi's informal sector residents experience serious food shortages. The report also estimated that by 2030, 50% of Kenyans will reside in urban areas and this will escalate the already bad situation of household food shortages (UN, 2012). Migration to urban areas is also expected to contribute to a decline in rural agricultural production due to transfer of farm workers to the urban areas (Muthaka, 2013). A study conducted in Nakuru Kenya showed that 35 percent of the residents were practicing UPA in 1998, with 27 % growing crops and 20 percent keeping livestock in urban centre (Lee-Smith, 2010).

Farmers in Nairobi County produce crops, keep livestock, fish, and value add the products on small plots of lands. This is practiced in both the urban and peri urban areas. Nairobi also serves as entry and storage point for food imports and exports and has therefore several food storage facilities. These facilities include, National Cereals and Produce Board for cereals and fertilisers, milk coolers and milk processing plants (NCIDP, 2018). Extension services are mainly provided by the County Government of Nairobi. However, extension is also carried out by parastatals, research organizations, and non-governmental organizations, training institutions, CBOs, private sector and civil societies in selected areas.

Urban and peri-urban farmers experience major challenges which include inadequate resources such as land, water and high cost of inputs. Farmers also experience contamination of water for irrigation by chemicals from the factories and liquid and solid waste (NCIDP, 2018). Extension services have been limited, and they lack specific adequate policy and legal framework to direct urban farming (Ayaga *et al.*, 2005). In linking UPA to the livelihoods of the urban poor, the National Government through the Departments of Agriculture, Livestock and Fisheries (DALF) contributed towards reviving agriculture in line with the Strategy for Revitalizing Agriculture (SRA) 2004-2014 and the Millennium Development Goals (MDGs). This contributed to the growth of the urban

market by contributing to employment and income as indicated by increased processing in the informal sector (Ayaga *et al.*, 2005).

Studies conducted in Nairobi by Mireri (2002), indicated that commercial UPA is a viable economic activity, and recommends strategized provisions of credit for its improvement. The author recommends the production of a favourable policy and the integration of UPA into the cities land use system in order to purposely improve the sector. Formation of farmers' associations to lobby for government recognition and a marketing society were recommended to improve the profitability of urban and peri urban agriculture. The report also recommended the provision of updated data on improved technological and support services through farmer associations (Veenhuizen & Danso, 2007).

2.2 Characteristics of Technology Transfer Methods and their Influence on Sustainability of UPA

Transformation has been witnessed worldwide in agricultural extension goals by changing from emphasizing on high yields in agricultural production, to emphasis on efficiencies on production factors (productivity) and now heading towards sustainability. Sustainable agricultural development can be achieved by improving agricultural dissemination services as a source of information. According to Vanclay and Lawrence (1995), studies indicated that traditional technology transfer methods were not effective in farmers making decisions on sustainable agriculture. The traditional methods depicted a technology transfer paradigm and the recent participatory approaches have not successfully contributed to sustainable agriculture due to failure to actively consider the adult learning principles.

The dominant extension model worldwide is the public sector extension approach which is coordinated by the Ministry of Agriculture. The National level handles policy issues and research while the implementation levels are the counties, districts and villages (Rivera, Elshafie, & Aboul-Seoud, 1997). The major aim is to transfer a new technology to the farmer making the model a top-down approach. Due to the rigidity of the approach's farmers are unable to seek further information and bring feedback on time. The national government researchers work independently and therefore research findings do not reach

the extension worker and the farmers on time (Cho & Boland, 2004). According to Chaudhry, Muhammad and Ashraf, (2006), agricultural extension programmes were disseminated effectively after decentralisation. These therefore creates a need for an alternative approach.

Participatory approaches assist the extension worker to involve the farmers in the implementation of activities which contributes to improvement of problem-solving abilities. For achievement of sustainable agricultural development, a local institution is a precondition (Okorley, Gray & Reid, 2009). Participatory approaches contributed to agricultural effectiveness, agricultural growth, and produced high returns. The extension worker should be empowered to use an effective and dynamic approach to disseminate agricultural information and skills to the farmers to achieve sustainability in agricultural activities. These approaches are anchored on adult learning principles (ALPs).

Several adult learning approaches have been used. Experimental learning approach has been used in the case of Farmer Field Schools (FFS), approaches for technology development and dissemination. FFS is a focus group approach (Witt, Pemsl, & Waibel, 2008) whereby farmers, extension agents and researchers serve the group on a common platform. A public-private extension approach integrates the input suppliers, the farmers, and marketers of the produce. Mass media approaches are used in dissemination of information and a lot of extension materials are produced such as leaflets and posters to document research findings (Al-Rimawi, & Al-Karablieh, 2002).

Adults learn in both formal and informal settings including their places of work. A facilitator should acknowledge biological and psychological development of the learners, and acknowledge the farmers prior knowledge and experiences (Merriam, & Caffarella, 1999). These experiences may be life or farming experiences and may have been positive or negative. A facilitator should also assist the learners to recognize their ability as lifelong learners and consider their socio-cultural perspectives on development (Merriam, & Caffarella, 1999).

In a study done in Louisiana, Tennessee, and Virginia by Franz *et al*. (2010), the authors examined how farmers learned and identified factors that affect extension workers to enhance farmer learning and improve adoption of new practices. Farmers preferred a learning process that considered prior experiences and were motivated by saving time and money. Farmers also appreciated updates on new research findings, and socialization in education. The authors also indicated that different farmer groups have different needs. Farmers enjoy learning from other farmers, participating in research and receiving new agricultural practices (Franz *et al*., 2010). The study concluded that farmers preferred a one-to-one method, personalized communication and group methods of on-farm demonstrations.

Studies were conducted in Eastern Libya to analyse the impact of alternative extension approaches for sustainable agriculture. A cross sectional survey was adopted by use of questionnaires to collect data (Omar *et al*., 2011b). The study interviewed 46 managers and deputy directors. The quantitative analysis indicated that, public-private approach, participatory approaches and farmer field schools had more impact on sustainable agriculture (Omar *et al*., 2011b). The contribution of alternative approaches to sustainable agriculture was as a result of transferring research results to farmers and extension staff (87.0 %) and undertaking reforms on agricultural markets (80.4 %). Other respondents (84.8 %) suggested the support of credit institutions for sustainability. The authors suggested a need to transform management components in strategy and functions to achieve sustainability in agriculture (Omar *et al*., 2011b).

2.3 The Theory of Andragogy

Andragogy is the "art and science of helping adults to learn" (Malcom Knowles, 1990). According to Pappas (2015), pedagogy focuses on teaching children, while andragogy is focused on adult learning. In pedagogy, the learner is dependent on the instructor who assumes responsibility for what is taught and how it is taught. The learner comes in with little experience and is motivated by external pressures such as examination grades according to Chan (2010). In andragogy the learner is self-directed and brings on board a lot of experiences. Learners are interested in performing tasks and problem solving. Adult

motivators include increased self-esteem, better quality of life and increased confidence to make decisions (Chan, 2010).

Top-bottom technology transfer paradigm approaches do not assist in the endogenous development of the human capital which contributes towards decision making. Bottom- up approaches build up the concept of the "Integrated learning package" and provides for mixed learning resources which drive sustainable development (Papageorgiou, 2004). To inspire development under the principle of sustainability is a demanding task, which calls for a high level of awareness and special skills among the extension workers (Papageorgiou, 2004). Lack of instilling responsibilities and authority and lack of providing extension networks for partnerships is a course for unsustainable UPA (Allahyari, 2009). These therefore calls for an educational change in the extension service that will empower workers and clients by providing training based on the endogenous development principles.

Andragogical (endogenous development) principles provides for a mode of learning which could be formal or informal, flexible and provides lifelong learning through an innovative approach of "blended learning", Papageorgiou (2004). It provides learning that is open, based on sharing of experiences and farmer-guided groups by focusing less on content more on the process of passing the technology (Papageorgiou, 2004).

The Worldwide Fund for Nature proposed that for development to be sustainable the strategy must go beyond education and must contribute towards transforming individual and societal values in interactions with the ecosystem (UN, 2005).The United Nations had recognized the important role of education, and had made a declaration on observing a decade for sustainable development, (2005–2014). The aim was to challenge all persons to change their behaviour and save the environment for the future. Educational change is a complex and dynamic process to transform the teachers' behavioural patterns, transform institutions identity and improve student knowledge on environmental changes (Nanchimas *et al.*, 2004).

Adult learning consists of many different theories according to Gutierrez (2018) which include neuroscience andragogy, self-directed learning, experiential learning, and transformational learning. The neuroscience theory suggests that adults are less able to learn and acquire new skills as compared to children (Knowland & Thomas, 2014). Transformative learning is geared to change the way individuals perceive their world by change of consciousness according to (Teaching Excellence in Adult Literacy (TEAL), 2011).

The theories are directed to the trainer to create an effective learning experience for the adult learner. Adult trainers should be aware of adult learning theories in order to prepare material that meet learner needs and devise instructional strategies which align with the actual learning context. The theories also assist the trainer to design an instructional strategy that is relevant to the current technological times (Gutierrez, 2018).

Malcolm Knowles developed a theory for adult training that emphasized on self-directedness for adults and ensuring they take responsibility for decisions that they make. Knowles indicated that there should be a different learning strategy for adults and conceptualized the adults learning theory which indicates how adults cultivate knowledge. Malcolm identified the principles of adult learning as being internally motivated, self-directed, considerations of past experiences have a learning purpose and prefer to be practical and respected. This andragogical model is not designed to fit all approaches in adult education but provides flexibility in planning and implementing quality adult education programs according to Knowles (1984 in Franz *et al.,* 2010).

In Kenya a study was conducted in Kakamega district by Ali-Olubandwa *et al*. (2011) on the contribution of extension methods to increased food production. The results indicated that most extension workers preferred group methods since they were considered to experience less challenges and proved to be effective. Farmers preferred farm visits which were less preferred by the staff. Tours and field days were less preferred by the extension workers (Ali-Olubandwa *et al*., 2011).

Cho and Boland (2004) indicated that among the objectives of agricultural sustainability should be effective transfer of technology and the setting up of an institution that can contribute to future research, policy needs and collective decisions over environmental issues. The author indicated that mass media methods do not provide relevant technical information and do not take into account farmers' feedback and provide solutions to local problems (Cho & Boland, 2004). Developing countries are also moving towards privatization and demand that farmers pay for services. There is also tendency towards regionalization or devolution and outsourcing extension services.

In the event that farmers have to pay for extension services they should be able to have a choice of an individual method (Blum, Lowengart-Aycicegi, & Magen, 2010). These services should also ensure the extension worker collaborates on their behalf to other stakeholders such as researchers and policy makers.

2.4 Characteristics of Extension Workers and their Influence on Sustainability of UPA

There is increased concern for sustainable practices globally. Extension workers are multi-functional and experience many challenges when working with farmers. According to Wals and Bawden (2000), these challenges are complex, uncertain, and conflict with common methods of dealing with issues. These issues necessitate the empowerment of the extension workers for improved competencies in sustainable agriculture for rural and urban development. The principles of networking and partnerships are important values that assist in sharing knowledge that motivate progressive social change (Hooks, 2003).

According to Lovren, (2004), the principles of considering learning for life, considering partnerships, mixed cultures, discipline and empowerment are promoted as relevant topics in education for sustainability. Nairobi has mixed races and cultures which should be considered. An institutionalised and digitised personal technology transfer method needs to be incorporated in sustainable urban agriculture, (Omar, Abu Bakar, Jais, & Ibraik, (2011a).

A study to examine the influence of extension workers to development of agriculture was carried out by Adefila, (2012) in Kaduna State, Nigeria. The purpose was to reveal the relevant factors that contribute to performance of extension workers in Nigeria. Data was gathered from 60 extension workers from six stations. Purposive sampling was used to identify the respondents. Descriptive statistics, chi Square and non-parametric techniques were used to analyse the data. Educational levels indicated that 36.7 percent had obtained either Ordinary National Diploma (OND) or Nigeria Certificate of Education (NCE).

A total of 20 percent of workers indicated that the income was sufficient while 75 percent indicated that the job performance was satisfactory. Job performance was however affected by poor working conditions, irregular wages and allowances. The statistical analysis indicated that there was a significant influence of education level and attitude of the extension workers on the job performance at 0.05 alpha levels. Most of the workers indicated that their job was satisfactory (Adefila, 2012).

A study was conducted in Iran by Allahyari (2008) to identify appropriate extension system indicators for agricultural sustainability. Simple random sampling technique was used to sample 87 respondents and survey method used to collect data using a structured questionnaire. The Cronbach's alpha of the questionnaire reliability indicated a result of 0.86. Descriptive findings revealed that empowerment, improved food security and enhancing adaptive management capacity, were important for an extension system towards sustainability according to Allahyari (2008). Table 2.1 present a summary of related literature.

Table 2.1 Summary of Related Study Literature Review

Author	Location	Are of Study	Conclusion
Jacobi, Drescher, and Amend, (2000)	Dar- es- Salaam, Tanzania	Contributions of urban residents to the sustainability of cities	The urban residents must be involved in sustainability issues
Drechsel, Graefe, Sonou, & Olufunke, (2006)	East and West Africa.	Challenges and importance of urban agriculture	UPA is profitable and provides the city with income and food.
Dima, Ogunmokun & Nantanga, (2002)	Kisangati, Harare, Addis Ababa, Dar es Salaam, Kampala, Nairobi, Ghana, Nigeria Khartoum, Botswana, Bolivia and South Africa	scope and extent of UPA in the cities	Urban residents who practice UPA have better meals and incomes than those of similar socio-economic levels who did not practice UPA.
Lee-Smith, (2010)	Nakuru, Kenya	Extent of UPA in Nakuru county	35 % of the residents were practicing UPA
Ayaga *et al.*, (2005)	Kenya	Extent of extension services in the country	Extension services have been limited, and lack specific adequate policy and legal framework to direct urban farming

Mireri (2002)	Nairobi	Importance and challenges of UPA in the county	Commercial UPA is a viable economic activity, and recommends strategized provisions of credit
Franz *et al*. (2010)	Louisiana, Tennessee, and Virginia	Enhancing farmer learning through the extension system	Farmers preferred a learning process that considered adult learning principles
Omar *et al*., 2011	Eastern Libya	The contribution and impact of alternative extension approaches to sustainable agriculture	Public-private approach, participatory approaches and farmer field schools had more impact on sustainable agriculture
Ali-Olubandwa *et al*. (2011)	Kakamega, Kenya	contribution of extension methods to increased food production	most extension workers preferred group methods since they were considered to experience less challenges and proved to be effective.
Adefila, (2012)	Kaduna State, Nigeria	Reveal the relevant factors that contribute to performance of extension workers	There was a significant influence of education level and attitude of the extension workers on the job performance
Allahyari (2008)	Iran	To identify appropriate	Empowerment, improved food

	extension system indicators for agricultural sustainability.	security and enhancing adaptive management capacity, were important for an extension system towards sustainability

2.5 Agricultural Sustainability

2.5.1 Dimensions of Agricultural Sustainability

Agricultural sustainability is a complex phenomenon with no common definition among scholars. There are several parameters for measuring sustainability and therefore according to Hayati, Ranjbar, and Karami (2010), indicators for agricultural sustainability should be location and researcher specific.

Generally, in measuring sustainability there are three dimensions that must be considered in the selection process which include economic, social and environmental. The economic indicator considers the efficient use of resources for profitability and productivity, contribution to wealth and diversification of sources of income. The environmental indicators include efficient use of water, protection of soils, climate change and landscape. Social dimensions include human employment, age, education levels, gender and urban verses rural population according to Organisation for Economic Cooperation and Development (OECD, 2008).

Different types of indicators have been developed according to Hayati, Ranjbar, and Karami, (2010) which do not represent all dimensions. OECD advices that parameters used

to measure agricultural sustainability should be within the specific socio-economic and ecological context and depend on the perspective of the researcher (OECD, 2008).

2.5.2 Factors of UPA Sustainability

In the World Summit conducted in 2005 on factors of sustainability for social development, three sustainability pillars were noted for consideration. These pillars include economic, environmental, and social equity (UN, 2005). United States has committed a lot of effort in sustainability through a community-based approach called "Smart Growth". Smart growth is committed to an ecologically sound urban community through planning and development in accordance to a Project on Ecological Governance (POLIS, 2007). Smart growth has been adopted in other countries such as Canada to curb the challenges of urban sprawl. These challenges include destruction of the environment and interference of agricultural lands. Smart growth provides solutions to these problems and contributes to change of local policy (POLIS, 2007).

Agricultural Sustainability has several economic indicators. According to Veenhuizen and Danso (2007) these indicators include yield, income per hectare, Gross National Product (GNP) and value of land. Environmental indicators include indicators on pollution, biodiversity, and energy and water conservation, detection of heavy metals in crops, soil improvement and recycling of organic waste. Social indicators to sustainability include contribution to employment or income, youth participation, gender consideration and social acceptance (Veenhuizen & Danso, 2007).

For the purposes of this study the economic indicator adopted were the average annual income per acre from UPA activities, the environmental indicator was number of environmentally friendly technologies adopted for UPA and the social indicator was the number of years a farmer had participated in UPA (UPA farming experience).

2.5.3 A Sustainability Theoretical Framework

The FAO Framework for Evaluating Sustainable Land Management (FESLM) considered by Drechsel and Dongus (2010) indicated in Table 2.2 has been adopted for sustainability assessment in this study. According to FESLM sustainable land management, protects the

natural resources, enhances production, reduces production risks, and protects soil and water quality.

Table 2.2: The Five Pillars of Sustainability in the Framework for Evaluating Sustainable Land Management for Rural, Urban and Peri-Urban Agriculture

Rural Agriculture	Urban and Peri urban Agriculture
Improves productivity	Improves productivity
Production risk reduction	Reduces risks of production and eviction.
Environmental protection	Human and Environmental protection
Economic viability	Economic viability
Social acceptability	Social and political acceptability

Source: Smyth and Dumanski (1993, cited in Drechsel & Dongus 2010)

This framework considers indicators contained in the three pillars of sustainability such as economic, environmental and social dimensions. It accounts for tangible and non-tangible values of sustainability (Nugent, 1999) that can be used in the urban context. The five pillars of the FESLM can be adopted to assess sustainability of UPA and are based on the three sustainability pillars (Drechsel &Dongus, 2010). The figure shows the complex interactions of the extension mechanisms and their contributions to sustainable agriculture.

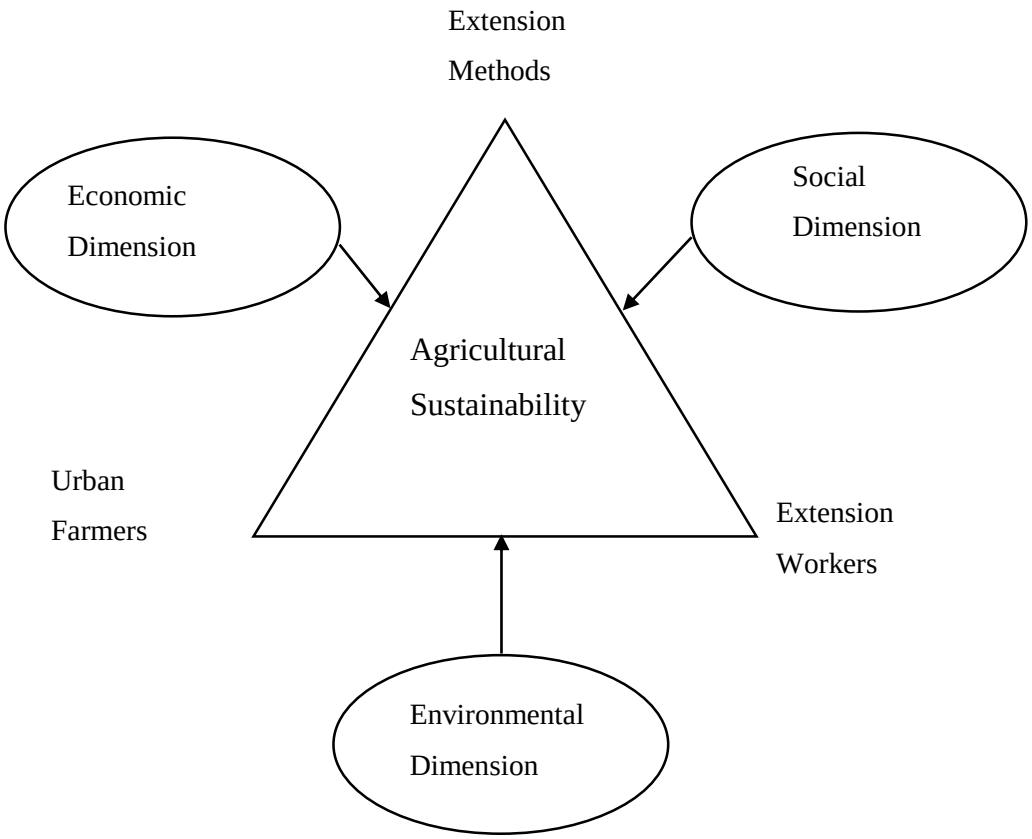

Figure 2.1: A Modified Theoretical Framework that Supports Agricultural Sustainability. Postulated from Allahyari, (2008)

The independent variables of different methods of information transfer, the socio economics of the extension workers and farmers influence the empowerment of the urban farmers and subsequent sustainability of UPA in Nairobi county. The extension system is considered in the economic, socio and environmental dimensions for sustainability to be achieved.

2.6 Conceptual Framework

The contextual setting under which several factors influence the sustainability of UPA is indicated in Figure 2.2.

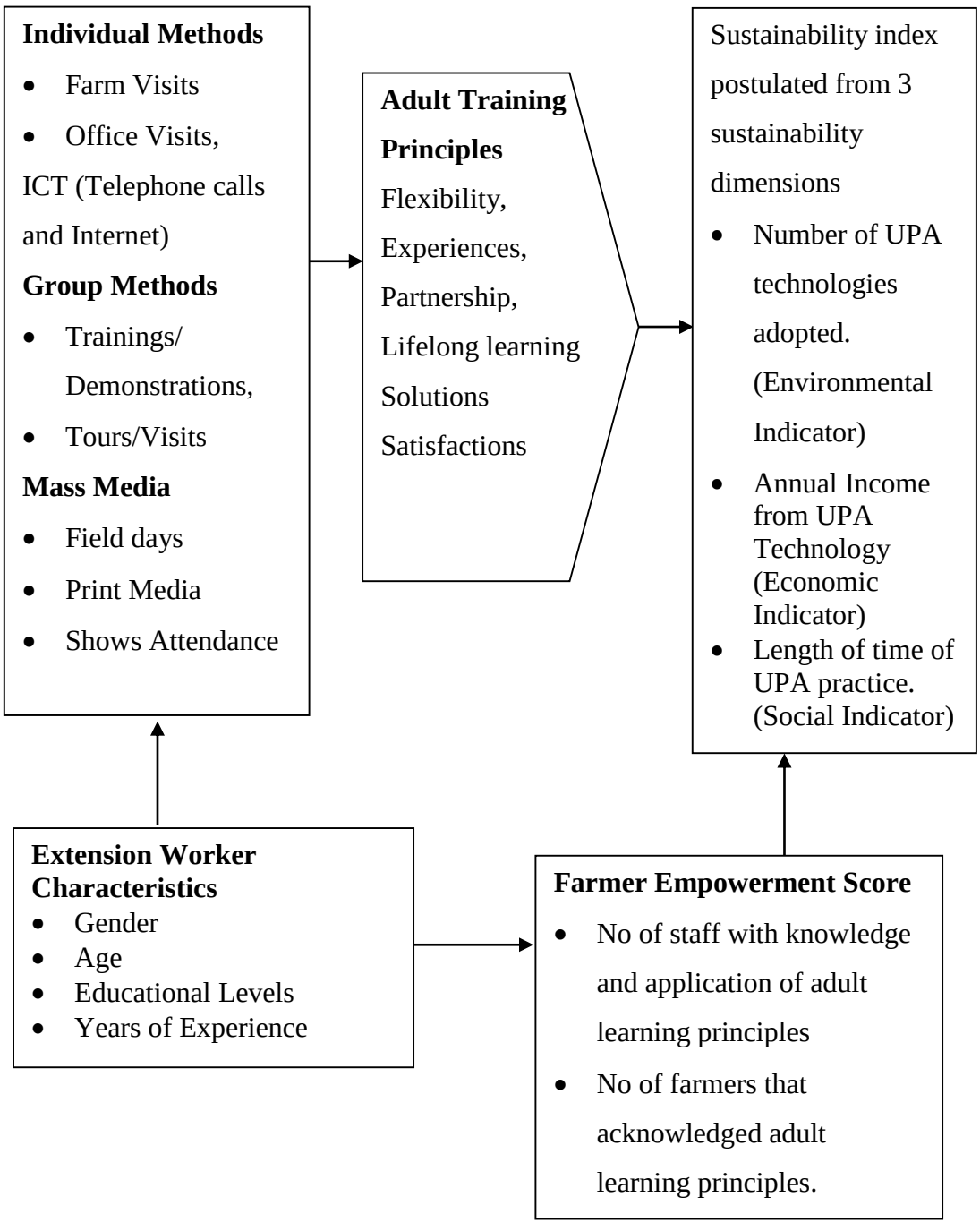
Independent Variables
Intervening Variables
Dependent Variable
Individual Methods
Farm Visits
Office Visits,
ICT (Telephone calls and Internet)
Group Methods
Trainings/ Demonstrations,
Tours/Visits
Mass Media
Field days
Print Media
Shows Attendance
Adult Training Principles
Flexibility,
Experiences,
Partnership,
Lifelong learning
Solutions
Satisfactions
Sustainability index postulated from 3 sustainability dimensions
Number of UPA technologies adopted. (Environmental Indicator)
Annual Income from UPA Technology (Economic Indicator)
Length of time of UPA practice. (Social Indicator)
Extension Worker Characteristics
Gender
Age
Educational Levels
Years of Experience
Farmer Empowerment Score
No of staff with knowledge and application of adult learning principles
No of farmers that acknowledged adult learning principles.

Figure 2.2: Conceptual Framework Relating the Independent Variables to the Intervening Variables and the Dependant Variables

The conceptual framework shows technology transfer methods as independent variables. They influence the intermediary variables that also influence both the independent and the dependent variables. Hypotheses were postulated and tested about influences of these technology transfer methods on the sustainability of UPA.

According to the conceptual framework, contribution to sustainability is dependent on the technology transfer method used and the consideration of the principles adequately utilised by a skilled extension worker.

The review identified the following gaps which were investigated in this study

i. There is limited data on the characteristics of Nairobi City County urban farmers and available resources.
ii. There is limited understanding on Nairobi County extension workers characteristics and their influence on the urban farmer empowerment.
iii. There is inadequate information on the influence of technology transfer methods on the sustainability of UPA in Nairobi County.
iv. The study will provide an understanding on the importance of considering adult learning principles on the use of extension methods for increased farmer empowerment.

CHAPTER THREE*:* METHODOLOGY

3.1 Introduction

This section highlights the research design, and introduces the area that the study was carried out. It also details the data collection tools, data collection procedures, sampling methods, data variables and data analysis procedures.

3.2 Research Design

The study utilized a cross-sectional survey method for gathering information from a sample of 149 individuals for the purposes of describing the attributes of the larger population (Mugenda & Mugenda, 2008). The design was favourable in describing the cross-sectional conditions and quantifying factors and was a valuable tool for assessing opinions and trends and can contribute to change of strategies (Etikan & Bala, 2017). Questionnaires were used to collect primary data in order to determine the current status of the population at a particular point in time (Cohen & Manion, 1989). This was in respect to understanding the influences of technology transfer methods and extension worker characteristics on the sustainability of UPA in Nairobi County.

3.3 The Study Area

The study was conducted in Nairobi City County which is also the capital and Kenya's largest city. The County population was 3,138,369 in 2009 and is expected to rise to 5,958,338 in 2022 (NCIDP, 2018). Nairobi is located to the south-east of the Rift valley. To the north is Kiambu County, south east is Kajiado County and to the west is Machakos County. It occupies an area of about 696 km^2 with an altitude of between 1,600 and 1,850 meters above sea level (NCIDP,2018).

Nairobi lies at a GPS of 1 0 17’11, 0004” S. and 36 0 49’2. 0028” E. and experiences a temperate to tropical climate with two rainy seasons. The long rains are received between

March and May and the short rains are between October and December. The study was conducted in 13 Sub Counties as representatives of the 17 Sub Counties of Nairobi as shown in Figure 3.1. These are urban areas of Starehe, Makadara, Roysambu, Embakasi West, Embakasi Central and Embakasi South and slum areas of Mathare and Kibra. Peri urban areas were Dagoretti North, Dagoretti South, Kasarani, Westlands, and Langata. These sub counties had the highest numbers of urban and peri-urban activities.

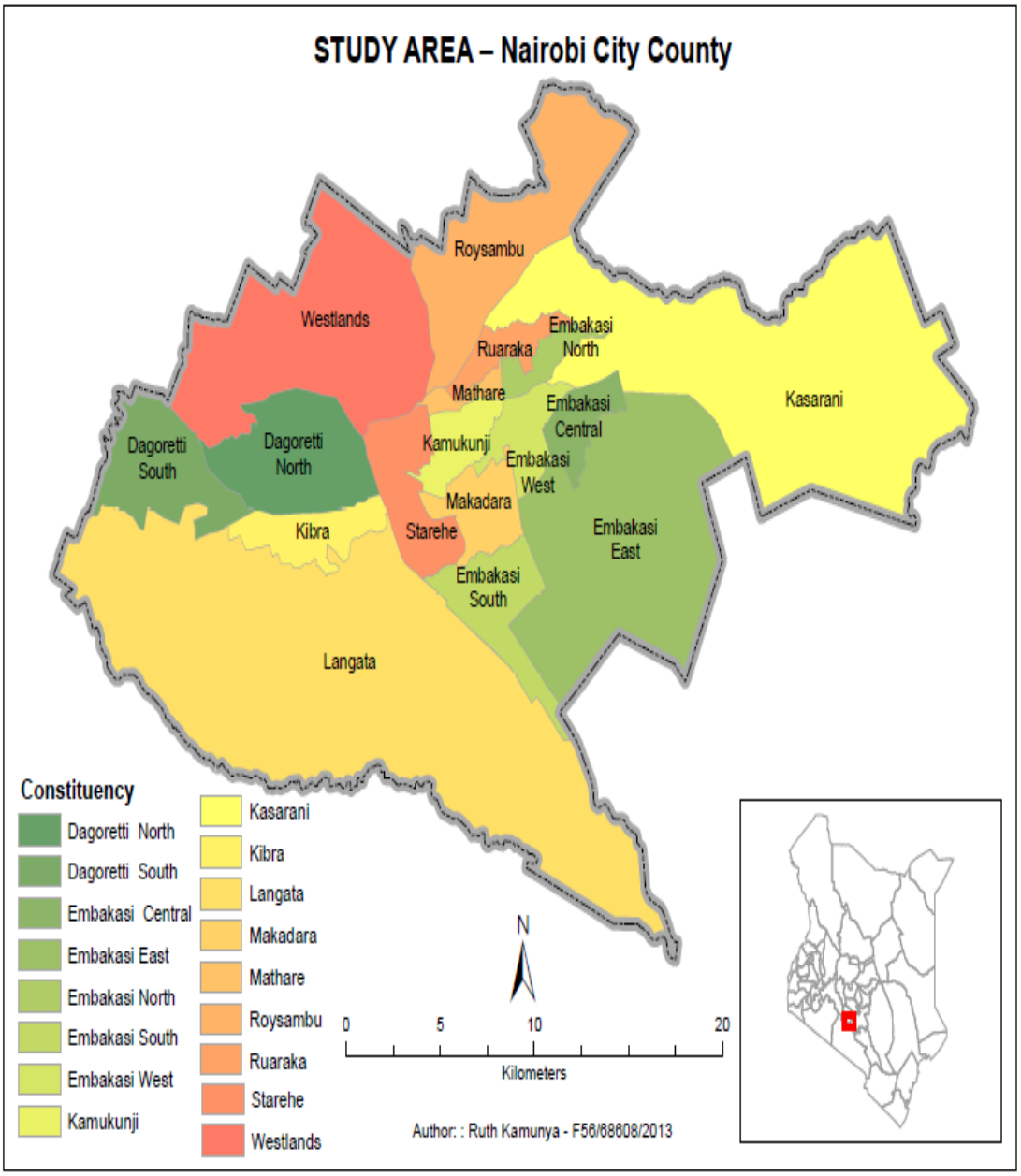

Figure 3.1: Nairobi City Map Showing the Study Area

Source: Kamunya, (2013)

3.4 Sampling Procedures and Sample size

The Sub- Counties of Starehe, Mathare, Makadara, Roysambu, Kibra, Embakasi West, Embakasi Central and Embakasi South, Dagoretti North, Dagoretti South, Kasarani, Westlands, and Langata were purposively selected due to their uniqueness in both urban and peri-urban agriculture. This was to allow the researcher to use representative cases and

gather the necessary information for analysis to meet the objectives of the study (Mugenda & Mugenda, 1999). Purposive sampling built a sample that satisfied the researcher's specific needs as per the objectives (Cohen & Manion, 1989).

3.4.1 Farmer Sampling

The target population of the study comprised of 985,000 households in Nairobi city according to Republic of Kenya (RoK, 2014). It is estimated that approximately 10-30% of Nairobi households practice various types of farming (Mwangi & Foeken 1996) depending on locality which translates to approximately 295,500 households. The county was estimated to have over 200,000 households practicing agriculture (Lee-Smith 2017). The sampling frame is approximately, 10 percent (98,500 farmers) of these households practice urban and peri-urban farming technologies.

Due to the heterogeneity of the population the UPA farmers were stratified whereby each stratum represented a ward which was either slum, urban or peri-urban in order to maintain an adequate cross-section of the area (Etikan and Bala, 2017). Nairobi City County is comprised of 85 wards of which 75 wards were stratified into slum, urban and peri-urban depending on the location while simple random sampling was used to identify the respondents. The sample size was achieved by use of the Cochran equation, (Singh & Masuku, 2014) to yield an adequate representative sample proportions from a large sample.

$$\mathbf{n_0 = Z^2\ p\ q\ /\ e^2}$$

Where n_0 is the minimum sample size,

Z is the value under the normal curve found in statistical tables

p is the estimated proportion of an attribute (persons involved in UPA) that is present in the population

q is 1-p.

e is the desired level of precision or the error term set at 0.05 significance level.

Data used for this study

Z = 1.96 which corresponds to 95% confidence level.

p =10% = 0.1

q = 0.9

e = 0.05

$\mathbf{n_0 = Z^2\ p\ q\ /\ e^2 = 1.96^2 * 0.1*0.9/0.05^2 = 138}$

Cochran (1963 cited in Singh & Masuku, 2014)

The Cochran equation produced a sample size of 138 farmers that would have been adequate for sampling. However, due to the nature of the study, the objectives, the heterogeneity of the population, the method of data analysis (Singh & Masuku, 2014) which is Multiple Linear Regression analysis and to cater for natural attrition a higher sample size of 150 was considered.

3.4.2 Extension Worker Sampling

The County of Nairobi had approximately 185 agricultural workers at the time of study (NCIDP, 2018). The extension workers were randomly selected from the sub counties. The study employed the Yamane formula to achieve a sample size of 64 agricultural extension officers promoting the uptake of UPA in Nairobi County.

$$\mathbf{n=N/ (1+N (e)^2)}$$

Where

n = Sample size

N = Population Size

e =level of precision (10%)

n =185/ (1+1.87) = 64 respondents

The Yamane formula produced a sample size of 64 extension workers which was adopted as appropriate for the study.

3.5 Data Sources

The study used questionnaires to collect primary data. The researcher selected a sample of respondents and administered questionnaires in order to collect data. The items in the questionnaire were both closed-ended (structured) and open-ended (unstructured) where more information was required. Questionnaires were in two sets, the first one for UPA farmers and the second one for extension workers as shown in Appendices A and B. Both

questionnaires sought information on influences of technology transfer methods and extension worker characteristics on the sustainability of UPA in Nairobi County.

3.5.1 Validity and Reliability

Validity is the degree to which the analysed results from the data actually represent the phenomena under study according to Mugenda & Mugenda, (1999). It is the extent to which the instrument measures the full meaning of the concept under study. The instrument was measured for internal and external validity in content, appropriateness, meaningfulness and usefulness by pilot testing and by having the instruments validated by the university supervisors.

Reliability is a measure of the research tool to yield consistent data after several trials (Mugenda & Mugenda, 1999). It reduces random errors, which include inaccuracy of the instrument, researcher errors, and unexplained error. Reliability was achieved by pilot testing and by use of a reliability test. Scores obtained from one item were correlated with other scores from other items in the instrument. The Cronbach's coefficient Alpha formula shown below, that is a general form of the Kunder-Richandson (K-R) 20 formulas were computed by SPSS analysis to determine how items correlated among themselves.

$$KR_{20} = \frac{(K)\left(S^2 - \sum s^2\right)}{\left(S^2\right)(K-1)}$$

Where

KR_{20} = Reliability coefficient of the internal consistency,

K = Number of items used to measure the concept,

S^2 = variance of all scores,

s^2 = variance of individual items.

Table 3.1: Reliability Test

Cronbach's Alpha	K = number of questionnaires
.788	25

The reliability test Table 3.1 indicated a correlation coefficient of 0.788 in 25 items. A correlation coefficient of over 0.7 in a range of 0 - 1 is usually accepted as criterion for questionnaire reliance (Mugenda & Mugenda, 1999) and this criterion confirmed that the instrument was reliable.

3.5.2 Pilot-study

To ascertain whether this kind of research was reliable a pilot-study was undertaken in Westlands Sub County of Nairobi County in areas of similar climatic, infrastructure and socio-cultural characteristics to the actual research areas. This was done in consultation with the local extension officers and local leaders. The data were used to test for reliability and were analysed to confirm appropriateness of methods of analysis (Mugenda and Mugenda, 1999). The pilot-study sample comprised of 15 percent of the cases in the farmer questionnaires and 5 percent of the cases in the extension workers questionnaires. The pilot study assisted in improving and finalizing the questionnaires that were used for the study.

3.6 Data Collection Procedures

For the purposes of this study two questionnaires were designed. The first questionnaire was designed for 150 farmers and the second complimentary questionnaire was designed for the 64 extension workers. These questionnaires are attached as appendices (A) and (B) and were administered in two ways. Questionnaire (A) was researcher-administered, whereby the researcher used the questionnaire to interview the respondents while questionnaire (B) for staff was self-administered whereby respondents were requested to complete the questionnaires.

Confidentiality was assured to the farmers before and after the interview. Pre-study visits were made to the Sub-County Agricultural Officers (SCAO) of the respective sub counties to plan for data collection which was done with the farmers' consent. Visits were made to respective wards and arrangements made to visit the farmers with the respective Ward Agricultural Extension Officers (WAEOs).

3.7 Data Analysis Procedures

3.7.1 Data Cleaning and Coding

The data collected was cleaned, coded and entered into the computer for analysis by the use of Statistical Package for Social Science (SPSS) and inference made at 95 percent level of significance for the farmers data and 90 percent level of significance for the extension worker data. Descriptive and inferential analysis of multiple linear regressions was used to analyse the data.

3.7.2 Data Analysis Procedures

Descriptive statistics were used to summarize data in order to assist the researcher to provide the current status of the characteristics of the farmers. Percentiles, frequency distribution tables and bar charts were used to establish trends and summarize the information. Results obtained from the open-ended questions were analysed qualitatively (Mugenda and Mugenda, 1999). Results are shown and discussed in chapter four.

The ability of a farmer to make logical decisions about their farming systems is dependent on the empowerment of the farmer achieved during extension trainings. Technology transfer methods used by the extension workers consider adult learning principles that are important for farmer empowerment. Farmers were asked the methods they considered to provide the adult learning principles for their empowerment. If a method provides for a principle it was coded as yes (1) and no (0). Frequency's, means and standard divisions were calculated for each method. The method with the highest mean was considered to provide higher empowerment to the farmers.

Multiple Linear Regression (MLR) is a parametric test where by the results can be generalised to the population (Frost, 2017). The purpose of using multiple linear regressions in testing the hypotheses was to assist in explaining the linear relationship between technology transfer methods which were measured in nominal scale and the dependent variable which was a calculated sustainability index.

Multiple linear regressions were also used to test the extension worker socio characteristics and a calculated empowerment score and to explain the interrelationships among variables.

The analysis indicated the strength and direction of the impact of the independent variables on the dependent variables. The study was multi-factorial in nature, indicating that more than one factor impacted on the dependent variable. Multiple linear regressions also provide for the strength of impact of multiple independent variables on a dependent variable (Frost, 2017).

3.7.3 Descriptions of Variables

In order to assess the influence of technology transfer methods on the sustainability of urban and peri-urban agriculture in Nairobi County, the independent variables were technology transfer methods and the dependent variable was a calculated sustainability index. Technology transfer methods used by extension workers to pass information assists the farmer to make logical decisions on their farming systems to achieve sustainability. These were individual methods of farm visits, farmer office visits and ICT (telephone calls and E-extension/internet), group methods of trainings /demonstrations and tours / visits and mass media methods of shows, field days and print (posters and fliers/handouts), as shown in Table 3.2.

Table 3.2: Description of Independent Variables for Hypothesis One Testing

S/NO	Variable	Description /Unit
Individual Methods		
1	Request for or Receive Farm Visits	1-Requests and appreciates farm visits, 0- Does not requests or appreciates farm visits
2	Make Office Visits	1-Makes office visits, 0- Does not make office visits
3	Consult through ICT (E-extension /internet and telephone calls)	Consult through ICT, 0 - Does not consult through ICT
Group Methods		

4	Attend group trainings and Demonstrations	1-Attends training and demonstrations, 0- Does not attends training and demonstrations
5	Participate in Group Tours and Visits	1-Participates in group tours and visits, 0- Does not participates in group tours and visits
Mass Methods		
6	Attend Shows	1-Attends shows, 0- Does attend shows
7	Receive Fliers/Handouts (Print)	1-Receives fliers, 0- Does not receive fliers.
8	Attend Field days	1-Attends field days, 0- Does not attend field days

The sustainability index was constructed from the farmers' annual average income accrued from the UPA technologies, number of years of farmers practice in farming (experience) and the number of UPA technologies adopted by the farmers. Multiple linear regression was used to test this hypothesis.

3.7.4 Computation of the Sustainability Index

A composite sustainability index was computed using 3 indices. The methodology was borrowed from the universal Sustainable Society Index (SSI) which integrated factors to be considered in the measurement of sustainability according to Sustainable Society Foundation (SSF, 2017). These were the human well-being, environmental well-being and the economic well-being.

This study considered the pillars of the FAO Framework for the Evaluation of a Sustainable Land Management (FESLM) as a useful guideline for the choice of indicators for the sustainability of urban and peri-urban farming (Drechsel & Dongus, 2010). In this study the annual average income of the farmer was considered as an economic indicator, the length of time a farmer had engaged in UPA as a livelihood was considered as a social

indicator while the number of technologies the farmer had adopted was considered as an environmental indicator.

In the SSI methodology, indicator scores are aggregated for the three well-being dimensions into a single score (SSF, 2017). SSI uses the geometric average as opposed to the arithmetic average for computation of aggregations. Arithmetic average offers compensation, meaning low scores for one indicator can be compensated by high scores for a different indicator. However, geometric average accounts for compounding of indicators over time. SSI also indicated that there lacks a scientific basis for the attribution of different weights to sustainability indicators, and thus appoints the same weight for the aggregation into dimensions. SSI has different formulas for different indicators (SSF, 2017).

The sustainability index for this study was derived from computation involving 3 variables. These were number of UPA technologies adopted, average annual income from the UPA technologies and farmer experience in years of practicing UPA as indicated in Table 3.3. The combination of these 3 different dimensions according to Mazziotta and Pareto, (2013) provides a composite index.

Table 3.3: Computation of the Sustainability Index

Number of UPA technologies adopted (NT)	Score	Categories
1-5	1	Very Few
6-10	2	Few
11-15	3	Average
16-20	4	Many
Over 21	5	Very many
Annual Income in Kshs from UPA Category one Technologies: (AI1)	Score	Categories
Less than 250,000	1	Very Low
250,001-300,000	2	Low

300,001-350,000	3	Average
350,001-400,000	4	High
Over 400,001	5	Very High
Annual Income in Kshs from UPA Category Two Technologies: (AI2)	Score	Categories
Less than 25,000	1	Very Low
25,001-35,000	2	Low
35,001-45,000	3	Average
45,001-50,000	4	High
Over 50,001	5	Very High
Length of time of UPA practice (Experiences)	Score	
1< 5 years	1	Very Short
5-9.9 years	2	Short
10-14.9 years	3	Average
15-19.9 years	4	Long
Over 20 Years	5	Very long

The computation of a composite index involves the consideration of several assumptions which included choice of indicators, whether the indicators were substitutable or non-substitutable, type of aggregation, comparisons to be made and the weights of the indicators according to Mazziotta and Pareto (2013).

According to Babbie (2007), a composite index can be obtained by getting an average from the dependent variables in the study. One representative indicator was considered from each dimension making a total of 3 individual indicators. Since the indicators were measured in different units, normalization of the indicators was conducted by SPSS and the mean hereby referred to as the index was computed Lun *et al.*, (2006 cited in Mazziotta & Pareto 2013). In this case weights were not assigned to the indicators meaning each variable was given equal importance.

3.7.5 Multiple Linear Regression Equation

Multiple Linear Regression (MLR) was used to test hypotheses in order to explain the influence of the sustainability index and the extension methods and may also be used to predict the values of a dependent variable Y, given the 8 explanatory variables (Farm visits, Office visits, ICT, group trainings and demonstrations, group tours and visits, print information, field days and shows).

The regression equation used was

$Y' = a + b1F/V + b2O/V + b3ICT + b4T/D + b5T/V + b6F/D + b7Print + b8Shows + e$

The equation has one intercept constant, *a*, but each independent variable (i.e., *X*1, *X*2, *X*3, *X4, X5, X6, X7, and X8*) yielded a unique regression coefficient

Where

a = intercept/constant

b = slope/regression coefficient (expected change in Y when X1 increases one unit while the rest are held constant.

*X*s are values for a set of independent variables of farm visits, office visits, ICT, group trainings and demonstrations, group tours and visits, print information, field days and shows.

To describe the influence of extension worker characteristics on the empowerment of UPA farmers for UPA sustainability in Nairobi County. The independent variables considered in this objective were the socio-economic characteristics of extension facilitators as shown in Table 3.4 of gender, age, educational level, and number of years of training UPA (experiences) in Nairobi County.

All variables were measured in categorical data. The dependent variable of the farmer empowerment score was constructed from an average number of extension workers and farmers aware of the ALPs and application of these principles. The principles considered were, flexibility, consideration of experiences, building partnerships, practice of life-long learning, building of self-concept, provision of solutions and famers attaining satisfaction in the process. Multiple linear regression was used to analysis this hypothesis.

Table 3.4: Description of Independent Variables for Hypothesis two

Variable	Description /Unit
Gender of Extension worker	1-Male, 0- Female
Age of Extension Worker	1= 20-30 years, 2=31-40 years, 3=41-50 years and 50 years as the reference age
Educational levels of Extension Worker	1- Certificate, 2- Diploma, 3- Bachelors and Masters and above as the reference level
No of years of experience of Extension Worker	1=Less than 4.9 years., 2=5- 9.9 years, 3= 10-14.9 years and 15 years as the reference experience.

3.7.6 Computation of Farmer Empowerment Score for the Dependent Variable

The Empowerment score considered the number of ALPS used by the extension worker and the farmer in their choice of technology transfer method to assist the farmer to make decisions that are sustainable in UPA. Babbie (2007) and Kaci and College (2007) indicated that a score can be obtained from a calculation of a simple arithmetic mean.

Multiple Linear Regressions was used to analyse the hypothesis in order to explain the relationship/association between the empowerment score and the extension worker characteristics (age, gender, educational level, and experience in working in UPA).

The regression equation used was

$$Y = a + b1\text{Age} + b2Gender + b3Educ + b4Exp + e$$

3.8 Ethical Issues

Ethical issues of confidentiality during data collection and personal involvement were upheld. The issues were adhered to by seeking authority from the University of Nairobi Graduate School to obtain a permit from the Ministry of Education, Research, Science and Technology for data collection. The interviewer sought to protect the interviewee's confidentiality throughout the interview process and thereafter by ensuring that the information collected was used for the intended purpose only.

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1 Introduction

This study presents the results of the study. It provides descriptive results for objective one and inferential results for hypothesis one and two. Results have been presented in frequencies, percentages, pie charts, bar charts and in form of tables.

4.2 Farmers and staff Response Rates

The study achieved a farmer's response of 149 respondents out of the 150 expected respondents indicating a 99.3 percent response rate as indicated in Figure 4.1.

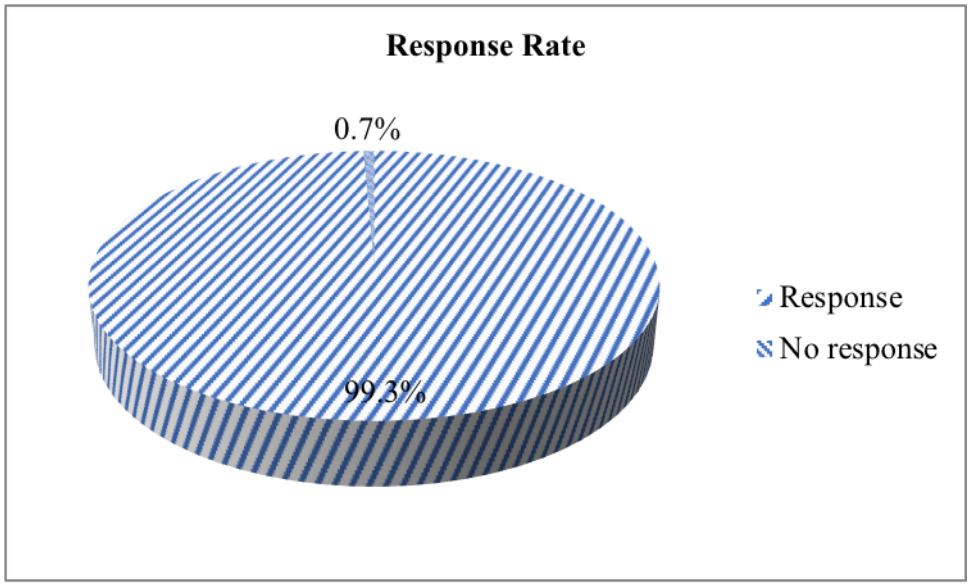

Figure 4.1: Response Rate of Farmer Respondents

The staff response was 100 percent of all the 64 staff members randomly targeted. A response rate of more than 50 percent is adequate for analysis, according to Mugenda and Mugenda, (2008). Babbie, (2007) indicated that response rates of 50 percent and above are acceptable, 60 percent good and 70 percent very good for analysis and publishing. The response rate achieved in this study was very good. The high response rate was attributed to self-administration of the questionnaires for the staff and researcher administered questionnaires for most of the respondents.

4.3 UPA Contribution to Food Self Sufficiency

Majority of the farmers in the city indicated that UPA contributed to family food sufficiency at 87.2 percent while 8.7 percent indicated that the contribution was partial. However, 4 percent indicated that UPA did not contribute to food sufficiency. These results were similar in all slum, urban and peri-urban areas as shown in the Figure 4.2.

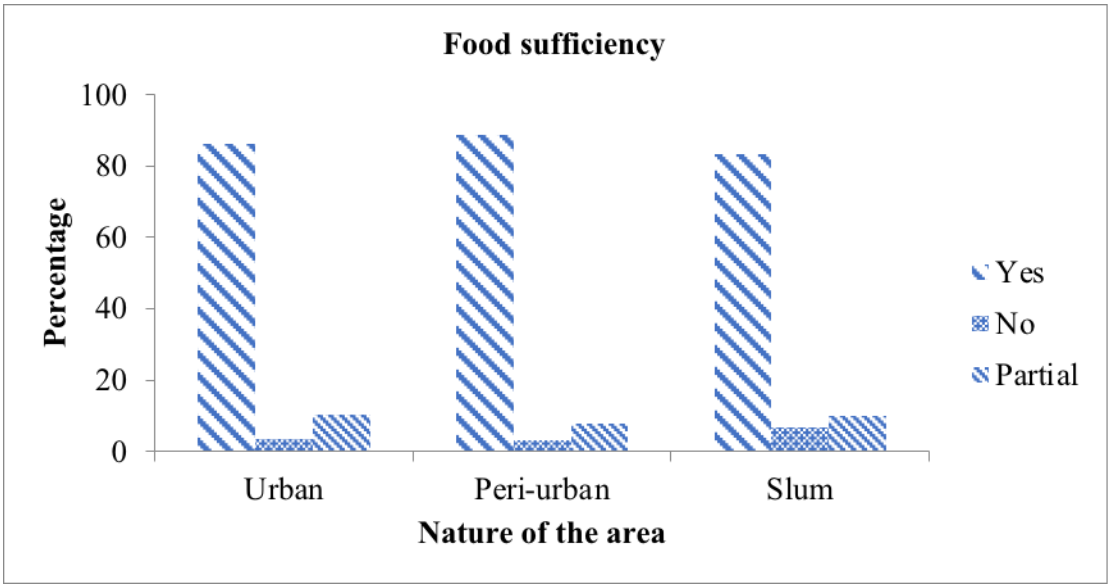

Figure 4.2: Distribution of Contribution of UPA to Food Sufficiency in Nairobi

These results agree with a study done in Kasarani district in Nairobi County of Kenya by Nkirigacha (2012) which states that UPA contributes to food self-sufficiency but does not contribute to nutritional sufficiency. Food was grown for household consumption and the surplus for sale. The sale proceeds were used to meet other household needs. The study stressed the importance of UPA for the urban poor.

4.4 Descriptive Analysis on UPA Farmer Characteristics in Nairobi County

A descriptive analysis was undertaken to provide an understanding of the characteristics of the UPA farmers for the purposes of improving information dissemination. Frequencies, percentages and bar-charts were used to summarize data.

4.4.1 Gender of the Farmers

Considering the 149 respondents' 58.4 percent were male and 41.6 percent were female from the sampled farmers as indicated in Figure 4.3

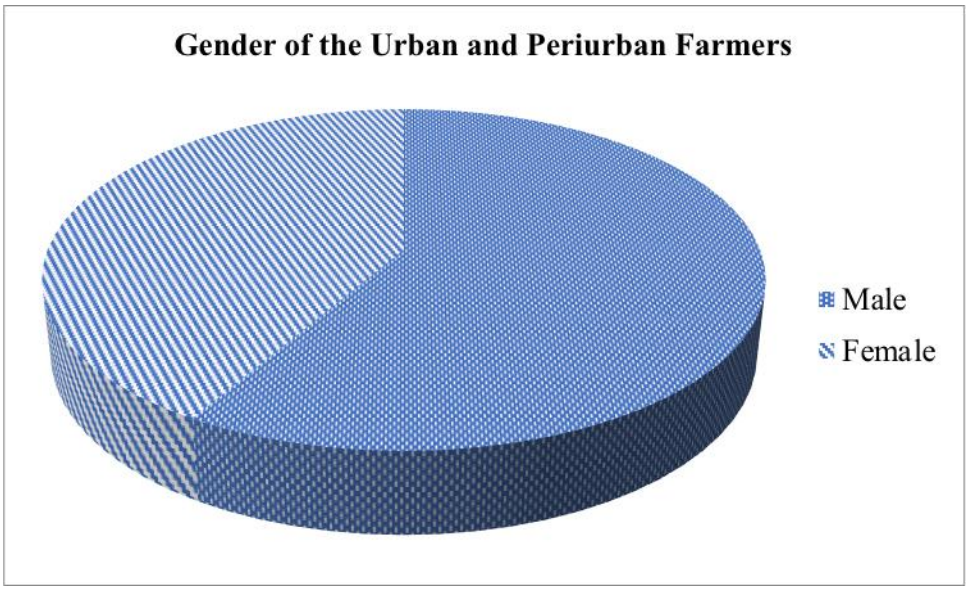

Figure 4.3: Gender of the Urban and Peri urban Farmers

Results indicated that generally there were more male farmers practicing UPA in Nairobi County and the pattern was replicated in all the sub counties across the urban, peri-urban and slum areas of the county. A study was conducted by Echakara (2015), on the determinants of growth of urban agricultural projects in Lang'ata Sub County in Nairobi. Gender results revealed that 60 percent were female farmers, while 40 percent were male. This study indicates that there has been a shift in gender from having more male than female farmers.

Similar studies were done in South Australia on the nature of urban agriculture. Results indicated that the majority of the farmers were female (77 percent) and 22 percent male (Pollard, Ward, and Roetman, 2018). This is a diversion from the Nairobi County case which indicated more male urban farmers as compared to the study in Australia and Lang'ata Sub County in Nairobi which indicated more female urban farmers. This difference could be attributed to "farming as a business" which is now practiced in the city

whereby more male farmers are attracted as compared to the former farming practices which was mainly subsistence. Urban farming policies were also favourable from 2015 by the urban agriculture policy. Gender differences was not seen to be influenced by differences in locality since all sub counties had more male farmers as compared to female farmers.

4.4.2 Age of the Farmers

Results on the age of the farmers indicated that 8.7 percent were between ages 21-30, 20.1 percent were between ages 31-40, and 30.2 percent between ages 41-50, 26.2 percent between ages 51-60 while 14.8 percent of the farmers were over 60. The age representation as shown in Figure 4.4

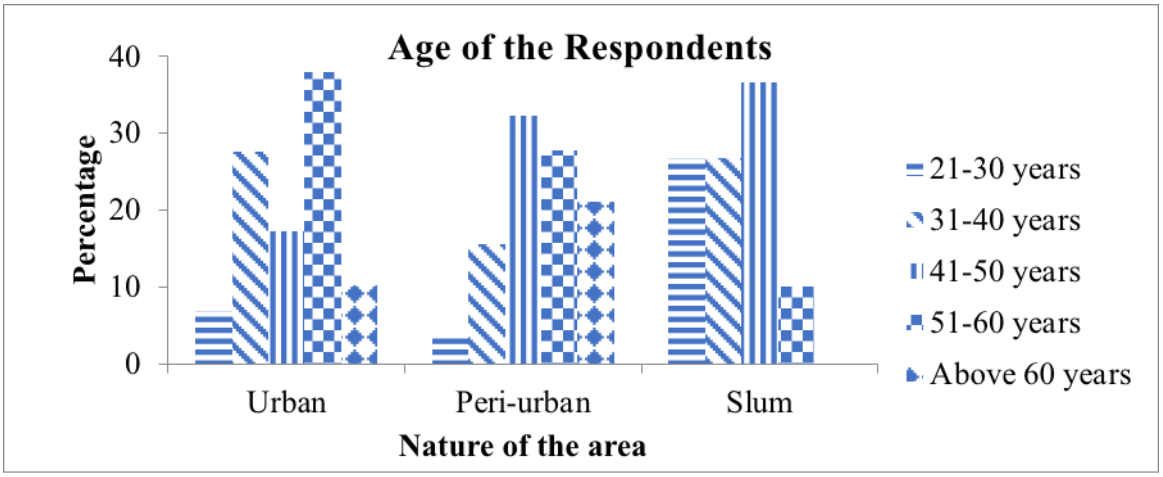

Figure 4.4: Age Distribution of the farmers according to the location of the area

The results indicated that there are more middle-aged farmers in Nairobi whereby 30 percent of the respondents were between the ages of 41-50 while young farmers represented 8.7 percent. This trend is true for peri- urban and slum areas but differs in the urban area where the highest numbers of farmers were in the older bracket of 51-60 years. These results agree with a study conducted in the up-market area of Langata in Nairobi County by Echakara (2015), which indicated that majority of the urban farmers (41%) in this area were actually over 50 years.

A study by Pollard, Ward, and Roetman (2018), conducted in South Australia indicated an age range of 18 to 81 years in urban farming with a median age of 41-50 years. These results concur with the studies in Nairobi County which indicated majority of urban farmers were in the age range of 41-50 years. A social-economic study conducted in Cape Town, in South Africa (Swanepoel *et al.,* 2017) indicated the average age of urban farmers to be 50 years. The results indicate that as the older farmers exit farming due to age, they are replaced by younger farmers and the results of age follow the normal curve.

4.4.3 Educational Levels of the Farmers

The analysis revealed the educational levels of the farmers are as indicated in the Table 4.1 below.

Table 4.1: Percent Distribution of Educational levels of Farmers across the Farming Areas

Education level	Urban	Peri-urban	Slum	Total% in all Areas
No Education	0	1.1	0	1.0
Primary level	20.7	30.0	30.0	28.0
Secondary level	41.4	35.6	30.0	35.6
Tertiary level	37.9	33.3	40.0	35.6

The farmers' level of education indicated that only 1 percent of Nairobi farmers had no formal education, 28 percent of farmers had primary education, 35.6 percent of the farmers had secondary education and 35.6 percent had tertiary education. Most farmers with tertiary education were either farmers owners of retired workers who opted to buy pieces of land and settle in various parts of the city.

These results agree with a social-economic profile of urban farmers conducted in Cape Town which indicated that 40.1 percent of the farmers had obtained secondary level of education according to Swanepoel *et al,* (2017). These results also agree with the studies conducted by (Echakara, 2015) in Langata area of Nairobi which indicated that 51 percent

of the respondents had acquired college education and above. In Nairobi County over 70 percent of the farmers had acquired a secondary school level of education and above.

This is an indication that UPA is an acceptable activity in Nairobi where the young and educated also venture into. The presence of ready market for farm produce creates income and employment and attracts educated individuals to UPA since it is lucrative and profitable.

4.4.4 Farmers Farming Experiences.

The length of time an activity is carried out is a measure of the social dimension of sustainability. Results on the length of time farmers have been farming in the city are as indicated in Figure 4.5.

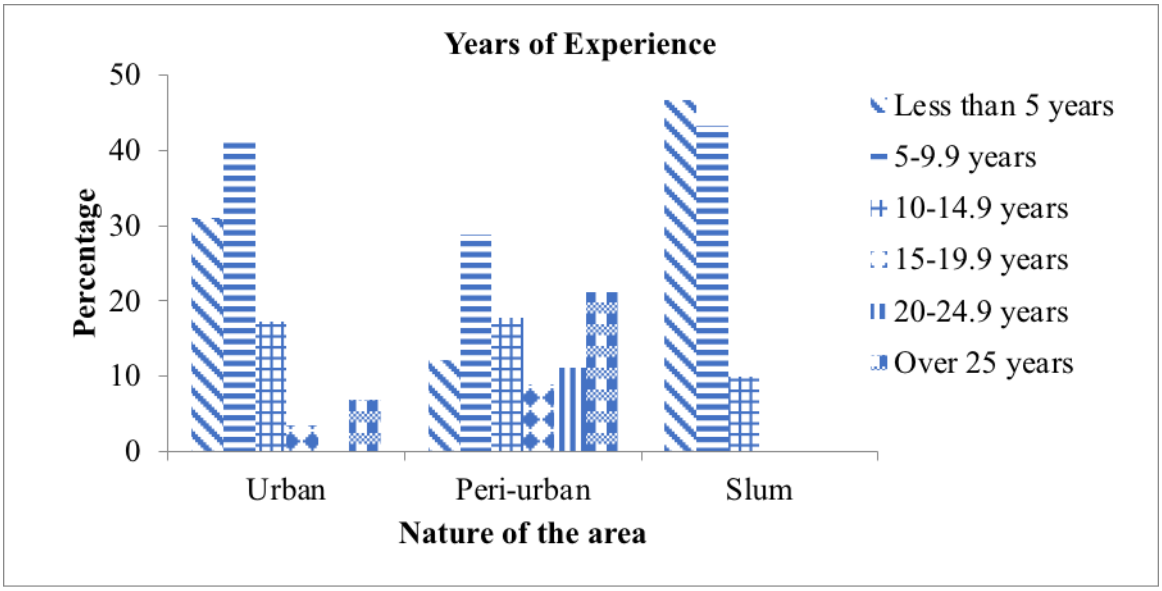

Figure 4.5: Distribution of Farmers Experiences with UPA Activities in the City

The results showed that 22.8 percent of farmers in Nairobi are actually new entrants in urban farming since they have been farming for less than 5 years. Majority of these new farmers are located in the slum areas which has a high percentage of 46.7 percent of the new farmers. Results indicated that 34.2 percent of the Nairobi farmers have been farming for between 5-9 years, 16.1 percent for 10 -14 years and 6 percent for 15 - 19 years. Farmers

who have farmed for between 20-24 years were 6.7 percent while 14.1 percent have been farming for over 25 years in Nairobi.

In general, all the 99.9 percent of farmers in the slums entered into farming activities in the last 15 years indicating a rising trend of farming in the slum areas. These results concur with the survey study conducted in West Africa by International Water Management Institute (IWMI, 2015) whose results indicate that most farmers had farmed for more than nine years.

In Nairobi County however, there are more recent entrants in urban farming with less than 5 years of experience. These results also agree with the study conducted by Echakara (2015) in Langata area of Nairobi County whose results indicated that the entry of new farmers (3 years and below) in UPA was 38 percent. This is an indication of the growing UPA phenomenon in Nairobi County.

4.5 Descriptive Analysis of Available Farmer Resources

4.5.1 Time Spent in Hours by Nairobi Farmers on UPA Activities

Results on average time spent by the farmers on UPA activities indicated the results shown on Table 4.2.

Table 4.2: Percent Distribution of Time Spent in UPA Activities in the Different Areas

Time Spent for UPA Activities	Urban	Peri-urban	Slum	Total Percentage
less than 2 hours	17.2	1.1	20	8.1
2.1 to 4 hrs	27.6	5.6	60	20.8
4.1 to 6 hrs	41.4	37.8	13.3	33.6
over 6 hrs	13.8	55.6	6.7	37.6

Majority of the farmers at 37.6 percent spent over 6 hours on the farm, 33.6 percent spent 4-6 hours, 20.8 percent spent 2-4 hours and 8.1 percent spent less than 2 hours on UPA activities. It was however observed that most of the farmers who spend over 6 hours in the farming activities were from the peri-urban areas that have larger farms and have adopted more farming technologies. Other full-time farmers are located in the river valleys where water is plenty. Farmers in the river valleys mainly produce vegetables that take a shorter period to mature and also have ready market.

4.5.2 Cost of Labour for UPA

The results on cost of labour for UPA activities are shown on Figure 4.6.

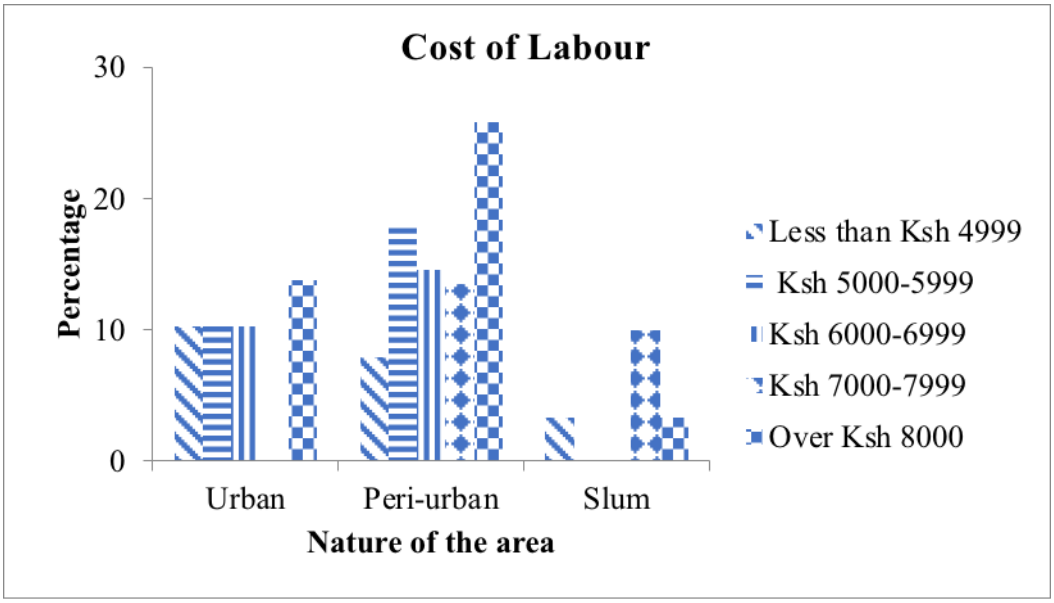

Figure 4.6: Cost of Labour for UPA Activities

The results indicated that 7.4 percent of the farmers paid less than Kshs 4999, 12.8 percent of the farmers paid between Kshs 5000 and 5999, 10.8 percent of the farmers paid between Kshs 6000 and 6999, 10.1 percent of the farmers paid between Kshs 7000 and 7999 while only 18.9 percent of the farmers paid over Kshs 8000 per month for urban farm activities. It should be noted that 40 percent of the farmers employed their workers on casual basis.

A further analysis of the results in the different areas of the city indicated that the peri-urban farmers paid better monthly salaries than the farmers located in the urban or slum

areas. Those workers in the slums who earned over Kshs 7,000 per month were employed by institutions.

4.5.3 Farm Sizes in Nairobi County

Results on the sizes of farms in Nairobi County are as indicated in Table 4.3.

Table 4.3: Percent Distribution of Land sizes in Nairobi Farmers

Acreages Under UPA	Urban	Peri-urban	Slum	Total Percentage
less than 0.5 acres	53.8	32.4	60.4	42
0.6 - 1 acres	10.6	18.0	24.4	18
1.1 - 2 acres	15.8	18.0	0	14
2.1 - 3 acres	10.6	15.3	15.3	14
3.1 to 4 acres	5.2	5.0	0	4.0
4.1 acres to 5acres	3.4	1.7	0	2.0
Over 5 acres	0	10.3	0	6.0
Total	100	100	100	100

Results indicated that 42 percent of the farmers farmed on less than 0.5 acres, 18 percent farmed on land between 0.6 and 1 acre, 14 percent farmed on land between 1.1 to 2 acres, 14 percent farmed on between 2.1 to 3 acres, 4 percent farmed on 3.1- 4 acres and 2 percent farmed on over 4.1- 5 acres and another 6 percent on over 5acres. The 6 percent of the farmers who farmed on over 5 acres are located mainly in the peri-urban areas of Dagoretti South, Langata and Kasarani sub counties.

In a related study, a survey was conducted by the International Water Management Institute in Colombo on the size of urban farms in the West African Cities of Tamale in Ghana and Ouagadougou in Burkinafaso (IWMI, 2015). Results indicated that the average farm size in Tamale was 1.98 hectares and 2.87 hectares in Ouagadougou. In Kenya, a study was conducted by Mukundi, Onyango, Masinde, and Muthoka (2014), on the characteristics of urban and spatial nature of agriculture in the city of Nairobi.

The results indicated that about 30 percent of the farmers had farm sizes of 0.125 to 0.25 acres. These results agree with the results of this study which indicated that 42 percent of urban farmers farmed on less than 0.5 acres. It also indicated that land sizes have continued to decrease with time.

4.5.4 Farm Ownership in Nairobi County

Most farmers in Nairobi are small scale farmers and the study sought to find out who owns the farms the farmers farm on. Results are indicated in Table 4.4.

Table 4.4: Percent Distribution of Farm Ownership in Nairobi County

Farm Ownership	Urban	Peri-urban	Slum	Total Percentage
Power lines Reserve	5.0	3.2	0.0	4.7
Railway Line reserve	5.0	3.0	0.0	4.0
Church owned	5.0	1.0	15	5.4
County Government Land	5.0	2.4	17	10.2
Veterinary Labs Property	2.5	2.4	0.0	2.0
School Property	18.0	5.0	18.5	9.7
Road Reserve	7.3	1.0	7.4	4.6
Personal	28.0	44.0	9.0	48.0
Other farmers/Rented	0.4	5.7	2.4	5.4
Other Institutions/Rented	2.5	10.0	0.0	6.0

The results showed that 30 percent of the farmers in Nairobi do not own any land. They farmed on public land described as under power lines, railway reserves, and road reserves and river valleys while other farmers hire or borrow from institutions or other farmers. There were 26 percent of farmers in the urban areas, 25 percent in the peri-urban areas, and 28 percent in the slum areas. It was also noted that some farmers did not know the owners of the land which they farmed on.

Having noted that 30 percent of Nairobi farmers do not own the land which they farmed on, the study sought to find out who actually owned the farms that 70 percent of the farmers farmed on. The results indicated the 48 percent of the farmer's farm on personal land, 10.2 percent farm on Nairobi City County Government vacant spaces 9.7 percent farm on School property 6.0 percent farm on other institutions. The study also revealed the 5.4 percent farmed on church grounds, 5.4 percent farm on rented land from other farmers.

Results also indicated that 4.7 percent farmers farmed on under power lines, 4.6 percent on road reserves and, 4.0 percent on railway reserve and 2.0 percent on Kabete Veterinary Laboratories grounds along the river valleys. Specifically, the results indicated that most of the farmers (52 percent) in urban and peri-urban agriculture do not farm on personal land as only 48 percent farm on personal land.

4.5.5. Main Water Sources for Nairobi County Farmers during the Dry Season.

Considering that water is a main and scarce resource for sustainable farming in the city, the results for the main water sources for farming in the city is shown in Table 4.5.

Table 4.5: Results for the Main Water Sources for UPA use during the Dry Season

Water Sources	Urban	Peri-urban	Slum	Total Percentage
NCWSC	44.8	17.8	33.3	26.2
Shallow wells	3.4	16.7	20.0	14.8
Spring Water	13.8	10.0	3.3	9.4
Rivers	0	30.0	6.7	20.5
Dams	3.4	1.1	0	1.3
Boreholes	13.8	17.8	0	19.5
Roof Catchment	6.9	2.2	30.0	5.7
Others	0	3.3	6.7	2.0
Road Run off	3.4	1.1	0	1.0

The results indicated that 26 percent of farmers in the city farmed with the water provided by Nairobi City Water and Sewerage Company (NCWSC) which is specifically provided for home use. The highest percentages of these farmers are found in the urban and slum areas. In the peri-urban areas most farmers who use irrigation as a method of farming use rivers, boreholes, shallow wells and spring water for irrigating their crops. Roof catchment water has not been fully utilised.

4.5.6 Access to Credit for UPA Farmers in the City

Credit accessibility is a major resource in sustainability of city agriculture. The study sought to find out whether farmers were able to access credit for farming. The results are as indicated in Table 4.6.

Table 4.6: Percent Distribution of Access to Credit for UPA in the City

Access to Credit	Urban	Peri-urban	Slum	Total
Yes	6.0	31.1	26.7	25.5
No	51.7	60.0	60.0	58.4
N/A	41.4	8.9	13.3	16.1

The results of credit accessibility indicated that 25.5 percent of Nairobi residents had accessed credit for city farming. The major creditors were Equity bank and SMEs run by NGOs such as hand-in-hand which lent credit to its members for farming. However, 58.4 of Nairobi farmers did not seek for any credit while 16.1 percent were not aware of availability of credit facilities for city farmers. These results concur with studies conducted by Resource Centre for Urban Agriculture & Forestry (RUAF, 2011) on financing urban agriculture in 17 cities in the "Global South" between 2008 and 2010.

The results indicated that credits for urban agriculture were not common. However, there were micro-credits available for raising animals, marketing and agro-processing. The study indicated that credit facilities were limited for urban farmers because they lacked financial management empowerment and proper collateral such as title deeds (RUAF, 2011). These

reasons also apply for Nairobi County among lack of awareness of such services by some farmers.

4.5.7 UPA Market challenges

Availability of ready markets for agricultural products had been an opportunity to sustainability of farming in many areas. The experiences of Nairobi farmers in marketing issues are as tabulated in Table 4.7

Table 4.7: Experience in Market Challenges for UPA Products in the City

Market Challenges	Urban	Peri-urban	Slum	Total
Yes	34.5	34.4	20	31.5
No	65.5	65.6	76.7	67.8
N/A	0	0	3.3	0.7

The findings indicated that 67.8 percent of Nairobi farmers did not experience any market challenges with their agricultural produce. This is mainly contributed by the fact that farm products are bought at farm gate by the wholesalers who the sell in the local markers in retail form. Other farmers have entered into marketing contracts with supermarkets and small shops (kiosks) in the city where they sell their products. However, 31.5 percent of the farmers indicated a problem with the market especially when there is surplus of products due to favourable weather conditions or due to flooding of products in the city from the rural areas.

4.5.8 Adoption of UPA Technologies in the City

Farmers were found to adopt various technologies in the city. The study found out the most common and popular technologies and the results are tabulated in Table 4.8.

Table 4.8: Number of UPA Technologies in the City

UPA Technologies	Urban	Peri-urban	Slum	Total
Green House	24	22	33	79
Shade net	3	13	3	19
Irrigation	52	60	28	140
Open field farm	80	89	43	212
Multi storey garden	17	17	63	97
Moist bed	27	11	38	76
Kitchen garden	21	31	43	95
Roof Top garden	3	1	3	7
Hanging gardens	0	0	3	3
Micro gardens	10	14	28	52
Cows	7	44	10	61
Sheep and goats	10	16	7	33
Chickens	35	50	27	112
Rabbits	10	17	23	50
Fish	21	8	0	29
Mushrooms	0	3	3	6
Compost	80	61	80	221
Use FYM	41	58	40	139
Value addition	14	13	40	67
Practice Hydroponic	7	2	0	9
Tree Nursery	10	10	17	37
Vegetable Nursery	49	56	50	155

Results indicated that the most common technologies among the Nairobi farmers are open field farming, composting, chicken farming, some form of irrigation, use of farm yard manures and vegetable or tree nurseries. The least popular technologies were hanging

gardens, mushroom productions, roof top gardens and hydroponics which were relatively new technologies and needed more intensive management.

A study was carried out in Nairobi, Kenya by Ogendi, Mukundi, and Orege (2014), on types and distributions of agriculture production systems in the city. Results indicated that crops were only grown in Kamukunji district (58.8 percent) while mixed farming was practiced mainly in Starehe district (39.1 percent). Multi-storey (42.5 percent) and moist gardens (25 percent) were the most common production technologies in urban areas. In the peri-urban areas, drip irrigation (23.6 percent) and multi-storey gardens (25.5 percent) were the most preferred technologies. Majority of farmers had adopted at least 3 technologies.

These results were different in that they indicated a variety of production technologies had been adopted by city farmers and technologies were not areas specific but depended on availability of resources.

4.5.9 Farmers Willingness to Pay for Trainings in UPA

The results of farmers' willingness to pay for trainings on new technologies were indicated in Table 4.9.

Table 4.9: Percent Distribution of Farmers Willingness to Pay for Trainings in UPA

Responses	Urban	Peri-urban	Slum	Mean percentage n=147
Yes	65.5	70.0	46.7	61.0
No	34.5	30.0	53.3	39.0
Total	100.0	100.0	100.0	100.0

A total of 70 percent of farmers in peri-urban areas and 65.5 percent of farmers in urban areas were willing to pay for trainings on new technologies and market information. However, 53.3 percent farmers in slum areas were not willing to pay for the trainings.

4.5.10 Average Household Annual Income per technology

The study examined some of the most profitable practices on a standard land area of 8mx15m (greenhouse standard area) with other production factors kept constant. Farmers were asked the average annual income per unit area of technology for each of the practices. Results on the average annual income per unit of technology are indicated in Table 4.10

Table 4.10: Average Annual Income per Technology

Technology	Average Annual income per unit in Kenya shillings
Greenhouse	300,000
Shade net	250,000
Irrigated area	150,000
Open field	50,000
Multi stories	250,000
Moist Beds	200,000
Kitchen Gardens	150,000
Roof Top Gardens	200,000
Hanging Gardens	200,000
Micro Gardens	200,000
Zero-grazed Cattle	650,000
Shoats	400,000
Broiler Chicken	500,000
Fish Pond	350,000
Mushroom house	500,000
Compost	150,000
Farm Yard Manure	150,000
Tree nursery	200,000
Hydroponics	450,000
Vegetable nursery	250,000
Rabbits	400,000

The income indicates that high input and high management technologies had the highest income per unit area such as dairy cows, hydroponics, broilers and mushroom farming. Results also indicated that most urban farmers got above average income from their technologies. This is due to good management and the ready availability of markets.

4.6. Descriptive Results on the Consideration of Provision for of Adult Learning Principles by the Technology Transfer Methods for the Empowerment of Farmers

For an extension method to be considered effective in empowering farmers to make decisions on their farming systems such as sustainability of UPA it must consider adult learning principles. Six ALPs are considered in this study which include farmer's flexibility, consideration of farmer experiences, provision of partnerships, consideration of lifelong learning, provision of solutions, and farmer satisfactions.

Farmers were asked as whether a certain method considered a certain principle where a yes (1) and no (0) answer was recorded for each principle and a mean calculated which was to lie between 0-1. Results indicated that most farmers had participated in farm visits (96), trainings and demonstrations (84), field days (75), print material (54) and office visits (46). However, few farmers had participated in group tours and visits (40), ICT (29) and shows (29).

4.6.1 Consideration of Farmers Flexibility by a Technology Transfer Method

Results on the consideration of farmer's flexibility by a technology transfer method are as indicated on Table 4.11.

Table 4.11: Results of Consideration of Farmers Flexibility by a Technology Transfer Method

Technology Transfer Method used	No. of farmers (N)	Mean	Std. Deviation
Farm visits	96	0.06	.241
Office Visits	46	0.45	.502
ICT	29	0.66	.450
Train/Demonstration	84	0.34	.377
Group Tours	40	0.24	.471
Field days	75	0.29	.462
Print Media	54	0.44	.499
Shows	29	0.24	.460

The means of the contribution of flexibility by a technology transfer method to empowerment of farmers indicated that ICT (mean = 0.66, SD =.450), office visits (mean 0.45, SD .502) and print media (mean 0.44, SD.499) were highly suitable. This indicates that ICT, office visits and print materials given to farmers as extension methods were more flexible to the farmers.

4.6.2 Consideration of Farmers Past Experiences by a Technology Transfer Method

Results indicated that more farmers participated in farm visits, group trainings/demonstrations and field days. Results in Table 4.12 indicated that trainings and demonstrations, ICT and group tours and visits considered farmers experiences more than other methods.

Table 4.12: Consideration of Farmers Past Experiences by a Technology Transfer Method

Technology Transfer Method used	No. of farmers (N)	Mean	Std. Deviation
Farm visits	96	0.22	.329
Office Visits	46	0.39	.502
ICT	29	0.53	.443
Train/Demonstration	84	0.58	.383
Group Tours	40	0.48	.468
Field days	75	0.33	.423
Print Media	54	0.46	.482
Shows	29	0.36	.465

However, more farmers indicated that group trainings/demonstrations (mean = 0.58, SD = .383) and ICT (mean = 0.53, SD =.443) had a higher mean as compared to other methods in the considerations of experiences. Sharing of experiences is a favourable principle in contributing to farmers empowerments which assist them to making decisions on sustainability of UPA.

4.6.3 Contribution of Provision of Solutions to the Farmer by a Technology Transfer Method

Farmers require that a technology transfer method provides for immediate solutions to the farmers for it to be effective. The contribution of solutions by a technology transfer method is as indicated in Table 4.13

Table 4.13: Analysis of the Contributions to Provision of Solutions by a Technology Transfer Method

Technology Transfer Method used	No. of farmers (N)	Mean	Std. Deviation
Farm visits	96	0.76	.253
Office Visits	46	0.56	.473
ICT	29	0.75	.404
Train/Demonstration	84	0.60	.399
Group Tours	40	0.47	.475
Field days	75	0.50	.435
Print Media	54	0.16	.471
Shows	29	0.29	.456

The results show that farm visits (mean=0.76, SD =.253), ICT (mean=0.75, SD=.404). farm visits, ICT and Trainings/demonstration contributed more towards solving farmer's problems and therefore contributed to empowerment and assisted farmers in making decisions towards sustainability of UPA.

4.6.4 Consideration of a Technology Transfer Method towards Building of Partnerships for the Farmers

Building of partnerships and networks is considered an adult learning principle that is considered favourable to the empowerment of farmers. Results of the contribution of a technology transfer method towards building of partnerships for the farmers are as shown in Table 4.14.

Table 4.14: Analysis of the Contribution of a Technology Transfer Methods towards Building of Partnerships for the Farmers

Technology Transfer Method used	No. of farmers (N)	Mean	Std. Deviation
Farm visits	96	0.30	.480
Office Visits	46	0.22	.465
ICT	29	0.57	.399
Train/Demonstration	84	0.34	.471
Group Tours	40	0.09	.465
Field days	75	0.43	.473
Print Media	54	0.12	.389
Shows	29	0.35	.443

Results indicated that participation in ICT (mean= 0.57, SD=.399), field days (mean= 0.43, SD=.473) and shows (mean=0.35, SD=.443) contributed significantly to farmers building more partnerships which contributed to farmer empowerment and therefore assisted farmers to make decisions towards sustainability of UPA.

4.6.5 Contribution of a Technology Methods to Farmer's Lifelong Learning

Lifelong learning is a principle that empowers a farmer to make favourable decisions on their farming systems. The results on the contribution of a technology method to farmers' lifelong learning are as indicated on Table 4.15.

Table 4.15: Analysis of Contribution of a Technology Method to Farmer's Life Long Learning Principle

Technology Transfer Method used	No. of Farmers (N)	Mean	Std. Deviation
Farm visits	96	0.14	.487
Office Visits	46	0.08	.383
ICT	29	0.36	.337
Train/Demonstration	84	0.12	.498
Group Tours	40	0.09	.414
Field days	75	0.18	.498
Print Media	54	0.28	.394
Shows	29	0.02	.365

ICT contributed (mean = 0.38, SD =.337), print media (mean = 0.28, SD = .394) and attending field days contributed significantly towards farmers making long life learning practices which contributes to farmers empowerments and assisted farmers to make decisions towards sustainability of UPA.

4.6.6 Contribution of a Technology Transfer Method to Farmer's Satisfaction

Farmer's satisfaction is a principle that is considered for farmer's empowerment. The results of the consideration of a technology transfer method towards farmer's satisfaction indicated the results on Table 4.16.

Table 4.16: Results of the Contribution of a Technology Transfer Method to Farmers Satisfaction

Technology Transfer Method used	No. of farmers (N)	Mean	Std. Deviation
Farm visits	96	0.32	.475
Office Visits	46	0.04	.414
ICT	29	0.29	.321
Train/Demonstration	84	0.24	.497
Group Tours	40	0.09	.431
Field days	75	0.08	.489
Print Media	54	0.11	.365
Shows	29	0.28	.351

Results showed that farmers got more satisfaction from farm visits (mean = 0.32, SD =.475), ICT (mean = 0.29, SD .321) and attending shows which contributed to farmers making decisions on sustainability of UPA.

4.6.7 Summary of consideration and contribution of technology transfer methods to the Adult Learning Principles.

The summary of results on the number of farmers who indicated that a technology transfer method considered an ALPs are as indicated in Table 4.17.

Table 4.17: Summary of the Considerations of Adult Learning Principles by a Technology Transfer Method

TTM	N=149	FLX	EXP	PoS	PoP	LLL	SAF	EMP
F/V	96	60	55	76	40	34	32	50
O/V	46	45	39	56	42	36	40	43
ICT	29	66	52	70	67	57	56	61
T/D	84	34	58	60	34	32	62	47
G/T	40	24	38	37	47	34	39	37
F/D	75	39	33	50	43	38	48	42
PM	54	34	36	36	32	28	41	35
Shows	29	24	36	39	45	40	58	40

Source: (Field survey, 2017)

Abbreviations used in Table 4.17 are indicated as follows

Technology transfer methods (TTM), farmers flexibility (FLX), farmers experiences (EXP), provisions of solutions (PoS), provision of partnerships (PoP), lifelong learning (LLL), farmers satisfaction (SAF) and empowerment (EMP).

The summary indicates that of the 149 respondents, 96 farmers had participated in farm visits (FV), 84 in Trainings and demonstrations (T&D), 29 in ICT, 46 in office visits (OV), and 54 had received print media (PM). However even though few farmers had participated in ICT as a method of technology transfer, most farmers revealed that ICT considered most of the ALPs. Results indicated that 61 percent of the farmers using ICT, 50 percent of those who used FV and 47 percent of those who used T&D revealed that these methods empowered them to adjust their farming systems to make decisions.

However, only 37 percent of farmers who used Tours and Visits and 35 percent of those who used print media indicated that the methods empowered them to make decision on their farming systems.

Having ascertained that technology transfer methods can influence the empowerment of farmers to make decisions, an inferential analysis was carried out to find out the influence of these technology transfer methods on the sustainability of urban and peri urban agriculture.

4.7 Inferential Results on the Influence of Technology Transfer Methods on the Sustainability of Urban and Peri-Urban Agriculture in Nairobi City County

Multiple linear regressions model was run to test the influence of the 8 independent variables and a constructed sustainability index (dependent variable). The independent variables were farm visits (FV), farmer office visits (OV), ICT (telephone calls and E-extension/internet), trainings/demonstrations (T/D), tours/visits (T/V), shows, field days (FD) and print (posters and fliers/handouts).

The dependent variable was a sustainability index constructed from the farmers' annual average income accrued from the UPA technologies, number of years of farming and the number of UPA technologies adopted by the farmers. All dependent variables factors were categorised and scored as 1-5. A correlation was run to ensure that the factors of the dependent variables were not correlated.

4.7.1 Pearson Product Moment Correlation (PPMC)

A Pearson Product Moment Correlation (PPMC) was conducted as shown in Table 4.18 to determine the extent to which the independent variables of the dependent variable were associated with each other. Values of correlation coefficient range from -1 to +1.

Table 4.18: Pearson Product Moment Correlation

Variables		Length of time	Annual income	Number of technologies adopted
Length of time	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	149		
Annual income	Pearson Correlation	-0.028	1	
	Sig. (2-tailed)	0.731		
	N	149	149	
Number of technologies adopted	Pearson Correlation	-0.018	.809(**)	1
	Sig. (2-tailed)	0.831	0.000	
	N	149	149	149

** Correlation is significant at the 0.01 level (2-tailed).

The results indicated that the independent variables for sustainability index were not associated since the r values were -0.028 and -0.018 indicating no association between the variables.

4.7.2 Multiple Linear Regression Model on Influence of Technology Transfer Methods on sustainability of UPA

A multiple linear regression was run to test the influence of the 8 technology transfer methods on a calculated sustainability index. The results are shown in Table 4.19.

Table 4.19: Model Summary of Multiple Linear Regression on Influence of Technology Transfer Methods on sustainability of UPA

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.787	0.619	0.610	0.31581

Predictors: (Constant), FVs, OVs, ICT, Train/Demos, Group Tours, Field days, Print Media, Shows

The model summary provided R as the population correlation coefficient of (0.787) which indicated a positive linear influence.

The multiple linear regression models with 8 independent variables indicated an R^2 of 0.619. This indicated that 62 percent of the changes in the sustainability index was explained by the changes in the 8 technology transfer methods.

An ANOVA test was run to find out the significance of the relationship as shown in Table 4.20.

Table 4.20: ANOVA for Technology Transfer Methods

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.327	9	1.147	3.808	.000(a)
	Residual	41.281	137	.301		
	Total	51.608	146			

Predictors: (Constant), FVs, OVs, ICT, Train/Demos, Group Tours, Field days, Print Media, Shows

Dependent Variable: sustainability index

The F- Test of the regression coefficient above indicated that the technology transfer methods contributed significantly (*P*-value < 0.001) to the variance accounted for in the sustainability index and the model as a whole was significant.

The MLR also generated the coefficients of the technology transfer method to quantify their individual contribution to the sustainability index as shown in Table 4.21.

Table 4.21: Coefficients for Technology Transfer Methods

	Unstandardized Coefficients			
	B	Std. Error	t	Sig.
(Constant)	3.136	.419	7.483	.000
Farm visits	0.520***	0.041	12.841	0.000
Office Visits	0.145***	0.052	2.782	0.006
ICT	0.492***	0.142	3.460	0.001
Train/Demos	0.407***	0.171	2.383	0.019
Group Tours	-.458	0.131	-3.504	0.001
Field Days	0.149***	0.055	2.703	0.008
Print Media	0.130	0.148	0.879	0.381
Shows	-.119	0.140	-.850	0.397

a. Dependent Variable: Sustainability index *** Significant at 0.05

Source: (Field survey, 2017)

The regression coefficients showed the magnitude of change, that is, the increase or decrease of the sustainability index considering a unit change in use of each of the methods. This indicated that a unit change in the frequency of use of farm visits would yield 0.520 change in the sustainability index.

A unit change in frequency use of office visits would yield 0.145 change in the sustainability index, ICT would yield 0.492, trainings and demonstrations would yield 0.407 and field days would yield 0.149 changes in the sustainability index. These

technology transfer methods were found to be provide a positive and significant change to the sustainability index.

However, a unit change in frequency of use of group tours and shows was found to negatively influence the sustainability index, while a unit change in frequency of use of print media was found to influence sustainability index positively but insignificantly.

The estimated equation is as indicated below

Sustainability Index (SI) = 3.136+0.520(FV) +0.145(OV) +0.492(ICT) +0.407(T/D)-0.458(GT) +0.149(FD) +0.130 (Print) -0.119(Show)+*e*

A similar study was conducted by Sanyang *et al.*, (2009), on the impact of agricultural technology transfer to women vegetable production and marketing groups in the Gambia. The researcher indicated that many researchers view technology transfer as a combination of different components. Kumar *et al*., (1999, cited in Wahab, (2012), identified two primary components of technology transfer. These include a physical component such as products, tools, equipment's, techniques and processes and an informal component which consists of knowledge and skills. In the process of knowledge and technology acquisition the end users need to evaluate which components of technology are appropriate to them.

4.8 Results for the Characteristics of Nairobi County Extension Workers and their influence on the Empowerment of Urban and peri - Urban farmers in Nairobi County.

Analysis were run on the socio-economic characteristics of extension workers of gender, age, education levels and years of work experience's and their influences on empowerment on UPA farmers.

4.8.1 Descriptive Results of Socio-Economic Characteristics of UPA Extension Workers

Descriptive analysis was conducted to assess the socio-economic characteristics of gender, age, years of UPA work experience and the educational levels of the extension workers. Results are as indicated in the Figure 4.7.

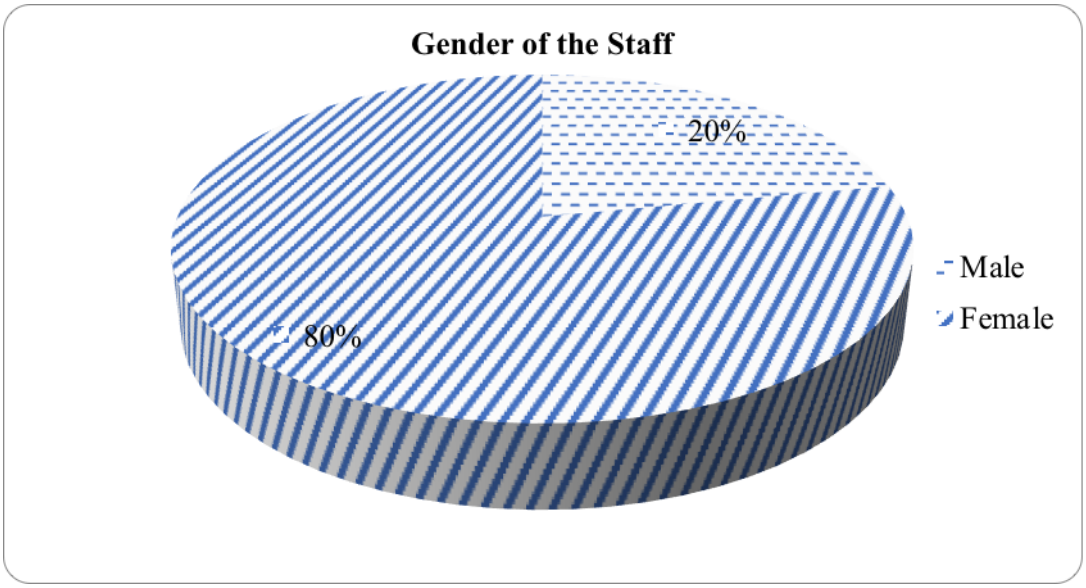

Figure 4.7: Gender Results of the Extension Workers in Nairobi City County

The results showed that 20 percent of the staff in Nairobi County was male while 80 percent were female. A related study was conducted by Maluvu, (2008) on the role of urban agriculture in enhancing food security in the city of Nairobi. A gender analysis of the extension workers indicated that 53 percent were male while 47 percent were female. These results indicated a gender balance of both males and females as opposed to the Nairobi City County current situation where there are more females than males indicating a gender imbalance.

Descriptive results of the extension workers characteristics are as shown in Table 4.22.

Table 4.22: Descriptive Results on the Socio-Economic Characteristics of Extension Workers in Nairobi County

	Frequency	Percentage
Gender		
Male	13	20.3
Female	51	79.7
Total	64	100
Age		
Below 30	0	0
31-40	9	14.1
41-50	16	25.0
above 51	39	60.9
Total	64	100
Education level		
Certificate	11	17.2
Diploma	17	26.6
Bachelors	26	40.6
Masters and above	10	15.6
Total	64	100
Years of Work Experience		
Less than 5years	3	4.7
5.1-10	19	29.7
10.1-15	38	59.4
Above 15 years	4	6.3
Total	64	100

Age results of the 64 extension officers indicated that 61 percent were over 51 years of age, 25 percent were between 41-50 years and 14 percent were between 31-40 years. The education level of the officers indicated that 17 percent had acquired an agricultural certificate, 27 percent held a Diploma, 41 percent held a first degree while 16 percent had acquired a second degree and above. The extension worker experience in years indicated that 5 percent of the workers had an experience of less than 5 years in UPA training, 30

percent had 5-10 years 60 percent had an experience of 10-15 years, and 6 percent had above 15 years of experience.

A similar study was conducted by Afzal, Al-Subaiee and Mirza (2016), on the attitudes of agricultural workers to ensure sustainability in the Kingdom of Saudi Arabia by the use of Internet-Extension. The study included the social-economic variable of age whose analysis revealed that the respondent's age ranged from 23 to 60 years with a mean age of 40.4 years. The age range of the results differs with those of the Nairobi County since the average age for extension workers in Nairobi was 50 years.

According to Afzal, Al-Subaiee and Mirza (2016), analysis of the educational levels of extension workers indicated that 54 percent of the workers held a Bachelor's degree, 38 percent held a diploma in agriculture, 6 percent held a Master's degree, and only 1.3 percent held other qualifications. These results agree with the results of this study indicating that most extension workers held a bachelor's degree.

A study was conducted by Iwuchukwu and Onyeme (2012), on the extension workers perceptions and awareness on climate change. The study was conducted in Agricultural Development Programme (ADP) in Anambra State, Nigeria. The results revealed that most of the workers at 63.2 percent were male and had served as extension workers for 21-25 years while approximately 42 percent of female workers had worked for 16-20 years. These results differ with the results of Nairobi City County.

4.8.2 Descriptive Results of the Socio-economic Characteristics on the Choices of Technology Transfer methods

A descriptive analysis was conducted to assess how extension worker characteristics influenced the choices of technology transfer methods.

4.8.2.1 Gender of Extension Worker and the choices of the technology transfer methods

The results of the choices of extension methods by gender are as indicated in the Table 4.23.

Table 4.23: Descriptive Analysis on the Choice of Extension Methods by Gender

	Male		Female	
	Frequency	Percentage	Frequency	Percentage
Staff preference for individual methods				
Farm visits	8	62	18	35
Office visits	3	23	16	32
ICT	2	15	17	33
Total	**13**	**100**	**51**	**100**
Staff preference for group methods				
Trainings and demos	7	44	32	63
Group tours	6	46	19	37
Total	**13**	**100**	**51**	**100**
Staff preference for mass method				
Field days	2	15	33	65
Print media	7	54	13	25
Shows	4	31	5	10
Total	**13**	**100**	**51**	**100**

The results indicated that more workers preferred farm visits as compared to other individual methods. More male workers at 62 percent preferred the individual method of farm visits as compared to 35 percent of female workers who preferred farm visits. Few male workers at 15 percent preferred ICT as compared to 33 percent of female workers. However female workers seemed comfortable with all individual methods.

Concerning the use of group methods, male workers preferred to use both trainings and demonstrations and group tours at 44 and 45 percent respectively. However more female

workers at 63 percent preferred to use trainings and demonstrations as compared to 37 percent who preferred tours and visits.

Results on mass media methods indicated that more male staff at 54 percent preferred to use print media as compared to other mass media methods while more female staff preferred field-days at 65 percent compared to other mass methods. 31 percent of male workers preferred use shows as a mass method while very few female workers preferred to use the show to pass information.

In Summary female workers were more flexible with all the individual methods as compared to male workers who preferred farm visits. Most male workers were more flexible with group methods as compared to female workers who specifically preferred trainings and demonstrations. Male workers preferred to use print media as a mass media method while female workers preferred field days. However only 15 percent of male workers chose to use ICT as compared to 33 percent of female workers.

4.8.2.2 Extension Worker Age on Choices of Extension Methods

Analysis conducted on the age of the extension worker and the choices of extension methods revealed the results tabulated on Table 4.24

Table 4.24 Descriptive Results on the Influence of the Age of the Extension Worker on Choice of Technology Transfer Methods

	31-40	41-50	Above 50	Total

Staff preference for individual methods							
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Percentage
Farm visits	1	1.6	5	7.8	20	31.3	40
Office visits	0	0.0	5	7.8	14	21.9	30
ICT	8	12.5	6	9.4	5	7.8	30
Total	9	14	16	25	39	61	100
Staff preference for group methods							
Trainings and demos	1	1.6	13	20.3	25	39.1	60
Group tours	8	12.5	3	4.7	14	21.9	40
Total	9	14	16	25	39	61	100
Staff preference for mass methods							
Field days	2	3.1	6	9.4	27	42.2	55
Print media	5	7.8	6	9.4	9	14.1	31
Shows	2	3.1	4	6.3	3	4.7	14
Total	9	14	16	25	39	61	100

Analysis of staff in the age of 31- 40 years indicated that most staff (12.5 percent) preferred to use ICT as individual method tours and visits (12.5 percent) for group method and print media (7.8 percent) for mass method.

Majority of the staff in the age ranges of 41-50 years preferred ICT (9.1 percent) for individual methods, 20.3 percent preferred trainings and demonstrations for group methods and 9.4 percent preferred field days and print for mass media methods.

Staff over 50 years preferred farm visits for individual method (31.3 percent, 39.1 percent preferred trainings and demonstrations for group methods and 42.2 percent preferred field days for mass media method.

In summary majority of staff in the age of 31-50 years preferred ICT as an individual method, while those in the age of above 50 preferred to use farm visits. Extension workers in the age of 31-40 years preferred to use tours and visits for group methods while those older than 41 years preferred trainings and demonstrations. The choice of mass media methods indicated that most workers in the age of 31-40 years preferred print methods, those in the age of 41-50 years preferred both print and field days while those above 50 years preferred field days for mass media methods.

4.8.2.3 Extension Worker Educational levels on Choices of Technology Transfer Methods

Results on the extension worker educational levels on the choices of technology transfer methods are as shown in Table 4.25

Table 4.25: Descriptive Results on Influence of Extension Workers Education Levels on the Choice of Technology Transfer Methods

	Certificate	Diploma	Bachelors	Masters	Total
Staff preference for individual methods					

	Frequency	%	Frequency	%	Frequency	%	Frequency	%	
Farm visits	8	12.5	9	14.1	9	14.1	0	0.0	40.7
Office visits	3	4.7	4	6.3	10	15.6	2	3.1	29.7
ICT	0	0.0	4	6.3	7	10.9	8	12.5	29.7
Total	11	17.2	17	26.7	26	40.6	10	15.6	100
Staff preference for group methods									
Train/demos	8	12.5	14	21.9	9	14.1	8	12.5	61
Group tours	3	4.7	3	4.7	17	26.6	2	3.1	39
Total	11	17.2	17	26.6	26	40.7	10	15.6	100
Staff preference for mass methods									
Field days	5	7.8	11	17.2	17	26.6	2	3.1	54.7
Print media	3	4.7	3	4.7	7	10.9	7	10.9	31.2
Shows	3	4.7	3	4.7	2	3.1	1	1.6	14.1
Total	11	17.2	17	26.6	26	40.6	10	15.6	100

The results on educational levels of the extension workers indicated that most of the staff held a first degree (Bachelors) at 40.6 percent, 17.2 percent held a Diploma, 11 percent were of certificates levels and 10 percent held masters and above. Results on choices of technology transfer methods by the staff indicated that most certificate holders preferred to use farm visits (12.5 percent) for individual methods, 12.5 percent preferred to use trainings and demonstrations for group methods and field days (7.8 percent) for mass media methods.

Staff that held Bachelors levels of education preferred to use office visits (16%) for individual methods, tours and visits for group methods (22 percent) and field days for mass media methods (17 percent). Those staff that held Masters levels of education and above preferred to use ICT (12.5 percent) as individual methods, trainings and demonstrations for group methods (12.5 percent) and print media (11 percent) for mass media methods.

In summary both diploma and certificate level workers preferred to use farm visits as an individual method, trainings and demonstrations as group methods and field days as mass media method. Workers who held a bachelor's degree were flexible in use of individual methods, preferred tours and visits as group methods and field days as mass methods. However, staff who held a master's level of education and above preferred to use ICT as an individual method, trainings and demonstrations as group methods and print media as mass method.

4.8.2.4 Descriptive Results on Extension Worker Years of Work Experience on Choices of Technology Transfer Methods

Results on the choice of technology transfer methods considering workers years of work experience in UPA in Nairobi County indicated the results in Table 4.26.

Table 4.26: Descriptive Results on Choice of Technology Transfer Methods Considering Years of Work Experiences

	Less than 5 years		5-9.9 years		10-14.9 years		Over 15 years		Total
Staff preferred individual method									
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	

Farm visits	3	4.7	4	6.3	18	28.1	1	1.6	40
Office visits	0	0.0	3	4.7	15	23.4	1	1.6	30
ICT	0	0.0	12	18.8	5	7.8	2	3.1	30
Total	3	4.7	19	29.8	38	59.3	4	6.3	100
Staff preferred group method									
Train/ demos	0	0.0	10	15.6	26	40.6	3	4.7	61
Group tours	3	4.7	9	14.1	12	18.8	1	1.6	39
Total	3	4.7	19	29.7	38	59.4	4	6.3	100
Staff preferred mass method									
Field days	0	0.0	8	12.5	23	35.9	4	6.3	55
Print media	0	0.0	9	14.1	11	17.2	0	0.0	31
Shows	3	4.7	2	3.1	4	6.3	0	0.0	14
Total	3	4.7	19	29.7	38	59.4	4	6.3	100

The results indicated that farm visits, T/D and field days were the most preferred individual method of technology transfer regardless of the years of experience. Staff with less than 5 years preferred to use farm visits as an individual method, Group tours as a group method and shows as a mass method. Staff with 5-9 years of experience preferred to ICT, T/D and print methods as individual, group and mass method. Most of the staff with 10-15 years of experience preferred to use farm visits, T/D and F/Ds. Staff with over 15 years of experience preferred ICT, T/D and field days.

In summary staff with work experience of 5-9 years and more than 15 years preferred to use ICT as an individual method. Workers with less than 5 years of work experience preferred to use farm visits, trainings and demonstrations and shows. Workers with 5-9 years of experience preferred ICT and were flexible with all other group and mass media methods.

4.8.3 Descriptive Results on Extension Worker Socio - Economic Characteristics and Knowledge of Adult Learning Principles.

Descriptive results on the knowledge and use of ALPs by the extension worker indicated the results shown on Table 4.27.

Table 4.27: Gender of the Extension Worker and Knowledge of ALPs

	Aware Frequency (Percentage)	Not Aware Frequency (Percentage)	Partially Aware Frequency (Percentage)
Male	0 (0)	21(33)	2(3)
Female	5(8)	21(33)	25(39)
Total	5(8)	32(50)	27(42)

Results indicated that 8 percent of the female workers were aware of the ADLs, 21 percent were not aware and 39 percent were partially aware. No male officer was aware of ADLs, 21 percent were not aware ad 3 percent were partially aware.

In summary 3 percent of male workers were partially aware of ALPs as compared to 47 percent of female workers were either aware of partially aware of the ALPs.

Descriptive results on the knowledge and use of ALPs by the age of extension worker indicated the results shown on Table 4.28.

Table 4.28: Age of the Extension Worker and Knowledge of ALPs

	Aware Frequency (Percentage)	Not Aware Frequency (Percentage)	Partially Aware Frequency (Percentage)

31-40 years	0(0)	8(13)	1(2)
41-50 years	3(5)	6(9)	7(11)
Over 50 years	3(5)	14(22)	22(34)
Total	6(9)	28(44)	30(47)

Staff in the age range of 31-40 years were not aware of the ALPs but 2 percent were partially aware as indicated in Table 4.28. 5 percent of the staff in the age range of 41-50 years were aware of ALPs, 9 percent were not aware and 11 percent were partially aware. However, 5 percent of the staff in the age range of over 50 years were aware of the ALPs, 22 percent were not aware and 34 percent were partially aware.

Descriptive results on the knowledge and use of ALPs by the educational levels of the extension worker indicated the results shown on Table 4.29.

Table 4.29: Educational Levels of the Extension Worker and Knowledge of ALPs

	Aware Frequency (Percentage)	Not Aware Frequency (Percentage)	Partially Aware Frequency (Percentage)
Certificate	0(0)	7(11)	4(6)
Diploma	0(0)	9(14)	7(11)
Bachelors	1(2)	12(19)	14(22)
Masters	5(8)	0(0)	5(8)
Total	6(9)	28(44)	30(47)

Results on the knowledge of the ALPs considering their educational levels indicated that certificate and diploma levels were not aware of ALPs. However, 6 percent and 11 percent were partially aware respectively as indicated in Table 4.29. 2 percent of workers who held a master's degree and 8 percent of workers who held a master's degree were aware of the ALPs.

Descriptive results on the knowledge and use of ALPs by the work experience of the extension worker indicated the results shown on Table 4.30.

Table 4.30: Work Experience of the Extension Worker and Knowledge of ALPs

Experiance	Aware Frequency (Percentage)	Not Aware Frequency (Percentage)	Partially Aware Frequency (Percentage)
Less than 5 years	0(0)	3(5)	0(0)
5 – 9.9 years	0(0)	8(13)	10(16)
10- 14.9 years	6(9)	16(25)	16(25)
15- 19.9 years	0(0)	1(2)	4(6)
Total	6(9)	28(44)	30(47)

Staff with less than 9 years of work experience was not aware of ALPs, while 16 percent of the staff with 5-9.9 year were partially aware as indicated in Table 4.30 above. 6 percent of staff with 10-14.9 years of work experience was aware of ALPs while majority of the workers were partially aware of the ALPs.

4.8.4 Inferential Results on the Influence of Extension Worker Characteristics on the Empowerment of Farmers

Multiple Linear Regressions were conducted to test the influence of the Socio-economic characteristics of the extension worker and a farmer empowerment score as indicated in Table 4.31.

Table 4.31: Multiple Linear Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.375	0.372	0.0796	0.5859

a. Predictors: (Constant), gender, age, education level, years of experience

b. Dependent Variable: Empowerment of famers

Multiple linear regressions results provided an R^2 of 0.372 indicating that 37.2 percent changes in the empowerment score is explained by the changes in the characteristics of extension workers.

The multiple regression model run with all four social-economic variables produced an $R^2 = 0.372$ ($p < 0.1$), indicating that 37.2 percent of farmer empowerment was explained by gender, age, educational levels and work experiences of the extension worker. Although the multiple linear regression model explanatory power of 37.2 percent was not strong enough, the statistical significance and positive influence of the extension worker characteristics on UPA farmer empowerment is an important finding.

Empowerment contributes to a positive human behaviour which is influenced by a wide range of unexplainable variables in complex environment such as sustainability (Cohen, 1988).

An ANOVA test indicated that the influences of the characteristics of extension workers were significant to the empowerment of UPA farmers (p-value = 0.063) as shown in Table 4.32.

Table 4.32: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.246	4	0.811	2.364	0.063
	Residual	20.256	59	0.343		
	Total	23.500	63			

a. Predictors: (Constant), gender, age, education level, years of experience

b. Dependent Variable: Empowerment of famers

The F- Test of the regression coefficient above indicated that the extension worker socio economic characteristics contributed significantly (*P*-value < 0.1) to the variance accounted for in the empowerment score and the model as a whole was significant.

Extension worker characteristics were measured in categories while empowerment was measured as an average score of the number of adult learning principles that the extension worker was aware of and the use of the same ALPs in the choice of technology transfer methods.

The coefficients are provided in Table 4.33

Table 4.33: Table of Coefficients on the Influence of Extension Worker Characteristics on the Empowerment of UPA Farmers

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	1.328	0.536		2.477	0.016

Gender of extension worker	0.424***	0.206	0.282	2.062	0.044
Age of extension worker	0.266***	0.120	0.319	2.223	0.030
Education of extension worker	0.217***	0.098	0.270	2.206	0.031
Years of experience	0.186***	0.073	0.332	2.532	0.014

a. Dependent Variable: Empowerment of famers. *** Significant at 0.1

The results indicated that a unit change in age, educational levels, and years of experience of the extension worker would yield positive changes, 0.266, 0.217, 0.186 respectively in the empowerment score of the farmers. All extension worker characteristics indicated positive contributions in the empowerment of farmers.

The estimated equation is as indicated below

Empowerment score = 1.328+0.424(Gender) +0.266(Age) +0.217(Education) +0.186(Experiences) +*e*

Extension workers preferred to use different extension methods according to their socio characteristics of gender, age, educational levels and years of work experience. 50 percent of the workers were not aware of the importance of adult learning principles and 42 percent had partial knowledge of the ALPs. Extension workers did not therefore consider them in their choice of extension methods and this therefore affected the dissemination of information and subsequently the empowerment of the farmers to make decisions on urban and peri - urban farmers in Nairobi County.

In summary the socio- economic characteristics of the extension worker was found to influence the knowledge and use of ALPs and hence contributed to the empowerment of farmers to make decisions on sustainability of urban and peri-urban agriculture in Nairobi County.

4.9 Summary of Results

The UPA farmer response rate to the questionnaire was 99 percent of which 87 percent indicated a sufficient contribution of UPA to food security and income.

Majority of Nairobi County UPA farmers were male (58.4 percent) and 41.6 percent of the farmers were female. Most of the farmers (60 percent) were below 50 years with a median age range of 41-50 years with a secondary to tertiary level of education. UPA farmers have 5-9 years of farming experience with a steady entrance of new farmers in the last five years especially in the slum areas.

Majority of the farmers worked on their farms on full time basis or employed full time workers. Those employed on a full-time basis were earning an average salary of Kenya Shillings 7,500 per month. Urban farmers experience several challenges since most of them (42 percent) farmed on less than 0.5 acres and 30 percent of UPA farmer did not own the land they farm on. Farmers did not have adequate water for farming since 26 percent used Nairobi City County Water which is specifically for domestic use. Few UPA farmers (25.5 percent) had received credit for farming. However, marketing of their products was not a challenge for most farmers.

UPA farmers had adopted various technologies depending on farm sizes, availability of finance, time and knowledge management levels. However, the most popular methods were open field farming of crops and keeping of chicken. The least popular methods were hydroponics and mushroom farming due to their high investment demands for installations and high management levels. The high investment technologies such green houses and dairy farming yielded approximately Kenya shillings 300,000 annually while the smaller technologies such as kitchen gardens and multi-storey gardens yielded approximately 35,000 annually.

Nairobi County farmers were found to participate in various technology transfer methods. Most of the 149 farmers (96) had participated in farm visits, 84 in Trainings and

demonstrations, 75 in field days, 54 had received print materials, 46 had made office visits, 40 had participated in group tours, 29 had participated in ICT and 29 had attended shows.

However, even though few farmers had participated in ICT as a method of technology transfer, most farmers' (61 percent) revealed that ICT considered most of the adult learning principles which contributed to their empowerment. Other methods that considered ALPs were farm visits (50 percent), training and demonstrations (47 percent) and field days.

An inferential analysis on the influence of technology transfer methods on the sustainability of urban and peri-urban agriculture in Nairobi City County indicated that technology transfer methods of ICT, Farm visits, office visits, trainings and demonstrations and field days were positive and coefficients were statistically significant. This results therefore rejects the hypothesis that there is no significant influence of technology transfer methods on the sustainability of Urban and peri-urban agriculture in Nairobi City County.

Most extension workers in Nairobi County were female at 80 percent and 20 percent were male indicating a gender imbalance. Majority of the workers (61 percent) were at an average age of 50 years, held an education level of a first degree and with an average work experience of 10-15 years.

Majority of the extension workers preferred to use farm visits, trainings and demonstrations, field days and print. ICT as a technology transfer method was not common. Younger extension workers preferred ICT while the older workers preferred the traditional methods. Extension workers at masters' levels and above preferred ICT as an individual method and staff with work experience of more than 10 years preferred to use ICT or a combination of methods.

Majority of female workers, with over 41 years of age, who held a master's degree and above and those who had an experience of 10-15 years in UPA had knowledge of adult learning principles. The socio-economic characteristics of the extension workers were found to influence knowledge and use of ALPs in the choice of technology transfer

methods. This subsequently affected the empowerment of farmers to make decisions on their farming systems.

Farmers in Nairobi County were found to come from across the socio-economic divide. The technology transfer methods that were found to consider adult learning principles, contributed to farmer empowerment to make decisions on sustainability of UPA were ICT, farm visits, office visits, trainings/ demonstrations and field days. ICT presented the best empowerment method. These were mainly individual methods of technology transfer except for trainings and demonstrations and field days. This results therefore rejects the hypothesis that there is no significant influence of technology transfer methods on the sustainability of Urban and peri-urban agriculture in Nairobi City County.

Extension workers of different socio-economic status preferred to use different methods of individual, group and mass methods for information dissemination. Most extension workers did not consider ICT as a preferable information transfer method except for the young and the more educated. Majority of the workers were not aware of the use of adult learning principles and therefore did not employ them in their choice of extension methods.

The socio-economic characteristics of the extension worker were found to influence the knowledge and use of ALPs and which influenced their choice of technology transfer method. The technology transfer method influenced the empowerment of farmers to make decisions on sustainability of urban and peri-urban agriculture in Nairobi City County. These results therefore reject the hypothesis that there is no influence of extension worker characteristics on the Empowerment of UPA farmers for the sustainability of UPA in Nairobi City County.

CHAPTER FIVE: CONCLUSIONS AND RECCOMMENDATIONS

5.1 Conclusions

The study was set to find out the influence of technology transfer methods and extension worker characteristics on the sustainability of urban and peri urban agriculture in Nairobi City County.

The study concludes that majority of Nairobi City County extension workers were not aware of adult learning principles and therefore they did not consider them in their choice for technology transfer methods used for information dissemination. Failure in this consideration indicated that the technology transfer methods used were deficit of adult learning principles and therefore were inadequate to empower farmers to make decisions for sustainability of urban and peri urban agriculture.

The study therefore contributes to the body of knowledge the cooperation of adult learning principles in the choice of technology transfer methods for farmer empowerment and contribution to sustainability of the agricultural farming systems.

5.2 Recommendations

1. The extension workers in Nairobi City County should be empowered on importance of the considering adult learning principles in the choices of extension methods to assist in empowerment of farmers.
2. The study also recommends a transformation of the technology transfer method to an "integrated digitized and individualised technology transfer method" based on ICT for information dissemination.
3. The results can be used to inform policy for recommendation for an improved extension system for farmer empowerment and sustainability of urban and peri urban agriculture in Nairobi City County.
4. The study recommends further studies on the contribution of the institutionalization of the extension system in Nairobi City County.

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APPENDIX A

Questionnaire for Farmers/Institution on the Influence of Technology Transfer Methods and Extension Facilitators on the Sustainability of Urban and Peri-Urban Agriculture in Nairobi City County.

INTRODUCTION; ***This information is strictly confidential and will only be used for the purpose of this study. Please answer the questions as accurately as you can remember.***

Fill in the spaces or tick where appropriate. Questionnaire Number----------
Date of Interview----------

A GENERAL INFORMATION

A1	Name of Respondent /farmer or Institution /Group (Optional)	
A2	Name of Sub County	
A3	Nature of area	1) Urban [ ] 2) Peri-Urban [ ] 3) Slum [ ]

B DEMOGRAPHICS

S/N	Characteristic	Response
B1	Gender of Respondent: 1) Male, [ ] 2) Female [ ]	
B2	Age of Respondent in years: 1) less than 20 yrs [ ] , 2) 21 – 30 yrs [ ] , 3) 31-40 yrs [ ] , 4) 41-50 [ ] , 5) Over 60 yrs [ ].	
B3	Highest level of education attained? 1) No education [ ] , 2) Primary level [ ], 3) Secondary level [ ] , 4) Tertiary level[ ] .	

B4	Has UPA farming contributed to food self-sufficiency 1) Yes [ ] , 2) No [ ] , 3) Partial [ ].	
B5	What type of labour do you have on the farm? 1) Family/Institution [ ], 2) Hired [ ], 3) Combined [ ], 4) Group [ ].	
B6	How many man/ women hours do you have working on the farm for UPA on daily basis? 1) Less than 2 hrs [ ], 2) 2-4 hrs [ ], 3) 4-6 hrs [ ], 4) over 6 hrs [ ].	
B7	How much do you pay for UPA Labour per day? 1) Less than Kshs 299 [ ], 2) Kshs 300-399 [ ], 3) Kshs 400-499 [ ], 4)Over Kshs 500[ ], 5) N/A[ ].	
B8	How much do you pay for UPA Labour per month? 1) Less than Kshs 4999 [ ], 2) Kshs 5000-5999 [ ], 3) Kshs 6000-6999 [ ], 4) Kshs 7000-7999 [ ], 5) Over Kshs 8000 [ ], 6) N/A[ ].	

C SUSTAINABILITY FACTORS

C1	For how long have you been practicing UPA? 1) Less than 5yrs [ ], 2) 5-9.9yrs [ ], 3) 10-14.9yrs [ ], 4)15-19.9yrs [ ]. 5)20-24.9[ ]. 6) Over 25yrs [ ].	
C2	How much land do you own in acres? 1) Nil [ ], 2) Less than 1/2[ ], 3) ½ -1[ ], 4) 1-2[ ] , 5) 2.1-3 [ ], 6) 3.1- 4[ ], 7) 4.1- 5 [ ], 8) Over 5 acres [ ].	
C3	How much land do you farm in acres? 1) Nil [ ], 2) Less than 1/2[ ], 3) ½ -1[ ], 4) 1-2[ ] , 5) 2.1-3 [ ], 6) 3.1- 4[ ], 7) 4.1- 5 [ ], 8) Over 5 acres [ ].	
C4	How much land do you rent for farming in acres? 1) Nil [ ], 2) Less than 1/2 [ ], 3) ½ - 9 [ ], 4) 1-1.9 [ ], 5) 2 – 2.9 [ ], 6) over 3 acres [ ].	
C5	Who owns the rented land? 1) Railways [ ], 2) Church [ ], 3) County [ ] 4) Veterinary [ ], 5) Institutional [ ], 6) Road Reserve [ ], 7) Personal [ ], 8) University [ ].	
C6	Do you have adequate access to water? 1) Yes[ ], 2) No[ ],	
C7	What is your main source of water? 1) NCWSC [ ], 2) Shallow well [ ], 3) Spring [ ], 4) River[ ], 5) Dam [ ], 6) Borehole [ ], 7) Roof catchment [ ], 8) Rain fed [ ], 9) N/A-Others……. [ ], 10) Runoff [ ],	
C8	Do You Pay for the water? 1) Yes [ ], 2) No [ ],	
C9	Do you access credit as an UPA Farmers? 1) Yes[ ], 2) No [ ],	
C10	Do you experience marketing challenges? 1) Yes [ ], 2) No [ ], Specify…….....	
C11	Do You keep records for the various enterprises on UPA 1) Yes [ ],2) No [ ],	

Please fill in the table by choosing the extension methods from the choices below.

1. Farm Visit by Extension worker, 2. Office visits 3. Internet Searches
4. Group Trainings and Demonstrations, 5. Field days 6. Show Visits
7. Tours 8. Others specify on the table

S/N	Name of Technology (UPA)	a) Do you practice this technology	b1) Nos/ b2Size of technology	c)Crops produced or animals reared	d)Extension Method Used	e) Income per season
C12	Green house farming					
C13	Shade net farming					
C14	Drip/bucket/furrow Irrigation					
C15	Open field farming					
C16	Multi-storey gardens					
C17	Moist beds					
C18	Kitchen gardens					
C19	Roof top gardening					
C20	Hanging gardens					
C21	Micro gardens					
C22	Cows					
C23	Shoats					
C24	Pigs					
C25	Poultry					
C26	Rabbits					
C27	Fish Farming					
C28	Mushroom Farming					
C29	Composting					
C30	Manuring					
C31	Value addition (specify).....					
C32	Hydroponics					
C33	Tree/ Fruit Nursery					
C34	Vegetable Nursery					

C35. Which of the above technology would you prefer to pay as you get the service as compared to not getting the service at all? ----------

D TECHNOLOGY TRANSFER METHODS

D1. What category of farmer are you? 1) Individual [ ] 2) Group [ ] 3) Institution [ ]

D2. Who do you consult for advice when you need information on the farm?

1) Government officer [ ] 2) Farmer [ ] 3) Private Officer (specify) ----------
4) Universities (specify) ---------- 5) Collaborations (specify) ----------
6) Researchers (specify) ----------
D3. How often does the Government extension worker visit you? 1) No visits [ ] 2) Weekly [ ] 3) Monthly [ ] 4) Quarterly [ ] 5) Twice a year [ ] 6) Not Consistent specify----------
D4. Are extensions workers available on demand? 1) Yes [ ] 2) No [ ]
D5. How often do you consult the extension worker 1) Nil consultations [ ] 2) Weekly [ ] 3) Monthly [ ] 4) Twice a year [ ] 5) Once a year [ ] 6) On Demand specify----------
D6. Have you received any UPA trainings? 1) Yes [ ] 2) No [ ]
D7. If yes to (D6) above where/who were you trained? 1) Government [ ], 2) NGO sponsored [ ] 3) Collaboration [ ] , 4) Self sponsored [ ]5) Private [ ] 6) None [ ]
D8. How long did the training take? 1) One Day [ ], 2) Three days [ ]
3) One Week [ ], 4) Not applicable [ ]

In your opinion and experience, do the Extension Methods consider the following Principles as explained below? Tick where appropriate

a). Empowerment (Moving from Dependency to self-Directedness by making decisions.)
b). Flexibility (Considers time and venue that is appropriate to you)
c). Experiences (provides for sharing your past experiences and builds on them)
d). Provides solutions (Helps you to solve your problems)
e). Partnership (Helps you to build on networks and partnerships)
f). Provides for life long-learning. Encourages you to continue searching for more information?
g). Provides Internal Satisfaction as opposed to financial gains

S/N	Extension Method	a	b	c	d	e	f	g
	Individual Methods							
D9	Farm Visits							
D10	Office Visits							
D11	ICT(Telephone /Internet)							
D12	ICT()							
	Group Methods							
D13	Group Demonstrations /Trainings							
D14	Group Tours /Visits							
	Mass Media							
D15	Field days							
D16	Print (Fliers/posters/handouts)							
D17	Audio (Radio) Media							

D18	Audio(TV)							
D19	Audio(CD							
D20	Visual (Posters)							
D21	Shows							

D22. Do you pay for any Extension services? 1) Yes [ ] 2) No [ ]
D23. If yes to (D23) above Indicate services paid for and amount in Ksh. ----------
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D24. Are your computer literate? 1) Yes [ ] 2) No [ ]
D25. Are you registered as an Electronic (E)-Extension farmer? 1) Yes [ ] 2) No [ ]
D26. What kind of information would you like to receive via E-Extension? ----------
---
D27. Is it a convenient method of passing information to you? 1) Yes [ ] 2) No [ ]
D28. Do you access any written documents on UPA? 1) Yes [ ] 2) No [ ]
D29. How often do you get the documents 1) Weekly [ ] , 2) Monthly [ ] ,
3) Quarterly [ ] 4) Annually [ ], 5) Not consistent [ ], 6) Nil [ ].
D30. In your opinion how would you like to access the UPA information?
1) Print [ ] specify ---------- 2) Audio [ ] specify ----------3) Audio - visual [ ] specify -
----------4) visual [ ] specify ---------- 5) Nil [ ] 6) E- Extension, [ ]
D31. Are you affected by the City By-Laws as a UPA farmer, group or institution? 1)
Yes [ ] , 2) No [ ] , 3) N/A [ ]. 2. What challenges do you experience as
aUPA farmer/Institution ----------

D33. What changes would you suggest towards the City by- laws to facilitate farming --
----------in the city? ----------

THANK YOU

APPENDIX B

Questionnaire for Extension Facilitators on the Influence of Technology Transfer Methods and Extension Facilitators on the Sustainability of Urban and Peri-Urban Agriculture in Nairobi City County.

INTRODUCTION: ***This information is strictly confidential and will only be used for the purpose of this study. Please answer the questions as accurately as you can remember.***

Please fill in the gaps or tick where appropriate. Questionnaire Number-------Date of Interview---

A GENERAL INFORMATION

Name of Extension worker (optional) ----------

1. Sub-County ----------
2. Department 1) Agriculture [ ] 2) Livestock [ ] 3) Fisheries [ ] 4) Private [ ]
3. Gender of officer 1) Male [ ] 2) Female [ ]
4. Age Range of Officer 1) 20-30 [ ] 2) 31-40 [ ] 3) 41-50 [ ] 4) Over 50 [ ]
5. Highest level of Education 1) Certificate [ ] 2) Diploma[ ] 3) BSc [ ] 4) Msc [ ]
6. Are you computer Literate? 1) Yes [ ] 2) No [ ]
7. Do you have specialized training on UPA 1) Yes [ ] 2) No [ ]
8. If yes to (7) above, where were you trained? ----------
9. How long did your training take? 1) Less than 2 weeks [ ] 2) 2weeks – One month [ ] 3) 1 -3 Months [ ] 4) 3 - 6 Months [ ] 5) Over 6 months 6) N/A [ ]
10. How long have you been training farmers on UPA? 1) Less than 5 years [ ] 2) 5- 9.9 years [ ], 3) 10-14.9Years [ ], 4)15-19.9 years [ ], 5) Over 20years [ ].
11. Where do you get updated information to deliver to the farmers?
    1) Government sector [ ] 2) Private sector/NGOs [ ] 3) Internet [ ] 4) Print [ ] 5) Researchers [ ] 6) Universities [ ] 7) Integrated Methods [ ].
12. Is the information adequate? 1) Yes [ ] 2) No [ ]

13. In which form would you prefer to receive information?
    1) Government sector [ ] 2) Private sector/NGOs [ ] 3) Internet [ ] 4) Print [ ]
    5) Researchers [ ] 6) Universities [ ] 7) Integrated Methods [ ].
14. Are you conversant with extension principles in adult learning 1) Yes [ ] 2) No [ ].

B- CONSIDERATIONS OF EXTENSION METHODS ON PRINCIPLES OF ADULT LEARNING.

Do the following extension methods consider the following Principles while training the farmers, in your opinion? (Tick where appropriate)

a) Empowerment (Moving from Dependency to self-directedness by making decisions.)
b) Flexibility (Considers time and venue that is appropriate to the farmer)
c) Experiences (provides in sharing the farmers past experiences and builds on them)
d) Provides solutions (Helps the farmer to solve their problems)
e) Partnership (Helps the farmer to build on networks)
f) Provides for life long –learning for the farmer.
g) Provides Internal Satisfaction as opposed to financial gains

S/NO	Extension Method	a	b	c	d	e	f	g
	Individual Methods							
B1	Farm Visits							
B2	Office Visits							
B3	ICT(Telephone /Internet)							
	Group Methods							
B5	Group Demonstrations /Trainings							
B6	Group Tours /Visits							
	Mass Media							
B7	Field days							
B8	Print (Fliers /brochures)							
B13	Shows							

B15. Which of the above methods do you prefer to use in trainings,

a) Individual farmers training ----------
b) Group Farmers training, ----------
c) Mass farmers training ----------

B16. Explain your response to (14) above ----------
B17. Which of the above methods do farmers prefer?

a) Individual farmers training ----------
b) Group Farmers training, ----------
c) Mass farmers training ----------

B18. Explain your response to (16) above ----------
B19. Are you competent enough to apply the above principles? 1) Yes [ ], 2) No [ ]

B20. What changes would you suggest towards the City by- laws to facilitate farming in Nairobi City? ----------

B21. What changes would you suggest to the existing extension methodologies in order to attain sustainability of UPA in Nairobi City County? ----------

THANK YOU