ORGANIC FARMING IN THE KIBERA SLUM IN NAIROBI, KENYA

BY LEAH ATIENO SAOKE

December 2011
Wageningen University

Acknowledgements

I am immensely grateful to a host of people, who gave me help and support, social and spiritual, commentary and advisory, while preparing this thesis. Undoubtedly, there is likely to be a couple of omissions from this list, for which I sincerely apologise. I would like to thank the Kenyan community in Wageningen including Jimmy Nyagwange, Fredrick Maati, Joel, Leah, Mutuko, Kibor, Jamlick, Linah, Fred, Huldah, Esther, Geofrey, Hongo, Judith and Maren. You formed the integral part of my stay and social network here by creating a small home away from home.

Thanks to my supervisor, Dr. Jack Peerlings who has provided fantastic guidance throughout the research period, inspiring and encouraging me in my endeavours, and nurturing me into a young independent researcher. Thanks to the students and the dedicated staff of WUR, particularly my study advisor Dr. Cor Langveld and the Organic Agriculture Class of 2010 for the great spirit of sharing (Keep it up!). I cannot forget Jony Meshesha, Natasja Poot, Dominika Anderova, Jerome Dogbatse, Danstan Ndanzi and Nurudeen Alimi and other international friends for their encouragement and friendship during my stay in The Netherlands. Through them I learnt to appreciate and live freely with other cultures. This journey would not also have been possible without financial support from the Nuffic Fellowship Programme (NFP). My appreciation of the support you provided.

Finally, lots of thanks to my family for remembering me in their prayers and supporting me during the entire study period in The Netherlands. My husband Mr. Elly Odhong', my children; Joyce and Knowles, my in-laws Charles, Jack, Sam, Wema, Jonathan, Monicah, George, uncle (Jared) and my aunt (Pamela), you always rejoice in my success and I will never be ashamed to say I love you all. To my late parents, Joseph and Sarah Saoke, thanks for providing an enabling environment to pursue my dreams and for instilling in me a culture of hard work.

To the almighty God, thanks for keeping me in good health and giving me strength. Glory and honour be unto you!

Organic farming in the Kibera slum in Nairobi, Kenya

Abstract

The objective of the study was to explore the socio-economic conditions that determine participation in organic agriculture and the economic impacts of participation, especially on income in Kibera slum, Kenya. A multi-stage random sampling procedure was used to select a total of 80 respondents from the study area. Descriptive and inferential statistics were used to describe socio-economic and institutional characteristics of the respondents which revealed that, there was significant mean difference regarding age, years of experience in organic farming, household labour, size of organic plots, number of organic plots, and income from organic farming. A Logit model was employed to identify factors influencing households' participation in organic farming. The result of the model showed that gender, age of farming household, years of organic farming, others in organic farming, access to credit and membership of a farmer group were the statistically significant factors influencing participation in organic farming. On the other hand, a multiple linear regression model was used to identify the variables that contributed to the share of income from farming. From the 12 explanatory variables included in the model, organic farming activity, size of organic farm and shares of sales from total production were found to be significant variables contributing positively to the share of income from farming, while gender of the household head, number of organic plots and number of visits/training from NGOs influences it significantly and negatively. Descriptive statistics in the form of a frequency table was used to analyse the data on the major limitations to participation in organic farming. Ignorance and lack of land for organic farming were the main constraints that affected participants in urban organic farming. Non-Governmental Organisations (NGOs) are coming up with more viable and sustainable ways in undertaking organic farming in informal settlements and these are being taught to farmers but their efforts are insufficient. There is the need for actors on the national and international levels to do more to help the people living in informal areas to capitalize on their experiences and to integrate organic farming in these areas.

Table of Contents

List of tables

Tables **Page**

List of figures

Figures **Page**

List of tables in the appendix

Appendix table **Page**

LISTS OF ABBREVIATIONS

FAO	Food and Agriculture Organisation
IMR	Inverse Mills Ratio
NGO's	Non-Governmental Organisations
OLS	Ordinary Least Squares
ROC	Receiver Operating Characteristic
VIF	Variance Inflation Factor

Currencies

1 USD = 90 Kenyan Shillings in August 2011

1 EURO=130 Kenyan Shillings in August 2011

1. Introduction

1.1 Background

Urban poverty is increasing dramatically in many African countries including Kenya (Oiro et al., 2004). Rural-urban migration has been cited as one of the main causes of poverty in Kenya (Oxfam, 2008). Consequently, most people are forced to live in slums since they cannot afford better housing elsewhere, and they have no regular occupation and reliable income to sustain decent living standards (Gathuru, 1993). The livelihoods of the inhabitants within informal settlements are made even worse by the increasing food and non-food prices, low income and lack of arable land. This sad state of affairs is further compounded by poor sanitation and nutrition status prevalent in the slums (Pascal et al., 2009).

Many of the slum dwellers largely depend on manual jobs, and the majority of them earn less than one dollar per day (Hope, 2004). As a result, there is an urgent need for economically viable alternatives that guarantee a sustainable source of income for these households. In light of this realization, several stakeholders are currently implementing complementary income initiatives, that include encouraging urban slum dwellers to adopt organic farming (Foeken, 2005).

Kibera slum is the largest and most densely populated informal settlement in Africa. It is located in Nairobi, the capital city of Kenya. Poverty incidence in the study area is estimated at 73% and the majority of households are food insecure (Gulyani and Talukdar, 2010). As a coping livelihood strategy, some households have now adopted organic farming to supplement their households' income (Pascal et al., 2009). This income can be directly realized through the sale of crops or indirectly as a result of the need to purchase less food. However, this contribution is currently not clear and is yet to be empirically investigated.

Organic farming in urban informal areas could face major economic constraints such as imperfect labour and land markets, lack of farm inputs and lack of access to credit services (Nugent, 1999). Although some local NGOs together with relevant government institutions are addressing these impediments (Foeken and Mwangi, 1998), their programs can only be sustainable if guided by better information in targeting of such interventions.

The current study aims to contribute to the better understanding of the role of urban organic farming to households' incomes. Household income improves through the use of locally available inputs like household refuse instead of synthetic pesticides and fertilizers which are expensive and

unaffordable. The farmers also use some environmentally friendly methods of weed, pest, and disease control and thus increasing their income level through considerable production.

The information generated from this study would also be useful in the formulation of appropriate policies in the area of organic farming in the slums. This will help promote organic farming resulting in increased income level of households' engaged in organic farming thereby shaping their livelihoods. Furthermore, the analysis and identification of factors affecting participation of organic farming is vital in the process of promoting urban organic farming and enhancing food production, food security as well as improving income levels in the region. This study also provides base line information for further research work and development activities that will benefit the organic farmers in the study area.

1.2 Study Objective and research questions

The objective of the study is to explore the socio-economic conditions that determine participation in organic agriculture and the economic impacts of participation, especially on income.

The research questions are specified as;

1. Why do households choose to participate in organic farming?
2. Does the share of income from organic farming significantly contribute to household income?
3. What are the limitations for those who are not involved in organic farming?

1.3 Organization of the thesis

This thesis constitutes five chapters. In the first and introductory chapter, subtopics that are discussed include; background, objectives of the study and research questions. The second chapter presents the theory and concept of urban informal agriculture. A brief description of the study area and a thorough explanation of the methodologies used for the study are presented in chapter three. The findings of the study are presented in the results part in chapter four. Finally chapter five provides a general discussion and conclusions that are drawn from the study.

2. Theory and concept of urban organic farming

This chapter will be organised as follows; Section 2.1 will briefly explain the concept of organic farming in relation to increasing informal household income. Section 2.2 will provide discussion on the need for organic farming in urban informal households and section 2.3 will be the outline of the theory and discusses household behaviour facing the decision of whether to engage in organic farming and its contribution to household income.

2.1 Organic farming in urban informal households

Organic agriculture in urban informal settlements in sub-Saharan Africa is a livelihood strategy that the poor use in combination with other strategies. It has been defined in various ways over the years and across many disciplines. For example, FAO (1999) defines organic agriculture as a production management system which promotes and enhances agro-ecosystem health. This is achieved by using agronomic, biological and mechanical methods, as opposed to using artificial resources, to fulfill any specific function within the system.

Organic farming in informal settlements areas in African cities takes a variety of forms reflecting land access, water availability and the potential for bringing other resources into production. It is portrayed as an easy industry to enter. Some urban farming systems require skilled workers and high capital investment, but most urban organic agricultural activities, including poultry and vegetables can be entered on a small scale with little investment and skills. Freeman (1991) indicated that land access for farming is evidently critical even when relatively little land is directly utilized. The informal urban farmers have therefore come up with innovative ways like a garden in a sack to curb this problem.

Sack gardening which involves the use of a small recycled sack filled with soil and seeds sown in it, is a low cost way to overcome the common problems that prevent food production in slums that is lack of cultivatable land and no land ownership. Some farmers received training on crop management and inputs like seeds and sacks from non-governmental organizations to start their sack gardens. The sacks can be placed in almost every corner. They are easy to set up, re-assemble and rearrange and require inexpensive materials.

Source: Photo taken during field survey

Freeman (1991) also noted that, organic farming can be carried out in in-built-up areas, in one's own compound (backyard farming) or on land belonging to someone else, the owner being either public or a private person. Public lands used for organic farming may include roadsides, river banks, open spaces, land acquired for roads, electrical-lines and other infrastructural projects. Public land is often used for farming purposes illegally and with no formal or informal tenure systems. Maxwel (1999) indicated that private lands used for farming usually comprise plots purchased but not yet utilized for building or housing development.

Chemical fertilizer in informal areas is used by a minority of the farmers who can afford it or who benefit through help from NGOs. A study conducted by Dennery (1995) in Kibera noted that only one farmer used chemical fertilizer while the rest could not afford it because it was expensive. Due to this, the farmers stopped relying on fertilizer or conventional inputs purchased from private organizations. Their agricultural inputs (local and cheap), come from kitchen wastes which are biodegradable. The waste can also be used for feeding the animals and improving soil fertility. The informal farmers have also adopted the use of plant leaves from the *Azadirachta indica* or Neem tree or "Mwarubaini" in Kenyan local language and the *Cucurbita maxima*. The leaves of the plants are soaked in water in a tank and left for about one week, the resultant solution is then used as pesticide.

The food produced stays in the community, where it is mostly needed. Any surplus produce these farmers have is sold to their friends and neighbours who enjoy the benefit of fresh produce. During the field survey, one of the participating farmers who own a sack garden mentioned that their home-grown vegetables taste better because they are grown without chemicals. The variety of foods produced in urban informal environments is considerable. These may involve a variety of animals kept in the home or backyard (rabbits, chicken etc.) as well as small vegetable plots. Food staples such as maize, rice or banana are more likely to be located in open spaces. Similar outputs are observed on a larger scale by households owning multiple numbers of plots. Production for sale in urban informal settlement areas typically comprises perishable commodities such as vegetables, eggs and poultry. This is because it provides a cost advantage as they sell them directly to consumers who are close by without incurring other costs like storage and transportation costs.

The problems with organic agriculture in informal settlements arise from its closeness to dense human populations sharing water and soil resources. This forces the urban farmers to divert municipal water supplies meant for other uses in the city, contributing to water shortages. There is also health concern

and great risk of chemical contamination from consuming organic products as organic farming is carried out in dense urban settlements. This arises from un-regulated use of uncomposted solid water and untreated waste water from sewage to irrigate crops or to water livestock. Due to this, serious food contamination and increased risk of diseases among farm workers and consumers of urban agricultural products may arise. A study conducted by Madden and Chaplowe, (1997) showed that recycled wastes sometimes contain toxic substances and industrial wastes are hazardous to human health if transmitted through food.

2.2 The need for organic farming

Farming in towns has increased enormously over the past two decades due to the economic crisis that prevailed in most African countries. This is basically because it has been discovered to be a viable intervention strategy for the urban poor to earn extra income, and to reduce their reliance on cash income to buy food. Organic farming yields direct income through sales and employment, or indirect income through reduction of expenditures on purchased food (Drakakis-Smith, 1993; Nugent, 1999). Whether the income is money or of any form, it has value to the urban poor farmer. Indeed, food produced in urban informal areas has value even if it is traded for other products or given to other needy people in the community.

The role of organic agriculture in urban informal settlements has become more critical in Kenya because of the increasing urban poverty situation. There is a wealth of literature that describes the social roles of organic farming, its economic functions and its potentials to sustain the livelihoods of urban informal households (Freeman, 1991; Memon and Lee-Smith, 1993). The main objective cited in different studies on organic farming in urban informal settlements is to increase food security and for some it is even a survival strategy (Rogerson, 1996; Martin et al., 2000). Nevertheless, many of the poor also sell some of their produce, in order to be able to pay for other basic household needs.

A study conducted by Maxwell (2000) showed that, urban informal organic agriculture contributes to household income through the sale of agricultural produce. The income level of organic farmers varies considerably from that of the non-organic farmers. This is because in organic farming, there is a reduction in the cost of farming as the farmers are able to replace expensive external inputs (including fertilizers and seeds) with organic inputs generally produced on the farm. The organic farmers will therefore have higher income level compared to the non-organic farmers.

The income generated from the sale creates a new opportunity for women to invest in other home-based income-generating activities e.g. sewing machines, typewriters, and kitchen appliances that contribute to improved household well-being (Gough and Kellett, 2001). Research carried out by Hovorka (2002) shows that organic agriculture is a means of stretching other sources of income. Organic farming in informal areas is thus considered a primary strategy deployed by farmers to maintain livelihoods and protect subsistence production.

Dennery's (1995) argues that households in low income areas use the revenues they got from sale of crops primarily for (other) food and such basics as paraffin, and maize and wheat flour, as well as school fees. Another reason for selling their crop is because some crops are perishable and cannot be stored due to lack of storage facilities. A study conducted in Kibera slum in Kenya by Pascal et al. (2009) indicated that, on average, each household who practiced organic farming increased its weekly income by 5 US dollars. This income level was due to the fact that the farmers did not incur any extra cost as they used the locally available inputs. The additional cash represented an important source of income given that rents in Kibera are 6 US dollar per month. The ability to earn cash income through organic farming is a significant determinant of poverty reduction and perhaps the biggest challenge urban informal dwellers face, is that, the majority of them work in sectors where wages are low, there are poor working conditions and job tenure is insecure (Maxwell, 1999).

Another important advantage of organic agriculture in informal areas is its role in poverty alleviation through creation of employment (Foeken, 2005). Unemployed and partially employed persons, youth, home-bound mothers, and elderly persons can supplement family food and income through small-scale organic farming. This does not require a lot of initial capital like growing of vegetables in sacks that requires little space and farm inputs. The youths can also come up with innovative ways of producing compost from household garbage and human waste. They can in turn use it for food production or sell it to other organic farmers hence generating some income. Urban organic farming therefore is an instrument to reduce urban unemployment, because it alleviates urban poverty among those who have migrated to the city but cannot find gainful employment.

2.3. Empirical evidence

Households are faced with choices on how to allocate their production factors (mainly labour) and their expenditures in order to maximise their welfare (Ellis, 1988). A simple household model is used to predict behaviour that would bring the most welfare to the family. This implies among others that family

members choose how to allocate their work time to the most income-generating activities over a given period of time (Sadoulet and Janvry, 1995). Households are likely to have a complex definition of welfare that could include diversification of income sources and other goals that will assure welfare under conditions of uncertainty.

In order to understand this behaviour with respect to urban informal agriculture, the existence of factors that affect participation in organic farming and household income must be analysed as indicated in the figure 1 below.

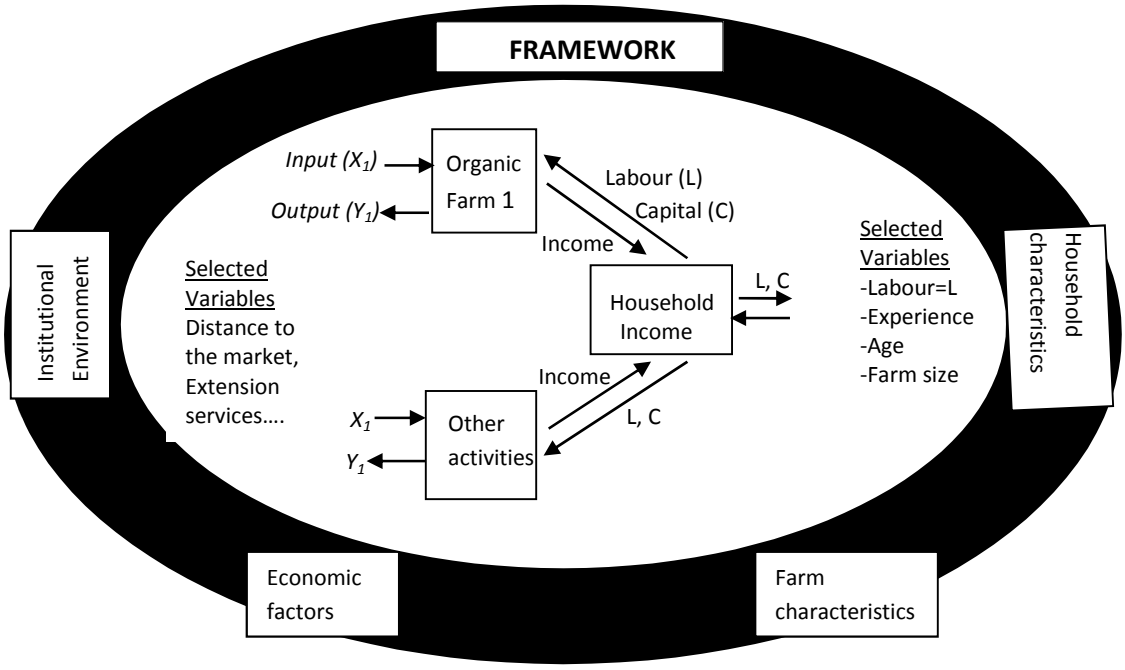


Figure 1: Factors affecting household welfare

Independent variables of interest in this study as informed by various empirical studies on participation in organic farming and contribution of organic farming to household income can be broadly categorized into: Household characteristics, farm characteristics, economic factors and institutional factors. The rationale for their inclusion and expected influence on relevant participation and total income measures are discussed in this section.

Household characteristics

The model adopts household characteristic variables such as age, education, experiences, gender and size of the household to explain differences in farmer's attitude towards participating in a certain

activity (Rogers, 1995). Gender of household head is a factor that indicates the sex of the household head who is the implicit key decision–maker for the household to participate in organic farming. One study by Obosu-Mensah (1999) stated that urban organic farmers in Ghana were male because most women preferred to engage in other forms of business activities. In addition, women have unequal access to markets, inputs, land, and credit compared to male farmers and they are not eligible for land ownership in many African cultures.

Rogers (1995) found out that early adopters of organic farming are younger and more educated. Another study by Gould et al., (1989) found education to be negatively related to adoption of organic farming. Other research indicates that age and farming experience have no influence on a farmer's predisposition toward participation in organic farming (Napier, 1982). Argilés (2007) denotes that the age of the farmer is a proxy for a farmer's experience. It is expected that, organic farmers with more experience will have better skills that enable them to make more effective decisions thus reducing their costs of production. This will improve farm output and increase income. Conversely, the author also denoted that younger farmers may be more energetic, innovative and better educated, and that aged farmers hardly put more effort in their farms and this contributes to their income level.

The ratio of household members who provide the farm with labour input is another factor to take into consideration. A study conducted by Franzel (1999) showed that household labour is a major constraint to the adoption of labour intensive farming practices. This is because household labour is the most important source of labour supply for informal urban farmers, given that low incomes constrains the hiring of labour. The direction of influence of farmer's age, gender, education, farming experience and labour on farm production and income will depend on which of the cases are predominant in the study area.

Farm characteristics

Farm characteristics may influence land investment decisions. The farm production model assumes that farm characteristics such as size of the plot, number of plots and type of inputs like access to organic materials are the determinants of a household's participation in organic farming. Access to land is the factor that urban informal farmers identify as most critical to their success, in terms of both the decision to enter organic farming and the level of income (Foeken, 2006). Nugent (1999) indicated that, the ability to obtain the necessary inputs also affects the level and timing of income from farming.

Inputs like chemical fertilizers, insecticides and pesticides for crop cultivation are generally used sparsely (Mwangi, 1995) as most households cannot afford them so they end up practising organic farming.

Economic factors

There are some economic factors that determine farmers' participation in organic farming. These economic factors can also influence the income level of the households. Foeken (2006) indicated that the net income flow depends on access to market, transport cost and portion of yield sold. Distance from the farm to the major market is a major proxy for access to market for the locally produced agricultural product. Location of the farm far from the market increases transaction costs like transport (Abdulahi and Huffman, 2005) and this affects income. Most farmers will therefore prefer to sell their produce to local buyers. Subsistence production in urban informal settlement is also cited as a way that yields direct income through sales (Nugent, 1999). The existing credit and investment support services favour urban informal farmers with initial capital in which they can use to secure land. Such farmers can buy the critical technical services, quality feeds and seeds and other inputs and adapt efficient management systems (Mireri, 2002).

Institutional factors

Access to extension services is another key factor that enables a farmer to participate in urban organic farming and hence increasing household income. This is because, access to extension services exposes farmers to new technologies of farming and their potential benefits. Organic farmers in contact with extension agents may be better able to manufacture and apply appropriate quantities of composts, and organic inputs (Rogers, 1995). Organic farmers in informal urban settlements also belong to different farmer groups. Membership of groups may expose individuals to a wide range of ideas and sometimes afford farmers the opportunity to have better access to information. This may either cause them to form a favourable or unfavourable attitude toward organic farming (Nkamleu, 2007). Organic farming requires inputs and human resources for activities like fencing, training on crop management and this requires other stakeholders like NGOs being involved (Van-Veenhuizen, 2006). This would make it more sustainable as the people involved in it would be able to produce food on their own without relying on others.

It follows from this theoretical analysis that, a number of factors that influence household participation in organic agriculture and those that contribute to the share of income from organic farming are interlinked.

3. Methodology

3.1 Data and empirical model

In this chapter, the study area and sampling procedures will be discussed briefly. A short overview of the data and empirical models estimated will also be given.

3.1.1 Study site and data collection procedure

The study was carried out in Kibera slum in Nairobi, Kenya. Kibera is a low income, informal settlement in Southwest of Nairobi, Kenya. With an estimated population of one million housed and about 3,000 people per hectare living on municipal residential land, Kibera holds one of the highest population densities in sub-Saharan Africa (Crosso, 2005).

A multi-stage random sampling procedure was employed to identify organic farmers in the study area. During the first phase, the different types of urban agricultural farming in the study area were identified by means of transect walks through the villages in Kibera plus unstructured interviews with key informants. The questionnaire was pre-tested on 10 households in the study area and the information obtained was used to construct the final questionnaire, which was more adapted to local conditions for the second phase of the study. In the second phase the households in the villages were stratified into strata: those practicing organic farming and non-organic farming households.

In total, 95 households (obtained using a probability multi-stage sampling procedure) in the study area were surveyed using a structured and face-to-face interviews; 80 of which were considered valid for further analysis of the impact of the intervention.The survey instrument was designed to collect data on participation on organic farming, share of income from organic farming and limitations for those who are not involved in organic farming.

The questionnaire survey was carried out by the author and two contact persons* who were familiar with the study area. As a first step, the survey team walked through the farms and talked to the farmers who were present. Most of the farmers were mostly present in the morning and evening when they were not busy in other jobs. Once all suitable farmers were identified, the survey team went to their farms to interview them. These farmers were the main source of information and this method made it possible to obtain representative data from a limited sample.

*The contact persons were compensated for their time and energy

The questions* were divided into four categories namely household characteristics, farm characteristics, economic factors and institutional factors. Data were collected by the author who was fluent in some local languages and this facilitated communication.

3.1.2 Data description

The questionnaire survey contained both general and more specific questions concerning participation and income from organic farming. The farmers were asked to mention whether they participated in organic or conventional farming. A brief explanation of the differences between organic and conventional farming was given for those who were not conversant with the two types of farming. Information on different income sources was obtained by asking respondents to mention their income sources and also estimate in share the contribution of each income source to their total income. Through this, one was able to derive the share of income* from farming from the different income sources. Demographic and education data were collected for each farming households. Data on farm characteristics (plot size, access to organic fertilizers) were also covered. The respondents were asked to state whether they perceived organic farming to be risky (the share of crop that they lose during the season). They were asked to rate the level of yield risk in a five point scale ranging from (a)being highly risky (b) risky (c) partially risky (d) not risky (e) not risky at all.

Data on economic and institutional factors such as access to credit, access to extension services, membership to farmer groups and transport cost to the market were collected. The respondents were also asked to estimate the share that they sold or consumed from their production in the previous season. The final institutional dimension -help from NGOs- was based on whether the respondents received any visit or got any training on organic farming from the NGOs. Information on whether it was safe (no theft of crops, reduced damage by other people) to grow crops in the study area was also covered. The respondents were asked to rate, on a five point scale ranging from whether they strongly agree that it was safe to grow crops to strongly disagree. The respondents were also asked to mention the major reasons why others did not participate in organic farming. They were also asked to mention the factors that inhibited increased participation of organic farming in the study area.

*The questions were administered to both organic and non-organic farmers

*Share of income from farming is the real income from farming. It constitutes the income that farming adds to total income.

Table 1 summarizes the pooled sample characteristics of the variables. The average contribution of income from farming was 53% to the total household income. Most households in the sample were male headed (54%) who operated the farms. Eighty five per cent of the households participated in organic farming.

Table 1: Summary of variables (N=80)

Variable	Mean	Standard deviation	Min	Max
Income from farming (%)	52.78	36.57	0	100
Gender (1=male)	0 .54	0.50	0	1
Age	34.01	13.38	15	77
Participation in farming (1=Organic)	0.85	0.36	0	1
Education (Yes=1)	0 .55	0.50	0	1
Years in organic farming	7.08	8.26	0	50
Household size	5.96	3.16	1	16
Household labour	4.15	2.78	1	12
Others organic farming (Yes=1)	0.9	0.30	0	1
Size of plot (m^2)	197.78	302.37	0	1000
Access to organic fertilizer (Yes=1)	0.71	0.46	0	1
Organic risky (Yes=1)	0.41	0.50	0	1
Sale (%)	57.31	24.80	0	100
Consumption (%)	40.31	25.22	0	100
Transport cost (Ksh)	24.5	41.24	0	150
NGO help (Yes=1)	0.28	0.45	0	1
Training NGO (Yes=1)	0.26	0.44	0	1
Access to Extension service (Yes=1)	0.29	0.46	0	1
Visit from extension officers	2.11	6.09	0	40
Access to credit (Yes=1)	0.1	0.30	0	1
Member of farmer group (Yes=1)	0.29	0.46	0	1
Safe to grow crops	3.08	1.35	1	5
Effort to secure crops	0.8	0.40	0	1

On average the household age was found to be 34 years old. More than half of the households had more than primary education (55%). The average years of experience in organic farming are 7 years. The average household size was six members and the average number of household labour was 4. Ninety percent of the household mentioned that they knew other people who were involved in organic farming.

The size of plot used for organic farming averaged 198m^2 per household. Seventy per cent of the households agreed that they got access to organic fertilizer and 41% of the household mentioned that organic farming was perceived to be a risky farming activity. Most households both sold their produce (57%) and consumed it (40%). Transport cost to the market averaged 25 Kenyan Shillings (USD 0.28). Twenty eight per cent of the household got help from NGOs in the form of fertilizers, seeds while 26% got help from NGOs in the form of training. On average, a household received two visits from extension officers in the last one year. Ten per cent of the households got access to credit facilities and 29% were members of farmer groups. On a point scale basis, most of the households mentioned that neither the slum area was secure for organic farming while 80% made some efforts to secure their crops.

3.2 Empirical models

To determine the combinations of variables that best predicted household participation in organic farming, a Stepwise Logistic Regression analysis was performed (Hair et al. 2006). Logit[1] analysis is a well-established approach in the literature on how farmers decide to adopt a certain practice (e.g. Feder et al., 1985). Ordinary Least square was used to analyse factors influencing the share of income from organic among sample farm households. Checking for multicollinearity of the variables was performed by use of the correlation matrix (see table I.1).

3.2.1 Logit Model

In making the decision whether or not to participate in a given farming activity, it may be assumed that the farmer weighs the marginal advantages and disadvantages of participation.

[1] Probit and logit regression models are used when the dependent variable is a binary variable and are known to yield similar results. The Logistic approach is used in this paper.

The parameters of this decision are not usually observable but we can define a latent variable, y*,which is an unobservable index of the willingness of each farmer to participate in organic farming practices, and which can be related to a set of explanatory variables X as follows:

$$y^*_t = \beta' X_i + u_i \qquad i = 1, \ldots, N \tag{1}$$

The observed pattern of participation can then be described by a dummy variable, y, such that yi = 1 if farmer i has participated in organic farming, yi = 0 if participated in conventional farming. These observed values of y are related to y* as shown below:

$y_i = 1$. if $y_i^* > 0$ for those who participate in organic farming

$y_i = 0$. for those who participate in conventional farming (2)

and

$$\Pr(y_i = 1) = \Pr(y_i^* > 0) = \Pr(u_i > -\beta' X_i) = 1 - F(-\beta' X_i) \tag{3}$$

where F is the cumulative distribution function for u. If a symmetric distribution is assumed,

$$\Pr(u_i > -\beta' X_i) = \Pr(u_i < \beta' X_i) = F(\beta' X_i) \tag{4}$$

For n independent observations and assuming a symmetric distribution for u, a likelihood function can be specified. Using maximum likelihood procedures, estimates of the β parameters can then be obtained. Assumptions about the functional form of F result in different models and here we focus on the logit model which is based on the logistic distribution,

$$P_i = \Pr(yi = 1) = \frac{1}{1+e^{-z_i}} \tag{5}$$

The figures of the logit model are presented in table I.4.

Definition of variables in the logit model

The dependent variable (Z_i) was specified to indicate which kind of farming the household took part in. The logit model was specified as:

$$Z_i = \beta_0 + \beta_1 Gen + \beta_2 Age + \beta_3 Edu + \beta_4 YrsOrg + \beta_5 Hlab + \beta_6 OthrOrgn + \beta_7 AccOrgnFrt + \beta_8 Plotsorg + \beta_9 Yloss + \beta_{10} VisitExtn + \beta_{11} TrainNGOs + \beta_{12} Accrdt + \beta_{13} Farmgp + \beta_{14} SafegrowCps + \varepsilon_i \quad (6)$$

The two categories of farming included actual organic farming and conventional farming (1=organic farming; 0=conventional farming).

The explanatory variables were as follows:

- Gen=Gender of the farmer (1=Male; 0=female)
- Age= Age of the farming household
- Educ= Education level of the farmer (1=More than primary education; 0=less than primary)
- YrsOrg= Years in organic farming
- HLab=Size of household labour (numbers)
- OtherOrganic= Non-family households are involved in organic farming (1=Yes; 0=No)
- AccOrgnFert=Access to organic fertilizer (1=Yes;0=No)
- Plotsorg=Size of the plot ($m^{2)}$
- Yloss= Share of yield loss from production (%)
- VisitExtn= Extension services in a year (Number of visits in the previous year)
- trainingNGOs=Farming household received any training from NGOs (1 = yes; 0= no)
- Acccrdt=access to credit (Dummy for credit access in the last one years (1 = yes; 0= no)
- Farmgp=Member of farmer group (Dummy for farmer group in the last one years (1 = yes; 0= no).
- SafeGrowCps=Slum area is a safe place for organic farming.

The explanatory variables can be further described as follows:

- Gender of household head is a factor that indicates the sex of the household head who is the implicit key decision–maker for the household to participate in organic farming. In the model, this variable is a dummy (1 = male; 0 = female).
- Age of the farming household (AGE): It is defined as the number of years of the respondent

household since birth until the survey was conducted. It is a continuous variable measured by years.

- Level of education may affect investment decisions in many ways. Early adopters of innovations are more educated and are likely to venture in more profitable activities. Education level of the farmer in the model is a dummy (1=More than primary education; 0=less than primary education).
- Years in organic farming (numbers). Farmers with more experience will have better skills that enable them to make more effective decisions. Number of years of experience in farming might also have a positive effect on participation in organic farming. However, in this study, experienced farmers do not necessarily participate in organic farming. So either sign can be expected for participation in farming.
- Household labour refers to the total number of people offering labour supply for farming. The household members are the most important source of labour supply for informal urban farming, given that low incomes constrains the hiring of labour. The notion that large families will have greater labour resources and are more likely to invest in organic farming in informal settlements is not always correct. This is brought about by the fact that children go to school and it is usual for large urban informal families to engage on other sources of income.
- Number of organic plots (PlotsOrg) is a factor indicating that multiple plots have several advantages for the farmer. These areas have different ecological qualities which make it possible to widen the range of crops produced.
- Yield loss is the share of total production that is lost. These losses occur mainly during harvesting, storage or transportation.
- Access to organic fertilizer indicates the ability to obtain needed inputs which affects the level and timing of income from farming. This is specified as a dummy variable (1=Yes; 0=No).
- Others organic is a factor that indicates whether the household know any non-family member who is involved in organic farming. The non-family household act as source of information. This variable is a dummy (1=Yes; 0=No).
- The number of visits from extension is a variable which affect farmers' access to information, and hence their perception. It measures the frequency of contacts by the farmer with extension agents. Contact with extension officers also improves farmers' technology understanding and perception of profit potential.
- Training from NGOs is whether the farmers receive any training which can be in the form of inputs use or pest and disease control measures. The NGOs have strong interest in organic farming, because it is about making farming more sustainable and improving the farmer's livelihoods. This

variable is specified as a dummy (1=Yes; 0=No)

- Access to credit is a factor that implies that urban informal households who can get access to credit are less likely to sacrifice their agricultural needs for other expenditures. Credit facilities necessary to purchase inputs and are repaid from sales after harvest. In this model, this variable is a dummy; access to credit in the last one years (1 = Yes; 0= No)
- Membership of farmer group: Being a member of a farmer group may expose individuals to a wide range of ideas and sometimes afford farmers the opportunity to have better access to information, which may either cause them to form a favourable or unfavourable attitude toward organic farming. In this model, this variable is specified as a dummy (1=Yes; 0=No)
- Safe to grow crops is a variable that implies whether the slum area is a safe place for organic farming. The variable is specified on a five point scale ranging from strongly agree to strongly disagree.

Hosmer and Lemeshow's goodness-of-fit test was used to check the goodness-of-fit of the model (table I.5). The test is computed as the Pearson chi-square from the contingency table of observed frequencies and expected frequencies (Hosmer and Lemeshow, 1997). Finding a p-value <0.05 means that we would reject that the model is fitting well.

Hosmer and Lemeshow, (1989) further noted that the interpretation of any fitted model requires being able to draw practical conclusions from the coefficients estimated in the model. However, in the logit models, these coefficients do not have a straightforward interpretation, so instead of coefficient estimates, table 2 also gives the estimated marginal effect of variable X_i on choice of whether to participate or not in organic farming. Then the induced change in probability is specified as:

$$\frac{\partial E(Y/X_i)}{dx} = \frac{1}{1+e^{-z_i 1}} - \frac{1}{1+e^{-z_i 0}} \qquad (7)$$

The interpretation of the marginal effect is the impact of a unit change of the variable X_i on the choice of practicing organic agriculture. These figures and results of logit and marginal effect are reported in chapter 4 (see table 2).

3.3.2 Model of income determination

The descriptive statistics presented in section 3.1.2 provide an initial indication that participation in organic farming in urban informal settlements in Kibera, Kenya appears to increase the share of income from farming (table 1). However, such descriptive statistics do not take account of other possible differences in the characteristics of households participating in organic agriculture and those which are not, and it may be these differences that are giving rise to the disparities in income rather than their participation in organic farming.

To account for this, a simple model was constructed for the determination of the share of income from farming. We first explore the simple correlation between share of income farming, household characteristics, farm characteristics, economic factors and institutional factors using a correlation matrix (table I.1). This was to check for multicollinearity between variables. The independent variables with a high degree of correlation with the dependent variable and a low degree of correlation with each other were included in the model. The Variance Inflation Factor (VIF) was also used to examine the degree of association among independent variables.

The relationship between the independent variables and the share of income from farming using a simple OLS model was specified as:

$$Y_i = \beta_0 + +\beta_1 Gen + \beta_2 Age + \beta_3 Edu + \beta_4 Farming + \beta_5 HLab + \beta_6 PltsNos + \beta_7 Sizeplt + \beta_8 AccOrgnFert + \beta_9 sale + \beta_{10} Transpt + \beta_{11} VisitNgos + \beta_{12} Securecps + +\varepsilon_i \quad (8)$$

where Y_i refers to share of income from farming of household i , and i = 1, …., 80. *Gen* is a dummy variable indicating the gender of the farming household; Age is a variable indicating number of years of organic farmers; *Educ* is a dummy variable indicating the educational level attained by the household head; *Farming* is a dummy variable indicating which type of farming one is participating in (1=organic farming; 0=conventional farming); *Hlab* is a variable indicating the total number of people offering labour supply for farming.; *PltsNos* is number of plots an individual household used for farming. *Sizeplt* is a vector indicating size of the plot in m^2 . *Accorgncfert* is a dummy variable indicating whether a household got access to organic fertilizer and *Sale* is a variable indicating portion of sale from produce (% share of yield). *Transpt* is a variable indicating how much an individual pays to get access to the

market. *VisitNGOs* is a variable indicating the number of times the NGOs visited the farmers; *SecureCps* is dummy variable indicating whether a household is putting some effort to secure crops and ε_i is an error term.

Ordinary least squares (OLS) was used to estimate the share of income as a function of household characteristics, farm characteristics, economic factors, institutional factors and a dummy variable representing participation in an organic farming system. One of the assumptions in regression analysis is that the errors (u_i), have a common (constant) variance σ^2.If the errors do not have a constant variance, we say they are heteroscedastic (Maddala, 1992). However, the estimated parameters of a regression in which heteroscedasticity is present are consistent, though they are inefficient.

In this study, heteroscedasticity was tested for all variables using robust standard error test (table 3). There was no serious problem of heteroscedasticity in the model. Hence, all the important variables were included in the analysis.

3.3.3 Frequency table

The urban informal cultivators face multiple limitations that prevent them from participating in organic farming. In the survey, respondents were asked to mention the major limitation that inhibited increased participation in organic farming. A frequency table was used to analyse the data on limitations to participation in organic farming. It was used because the data was qualitative and from the frequencies, one can be able to determine the most prevalent limitations. The most important of these factors are presented in table 4. Moreover, table I.8 lists all other limitations that were mentioned during the survey.

The results of the analysis are presented in the next chapter. All statistical analyses were performed using Stata version 10.

4. Results

The emphasis in this chapter will be on the discussion of the results coming from the Logit, regression model and frequency table.

4.1 Logit Model Results

Results of the model are presented in table 2 that also presents some goodness of fit measures. Hosmer and Lemeshow's goodness-of-fit test shows that the predicted frequency and observed frequency matched closely and the p-value is >0.05 indicating that the model fits the data well (see table I.5). The area under the Receiver Operating Characteristic (ROC Curve) was 0.875 and this gave a good indication of the model performance (figure I.1). Heteroscedasticity was tested for all variables using robust standard error test (table 2). Thus considering all goodness of fit measures above, it can be concluded that the model fitted the data well.

Significant factors related to participation in organic farming include *GEN*, gender of the farming household; *YRSORG*, years of organic farming; *AGE*, age of the farming household, Others in organic farming, number of visits from extension officers, *ACCCDT*, access to credit and *FARMGP*, being a member of farmer group (table 2). These significant explanatory variables do not have the same level of impact on participation in organic farming. Therefore, it is important to discuss their effects on individual basis.

Gender of the farming household was significant ($p<0.1$) and had a negative influence on participation in organic farming. This variable is a dummy (1=male; 0=female). This implies that women are more likely to participate in organic farming than men. Men were involved in other income generating activities like construction of houses and so they did not have enough time to engage in organic farming. This is in line with study by Ngome and Foeken (2010) which noted that women in African cities dominate urban organic farming because they continue to bear primary responsibility for household sustenance and wellbeing largely due to traditional or cultural values.

Years of experience in organic farming was significant ($p<0.1$) and had a positive effect on participation in organic farming. A unit increase in years of experience increases the rate of participation in organic farming by 1% among the whole sample respondents. The so-called 'urban informal farmers' who are emerging in the informal area are coming from diverse horizons and they have some form of experience

in organic farming which enables them to participate in it. This implies that they have been practicing organic farming from where they migrated.

Table 2: Determinants of participation in organic farming (Logit model)

Variables	Coefficients	Robust Standard errors	dy/dx[a]
Gender (1=Male)	-1.901*	0.068	-0.111*
Age	-0.085**	0.003	-0.005
Education (1=More than primary)	-1.439	0.065	-0.081
Years in organic farming	0.140**	0.005	0.008*
Household labour	0.151	0.011	0.009
Others in organic farming (Yes=1)	-1.743**	0.043	-0.058
Access to organic fertilizer (Yes=1)	-0.942	0.051	-0.045
Number of organic plots	0.427	0.032	0.024
Share of yield loss	-0.062	0.005	-0.004
Number of visits from Extension	0.102*	0.005	0.006
Training NGO	1.087	0.045	0.051
Access to Credit (Yes=1)	-2.326**	0.282	-0.294
Farmer group (Yes=1)	-2.126**	0.115	-0.193*
Safe to grow crops	0.233	0.020	0.013
Constant	7.303		
Number of respondents	80		
Log likelihood	−20.96		
Likelihood ratio χ^2	14(27.45)**		
Prob > chi2	= 0.0282		
Mc Fadden's R^2	= 0.3801		

*p < .1. * *p < .05. * * *p < .01.

[a] Marginal change in probabilities evaluated at the sample means

Age of the farming household also was significant and had a negative effect on participation in organic farming. Older farmers are more likely to participate in organic farming, which is probably related to longer experience. Yet the negative sign for the variable age implies that beyond a certain age farmers become less innovative and less energetic. The youth will therefore participate in organic farming as they may be more energetic than the old people.

ACCCRDT, access to credit which is a dummy variable (1=Yes; 0=No) was significant ($p<0.1$) and had a negative sign, meaning that those households who get access to credit facilities do not necessarily use it for organic farming. Instead of using it to secure a plot or buy farm inputs like seeds, they rather use it

on other things like paying their children's school fees. The negative sign and significance ($p<0.05$) of FARMGP (member of farmer group) suggests being a member of farmer group does not increase the probability of participating in organic farming. A household may be a member of farmer group but lack the means in the form of capital to go into organic farming. Others in organic farming was significant and had a negative influence on participation in organic farming. This implies that the slum dwellers did not copy their neighbours who were participating in organic farming. This was brought about by lack of knowledge on organic farming practices.

Lastly, visits/training from extension officers was also significant and had a positive influence on participation. This suggests that if farmers were in contact with extension officers and received training on organic farming in the last 1 year, their probability of participation in organic farming increases by 1%.

4.2 OLS results

The set of the econometric results of the OLS is reported in table 3. Based on the correlation results, there is no concern for multicolinearity, given that none of the explanatory variables were strongly correlated with each other (see table I.1). The VIF which was also used to check for multicolinearity indicated that the variables have low VIF values and therefore all were retained for further analysis (table I.2). Heteroscedasticity was tested for all variables using robust standard error test (table 3). There was no serious problem of heteroscedasticity in the model. Hence, all the important variables were included in the analysis.

Regressing each of the explanatory variables on all the rest, R^2 values of 0.60 was obtained indicating that multicollinearity was not severe. Years in organic farming was omitted from the model as it had a highly insignificant value compared to the other independent variables (see table I.5). The adjusted R square of 0.53 demonstrates that 53% of the variation in the share of income from organic farming is explained by the explanatory variables. The F ratio of explanatory variables in the model was statistically significant at 0.001 confidence level. This indicates that the variables included in the model are correct.

In the OLS regression (table 3) several household characteristics, farm characteristics, economic factors and institutional variables were significantly correlated with the share of income from farming. The effect of these significant variables on the dependent variable is discussed below.

Household characteristics

Gender of the farming household was negatively and significantly correlated with the share of income from organic farming ($p<0.01$) as indicated in table 3. This suggests that when the gender of the farming household is male, there would be less income obtained from farming. This is probably because men do not take as good care of their crops like weeding, guarding than women. This influences their output level and thereby reduces their share of income.

Table 3: Output of the OLS model of share of organic income analysis

Dependent variable: Share of farm income	Coefficient.	Robust Standard Error	t	P>t
Gender (1=male)	-23.038***	5.885	-3.91	0.000
Education	-2.257	5.843	-0.39	0.701
Age	0 .098	0.269	0.36	0.718
Farming (1=Organic farming)	50.648***	6.266	8.08	0.000
Household labour	-0.436	1.317	-0.33	0.741
Number of organic plots	-8.320***	2.990	-2.78	0.007
Farm size	0.038***	0.008	4.57	0.000
Access to organic fertilizer	5.159	7.182	0.72	0.475
Sale	0.231**	0.110	2.11	0.039
Transport cost	-0.081	0.077	-1.05	0.297
Visit NGOs	-2.386**	0.951	-2.51	0.015
Efforts to secure crops (1=yes)	6.248	8.192	0.76	0.448
Constant	8.022	14.286	0.56	0.576
R squared	0.60			
Adjusted R square	0.53			

*p < .1. * *p < .05. * * *p < .01.

Farm characteristics

Organic farming activity and size of organic plots were significantly correlated with share of income from farming. They are all associated with high income levels. Participation in organic farming positively influences share of income from farming and significant at 1% significance level (table 3). That is, households who participated in organic farming increased their share of income from farming by 50.65%, ceteris paribus. This is brought about by crops that are produced which are later sold to the community or consumed to reduce food expenditures. As expected, size of organic farms positively influences share of income from farming ($p<0.01$). This implies that households who possess a large

farm will produce more agricultural output thereby increasing their share of income.

Economic control variables

The number of organic plots was negatively and significantly correlated with share of income from organic farming ($p<0.01$). Thus, a unit increase in number of plots decreases the share of income from farming by 8.32%, ceteris paribus. This is because having multiple numbers of plots requires a lot of management practices that are associated with higher cost thereby reducing the share of income from organic farming. Share of sales from production ($P<0.05$) was a significant predictor of the total percentage of income derived from farming. A unit increase in share of sales increases share of income from farming by 0.23%, ceteris paribus. This implies that when a household sells some of its farm produce, the cash obtained from the sale increases its share of income.

Institutional variables

Number of visits/training from NGOs was the institutional variable that was significantly and negatively correlated with share of income ($p<0.05$). This implies that farmers that experienced problems like of pests and diseases got visited, but since they already had the problems, their share of income from farming continues to decline.

4.3 Limitations to participation in organic farming

Some of the limitations mentioned by the farmers are not specific to the urban circumstances and are the same as those which any rural farmer can face (table 4). Ignorance (farming should be done in the village and not in town) was mentioned as the main factor limiting participation in organic farming. The farmers mentioned that some of urban informal dwellers claim that they did not come to the city to engage in farming but rather to engage in other forms of income generating activities. This was mainly due to the perception that farming is a dirty job.

Lack of land for farming was also mentioned as one of the main constraints for participating in organic farming. Most of the land that was available was municipal land. This forced some of the slum dwellers to cultivate their crops near the railway lines or near the roads. Laziness was mentioned by farmers as another major limitation to organic farming. Most of the poor families did not want to work in the farms but only rely on relief food. This also contributed to increased crime rates like stealing of farm produce.
Another general limitation is lack of knowledge/extension services on farming practices. The farmers complained that they did not have sufficient knowledge on organic farming and this was mainly due to

lack of education on agricultural practices. The farmers indicated that, they needed extension advice/training on organic farming and this should be provided by the government.

Table 4: Major limitations to Participation in organic farming

	Frequency	Percent
Ignorance (farming should be done in village)	19	23.75
Lack of land	16	20.00
Laziness (Consume but not work)	15	18.75
Lack of knowledge/extension services	10	12.50
Lack of finance	7	8.75
Dirty job	4	5.00
Insecurity	4	5.00
Busy in other jobs	3	3.75
Water shortage	2	2.50
Total	80	100.00

Lack of finance was one of the main drawbacks to participation in organic farming. This was mainly due to the fact that majority of the farmers in informal areas are poor; many of them have no financial means to purchase inputs needed for farming. This is in line with one of the research by Dennery (1995) which indicated that production of staple crops like maize is expensive in urban informal areas since cash is needed to purchase seed and fertilisers.

Some of the farmers were busy in other jobs and did not have enough time to practice organic farming. Others claim that farming was perceived to be a dirty work which is not supposed to be done in the city. Water shortage was mentioned as the least relevant limitation to participation in organic farming. This is because irrigation was mainly done through the use of sewage water which was often considered beneficial for crop production through sludge of nutrients.

Some other limitations that were mentioned included organic farming being risky and insecurity reasons (see table I.8). Some of the crops were stolen and it was costly to employ guards to watch over the farms. Organic farming was also viewed to be risky in terms of use of sewage water for irrigation purposes. This poses as a health hazard to the farmers. Eviction or destruction of crops by the local

authorities was not mentioned as a major limitation. The farmers made sure that they produced healthy crops to prevent the city council employees from destroying them. False promises from NGOs to provide inputs in the form of sacks and organic fertilizers for growing crops were also mentioned as some of the constraints. This shuttered the farmers' hopes of increasing their production level. The farmers also experienced flooding or at times insufficient rainfall in the growing season. Flooding and/or waterlogging was a problem commonly encountered by those who have plots along rivers and this hindered production.

5. Discussion and conclusions

This section discusses the main conclusions and gives a critical reflection on the research and some recommendations.

5.1 Discussion

This study demonstrated the importance of organic farming in informal settlements as Kibera slum. The people living in this area are particularly vulnerable to soaring food prices due to the economic crisis of the past decades in most Sub-Saharan African countries. This has caused a strong growth in the importance of organic farming which contributes to human sustainable development. Produce from the farms is used directly and indirectly by the household as food, to access cash when needed and to educate children. Due to this, the urban informal organic farmers respond to opportunities, such as available land, income enhancement potential and supportive local environment in order to achieve their goal of food production.

The analysis indicated that organic farming was being carried by women while men took part in other forms of income generating activities. The farmers' years of experience in organic farming also predisposes them towards participation in organic farming. They have better skills that enable them to come up with more innovative ideas on organic farming. Access to credit services may also offer the informal farmers with initial capital that they can use to secure land and increase their participation in organic farming. This is not the case in this study because the farmers used the credit facilities for other activities than farming. Being a member of a farmer group does not necessarily influence the participation in organic farming. This is because most of the training activities that are organized by the farmer groups and/or with other organizations for the farmers groups are all focused on conventional farming to the neglect of organic farming. Most often too, these farmer groups are provided with inputs such as inorganic fertilizers and pesticides by NGOs and this goes to encourage them rather to go into conventional farming.

The current study showed that the contribution of participation in organic farming to share of income from farming was generally modest. The organic farmers' earned more than the non-organic farmers even when growing the same crops. The higher share of income was due to the share of sales from total production and the size of the farms. Besides income, there is improved food security which is achieved from food crops that they produce. Variables that change over time but are identical for all households

within a year, like prices, that influence share of income could not be included in the model because we have a cross-section (data for one year).

Despite the fact that organic farming in informal settlements has the proven capacity to contribute to income generation, it faces a large number of constraints that limit the achievement of this goal. Ignorance, lack of land and laziness were the main constraints that affected increased participation in organic farming in the study area. These constraints existed because of poor perception of organic farming and over-population in urban informal areas. Other limitations include insecurity reasons and false promises from NGOs that leave the slum dwellers with no hope of participating in organic farming as they lacked the knowledge and finance to start farming activities.

5.2 Conclusion and recommendations

Based on the findings of the study, the following recommendations are forwarded.

- The finding of this study revealed that, participation in organic farming in Kibera can improve the share of income from farming. The government of Kenya has not yet recognized the role of organic farming in informal areas through its policies and could increase efforts to promote the sector.

- Training from NGOs increases participation in organic farming in informal areas. The NGOs may see organic farming as serving economic goals, such as provision of food and employment for the disadvantaged. Partnership with different stakeholders may help to achieve this goal.

- Women should be encouraged to participate more in organic farming. This is because the finding shows that when women participate in organic farming, the share of income from organic farming increases.

- To ensure that the findings of the study reflect the state of organic farming in informal areas in Kenya, more than one informal area must be studied in order to come to conclusions that can be more representative for the entire informal areas in Kenya.

References

Abdulai, A. and Huffman W.E., 2005. The diffusion of new agricultural technologies: the case of crossbred-cow technology in Tanzania. Am. J. Agric. Econ. 87: 645-659.

Argilés i Bosch, J.M., 2007. Empirical study on costs and incomes of organic farming. Facultat de Ciències Econòmiques i Empresarials, Universitat de Barcelona.

Crosso, C., 2005. Youth information networks in Kibera, Nairobi, Kenya 2.Duke University.

Dennery, P., 1995. "Inside urban agriculture": an exploration of food producer decision making in a Nairobi low income area. Wageningen: Agricultural University (MSc thesis).

Drakakis-Smith D., 1993. ``Food security and food policy for the urban poor'', in Land, Food and Basic Needs in Developing Countries Eds J Dahl, D Drakakis-Smith, A Narman, Department of Human and Economic Geography, University of Gothenburg, Gothenburg, pp 197 – 212.

Ellis, F., 1988. Peasant economics : farm households and agrarian development. Cambridge Univ. Pr., Cambridge u.a.

FAO, 1999. Organic Agriculture. Food and Agriculture Organization of the United Nations, Rome.

Feder, G., Just, R and Zilberman, D., 1985. Adoption of Agricultural Innovations in Developing Countries: A Survey, Economic Development and Cultural Change, vol 33: 255-298.

Foeken, D., 2006. "To subsidise my income": urban farming in an East-African town. Brill.

Foeken, D., 2005. Urban agriculture in East Africa as a tool for poverty reduction: a legal and policy dilemma? African Studies Centre, Leiden, The Netherlands.

Foeken, D., Mwangi, A.M., 1998. Farming in the City of Nairobi. African Studies Centre, Leiden, The Netherlands.

Franzel, S., 1999. Socioeconomic factors affecting the adoption potential of improved tree fallows in Africa. Agrofor. Syst. 47: 305-321.

Freeman, D. B., 1991. "A City of Farmers": informal Urban Agriculture in the Open Spaces of Nairobi, Kenya. McGill-Queen's University Press, Montreal.

Gathuru, P.K., 1993. Women in sustainble urban improvement:Urban farming in Informal sector of Nairobi.

Gough, K. V. and Kellett, P., 2001. "Housing consolidation and home-based income generation", *Cities*, vol 18, no 4:235–247.

Gould, B.W., Saupe W.E., Klemme R.M., 1989. Conservation tillage: therole of farm and operator characteristics and the perception of erosion. Land Econ. 65: 167-182.

Gulyani, S., Talukdar, D., 2010. Inside Informality: The Links Between Poverty, Microenterprises, and Living Conditions in Nairobi's Slums. World Development 38, 1710-1726.

Hair, J.F. jr., Black, W.C., Babin, B.J., Anderson, R., and Tatham, R., 2006. Multivariate Data Analysis, 6th edition. Upper Saddle River, New Jersey, Pearson Prentice Hall, USA.

Heckman, J., 1979. "Sample Selection Bias as a Specification Error." Econometrica 47(1): 153-161.

Hope, K.R., 2004. The poverty dilemma in Africa: toward policies for including the poor. Progress in Development Studies 4: 127-141.

Hosmer, D. W., Hosmer, T., Le Cessie, S., and Lemeshow, S., 1997. A comparison of goodness-of-fit tests for the logistic regression model. Statistics in Medicine 16: 965–980.

Hosmer, D.W., and Lemeshow, S., 1989. Applied logistic regression. New York: JohnWiley & Sons.

Hovorka, A. J., 1998. Gender Resources for Urban Agriculture Research: Methodology, Directory and Annotated Bibliography Cities Feeding People Series Report No. 26, International Development Research Centre, Ottawa.

Maddala, G.S., 1992. Introduction to Econometrics. Second Edition. Macmillan Publishing Company, New York.

Madden, J. P., and Chaplowe, S. G., 1997. For All Generations: Making World Agriculture More Sustainable. Glendale: OM Publishing.

Martin, A., Oudwater N. and Meadows, K., 2000. Urban Agriculture and the Livelihoods of the Poor in Southern Africa: Case Studies from Cape Town and Pretoria, South Africa and Harare, South Africa. Natural Resource Institute, Chatham. 45 pp.

Maxwell, D., 2000. The Importance of Urban Agriculture to Food Security and Nutrition. Nairobi: CARE-East Africa Regional Management Unit: 23-25.

Maxwell, D., 1999. Urban food security in sub-Saharan Africa. In: Koc M, MacRaeR, Mougeot LJA & Welsh J (eds), For hunger-proof cities: sustainable urban food systems (Ottawa: IDRC): 26-29.

Memon, P.A. and Lee-Smith, D., 1993. "Urban Agriculture in Kenya." Canadian Journal of African Studies 27(1): 25-42.

Mireri, C., 2002. "Private Investment in Urban Agriculture in Nairobi", Urban Agriculture Magazine, No. 7, www.ruaf.org

Mougeot L., 2000. Urban Agriculture: Definition, Presence, Potentials and Risks and Policy Challenges. IDRC Cities Feeding People Series. Report 31.

Mwangi, A. M., 1995. The role of urban agriculture for food security in low income areas in Nairobi. Nairobi; Leiden [Netherlands], Ministry of Planning and National Development; African Studies

Centre.

Napier, T.L., and Forster, D. L. , 1982. Farmer attitude and behavior associated with soil erosion control. In H. G. Halcrow, E. O. Heady, and M. L. Cotner (eds.), Soil conservation policies, institutions and incentives.

Ngome, I. and Foeken, D., 2010. “My garden is a great help”: gender and urban gardening in Buea, Cameroon." GeoJournal: 1-16.

Nkamleu, G.B., 2007. Modeling farmers’ decisions on integrated soil nutrient management in sub-Saharan Africa: A multinomial Logit analysis in Cameroon. In: Bationo, A., Waswa, B., Kihara, J., Kimetu, J. (Eds.), Advances in Integrated Soil Fertility Management in sub-Saharan Africa: Challenges and Opportunities. Springer Netherlands, pp. 891-904.

Nugent, R., 1999. The impact of urban Agriculture on the household and Local Economies. Thematic Paper 3.

Obosu-Mensah, K., 1999. "Food Production in Urban Areas: a study of urban agriculture in Accra, Ghana. Aldershot: Ashgate".

Oiro, M.W., Mwabu, G.M. and Manda, D.K., 2004. Poverty and employment in Kenya. Kenya Institute for Public Policy Research and Analysis, Nairobi, Kenya.

Oxfam, G., 2008. Oxfam response to Urban Food Crisis:situation analysis and strategy options. Unpublished.

Pascal et al., 2009. A Garden in a Sack: Experiences in Kibera, Nairobi. Urban Agriculture magazine.

Rogers, E.M., 1995. Diffusion of Innovations. 4th Edition. Free Press, New York.

Rogerson, C.M., 1996. Urban poverty and the informal economy in South Africa’s economic heartland. Environment and Urbanisation 8 (1): 167-179.

Sadoulet, E., Janvry, A.D., 1995. Quantitative development policy analysis. John Hopkins University Press, Baltimore, Md.

Van Veenhuizen, R., 2006. Cities Farming for the Future. Urban Agriculture for Green and Productive Cities. RUAF Foundation, IDRC: Ottawa.

APPENDICES

Appendix I: Descriptive statistics and data

Table I.1: Correlation Matrix

	Gen	Age	Farming	IncomeOrgani	Educ	YrsOrg	Hlab	OtherIncom	PlotsOrg	SizeOrg	AccOrganic	Traveltime	Organicmkt	Sale%	Consume%	%Loss(%)	Timefrommark	Transport(Ks	Training(NG	AcceExten	VisitExten	VisitNGOs	AccCrdt	Farmgrp	Securecrops
Gen	1																								
Age	-0.24611	1																							
Farming	-0.24925	-0.00751	1																						
Incomeorgani	-0.37581	0.047339	0.604662	1																					
Educ	-0.08815	0.068129	-0.16888	-0.14122	1																				
YrsOrg	-0.0676	0.609012	0.093525	0.172655	-0.05421	1																			
Hlab	-0.14857	0.530173	0.073688	0.08405	-0.06936	0.322629	1																		
OtherIncom	-0.0585	0.047339	-0.02394	0.023485	-0.13401	0.160509	-0.04231	1																	
PlotsOrg	-0.20901	0.200788	0.256868	0.129193	-0.03643	0.138012	0.051499	0.120824	1																
SizeOrg	0.026506	0.110676	0.112134	0.348993	-0.0404	0.277956	-0.00551	0.156864	0.349325	1															
AccOrganic	0.166258	-0.26749	-0.03481	-0.05075	-0.12598	0.039643	0.044534	-0.02762	-0.30367	-0.19727	1														
Traveltime	-0.04494	-0.12087	0.087392	0.05646	-0.08871	-0.06184	0.017365	0.030072	-0.05487	-0.17688	0.209365	1													
Organicmkt	0.013368	0.190238	-0.07467	-0.02416	-0.00766	0.233369	-0.01717	0.02592	0.246504	0.15448	-0.15706	0.167265	1												
Sale%	0.173495	-0.18628	-0.0316	0.109882	-0.19548	0.126026	-0.0143	0.039726	0.008865	0.179071	-0.00203	0.052261	-0.08457	1											
Consume%	-0.20947	0.147795	0.08909	-0.08112	0.151607	-0.1268	-0.01057	-0.0416	0.029581	-0.17836	0.029953	-0.03948	0.056287	-0.97739	1										
%Loss(%)	0.155465	0.167194	-0.27402	-0.12703	0.131934	0.056154	0.155748	-0.36504	-0.13389	0.000811	-0.13238	-0.06095	0.175407	-0.02766	-0.18429	1									
Timefrom	0.007747	-0.19074	0.013568	0.00877	-0.07279	0.019735	0.000882	-0.0618	-0.08671	-0.03724	0.256174	0.09738	-0.06728	0.133962	-0.10345	0.005707	1								
Transport(Ks	0.1202	-0.07031	-0.06492	-0.10379	-0.12752	0.133617	0.106863	0.057396	-0.10981	0.015388	0.15061	-0.00046	-0.06561	0.124265	-0.13135	0.097306	0.64089	1							
Training(N	-0.07336	-0.02835	-0.05763	-0.12496	0.197013	-0.13682	-0.04276	-0.08528	-0.1476	-0.13342	0.000354	-0.02604	-0.09823	-0.1306	0.068231	0.125308	-0.15584	-0.0868	1						
AcceExten	0.095513	-0.15127	-0.11989	-0.18195	-0.05688	-0.12726	-0.17479	0.027618	-0.20125	-0.10028	-0.00345	0.006717	-0.08845	0.041251	-0.07489	0.15823	-0.09584	-0.08696	0.162577	1					
VisitExten	0.01311	0.025796	-0.00576	-0.08883	-0.15767	-0.09682	-0.17118	0.01996	-0.04171	-0.01705	-0.00315	-0.05361	0.190143	-0.15779	0.169827	-0.06576	-0.02599	-0.02978	0.261581	0.31336	1				
VisitNGOs	0.056094	0.08715	-0.11784	-0.20524	0.130579	-0.09674	0.006107	-0.10095	-0.12834	-0.10899	-0.10755	0.060202	0.098971	0.007925	-0.05987	0.146712	-0.06265	-0.108	0.753327	0.486877	0.241179	1			
AccCrdt	0.058498	0.05611	-0.32673	-0.22413	0.124005	0.017157	-0.04866	-0.00278	-0.17117	-0.17517	0.11958	-0.05613	-0.02569	-0.01437	-0.10208	0.115037	0.111526	0.126895	0.179927	0.116504	0.269396	0.156011	1		
Farmgrp	-0.03606	0.094453	-0.10847	-0.00141	-0.31365	0.023471	0.10789	0.086066	0.08939	0.054717	0.035655	-0.11893	0.190128	0.011121	-0.04066	0.140012	-0.12368	-0.13695	0.183583	0.078441	0.164904	0.154312	0.086066	1	
Securecrops	-0.06975	-0.0395	0.227546	0.159568	0.080252	0.027563	-0.16547	-0.0625	0.105721	0.024986	-0.04145	-0.00736	0.100567	-0.14337	0.114867	0.095925	-0.04921	-0.15097	0.227276	0.17952	0.100311	0.153451	-0.04367	0.128099	1

*The positive signs indicate that there is positive correlation between the two variables whereas negative signs indicate that there is a negative correlation between the two variables.

Table I.2: Variance Inflation Factor

N=80

Variable	Variance Inflation Factor (VIF)
Access to Extension servives (1=yes)	1.52
Number of visits from NGOs	1.49
Number of organic plots	1.37
Size of organic plots ($m^{2)}$	1.32
Access to organic fertilizers(1=yes)	1.31
Organic farming	1.24
Gender (1=Male)	1.22
Effort to secure crops (1=yes)	1.21
Education(1=More than primary)	1.18
Sale	1.17
Household labour	1.13
Transport cost	1.13
Mean VIF	1.27

Source: Computed from the field survey data, 2011

Table I.3: Logistic regression

Parameters estimated by the logit model (n=80)

Farming	Coefficient	Standard error	z	P>|z|
Gender (1=male)	-1.901*	1.182	-1.61	0.108
Age	-.0854**	0.062	-1.39	0.026
Education (1=Yes)	-1.439	1.060	-1.36	0.175
Years in organic farming	0.140**	0.091	1.54	0.013
Household labour	0.151	0.195	0.77	0.440
Others organic	-1.743	2.050	-0.85	0.395
Number of organic plots	0.427**	0.523	0.82	0.037
Access to organic fertilizers	-0.942	1.120	-0.79	0.428
Yield loss	-0.062	0.087	-0.71	0.475
Training NGOs (1=yes)	1.087	1.088	1.00	0.318
Visit from extension officers	0.102*	0.080	1.27	0.102
Access to credit	-2.327**	1.394	-1.67	0.045
Farmer group (1=yes)	-2.127**	1.007	-2.11	0.035
Safe to grow crops	0.233	0.331	0.71	0.480
Constant	7.303	3.879	1.88	0.060

Number of obs	= 80
LR chi2(14)	= 25.71
Prob > chi2	=0.0282
Log likelihood	= -20.963013
Pseudo R2	=0.3801

*p < .1. * *p < .05. * * *p < .01.

Table I.4: Logistic model for farming, goodness-of-fit test

Table collapsed on quantiles of estimated probabilities (n=80)

Group	Probability	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.5927	1*	2.1*	7	5.9	8
2	0.7843	6*	5.5*	2	2.5	8
3	0.8764	7	6.6	1	1.4	8
4	0.9184	8	7.2	0	0.8	8
5	0.9364	7	7.4	1	0.6	8
6	0.9605	8	7.6	0	0.4	8
7	0.9789	8	7.8	0	0.2	8
8	0.9863	8	7.9	0	0.1	8
9	0.9939	7	7.9	1	0.1	8
10	0.9995	8	8.0	0	0.0	8

Number of groups = 10
Hosmer-Lemeshow chi2(8) = 14.85
Prob > chi2 = 0.0620

*Hosmer goodness of fit test shows that the predicted frequency and observed frequency match closely and the p-value is >0.05. This test indicates that the logit model fits the data well.

Table I.5: All variables in the OLS regression

Output of the OLS model of share of organic income analysis

Income organic	Coefficients	Robust Standard Error	t	P>|t|
Gender (1=male)	-23.039***	6.378	-3.61	0.001
Age	0.103	0.375	0.28	0.784
Education	-2.250	6.160	-0.37	0.716
Years in organic farming	-0.012	0.530	-0.02	0.982
Farming	50.670***	8.978	5.64	0.000
Household labour	-0.439	1.289	-0.34	0.735
Number of organic plots	-8.315**	3.957	-2.10	0.039
Size of organic farms	0.037***	0.011	3.40	0.001
Access to organic fertilizers	5.222	7.998	0.65	0.516
Sale	0.232*	0.132	1.75	0.084
Transport cost	-0.080	0.075	-1.07	0.287
Number of visits from NGOs	-2.389**	1.095	-2.18	0.033
Efforts to secure crops	6.271	7.847	0.80	0.427
Constant |	7.767	22.714	0.34	0.733
Prob > F = 0.0000 R-squared = 0.60 Adj R-squared = 0.52				

*p < .1. * *p < .05. * * *p < .01.

Table I.6: Other limitations of participation in organic farming

Natural Problems:

Pests and diseases
Flooding
Poor soil
Destruction by animals
Long distance to the farms

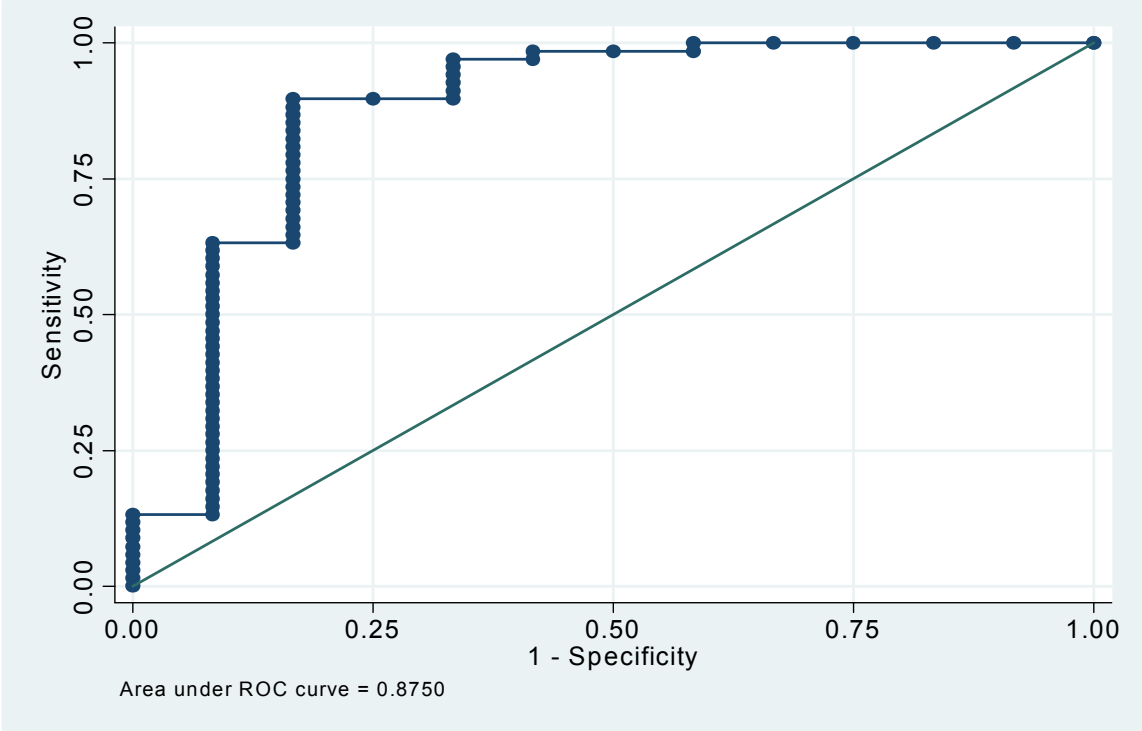
Urban problems:

Lack of good returns (output) from organic farming
False promises from NGOs
Eviction from their plots by city council
Land grabbing
Tiresome (needs a lot of energy)
Waste of time (staying on farm the whole day while can do other jobs)

Table I.7: NGOs involved in the organic agricultural sector in Kibera slum in 2011.

Name of NGO	Activity or role
Solidarite International (French non-governmental organization). http://www.solidarites.org/ourprog/Kenya/humanitarian-action.shtml	Implementing Food Security program in the Nairobi slums and also in other countries. Two major objectives: -To increase access to food using the garden in a sack concept. -To increase the income available for household through the sale of vegetables from the garden in a sack.
Green Dream-Food Network on Organic Farming. http://greendreams.edublogs.org/	Advocates for organic farming in Kenya. Offers training on organic farming to reformed criminals in Kibera slum and is the founder of the Kibera Youth Reform Organic Garden, where they transformed a garbage site into a farm. The farm now feeds 30 families and the farmers also earn income.
The Foundation for Sustainable Development in Africa http://www.cityfarmer.org/NairobiCompost.html	Training and equipping local communities (especially youth and women) with skills in sustainable resource management.
Italian organization Cooperazione Internazionale (COOPI) http://www.foodfirst.org/en/node/2844	COOPI brings in rural agriculturists to teach community groups how to create vegetable farms in the slums. COOPI provides each participating household in the project with one sack containing soil mix and 43 seedlings to cultivate.
Undugu Society of Kenya (Local NGO) http://www.cityfarmer.org/NairobiCompost.html	Provide training to farmer groups in Kibera on compost use on their own farms in addition to its main objective of rehabilitating street children. Sell their ready to use compost on site to farmers at affordable price.
Urban Harvest Kenya http://www.voanews.com/english/news/africa/pan/Innovative-Kenyan-City-Farmers	Enhance urban agriculture potential and food security, supports community farms and projects in Kenya. These help women improve their income and create networks of information and skills. Helps over 1000 farmers in Kibera to grow crops in small spaces by filling tall sacks with soil and poking holes on different levels to plant seeds.

Figure 2: Area under ROC curve after logistic analysis



Appendix II: Survey questionnaire

ANALYSIS OF INCOME EFFECTS OF ORGANIC FARMING TO URBAN INFORMAL SETTLEMENT HOUSEHOLD: A CASE STUDY OF KIBERA SLUM IN NAIROBI KENYA

Gender: …….

Age: …….

Location: ……..

1. Do you participate presently in organic farming? (1=organic farming; 0=conventional farming)

2. a. What are your most important sources of income?
   –
   –
   –
   b. What is the contribution of these different sources to your total income? (%)
   –
   –
   –
   c. How much income do you derive from organic farming? (%)

3. What is your education level? (1=More than primary education;0=less than primary education)

4. a. How many years have you been into farming in general? (Years)
   b. How many years have you been into organic farming? (Years)

5. a. What is the size of your household (numbers)
   b. How many children younger than 12 or people older than 70 are in your family? (Numbers)

6. a. Do you know any (other) people engaged in organic farming?(YES/NO)
   b. How many? (Number)

7. a. How many plots does the family have? (Number)
   b. What are their sizes? (m^2)
   c. How many plots do you use for organic farming? (Number)
   d. For each plot what is the size? (m^2)

8. a. Do you have access to chemical inputs e.g. chemical fertilizers, pesticides in the last 1 year? YES?NO
   b. If YES do you use them? YES/NO

9. a. Do you have access to organic fertilizers? YES/NO
   b. If YES do you use them? YES/NO

   c. What is the travel time (from the plot(s)) to the dumpsite) or where you get organic fertilizers.
   –
   –
   –

10. a. Do you perceive organic farming to be risky (share of crop that you lose due to diseases) compared to conventional farming?(YES or NO)
    b. What is the level of yield risk that is the share of crop that you lose during the season?

1. Highly risky	2. Risky	3. Partially risky	4. Not Risky	5.Not at all risky

11. a. How much from production in the previous season did you sell in the market? (%)
    b. How much from production did you consume in the previous season? (%)

12. a. How many minutes do you or a household member take to walk to the market?(Minutes/hours)

    b. How much time do you or a household member sit in the market to sell products? (Hours)

13. How much do you pay for transport to the market? (Kshs)

14. a. Do you get any help from a NGO? (1=Yes; 0=No)
    b. What kind of help do you get?
    –
    –
    –
    c. Have you received any training from the NGOs? (YES/NO)

15. a. Do you have access to extension services from public sector in the last one year? (Yes or No)

    b. How many visits from extension officers or training did you receive in the previous one year? (Number of visits in the previous year)

Extension officer(Number of visits)	NGOs (Number of visits)

16. a. Do you have access to credit facilities that helps you in your organic farming? (Yes or No)

b. If YES where do you get credit facilities?

–
–
–
–

17. a. Are you a member of any farmer group?(Yes or No)

b. What kind of benefits do you get from being in the farmer group?

-
-
-
-

18. a. In your view, do you think it is safe (no theft of crops, reduced damage by other people...) to grow crops in this area?

1. Strongly agree	2. Agree	3. Neither	4. Disagree	5. Strongly disagree

b. Do you put in efforts to secure your crops (from theft, damage by other people ...)? (YES/NO)

c. Which kind of effort do you put in place to safeguard your crops (from theft, damage by other people ...)?

–
–
–

19. a. Why do you think others do not participate in organic farming

–
–
–

b. What is the major limitation to increasing the area under organic farming in your plots?

–
–
–

c. What limits increased participation in organic farming in your community or this area?

–
–
–