ECONOMIC ANALYSIS OF URBAN FARMING BY HOUSEHOLDS FROM LOW INCOME AREAS OF NAIROBI, KENYA

BY

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At thesis submitted in fulfillment of the requirement of the Degree of Doctor of Philosophy in Agricultural Economics of the University of Nairobi

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DECLARATION

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

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estimation of the profit and wage share functions was used to test for economic, allocative (price), and technical efficiencies differences between groups of farmers based on these factors.

The average low income urban farming household had seven people and was headed by a 47 year old person with only 5 years of education residing in Nairobi for 27 years and cultivating urban land for 13. About two fifths of the households were women headed. An average of 1.4 decares of land was cultivated usually in one or two land parcels about three quarters walk from the residence. The majority (86%) did not use external inputs such as fertilizer, improved seed or manure. Therefore, family labour and own saved seed of uncertified quality were the main inputs in the activity carried out with the participation of most of the household's members (90%). Labour was hired by 42% of the households. Majority of the households "acquired" cultivation rights because land was seemingly idle and staked as claim on it by ensuring that it was tended to through out the year. Few of them keep livestock (18%) as expected from the congested high-density housing. In over 75% of conjugal households, both spouses made the decision to embark on urban farming. In all households, nearly all members worked on the land parcels. Theft of produce was by far the most serious problem followed by small parcels of land and lack of money for inputs. The type of assistance needed most for the activity was stated as access to land and inputs and supplementary income to subsist on when the produce run out.

A total of Ksh909, 938 profits for the long rains of 1997 was generated by the 89 households in the sample (with 588 people) from a total area of 12.4 hectares (124 decares). This is an average of Ksh10, 224 per household for the season or Ksh1, 705 per month. It is about 74% of the minimum wage per month for a labourer in Nairobi for the survey year, 1997. In other words if UF was done away with, 49% and 31% of the households would loose more than third and

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Finally, I will forever owe a debt of gratitude to my family for their positive perseverance over the years and being there for me, making the challenge bearable.

DEDICATION

I
dedicate this thesis
to
the very pleasant, fond
and
encouraging memories of
my
maternal grandparents,
to
my mother
for her hard work
and
courage over the years,
to my children
Mwangi, Muriithi and Chiru
who
fill my days with pleasant wonder,
and to all
children of their generation who endured
poverty.

ABSTRACT

In Kenya, as in other urban cities in sub-Saharan Africa, urbanization is characterised by increasing number of people who are food insecure, unemployed and poor. They live in unplanned, overcrowded structures in slum areas, which are unrecognised by city planners and lack adequate potable water, sewerage, drainage, garbage collection, roads, schools and health services, and have high crime rate. Poverty and waste management are therefore the two main problems common to most cities of developing countries.

Food insecurity and lack of basic needs prompt some low-income households to embarking on farming using their family labour and minimal capital inputs. They combine them with seemingly idle, vacant, public or private urban land that they do not own to generate food and income. However, the activity is not recognized and city authorities view it as nuisance and a public health risk getting in the way of other urban activities. UA is unique because it can contribute to solving the problems of poverty and waste management. However, for the contribution to be realised, UA by low-income households has to be transformed into an efficient activity that is integrated into the entire economy. The factors constraining the possible transformation and integration are not clear, and facilitating policies and programs are lacking. Therefore the objectives of the study were to characterise urban farming households, determine the profit level and factors influencing it, and compare allocative, technical, and economic efficiency among different socio-economic groups of households.

A random sample of 92 UF households, stratified by gender, was selected in Korogocho, one of the low-income areas in Nairobi, in 1998. Cross tabulation facilitated descriptive analysis, while the profit, function model was used to determine factors explaining variation in profit. Joint

estimation of the profit and wage share functions was used to test for economic, allocative (price), and technical efficiencies differences between groups of farmers based on these factors.

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more than half of their incomes, respectively. For 50% of households, UF profit was higher than other income earned by household head and spouse from sources other than UF. Considering the basic needs per adult equivalent, an average household needed a monthly income of Ksh13, 371 to be above poverty line. The households in the sample were poor because only 4% of the them earned combined income from UF and other activities to be above poverty line. The other households earned only 28% of the average minimum income needed to be above poverty line (Ksh3, 634), underscoring the magnitude of deprivation. UF contributed 14% of the available minimum average income, against 15% from other sources.

Differences in economic, allocative and technical efficiency were analysed for different groups based on the seven variables hypothesized. There were no differences in efficiency between farmers cultivating more than 1.4 decares and those cultivating less. The groups of farmers maximizing profits were those who had cultivated urban land for less than 13 years, earned less than Ksh3099 from other activities, had no access to technical information, and those whose main objective in embarking on the activity was to earn cash income, unlike their counterparts. Conjugal household heads with seven or more years of formal education also maximized profits while non-conjugal households, irrespective of the level of education, did not. Integration of UF with other activities is likely to be facilitated by households allocating optimal variable inputs to production because they are more likely to respond to incentive for more inputs needed in Stages II and III of the transformation process.

The groups of households found to be more technically efficient were those who had cultivated urban land for 13 or more years, were headed by women with less than seven years of formal education, and operated the activity with the objective of generating cash income unlike their counterparts. Technically efficient groups of farmers are more likely to facilitate the envisaged

integration of UF because their operations make the activity compete favourably for available resources with alternative activities

The evidence form the study adds further weight towards persuading the urban policy makers to accept UF as a legitimate land use and focus on its actual and potential contribution to food security, income, wastewater and organic waste reuse, open space management and aesthetic value. Zoning of urban land and lease arrangements specifying, duration and the type of UA that can be practiced, are crucial for the envisaged transformation of the activity. Farmers organized in groups can hold user rights and facilitate relevant research, extension contact, group credit, farmers markets and enforcement of health risk standards. A flexible facilitating agency is needed to promote favourable official policy for UF, facilitate organization of farmers into groups, certify "safe food" labels to increase consumers' confidence, endorse financing applications and ensure that macro and micro benefits of the practice evolve with participatory research.

Although the transformation and integration of UF is envisaged over time, it probably exists in cross section among different income groups of farmers with a variety of technologies, objectives, financing, and access to markets. Research focusing on the constraints at different levels is likely to suggest strategies for the integration process that are more efficient. Even without UF, the municipal authorities are faced with the daunting task of safe management and disposal of wastewater and organic waste. The challenge will increase with increase in urban population particularly that of unplanned settlements. UA can be a component of a large-scale system of managing wastewater and organic waste. In the process UF will generate income, jobs and more pleasant urban environment, through sustainable use and reuse of urban of resources.

CHAPTER 1

1.0 INTRODUCTION

1.1 Background

Urbanization is the progressive increase in the proportion of the total population living in cities and towns (O'Connor, 1983). Globally, urban population is increasing. In the twentieth century alone, global urban population increased from 1.5 to about 6 million constituting an increase of about 35% (Deelstra and Girardet, 2000). In 1990, only one tenth of the world population (160 million people) lived in urban areas (International Development research Centre (IDRC), 1999). By the year 2008 in contrast, it is estimated that half of the world's population of over 3.2 billion people will be living in urban areas (World Bank, 2004), and it will increase to two-thirds by 2025 (Wilson, 2001). This will make the twenty-first century the first urban century in history.

Regional disparities however exist in the rate of urbanization. International Institute for Environment and Development (IIED) notes that in 1950-2000 period for example, urban population in low- and medium- income countries in Africa, Asia, Latin America and the Caribbean, increased by more than five fold to 1.9 million, making up two-thirds of the world's urban population (IIED, 2001a). Furthermore in Africa and Asia, more than half of the population will be urban by 2020 (Garrett, 2001). In contrast, more than three quarters of the people in Latin America resided in urban areas by the end of the 20th century.

The increasing rate of urbanization raises concern because even though the rural poor still out number the urban poor residents, there has been a long-term trend of increasing concentrations of population and poverty in urban areas of Asia and Africa (IIED, 2001a). In 2002 for instance, the incomes of close to 30% of the urban population in developing countries were below those required for basic needs (Cities Alliance, 2000). In terms of

shelter and basic sanitation, one third of the urban residents lived in slums and squatter settlements in 2004 (World Bank, 2004).

Increased urban poverty and inequality in opportunities to earn decent livelihoods threatens the social cohesion and political stability needed for social development and economic growth (Cities Alliance, 2000). The urban residents' need for food, water, shelter, and social organization will exert social and environmental pressure hitherto not experienced. The implication is that pro-poor policies are needed and changes must be made in the ways cities are provided with food and water, land is used, people and goods are transported, and waste is disposed (Cities Alliance 2000; IDRC, 1999). It is therefore noted that the demand for pro-poor policies is increasing because the urban poor are influencing investment priorities, and they are voting in increasingly large numbers. Decentralisation too has put pressure on local governments to be more accountable (Cities Alliance, 2000). Ensuring sustainable urban environments will therefore be one of the key challenges to urban management in the twenty-first century.

DFID (undated) concludes that there is no internationally agreed definition of what constitutes an urban area because the cut-off point between a village and a town vary from 200 to 20,000 people in many definitions. Moreover, population thresholds are not the only criteria used to define urban areas. The distinction between small urban towns and large rural villages is particularly imprecise. Owing to the varying definitions of urban areas, the global level of urbanization was officially quoted as 47% in 2000 while the reality is considered to have been between 40 and 55%.

1.2 Urban poverty in developing countries

As the twenty-first century begins, the urbanization challenge in developing countries is unique and surpasses that faced by developed countries in the past, because they urbanized at a gradual pace. The steady process in those countries was accompanied by adequate gross domestic product per capita, education and time, to allow market instruments, political and economic institutions to develop, facilitating efficient urbanization and reasonable quality of urban life (Henderson, 2002) In contrast, the urbanization experience in developing countries is essentially different because it is not accompanied by economic growth and improved livelihoods, but by increasing poverty and urban squalor. At the end of the 20th century for instance, urban poverty in Latin America was as high as 90% while in the poorest countries in Africa and Asia, it was 50% (World Bank, 2001).

Department for International Development (undated) attributed rapid urbanization to four main factors (1) New work opportunities usually, with higher incomes, accompany growth of industries and services worldwide, prompting rural-urban migration. (2) Reduced potential to make a living in the rural areas fuels rural-urban migration as a result of declining soil fertility, reduced plot size, or reduced market for labour in modernised agricultural sector. (3) Conflicts in some areas have stimulated migration to towns and cities, while in others, large settlements of refugees and internally displaced people have been created. (4) Urbanization levels have also increased where boundaries of urban centres have been redefined and enlarged.

The World Bank (2001) defines poverty as a pronounced deprivation of well being related to lack of material income or consumption, low level of education and health, vulnerability and exposure to risk, including powerlessness and lack of opportunity to be heard. Urban poverty

is multi dimensional in nature and is brought about by number factors. IIED (2001a) summarizes them into six categories. (1) Inadequate household income resulting in inadequate consumption of basic necessities, often aggravated by intra household distributional inequalities. (2) Limited asset base for individuals, households or communities such as housing, capital goods, social and family networks and 'safety nets'. (3) Inadequate provision of 'public' infrastructure and services for example, piped water, sanitation, drainage, and health care, schools and emergency services. (4) In adequate protection by the law–for example, enforcement of health and safety regulations in the workplace, environmental legislation, protection from violence, and access to civil and political rights. (5) 'Voiceless ness' and powerlessness within the political system shown by lack of means or right to receive entitlements, make demands within political systems or to receive a fair response. (6) Exploitation and discrimination often on the basis of gender, caste, age, ethnicity among others.

In addition, urban poverty is exacerbated by environmental threats particularly in low-income cities and neighbourhoods, where they account for the larger share of ill health, early deaths and other hardships. Urban environmental problems are defined as threats to people's present or future well-being, resulting from human-induced damage to the physical environment, originating in urban areas or borne by urban residents (IIED, 2001d). Environmental threats include substandard overcrowded housing manifested by cooking and sleeping in the same room, increasing indoor pollution, few paved paths, inadequate potable water, lack of basic sanitation in terms of sewerage and drainage facilities often overwhelmed by flooding during the rains. Incidence of malnutrition is high and access to health and medical facilities is limited, resulting in high rate of infectious diseases and child mortality. Rising numbers and severity of crime compound the existence in the squalid conditions. In these surroundings,

many women are the main breadwinners. They work long hours away from home for meagre wages, because they have poor training and hence fewer job opportunities. Urban poverty is also characterised by increasing number of children pressurized to earn additional income for households, or abandoned to survive on their own (IIED, 2001a, 2001d; World Bank, 1995; Cisneros, 1995; UNICEF, 1994; Strong, 1995; Hassan and Ahmand, 1991). Rapid urbanisation is also accompanied by additional threats to life and health in form of increasing outdoor air pollution, inadequate waste management, pollution of rivers, lakes and coastal areas and loss of green areas. This is because the infrastructure and the capacity of municipal governments to provide these services continue to be overwhelmed by the rapidly growing population, and the dwindling tax base to finance them (Wilson, 2001; Becker *et al.*, 1994). It is acknowledged that some of these problems are interrelated and are experienced by other groups who are not poor or urban residents. None-the-less they pinpoint the under lying causes of poverty, and in turn, the interventions likely to be cost effecting in reducing it (IIED b, 2001).

The urban poor face daily uncertainty of meeting basic needs because many of them such as food, potable water, cooking fuel and housing, require cash income but the incomes earned are in adequate and irregular. In Sub-Saharan Africa (SSA) for example, the urban poor have fewer coping strategies than the rural poor in procuring food. Even thought their diets are poorer (Ratta and Nasr, 1996), they also pay higher prices for food partly because of increased spoilage from inefficient transport system and inadequate handling methods (Garrett, 2000). In addition, the urban poor spend up to 70% of their income on food, and the proportion tends to be higher in larger cities, and for the poorest households. Consequently, urban poverty is manifested to a large extent as food insecurity.

The United Nations (as cited by Armar-Klemesu, 2000) defines household food security as a situation where all its members have access to adequate food (in quality, quantity, safety and cultural acceptability), needed for a healthy life, and it does not face undue risk of losing such access. In most developing countries and in SSA in particular, urban poverty has been driven by rapid population growth, economic recession, structural adjustments policies and programs which aggravated, at least in the short run, the food security problems of the urban poor (Armar-Klemesu, 2000). The situation is aggravated further by widespread persistent unemployment and underemployment (UNCHS, 1996).

Since better management of the urban environment is possible, but preventing urbanization is rarely possible or even desirable (IDRC, 1999), poverty and waste management, as the two main problems facing cities of developing, need to be understood and addressed within their social, economic and political context, in order to formulate appropriate strategies. Urban agriculture, the focus of this study, can be one of the functional links between the two problems because it can make contributions to each of them (Baumgarter and Belevi, 2001). This concept in is in line with at least two specific targets of the millennium goals. These are, to reduce by halve the proportion of people whose income is less than one dollar a day, and to have achieved a significant improvement in the lives of at least 100 million slum dwellers by 2020 (United Nations, 2000).

1.3 Urban poverty in Kenya

Poverty in Kenya illustrates the plight of many countries in SSA. Agriculture is the source of livelihoods for about 80% of the population in rural Kenya, but its growth rate has not kept pace with that of the population (Figure 1). In the 1991-1998 for example, the annual population growth rate decreased from about 3.1 to 2.4%. In contrast in 1991-1993, the

annual growth rate of agriculture was negative. It only exceeded the population growth rate in 1994-1996. This performance is dismal because for agriculture to contribute effectively to the overall economic growth, increased rural wealth and better livelihoods, it has to grow at 4-6% per annum (Kenya, 2000a). The poor performance of the agricultural sector is attributed to various factors and in particular to inappropriate technology as smallholder farmers, particularly women, lack access to external inputs and credit; high cost of farm inputs; poor and inadequate rural infrastructure mainly roads, power supply and market facilities. Participatory studies link low agricultural productivity to most of these factors and others such as unemployment or low wages, limited availability of affordable basic services, living with HIV/AIDS or disability, degraded environment and natural calamities (International Monetary Fund (IMF), 2005). The poor performance is also ascribed to inappropriate sequencing of the liberalization process, inconsistent policies, poor institutional and legal framework, inadequate research, extension and support services, unfavourable weather conditions,

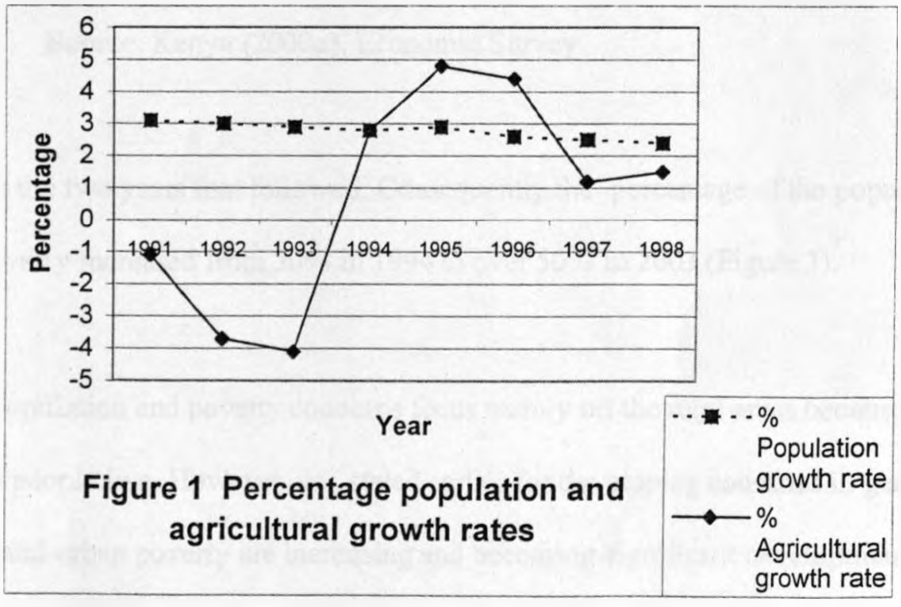

Figure 1 Percentage population and agricultural growth rates

Source: Kenya (2000a), Economic Survey

Dependence on rain-fed agriculture, insecurity in some parts of the rural areas and high population pressure on degraded natural resource base (Kenya, 2000b).

Since agriculture is the major sector in the economy of Kenya, its poor performance affects negatively the performance of the entire economy as shown by declining GDP per capita from K£188 in 1991 to K£ 170 in 1994 (Figure 2). The recovery made in 1995 and 1996 was not

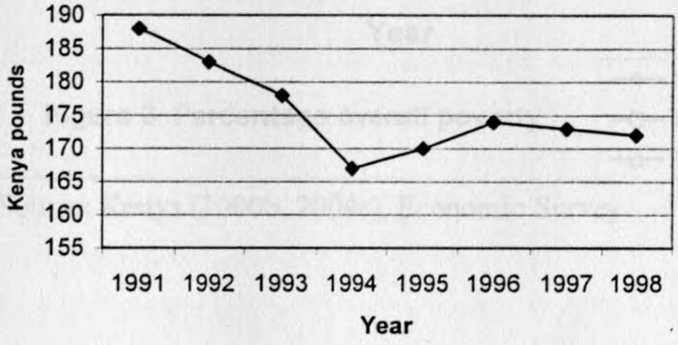

Figure 2 GDP per capita (1982 prices)

Source: Kenya (2000a), Economic Survey

sustained in the two years that followed. Consequently the percentage of the population living in poverty increased from 30% in 1994 to over 50% in 2003 (Figure 3).

In Kenya, population and poverty concerns focus mainly on the rural areas because that is where most people live. However, as stated earlier for developing countries in general, urban population and urban poverty are increasing and becoming significant development concerns. For example in 1979, the urban population in Kenya was only 15% of the total, increasing to 35% in 1999 (Figure 4). According to United Nations estimates, the urban population will be

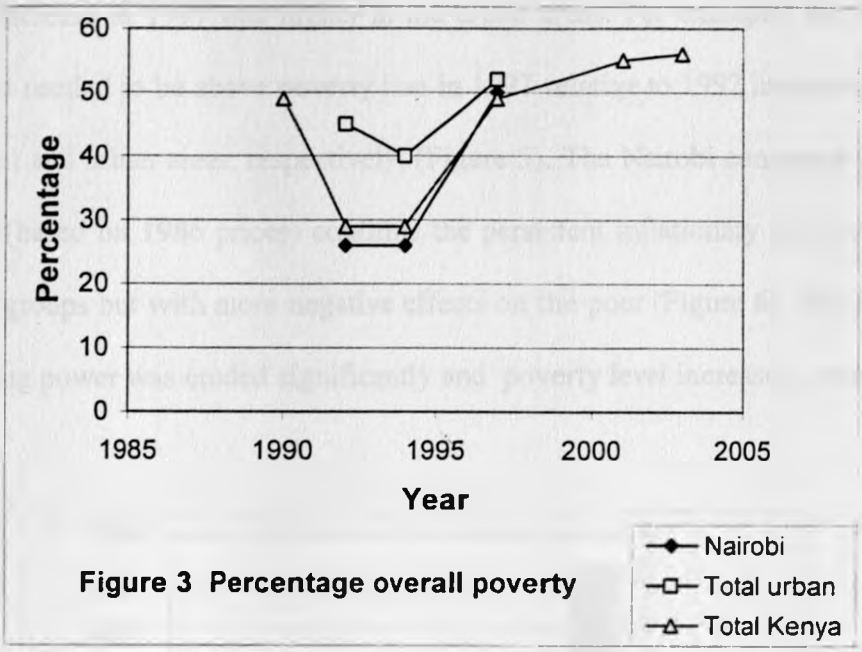

Figure 3 Percentage overall poverty

Source: Kenya (2000b, 2004c), Economic Survey

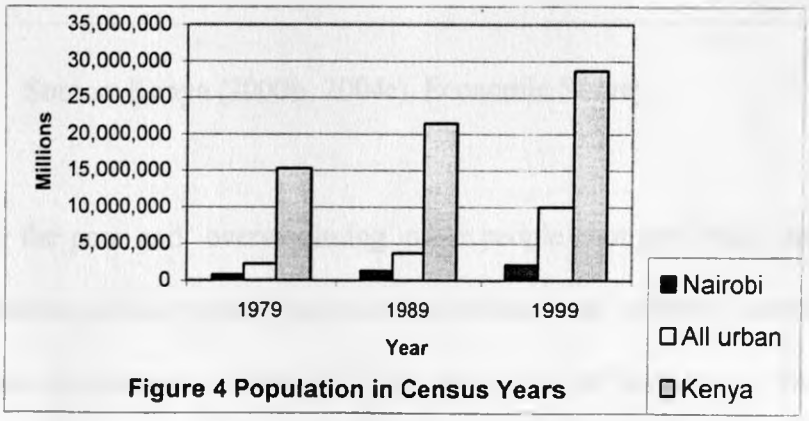

Figure 4 Population in Census Years

Source: Kenya (2004a), Statistical Abstract and Kenya, UNICEF (1992)

52% by the 2020. As expected because of inflation, the minimum income used to define the proportion of the population living in poverty increased between 1992-1997 period.

However, the increase in 1997 was higher in the urban areas. For example, the income per adult equivalent needed to be above poverty line in 1997 relative to 1992 increased from 255 to 262% in rural and urban areas, respectively, (Figure 5). The Nairobi consumer price index for 1992-1999 (based on 1986 prices) confirms the persistent inflationary trend experienced by all income groups but with more negative effects on the poor (Figure 6). The implication is that purchasing power was eroded significantly and poverty level increased, to intensifying

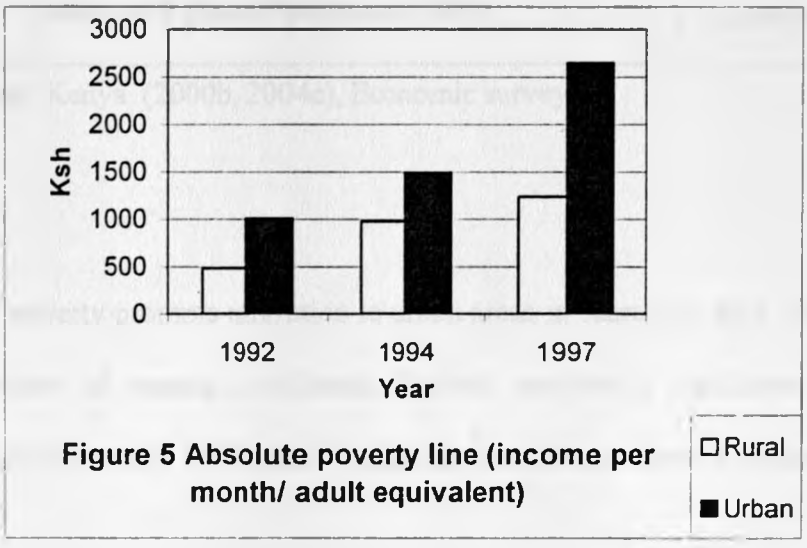

Figure 5 Absolute poverty line (income per month/ adult equivalent)

Source: Kenya (2000b, 2004c), Economic Survey

deprivation for the poor and overwhelming other people not previously described as poor (Figure 3). However, urban poverty increased more than rural poverty particularly in 1992-1994. It is worth to note that in 1994-1997, the proportion of the poor in Nairobi increased at a higher rate than in the rural areas.

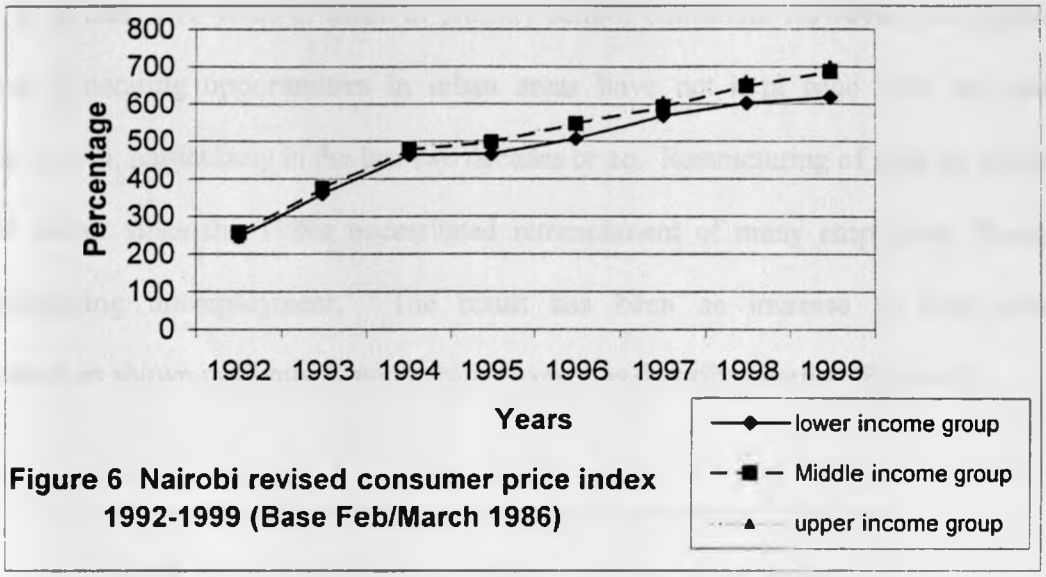

Figure 6 Nairobi revised consumer price index 1992-1999 (Base Feb/March 1986)

Source: Kenya (2000b, 2004c), Economic survey

Increased rural poverty prompts migration to urban areas in search of paid employment and other opportunities of earning livelihoods. Nairobi receives a significant proportion of immigrants. Since the early 1990s, the immigration rate has accelerated (Figure 7).

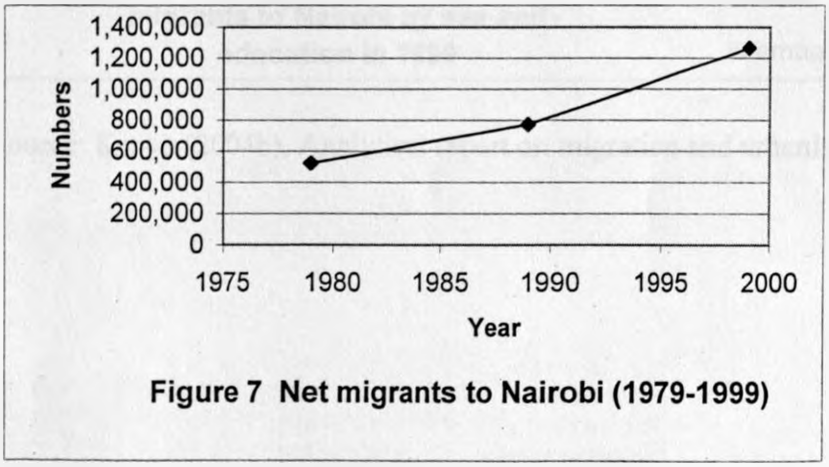

Figure 7 Net migrants to Nairobi (1979-1999)

Source: Kenya (2004b), Analytical report on migration and urbanisation vol. VI

As shown in Figure 8 for 1999, the bulk of the migrants have some secondary school education or at least five years or more of primary school education. However, job creation and income generating opportunities in urban areas have not kept pace with the rapid population growth, particularly in the last two decades or so. Restructuring of both the private and public sector since the 1980s necessitated retrenchment of many employees (Kenya, 1998) aggravating unemployment. The result has been an increase in both urban unemployment as shown in Figure 9, and urban poverty as described earlier (Figure 3).

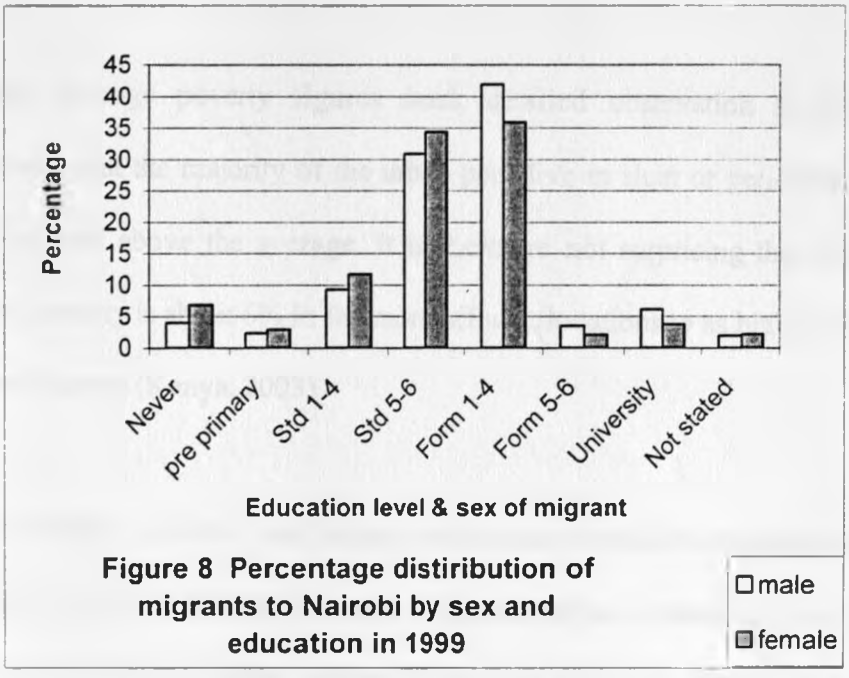

Figure 8 Percentage distiribution of migrants to Nairobi by sex and education in 1999

Source: Kenya (2004b), Analytical report on migration and urbanisation vol. VI

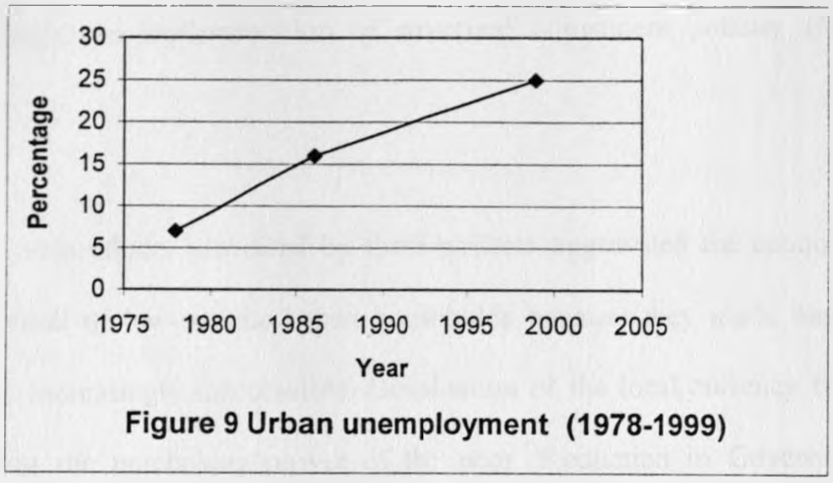

Figure 9 Urban unemployment (1978-1999)

Source: Kenya and IMF (2005), Poverty Reduction Strategy Paper

As is expected, average poverty figures mask detailed observation made by welfare monitoring surveys that the majority of the urban poor live in slum or peri-urban settlements where poverty is well above the average. It is therefore not surprising that at sub-location level in Nairobi, poverty is about 6% in the more affluent locations to as high as 78% in slums and informal settlements (Kenya, 2003).

Concentration of people in slums[1] and squatter settlements is the first characteristic of urban poverty (UNICEF, 1994). In Kenya, slums are unplanned urban extensions found in and near towns and cities in virtually all urban centres (Kenya and UNICEF, 1992). In this study the term slum was used to refer to such urban structures, erected illegally and contravening building and land laws, and which are overcrowded, lack basic services such as sewerage,

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[1] Drakakis (1987) distinguishes between squatter and slum types of urban housing for the poor noting that squatters consists of those structures erected illegally by contravening building and/or land code and without the permission of the owner. Slums on the other hand are permanent buildings that have become substandard owing to a combination of age, neglect and subdivision, resulting in considerable pressure on basic services. However, the available literature indicates widespread interchangeable use of the two terms. Drakakis (1987) pointed out that in many cities, slums and squatter housing actually blend in space and in form.

resources, through the implementation of structural adjustment policies (Mwarania and Ayako, 1989).

Some negative side effects generated by these policies aggravated the economic crisis and threatened survival of low-income urban households because they made basic necessities, including food, increasingly inaccessible. Devaluation of the local currency forced prices to increase eroding the purchasing power of the poor. Reduction in Government spending decreased the quantity and quality of public services such as education and health. The introduction of cost sharing through user fees reduced even further access of social services by the poor (Kenya, 1997; UNICEF, 1994; and Rae *et al.*, 1989). As reported by Kenya Interim Poverty Reduction Strategy Paper 2000-2003 (Kenya, 2000a), 58 and 56% of the urban and rural poor, respectively, reported not seeking public health care because drugs were not available. Moreover, charges at public health care were affordable by only 20 and 8% of the urban and rural poor, respectively. Rents in urban area have also continued to increase due to increased demand from higher population (Osiemo, 1994), and transportation cost has escalated with increase in fuel prices.

The foregoing account leads to the conclusion that one of the major concerns of urban poverty in Kenya will continue to be access to food and basic needs, which include a decent environment to live in. It meshes well with Kenya's commitment to mobilize resources to achieve the eight-millennium development goals among them, reducing extreme poverty and hunger by half and ensuring environmental stability (Kenya, 2000a). Similarly, the poverty reduction strategy targets increased ability of the poor to generate higher incomes and to improve the quality of their lives as one of the five basic policy objectives, (Kenya and IMF, 2000). The foregoing account strongly suggests that many of the problems of the urban poor

are closely linked to scarcity of activities to earn a decent living, while those that are available yield poor returns or are not efficiently operated. Kenya Government and IMF confirm this observation by stating *"Kenya must mobilise all available resources and use them efficiently and effectively in the fight against poverty"* (Kenya and IMF, 2000, p.2-3).

1.4 Urban agriculture in developing countries

As state earlier, urban agriculture is a possible link between poverty and environmental management in urban areas. The practice of urban agriculture (UA) has been increasing in cities of developing countries. Any farming in an urban environment constitutes urban agriculture (Maxwell and Zziwa, 1994). Lee-Smith *et al.*, (1987) classified urban farmers as those people whose traditional activities on their land have been surrounded by urban growth, and immigrants to towns who cultivate available urban land and rear livestock. Most definitions of UA focus on the agricultural production particularly food production. The actual products include grain, root, vegetable, ornamentals, aromatic and medicinal plants, trees and fruit trees, more perishable and high value vegetables, including animal products and by-products. Mougeot (2000a) cautions that: *"to exclude the non-food category from the general urban agriculture concept would truncate the understanding of city farming at large"* p.6.[1] This implies that the terms urban farming (UF) and urban agriculture (UA) can be used interchangeably. Even in the rural context farming or agriculture embraces food and non-food production. Unless otherwise stated, the terms UF and UA will be used interchangeably in this study.

According to Mougeot (2000b), location of UA in terms of inter-urban or peri-urban is considered the most contentious determinant in defining UA, because the criteria distinguishing the two locations vary from study to study. Definitions of UA based on type of

area also vary from author to author. For example, the area can be defined with respect to: the residence as on-plot or off-plot; development status of the site as built up or open space; or to the tenure arrangements of site such as lease, sharing, cession, unauthorised or authorised through personal agreement, customary law, or commercial transaction. Own-consumption, trade or varying combinations of the two are the common product destination criteria sometimes used to define UA. Most studies have focused on the individual family or small and medium enterprises as opposed to large-scale entities, or the national or trans-national perspective of the activity. In view of the different bases for defining UA Mougeot (2002a, 2002b) makes a number of observations. (1) All the dimensions of UA except location, can apply to rural agriculture as well. Therefore they do not suffice to distinguish UA from rural agriculture or to justify the need for specific knowledge, and policy. One would therefore expect UA to be carried out more or less like rural farming (2) Location in the urban area is not the characteristic that distinguishes urban from rural farming. It is distinguished by the fact that it is embedded in and interacts with the urban ecosystem. The policy challenge is to make the interaction more positive. (4) Rural agriculture, urban food supplies systems, sustainable urban development, urban food security, urban survival strategies, and urban land management are other development concepts that influence or are influenced by UA. Few studies if any, have focused on these interactions with the objective of suggesting options for harnessing their positive synergies. In sum, Mougeot (2002b, p.7) suggests a revised definition of the activity:

> *Urban agriculture is located within (intra-urban) or on the fringe (peri-urban) of a town, a city or a metropolis, and grows or raises, processes and distributes a diversity of food and non-food products, (re-) uses largely human and material resources, products and services found in and around that urban area, and in turn supplies human and material resources, products and services largely to that urban area .*

The above definition suggests that UA is versatile. Baumgarter and Belevi (2001) confirm this versatility by summarising the benefits of UA based on a systematic overview of UA in

developing countries as: one of several food security options for the household; one of several tools of making productive use of open space, treating urban waste, generating employment income and savings, and managing freshwater resources more effectively. IDRC (1999) expresses as similar view that modern UA is a lifeline at macro and micro level.

At macro-level, idle or under-utilized resources in terms of manpower, space, land, solid and liquid waste, as are put to work. Concentration of consumption in urban areas causes problems of pollution and waste disposal (Rijsberman and Dada, 2001). In cities of developing countries, the rate of urbanization has been accompanied by generation of immense and ever-increasing amounts of solid waste, which have long outstripped the capacity of nature to assimilate them, and of city authorities to collect and dispose of them safely and efficiently (Agbola, 2001). Problems caused by inadequate waste management and the negative effect on the urban poor are less well documented than deprivation from inadequate incomes. In contributing to waste management, UA is a tool for solving one of the endemic problems of large urban environments.

At micro-level, it contributes to poverty reduction by providing some urban residents with better diets, improving human health, generating employment and higher incomes, even enabling participation by disadvantaged groups, particularly poor women heading households. Where food supply systems function efficiently in urban areas, adequate income can translate into household food security. However, the poor have limited and uncertain cash incomes pitted against high food prices and cost of other basic services. In this situation UA, becomes one of the strategies of generating some food independent of market prices, saving cash income, supplementing diets and in some cases, accumulating livestock assets against emergencies. UA therefore contributes to combating poverty, the other endemic problem of

cities in developing countries. As such, UA *"is spurred by a complex web of factors still little understood, not least of which are urban poverty and food insecurity"* (Mougeot, 2000b), p.1.

However, the urban poor are not the only ones who engage in UA (Mougeot, 2000b). Nugent (2000) notes that households across the income spectrum engage in the activity spurred by any of the following factors or a combination of them, civil upheaval, conflict, macroeconomic down turns, poverty, inaccessibility to adequate food supplies, good growing conditions or even long tradition of urban food production. For others, it is a commercial activity in it own right (Armar-Klemesu, 2000). The diversity of these factors support the view that UA is a dynamic concept which includes a variety of farming systems ranging from subsistence production and processing at household level to fully commercialised enterprises (De Zeeuw *et al.*, 2001). UA therefore has a niche function of varying components as described by Baumgarter and Belevi (2001). They include: time (transitory), space, social (women and low income group), economic conditions (such as financial crisis, food shortage), improved sanitation (management of organic solid waste and wastewater) including more green space in the cities (recreational value, well-being, air quality). Mougeot (2000, p.2) summarizes the attributes of the activity by stating that:

> *Despite limited support and heavy losses, UA is generating products valued in the tens of millions of USD, year in and year out, in major LDC (least developed countries) urban centers. UA is comparatively affordable, a noteworthy source of income and savings and is more profitable than rural-based production. The up and downstream effects of UA in the local economy are largely unknown and could be considerable."* p.2).

For the upper and middle-income groups "on-plot" land may be available for UA. However, most surveys have found that residential backyard UA is only a small share of UA in the city or even within the same households (Mougeot, 1996). For those residing in congested low income areas with very high population densities, "on-plot" land for farming does not exist and often cultivate "off-plot" public or private land that they do not own, found on roadsides,

riversides and any other accessible seemingly vacant under utilized land (Mougeot, 2000). They combined it with the household's inputs of labour and capital and the result is an informal, own food crop production activity to earn a living. This is one type of urban farming or agriculture and is the focus of this study.

1.5 Importance of Urban farming in Kenya

Since 1980s in Kenya, UA by resource poor households has attracted empirical research because of rising urban poverty. The urban poor are the best placed people to assess the contribution of UF to their livelihood as shown by a number of empirical studies. The survey by Lee-Smith *et al.* (1987) covered six urban areas in Kenya, including Nairobi. The respondents were asked to state the consequences they would face if they were forced to stop urban farming. In Nairobi alone, 21% of them stated that they would starve, while 56% said they would be forced to buy food. In another study, Freeman (1991) sampled 617 respondents from people actually found carrying out cultivation activities in the open spaces of Nairobi. They ranked the incentives for UF in descending order of importance as follows: (1) to acquire basic subsistence against the alternative of hunger, threat of malnutrition or even starvation; (2) to supplement diet, particularly by growing kale and cabbage; and (3) to generate supplementary cash income and to increase fungibility. Fungibility is defined as the act of freeing-up scarce cash income that would otherwise be spent to purchase food, but, can be devoted to other pressing household needs as a result of subsistence cultivation (Freeman, 1991). Substitution of goods or labour for money that would have to be earned to acquire these or equivalent goods and service constitutes fungible income.

A subsequent study by Mwangi (1995) in Nairobi, agreed with the conclusion of the studies done in the 1980s that UF makes positive and significant contribution to household food

security. The study assessed nutritional status of household members using data from one of the slums in Nairobi and found that farming households had higher energy and protein intake, as well as less stunting and wasting in children, compared to non-farming households. Despite these benefits, UF as practiced by households from low-income urban areas is not understood, and the extent to which the activity meets the livelihood objectives of different types of low-income households is not clear.

In spite of its positive role, city authorities shun it as a threat to public health for a number of reasons. (1) Consumers, handlers, and producers risk contamination particularly from crops irrigated with contaminated wastewater or untreated sewerage. Crops grown on contaminated soils and zoonotic diseases from livestock living in close proximity with people, are additional health risks. (2) Others view UA as a nuisance and a safety hazard to people living in the vicinity of production areas, either from inputs used or from products and by-products of the activity (Mougeot, 2000a; Lock and Zeeuw, 2001). (3) UA is also perceived as a source of negative environmental impacts cited as visual untidiness, soil erosion, destruction of vegetation, siltation of rivers, depletion of water bodies and pollution of soil, air and water (Mougeot, 2000a). (4) Some farmers also illegally tap municipal fresh treated water for irrigation aggravating domestic water shortages in the city (Baumgarter and Belevi, 2001).

In spite of these concerns, it is often overlooked that rural agriculture can also pose potential health risk to the urban consumers if production, transportation, storage and handling of produce are not properly carried out (Lock and Zeeuw, 2001). Moreover, the health risks of UA are not intractable; they can be addressed through enforcing known standards for safe use of wastewater, available soils and appropriate livestock management to prevent zoonotic diseases (Muogeot, 2000a; IDRC, 1999). It is known that ignoring UA and denying it support

aggravates the public health risks because the activity still goes on. Passing general laws prohibiting it is not effective either. A viable alternative is to articulate policies that actively manage the health risks based on detailed information on the actual health impacts of UA.

Valuable insights can be gained from policy based on research findings on small-scale fresh milk vendors prompted by public health risk concerns after liberalization of the milk industry (Omore, 2005). Such information however is not readily available (Lock and Zeeuw, 2001) possibly because UF as a production activity, particularly of resource constrained households, on land they do not own, has not attracted adequate research interest. Effective management of health risks underscores the need for urban policy makers and planners to move a step further from simply tolerating UA, to a more informed process of integrating the activity into the urban economic and ecological system. An understanding of the constraints likely to limit returns and efficiency of the activity at household level is part of the required information. The integration will ensure that the benefits of UA at all levels are enhanced while possible negative effects are mitigated.

1.6 Statement of the Research Problem

The purpose of analysing a livelihood activity of resource constrained households such as low-income urban farmers is to understand the activity better by identifying constraints limiting its productivity, returns, efficiency and sustainability, and the variation of these performance indicators within the group. The overarching objective is to contribute to effective policy options, program and initiatives needed to overcome identified constraints, so that the activity can generate improved and sustainable livelihoods at household level, and ultimately contribute to the wider economy. It tallies with the objective stated in the poverty

reduction strategy paper cited earlier, that is to mobilise all available resources and to use them efficiently and effectively in the fight against poverty (Kenya and IMF, 2000).

The underlying assumption is that an activity such as UA can go through a transformation process marked by distinctive stages and ultimately be integrated in the wider economy. Each stage has specific milestones towards desirable goals of employment and income generation, equitable distribution of opportunities to make a decent living and poverty eradication. Contributing towards environmental management, sustainable use of environmental resources and integration with other activities are additional characteristics signifying the different stages in the transformation process. Although the available literature stresses that UF by resource constrained households keeps them from starvation and abject poverty by complementing irregular sources of income, there is little mention of how the activity can go though the transformation process and be integrated with other activities in the economy.

Transformation of UF can be envisaged in three stages (Figure 10). Characteristics of Stage I are hypothesized to be use of traditional technology by low income households for crop and livestock production with no external inputs, on urban land accessed with no formal recognized, often flouting city ordinance and in conflict with other urban activities. The livelihoods earned are meagre and producers and consumers are exposed to health risk. Sustainability of the activity is threatened by low productivity, inefficiency, degradation of the resource base through depletion of nutrients and soil erosion, insecure land tenure, elimination by other land uses considered more appropriate for urban area, poorly adapted technology, lack of relevant adaptive research and negative perception by city planners. The premise of this study was that although majority of UF households from low income fit this description, some of them might depict characteristics suggesting progressive transforming to

Figure 10 Transforming and Integrating Urban Agriculture in to the Economy

	Stage I	→	Stage II	→	Stage III
Objective of UF	EARN LIVELIHOODS FOR SURVIVAL For the majority, income earned does not cover all basic need. For the minority it's a means of escaping poverty and moving to Stage II .		EARN BUSINESS INCOME FOR THRIVING LIVELIHOOD Sales cover all basic needs adequately. Efficiency at farm level, asset accumulation and moving to Stage III		MAXIMIZATION OF PROFIT & RETURNS TO CAPITAL Target value adding production. Returns to capital comparable to alternative investment opportunities. Efficiency from integration.
Who is involved	INDIVIDUAL HOUSEHOLDS Majority struggling to survive. A few almost escaping poverty		INDIVIDUALS OR GROUPS OF FARMERS. All are at varying levels of success in profitability and efficiency		AGRIBUSINESS UNITS Vertically integrated with competitive earnings to factor inputs and returns to capital
Output	GENERAL CROPS, LIVESTOCK PRODUCTS FOR FOOD & FOR SALE Direct consumption & sales earning cash income for basic needs Employment for unskilled labour		MARKET DICTATED SPECIFIC PRODUCTION Fresh horticultural produce and livestock product targeting specific urban markets Employment for skilled and unskilled labour		VERTICALLY LINKED SPECIFIC MARKET PRODUCTION Pig, broiler and milk production on contract farming linked to processors. Employment for skilled & unskilled labour
Technology & use of external inputs	TRADITIONAL TECHNOLOGY No credit for inputs Negligible, own saved seed or unimproved seed , mining soil of nutrients. No investment in livestock health and hygiene		IMPROVED TECHNOLOGY Group credit for inputs; HYV seed, fertilizer, pesticides & herbicides, Compositing organic waste; Routine investment in livestock health and hygiene		HIGH LEVEL TECHNOLOGY Credit borrowed at market interest rate Bulk buying of inputs for lower prices
Tenure to land parcel	NONE Informal access to seemingly vacant land		SECURE Formal access of public or private land designated for UF		SECURE Formal access of public or private land designated for UF & peri-urban farming
Income from other activities for livelihoods	NEEDED for survival & has significant contribution		NOT NEEDED		NOT NEEDED
Level of integration with other activities in the economy	NONE		EMERGING Fresh produce outlets; Micro-credit sources; External input suppliers; Public health certification system		HIGH Transporters; Processors ; Retail outlets
Viability, sustainability & concerns for environment	THREATENED Mining of soil nutrients/low yields Soil erosion ;Displacement by competing land use; No inputs to maintain/improve resource base		ASSURED Input cost for soil fertility improvement , maintenance & conservation routinely considered. Looks out for appropriate technology &adaptations		ASSURED Input cost for soil fertility improvement , maintenance & conservation routinely considered. In house development & adaptation of technology
City ordinances & aesthetic contribution	Flouted by farmers Activity negatively perceived by city authorities		Compliant & involved in updating them Contributes to orderly urban green space & organic waste & waste water management		Compliant & involved in updating them Contributes to orderly urban green space & organic waste & waste water management

Stage II, but policy and support might be lacking to anchor purposeful transformation. In particular, it was hypothesized that there is inadequate policy and support in form of technology adapted to the resources available in urban area such as small land parcels, financing, secure tenure for designated sites, facilitating city ordinances, informed health requirements, and access to adequate markets backed by consumer confidence in the quality of produce. These factors are envisaged as basic requirements needed to transform majority of urban farmers to next stage.

Stage II would be characterised by use of improved technology through access to business credit for individuals or groups, secure tenure of cultivation sites in compliance with city ordinances and health regulations, updated after wide stakeholder consultation, including urban farmers. Production would target specific markets where proximity gives UF an advantage. Producers would invest part of the returns earned from enhanced productivity and efficiency to ensure that the activity is sustainable, and continues to generate thriving livelihood without requiring incomes from other activities. City authorities would encourage UA because of its contribution wastewater and organic waste management, creation of green space, amenity value and synergies with other urban activities such as community development and involvement in urban management. In Stage III, UF is envisaged to be fully in to the economy with competitive returns to capital and efficiency driving the profit objective. Vertical integration increases competitiveness as is evident in pig, dairy and broiler urban and peri-urban agribusinesses in Nairobi (Mireri, 2002). It generates skilled and unskilled employment, market for large-scale input suppliers, less risky business for financiers, and is more amenable to city bylaws. At this stage urban farmers are key business partners in development of orderly, sustainable and aesthetic urban environment attractive to investors.

The transformation process described is impeded by lack of empirical evidence to guide policy. A possible reason is that in the past, UF has largely failed to attract academic interest. Freeman (1991) attributes this reluctance to the perception that UF is a temporary occupation, and researchers seem to have a strong preference for evaluating activities considered permanent and visible. It is also likely that within the current focus on globalization, industrialization and decentralization, activities such as UF are considered too mundane to attract research interest and funding. Therefore, rigorous economic analysis of the activity as a production endeavour of some households contributing to livelihoods, particularly in low-income urban areas as describe in Stage I appear to be missing. In particular, no analyses have been undertaken to describe the nature of UF and characterize households practicing it for purposes of determining the factors constraining any returns it may generate. Also, it is not clear whether or not the activity is profitable and whether its efficiency varies depending on socio-economic characteristics of low-income households. It is unlikely that residents of low-income areas are not uniformly poor. Dennery (1996) noted that there is a large variation between the better-off and worst-off households in Kibera informal settlement. For the farming households, such differences are likely to be reflected in relative differences in profitability and efficiency, pinpointing those households progressing to Stage II in the envisaged transformation process.

The anticipated differences may be explained by variation in socio-economic characteristics such as: the number of years the household head has been an urban farmer, whether the household is conjugal or is headed by mother alone, area of land parcel cultivated, access to technical information in farming, years of formal education of household head, income earned from sources other than UF, and the objective of engaging in the activity. The differences would inform policy by explaining why majority of households are trapped in Stage I as

described in the transformation process, and highlights the factors prompting some of them to make some progress towards Stage II. If the activity was properly understood, its contribution to low-income urban household food security and poverty alleviation would be enhanced. In addition, the potential contribution to sustainable urban resource management would be tapped. possible negative effects would be minimized, and synergies resulting from integration with the other activities would be realised facilitated by substantive public policy.

1.7 Objectives of the Study

The overall objective of this study was to determine the nature, profitability, efficiency and sustainability of urban farming by households in low-income areas of Nairobi with a view to determining what can be done to realise the potential contribution to the economy

The specific objectives were to:

1) Characterize urban farming households in low-income areas of Nairobi to in order to facilitate understanding of the incentives driving the activity.
2) Determine the profit levels of UF by low-income households the factors that affect it as a guide to policy and programs intending to improve its performance.
3) Compare technical, allocative and economic efficiency of urban farming among different socio-economic groups of these households with a view to identifying possible disparities likely to inform the transformation and integration process of the activity.

1.8 Hypotheses of the Study

It was hypothesized that:

1) Urban farming by households from low-income areas does not generate profits.
2) Technical, allocative and economic efficiency in urban farming does vary between

groups of households depending on; area of land cultivated, years of urban farming, access to technical information on farming, years of formal education of the farmer, amount of income earned from sources other than UF, gender of household head, or the objective of embarking on the activity.

1.9 Justification of the study

Immediate solutions are unlikely to be found to eradicate harsh economic conditions or to curb the increase in low-income households in urban areas of Kenya. This study focussed on low-income urban areas or slums because that is where the majority of the urban poor live and constitute the environment in which they have evolved their type of urban farming, on seemingly idle land they do not own. Rural migrants come to urban areas in search of wage employment and not to cultivate urban land of any nature. Failing to secure employment, some of them embark on urban farming and seek shelter in congested informal low-income settlements where poverty levels are high, and life and health is under environmental threat from inadequate basic services such as sewerage, garbage collection, potable water and essential infrastructure. These are some of the realities of urban life particularly in the slums of Nairobi. Therefore, it is critical for all stakeholders in sustainable urban environments to understand UF as one of the activities, which have evolved in response to the constraints, and opportunities of earning livelihoods in urban slum areas. At households level, UF has potential to contribute to food security and poverty alleviation. At macro level, it can contribute to sustainable urban resource management through reuse of urban organic waste and wastewater, including development of urban greening and microclimate, as part of ecologically sound urban environment. Since urban planning is essentially a process of balancing competing use of resources and diverse interest of different stakeholders, results such as anticipated from this study will contribute to the evidence needed to determine the

policies, programs and regulations needed to transformation and integrate UF so that its benefits are realised at micro and macro level.

1.10 Organization of the thesis

The rest of the thesis is organized as follows: Chapter 2 presents the literature review while Chapter 3 gives the methodology. Results are presented and discussed in Chapter 4, which is divided into two sections. The first describes the characteristics of UF households from low-income areas, while the second gives the factors determining profit and compares differences in economic efficiency between different groups of households based on the six hypothesized factors, and their implications for policy. The summary of the study, conclusions and recommendations are presented in Chapter 5.

CHAPTER 2

2.0 LITERATURE REVIEW

The chapter stands by a brief review placing UA in its historical context globally and in the perspective of sustainable cities in an urbanizing world. The main issues in UA follow under various subheadings starting with an assessment of its positive role under the headings of UA in food security, income and employment generation and its potential as tool of sustainable urban environmental management. The facilitating requirements of UA are articulated under land as an input and financing, while gender in UA is singled out for specific mention. Public health risk concerns precede issue of irrigation as a logical prelude to wastewater reuse and solid waste management in UA. A brief review of urban livestock recaptures the benefits and concerns itemised in earlier sections. The chapter concludes by summing up the cost and benefits

2.1 UA in history

Food production in cities in not new (IDRC, 1999). Archaeological evidence globally shows that agriculture and livestock keeping were developed in cities and not in rural settlements. As hunters and gatherers settled in what was to become cities and centres of civilization, regular production of food was essential for the communities to thrive. However, the limitations of the transportation and storage systems of the day, dictated that plant and animal products for urban consumption be grown within the city boundaries, or in the immediate surrounding areas (IDRC, 1999). It resulted in selective domestication of animals and growing of crops within the pre-industrial cities, and a close relationship existed between a city and its hinterland (Lee-Smith and Memon, 1994).

The practice of UA dates back to ancient civilizations such as the Incas of South America, Aztec and Maya of Mexico, the early settlements of Java and Indus Valley in Asia, and the

towns of the rivers Tigris and Euphrates (Mougeot, 1993). It is also on record that where Mexico City stands today, maize was grown on artificial farmland created by dredging mud from the bottom of the lake. In times as recent as the nineteenth century, one-sixth of Paris was allocated to urban gardens, boosted by horse manure from stables in the urban area (IDRC, 1999). Similarly, urban fishponds have long been perfected in Asia. In Egypt, women for decades have sold butter and cheese made from milk of urban stall-fed cows in their homes (Tinker, 1999).

In Kenya, the available literature shows that UF is commonly identified with low-income households and in turn, with urban poverty. However, in Kenya UF is not new and its not only carried out by the poor. As early as 1899, Indian immigrants residing in railway towns such as Nairobi, cultivated urban land and sold their surplus agricultural production to Europeans. Since the late 1940s however, expansion of urban agriculture correlates positively with rapid population growth and grim economic prospects in the urban areas (Eberlee, 1993). The correlation became even more significant from the mid-1970s when the economic crisis and negative effects of SAPs compelled the urban poor to seek non-market coping strategies (Lee-Smith *et al.*, 1987). From these accounts, it is evident that in history, UA developed in response to food and income needs in urban areas, prompted by available resources and easily accessible markets. As the twenty-first century begins, these are the same factors documented as incentives and opportunities spurring the activity in many cities and urban areas globally.

Dissociating agriculture and food production from cities is a relatively recent but not a universal phenomenon. It is thought to have started in Europe during the renaissance period, and was later spread to the colonies (IDRC, 1999), probably with varying success because in Kenya for instance, urban farming seems to have accompanied urbanization by the colonialists. At the end of the twentieth century however, it is estimated that 800 million

people harvest 15 % of world's food supply by growing vegetables and raising livestock in cities. In doing so, IDRC (1999) noted, they are continuing a tradition that is probably as old as cities themselves.

2.2 Sustainable cities in an urbanizing world

As stated in chapter 1, mass urbanization will be the distinguishing feature of the twenty-first century. Cities suck up resources in form of food, energy and fresh air, and in return spew out waste. The non-urban areas carry the burden of generating the resources and acting as receptors for waste. However, with rapid urbanization, the non-urban areas are increasing overwhelmed by the burden, prompting the principle that cities should carry part of that load. Therefore, there can be no sustainable world without sustainable cities because as *Deelstra* and Girardet (2000) observe:

> *"The cities of the 21st century are where human destiny will be played out, and where the future of the biosphere will be determined ..... The challenge faced is whether cities can transform themselves into self-regulating, sustainable systems – not only in the internal functioning, but also in the relationships to the outside world"* p. 43.

Sustainability implies that cities would be viable in the long term, socially, economically and environmentally. Rapid urbanization raises two main sustainability concerns. First, sustainable urban environments and their coexistence with non urban population will be determined by the ways the urban need for food, water, shelter, and social organization are met. Second, survival will depend on the way in which these social and environmental pressures are handled. Consequently, changes must be made in the provision of goods and services to cities, in particular food, water, transportation of people and goods, disposal of waste, including land use (Mumford, 1999). In history, cities have been identified with change and perceived as cultural engines driving civilization. It is not clear if they will continue to do

so in view of challenges posed by rapid urbanization, increasing poverty and environmental threats, particularly in cities of developing countries.

It is acknowledged that change is occurring in cities, but it is accompanied by substantive negative side effects. In 1988 for instance, about 25% of the absolute poor in the developing world lived in urban areas. In 2000, the estimate was approximately 56%. As a result, the urban administrators are increasingly unable to cope with pressure on public infrastructure, food insecurity, unemployment, unsanitary living conditions and squalid shelters, in addition to environmental management problems (World Water Resources, 1997 cited by Baumgarter and Belevi, 2001). Therefore, poverty and waste management as the two most intractable problems facing third world cities but they are also the linchpins of sustainable cities (Baumgarter and Belevi, 2001). As was outlined in chapter 1, UA is a link between the two problems and can therefore contribute to the sustainability of cities. This study took the view that the constraints facing low-income urban farmers need to be identified, because the activity must be sustainable at micro level, before it contributes to sustainable urban environments at large.

2.3 The role of UA in food security

According to Baumgarter and Belevi (2001), FAO defines the key components of food security as food availability, access and adequacy. Availability is achieved when safe and nutritious food is consistently available in sufficient quantities to all individuals within a country. Access is ensured when all persons within the household have adequate resources to obtain appropriate food for a nutritious diet. Adequacy is considered in terms of quality, quantity, safety, cultural acceptability and food preferences. It is worth to note that food insecurity in urban areas is increasing, even as food and fuel continue to absorb the largest

share of income in poor households. In 1990 for instance, households in nearly half of the largest urban areas in developing countries were spending 50-80% of their income on food alone (IDRC, 1999). In Dar-es-Salaam, UA contributes about 30% of the food supply and has become an integral part of urban livelihood strategies prompted by poverty, decreased formal employment opportunities, proximity to markets, culture such as keeping livestock and non enforcement of by laws and regulations, among others (Kitila and Mlambo, 2001).

UA is one of several food security options for the household. This was the premise of one of the pioneering UF studies in Kenya conducted by 1985, Lee-Smith *et al.*, (1987). The overall objective was to investigate and document the extent of subsistence food and fuel consumption in urban areas, and their significance as sources of income and employment. It consisted of 1,576 urban households in Kenya, sampled from all income groups in Nairobi, Mombasa, Kisumu, Kakamega, Kitui and Isiolo. Among them, 455 were farmers with 154 sampled in Nairobi. The method of analysis was mainly descriptive. No causal or functional relationship was analysed between value of output and inputs to determine profitability and efficiency as hypothesized in this study. The analysis showed that 90% of the households interviewed in Nairobi, with access to land in rural or urban areas, grew food crops. Among the respondents with no access to land, 64% indicated that they would like access to urban land to grow crops. Kale, beans, maize and other vegetables were grown by 63%, 38%, 35% and 31%, respectively, of the 154 farmers interviewed in Nairobi. However, maize was the crop grown by the majority of farmers in the other five urban centres.

Since the respondents were sampled from all income groups, specific focus on the low-income households and their characteristics was lacking. Furthermore, the economic conditions, which existed in the urban areas of Kenya during the time of the survey, 14 years

before the current study, have worsened (Kenya, 1997). For instance, the performance of the economy has continued to deteriorate despite implementation of SAPs, and the urban population living in absolute poverty has increased. Retrenchment of employees, down sizing and rationalizing of private enterprises, parastatals and public sector since the late 1990s, has left many households in urban areas without any means of making a living.

Other urban residents in the region faced similar difficulties. In Kampala for instance, residents survived the severe economic crisis stretching from the 1970s to the 1990s, because a sizeable proportion of them had informal access to urban land for housing and subsistence production (Maxwell, 1995). In the early 1970s in Dar-es-Salaam, the government encouraged residents to cultivate every available space in the city in recognition of UA's contribution to food security, income, and employment[3] (Jacobi, et al., 2000). In these circumstances, livelihood strategies such as UF tend to become inherent because they are likely to be the next best available alternative. Therefore, a revisit of most of the descriptive analysis by Lee-Smith *et al.*, (1987), with special emphasis on the nature, profitability and efficiency of the activity, as carried out by urban households from low income areas in Nairobi, is a timely undertaking.

The stated objective by Mwangi (1995) was to determine the relationship between household nutrition status, an indicator of household food security and UA in low-income areas in Nairobi. The sample was divided into three groups of households. The first group consisted of 67 households who did not cultivate urban land. The second group consisted of 48 households cultivating urban land on their own. The third group was made up of 62 households cultivating urban land under the guidance of the Undugu Society Urban

[3] Low cost slum squatter settlements are also officially recognized in Dar-es-Salaam master plan of 1978 with a view to providing them with basic infrastructure than demolishing them (Jacobi, *et al.*, 2000)

Agriculture Project (Undugu Project)[4]. The food security indicators used to compare the three groups of households were energy intake, protein intake as well stunting and wasting in children. It was found that non-farming households had the least desirable levels of the food security indicators. These were measured as: the shortfall in the required average energy intake per consumer per day; proportion of households consuming less than 75 percent of recommended protein intake; and stunting and wasting in children. These indicators were lowest, and hence food security was highest, among the households cultivating under the Undugu Society, followed by those cultivating on their own. The results demonstrated that UF could play a positive role in enhancing household food security. They also show that food security can be enhanced by availing to low-income households, under utilized land for cultivation complemented by technical farming advice. Despite these results, the optimum area of land parcel per household for UF has not been empirically established. It is not clear whether these farmers have access to technical farming advice. The available literature suggests that agricultural extension service does not deliberately target low-income urban farmers.

2.4 The role of UA in generating employment and income

In addition to providing food security, UA provides employment as it generates real and fungible income. Urban Agricultural Network estimates that there are about 800 million people involved in UA worldwide. Among them, 150 million are full time employees (IDRC, 1999). In the early 1970s in Dar-es-Salaam, Tanzania, the government gave UA official recognition acknowledged that 30% of the urban population earns income from the informal

[4] In 1988, the Undugu Society of Kenya started an urban agriculture project to enhance food security for low-income households in Nairobi. Initially, 105 households were selected from three poor urban villages in the eastern part of Nairobi. For the first two years, the farmers were given farming demonstrations and other forms of assistance. There after, technical advice was still provided but the farmers were allowed to manage the plots on their own. The land area allocated was modest consisting of land parcels of 165 square metres each, along the Nairobi river. The allocation was done with the approval of the local government

sector. At the same time 6.5% of the informal workforce is absorbed in UA, excluding those engaged in subsistence (Jacobi *et al.*, 2000).

Even though UA is not officially recognized as in Tanzania, it generates similar benefits. For instance in 1991, Freeman established that UF in Nairobi was to a large extent undertaken by the working poor, the unemployed and those holding low-paying, informal jobs in self–employment, including jobless women headings households. The study estimated that UF in Nairobi frees cash income of up to Ksh100-200 per month for the average household. This is fungible income, which would otherwise be spent on fresh food produce, but is saved to meet other basic needs. The period of fungibility is extended beyond the growing rainy season by producing maize and beans, staples storable for extended periods. The author emphasized that savings in cash income is crucial particularly for families occupying rented accommodation, and those paying fees for children in high school. This study will depart from that by Freeman (1991) by starting with a sample of farmers from low-income areas. It will compare their characteristics and reasons for engaging in the activity with those found farming open spaces. Identifying the factors limiting profitability and efficiency of the activity as hypothesized in this study, is likely to contribute to improved fungibility, by suggesting options for making the activity a source of thriving rather than struggling livelihoods.

Other studies conducted in 1983-1992 period found that most of the urban poor have no regular jobs and earn livelihoods from casual work and informal micro-enterprises (Foeken and Mwangi, 2000). By the late 1990s in Nairobi for example, two-thirds of the working population was in the informal sector. In the 1994-1997 periods, employment in the informal sector was estimated to have grown by 65% compared to 5% in the formal sector (Kenya, 1998). The informal sector activities are diverse such as shop keeping, waste collection and

recycling trading and other activities including farming. However, some of them resort to stealing, illegal brewing, prostitution and begging. For instance Kibera, the largest informal settlement in Kenya, is well known for a vibrant small business sector with a wide variety of enterprises which include: preparing and selling street foods, selling fish, groundnuts, fresh vegetables, drugs and medicinal plants, making shoes and furniture, tailoring, operating kiosks, construction work, and brewing and selling illicit alcohol, prostitution, (Dennery, 1996) stealing and begging, among others. The last four activities are unlikely to be stated explicitly as way of generating household income in a household survey as used in this study. A large variation was observed between the well-off and worst-off households in Kibera, supporting the view taken by this study that low-income households are not homogenous. The diversity is likely to be reflected, at least in part, by the efficiency of operation and returns (profit) generated from the different livelihood activities including UF as hypothesised in the current study. It is also likely to show the characteristics of groups of households who's UF is more likely to be transformed and integrated with the rest of the economy.

The contribution of UA in the foregoing discussion is sometimes doubted on the basis that the poor do not own the urban land they cultivate. The view over looks the fact that even the poor and not so, poor in the rural areas supplement their livelihood by exploiting the rural commons. For instance, income-in-kind is earned by using firewood collected from the rural commons (Yang, 1999) and from consumption of own production. The latter is accepted as part of the net revenue or profit of the farm business commonly termed as management and investment income. Use of common property resources to generate income-in-kind is however less recognized. The fact that households do not own the common property resources, pay for their use or invest in ensuring their sustainable use does not mean that they do not derive fungible income from them. On the contrary, it means that the stream of

fungible income will dwindle with the exhaustion of the resource base with continued use. The urban farmers tilling land they do not own are also tapping the urban commons to generate net returns (income in-cash and in-kind). However, exhaustion of the resource base undermines long-term benefits.

Rural and urban farmers are not the only agents exploiting the commons for livelihoods. Other informal business in the urban Kenya such as small-scale retailing, street food kiosks, curios vendors or open sheds for furniture making or an assortment of repair work, are located on the urban commons particularly on the road sides and other open spaces. Demolition of these business premises does not deter owners from reconstructing them. They take the confrontation as an opportunity to challenge the government and urban authorities to give them alternative opportunities to generate livelihoods, devoid of "the obnoxious characteristics" objected to in the regularly harassed informal businesses. A similar challenge is appropriate for urban planners who object to UF because of its "visual untidiness". Harare, Zimbabwe has similar dilemma visibly demonstrated by the regular street skirmishes between the municipal authorities and fruit and vegetables vendors determined to sell their commodities in undesignated areas oblivious of other urban activities (Chip, 2001).

Resource constrained households in rural and urban area are not the only entities tapping the services of common pool resources without explicitly acknowledging their cost. Manufacturing industries for instance, discharge effluent into rivers or smoke into the air (negative externalities to other users) incurring no direct cost. Some large-scale farmers use cultivation method that discharge fertilizer, pesticides and herbicide residues leached through the soil into rivers and lake with negative effects. They are tapping on the capacity of the

environmental commons to absorb waste. Evaluation of their profitability and efficiency does not take these costs into consideration.

2.5 The role of UA in urban environmental management

According to IIED (2001c), the urban poor do not contribute appreciably to resource degradation, except perhaps in their own neighbourhoods, because unlike their rural counter parts, they have very little access to environmental resources. However, the urban poor are often exposed to high levels of environmental risks though poor quality and overcrowded housing, inadequate provision of water, sanitation, drainage, health care and garbage collection. The very large health burden that arise from these risks is also a major cause or contributor to urban poverty. Selective environmental improvements addressing some of these threats could therefore reduce the extent and depth of urban poverty considerably.

UA can reduce cost of waste collection, treatment and waste disposal, and facilitate environmental management through composting of organic waste (Bakker et al., 2000). Along side its beneficial products like food, money, compost and health impacts in terms of fresher, cheaper and more diverse food, especially for the poor, UA can be used to provide better sanitation and more green space in the cities for recreational value, well-being and improved air quality. In addition, UA is one of the tools of making use of open space, and managing freshwater resources more effectively by using domestic wastewater to safely irrigate selected crops. These products illustrate that UA can have additional value in public health and sustainable resource management. If crop production in UA is similar to rural farming, the cost of external inputs particularly inorganic fertilizers is likely to be a constraint. Similarly, continued use of inorganic fertilizer without organic inputs, as manure is detrimental to productivity in the end. Composting organic waste for UA reduces both constraints.

Characterisation of urban farmers as hypothesized in this study is one way of suggesting specific alternatives for UA to complement waste management objective in an urban area.

The link between urban environmental improvement and poverty reduction is sometimes explained in terms of The Green Agenda and The Brown Agenda. The link creates a niche for UA in contributing to benefits of urban environmental management, enjoyed by the urban residents in general. It also gives an opportunity for the city administrators to involve the residents and the private sector in enhancing urban environmental health. According to IIED (2001c), both Green and Brown Agenda focus on environmental problems but with different priorities. The Green Agenda seeks to have human activity reach a more harmonious balance with nature for the benefit of future generations. It advocates reduction of the negative impact of urban-based production, consumption and waste generation, on natural resources and ecosystems and in turn, on world's life support systems. These are commonly perceived as the environmental degradation concerns of affluent society, because urban poor groups generally have low levels of use for renewable resources. This is not from choice or lack of need, but because the supplies are inconvenient or too expensive (IIED, 2001b). For instance, the urban poor consume less fresh water, occupy less land, consume less food per person, and have diets that are less energy and land intensive, relative to middle- or upper-income groups.

On the other hand, The Brown Agenda focuses on the environmental health problems and burdens typically associated with poverty and are characteristic of cities in developing countries such as, poor sanitary conditions, overcrowding, inadequate water provision, air and water pollution and accumulation of solid waste. However, the available literature shows that the use of the two terms overlaps as in the following description of Ahmedabad city in India, and Dar-es-Salaam, Tanzania.

In 1995, an empirical assessment revealed that the ambient air quality in the industrial and dynamic Ahmedabad city was a major health risk to residents. Consequently the greening program was launched. UA, forestry, and other greening activities were initiated as strategies for sustainable city development. The objective of the municipal administration was to reduce air pollution with jobs and income generating activities that could attract investment from the private sector and residents. The activities included greening of roadsides and traffic islands, park and garden development and maintenance, regeneration of wasteland and restoration of vacant lots. The approach solicited participation and partnerships among citizens, civic organizations and private sector. These groups however required a guaranteed of adequate time to recover their investments in crops and trees grown. Therefore, the city administrators planned, approved and set aside land with adequate tenure duration for the greening initiative (Marulanda, 2000).

In 1992, Dar-es-Salaam become one of the eight cities in Africa to adopt and apply the environmental planning and management (EPM) approach in urban planning under the Local Agenda 21 and Habitat Agenda. Through EPM, UA was identified as one of the environmental issues to be included in the Sustainable Dar-es-Salaam Project. Working groups (formed with comprehensive representation of the wide range of interests found in the city) were set up to device strategies of ranking UA in the city agenda (Kitila and Mlambo, 2001; Mwalukasa, 2000). The Urban Agriculture Working Group (UAWG) addressed broad policy and structural issues among them; insufficient planning, financial services and access to extensions from ministries, loss of agricultural and green belt land to urban expansion, land tenure issues in relation to UA, potential urban development particularly in peri-urban areas, and water use conflict between UA and other urban users. The neglect of processing, marketing and extension needs of small urban livestock keepers and small urban farmers was underscored (Mwalukasa, 2000). The two examples support the premise of this study that

returns to the private investor is a key incentive if UA and other greening activities are to generate additional benefits to urban residents at large.

In the envisaged transformation and integration of UF with the rest of the economic activities (Figure 10), Stages I and II depend on private investor participation. The constraints in Stage I, the focus of this study, are likely to be different from those of the other stages. However, if they are systematically identified as hypothesised in this study they can form the basis of facilitating majority of households to move to Stage II where pursuit of the objectives of households in UF meshes better with those of city residents at large as pursued by city authorities.

2. 6 Land as an input in UF

Some of the sceptical views of UF are based on the notion that land suitable for farming is not available because urban areas are commonly perceived as consisting of continuously built environment. However, the notion is inaccurate because most cities, including those in highly industrialized countries, have open spaces where food can, and is often grown. Community gardens on empty lots are found in the urban areas of US and Europe (IDRC 1999). Moreover, the dynamic development of cities means that new spatial structures are created while others decay. Consequently, most cities often have a lot of (temporary) vacant open space that could be used for UA. For instance, in Dar-es-Salaam low density urban pattern and availability of open spaces in town is cited as one of the factors prompting UA (Jacobi *et al.*, 2000). Similarly, only 47% of municipal land in Addis Ababa, Ethiopia is built up and buildings are unlikely to take all the remaining land in the immediate future. The land can be allocated to UA according to assessed needs in the population, preferably through farmers' groups like cooperatives. Therefore, land is available in urban areas for UA. What is lacking is the official

recognition of that availability making access to that land the problem. Where national and local urban planners do not recognize UA as one of the legitimate land uses, the activity faces challenges of land availability, access and usability (Mubvami, et al., 2003).

Availability refers to the existence of land that can be utilised for UA in the short-, medium-, or long term. Making an inventory of available vacant land in the city is the initial step in enhancing availability. It involves collecting data using a combination of participatory methods and geographical information systems (GIS) followed by an analysis to determine land suitability for agricultural use. Such exercises were carried out in the municipality of Santiago de los Cabarellos in the Dominican Republic, (Abinader, 2001) Glen City, Gaberone and Botswana (Cavric and Mosha, 2001). In Dar-es-Salaam, one of the outputs of the Urban Agriculture Working Group under Local Agenda 21 and Habitat Agenda cited earlier was the strategic urban development plan framework designating special land zones for agriculture. The plan emphasized that in these area agriculture was not a transitory activity awaiting land uses considered permanent such as residential or industrial development. This was a major departure from the earlier ranking of UA. In addition, some strategies were identified to address existing constraints such as restructuring land access and land-use laws (Kitila and Mlambo, 2001).

UA cannot be sustainable unless it has access to suitable and adequate land within a favourable legislative framework. Accessibility of land refers to the opportunity for actual use of available land by households or groups, mediated through favourable legislative framework consisting of the actual administrative procedures and conflict resolution mechanisms. Accessibility as a requirement is not unique to UF because rural farming is also constrained by inappropriate systems of land ownership, tenure and land transfer, together with access and user rights.

The not-so-poor urban residents access land through holding formal titles as in private ownership. They also access municipal, state or institutional land through other informal means like lobbying or even corruption. The poor access land formally or informally through squatting, sharecropping, renting, leasing, inheriting through customary mechanisms or outright purchase. Claiming formal access to urban land is made difficult by long and unclear procedures. Municipalities are also often reluctant to give long-term land leases (Mubvami *et al.*, 2003 and Kiguli *et al.*, 2003). Therefore, farmers usually opt for alternative arrangements that are less secure. For instance, Nairobi bylaws only prohibit cultivation on public streets maintained by the city authorities (Lee-Smith and Memon, 1994). Therefore, the bulk of cultivation done by low-income households in areas that are not public streets is essentially legal but insecure because farmers have nothing they can show to back their legality claim. It could also be observed that city authorities have been unable to maintain the road clearance on many public roads in a visually tidy manner, making them appear like seemingly idle land and therefore target areas for UF.

The role of informal ties, networks, kinship, and information, is important as a strategy for informal access to off-plot land for UA. For instance, land is accessed through investing in social relations such as marriage, lobbying in groups with caretakers to lease land, and in some cases even occupying vacant land (Mubvami et al., 2003). As such, the very poor and those who have recently arrived in urban centres find it more difficult to access UA inputs, particularly land (Dennery, 1996). Farmers who have cultivated for longer periods have advantages of better access. For instance in Kibera, Kenya, some of them even grew fruit trees like paw-paw and cultivated parcels located on sites least attractive to private developers and were therefore less likely to be edged-out.

In many urban areas including Nairobi, urban boundaries have continued to expand to include hitherto rural agricultural land. The resulting peri-urban area is considered as the most freely available category of land for UA, because its access is determined by ownership patterns reflecting traditional and modern rules. In urban and peri-urban Kenya for instance, a common strategy for pre-empting land grabbing is to allow a relatively low income person informal cultivation rights pending development of the land parcel. However, it is not clear the extent to which this mode of accessing land is important to low-income households, and the extent to which different modes of informal access to land constraint profitability of UF.

Access to land for UA has five main problems (Mubvami *et al.*, 2003) and they are instructive to policy for the activity in Nairobi. First, most cities and towns have not zoned land specifically for UA. Dar-es-Salaam and Gaberone cited earlier are some of the few exceptions. Second, UA has not been incorporated in other social support programmes that yield positive benefits as public goods. Usually these programmes use community gardens to contribute to poverty reduction, facilitate local economic growth, create employment, support urban youth initiatives, or manage HIV/AIDS at the community level. Since UF has unexploited potential to contribute in these areas, government support to UF can be viewed as an innovative way of focusing on these objectives.

Third, the high demand for urban land for residential, institutional, commercial and industrial use means that UA is often out-competed and ends up in marginal areas with fragile ecosystems such as wetlands, hill-slopes or in boundaries of the cities where it is tolerated until displaced by other development ventures. A possible solution is to formulate policies that do not provide land for UA based on demand and supply on the open market, but on the important role, it plays in sustaining livelihoods, particularly of the urban resource poor as done in Dar-es-Salaam. However, the size of land parcels cultivated by low-income

households, for example in Nairobi, is not known and it is not clear if it is a major constraint to returns and efficiency as hypothesised in this study. The results would guide urban planning where land is deliberately set-aside for UA.

Fourth, lack of user rights for land or brevity of their duration limits the services and resources, such as finance, that UA can attract. The disincentive arises because in most cases government or municipality owns the land used, and in other cases, it is earmarked for future development. In Accra for instance, land is leased for short duration such as one year, and renewal is not secure meaning that the urban farmers cannot plan for longer periods. It is worth to note that recognition and in turn adequate duration of user rights was an important prerequisite for attracting participation by the private investor in the greening program of UA in Ahmedabad city, India explained in an earlier section (Marulanda, 2000). Five, access to land is limited further by contamination of soils and irrigation water. Land grabbing, corruption, and increasing land rent further aggravates the conflicts in land use, making conflict resolution mechanisms necessary. However, since land use and ownership disputes handled by the judicial system, in Kenya for instance are protracted, faster mechanism would be recommended for UA

The foregoing discussion of UF under access to land pinpoints some of the requirements necessary to enhance integration of UF as envisaged in Figure 10. Appropriate zoning of urban land would ensure that land with potential for UA is accessed with specified user rights to encourage invest even of borrowed funds. In the process of combining UA with other community initiatives, problems faced by special groups, such as women, would be more easily identified. During zoning, concerns emanating from potential use of contaminated water and soils would be addressed with a view to pre-empting them. Consumer confidence would be boosted and production targeting specific markets would be enhanced. This is a

crucial component in the transformation of the activity to become a business as envisaged in Stage II.

Usability of the land for UA is determined by several factors. Some of them influence accessibility as outlined in the foregoing discussion. For instance usability is determined by security of tenure or ownership, size and previous use of the plot; planned city development; proposed urban farming system including potential competition from groups interested in the activity. Water supply and its usability is closely linked to usability of land. Use of contaminated water for irrigation poses potential health risk, but on the other hand, it contains nutrients reducing the need for external inputs. Topography, soil quality, texture, fertility and moisture content are components of environmental quality determining usability. It is not clear the extent to which variables related to usability of land such as irrigation and size of land parcel cultivated are important in influencing UF returns and efficiency among low-income households.

The foregoing account suggest that UA is caught up in a vicious cycle in that if land is available, access is denied, and if land is available and accessible, it is unusable (Mubvami, et al., 2003). One option of breaking the vicious cycle is to amend the legal frameworks to recognise agriculture in the city, so that it becomes a legitimate activity able to attract resources to develop it. It is noteworthy that most by laws of UA tend to control the activity rather than facilitate and develop it. Innovative ways can be found to improve access to land and other resources and examples exist. For instance, there are temporary arrangements for community gardens in eThekweni[5], South Africa (Leech, 2003).

[5] This is the new name for metropolitan Durban. The council had zoned-off large tracts of public land on the western side of the city for different developments that failed to take off due to lack of finances. It allowed them to be cultivated as community gardens by groups. They must observe certain conditions such as, the group must be organized under chairmen and they have to comply with the set gardening regulations in the region. The

In Rosario, Argentina, (Dubbeling, 2003) the municipality has ordinances allowing community run UA gardens on public and private land. For public land, temporary user permits are obtained from the relevant authority. The private land owners are encouraged to "give" their land to the municipality for a period of two years and in turn be exempted from paying property land tax. Even though in urban Kenya cultivation of urban land pending construction type of development by low-income residents is common, the available literature did not reveal any study focussing on the user rights and constraints of such urban farmers. This study will reveal whether this form of access to land is important to urban farmers from low-income households.

The case of Dar-es-Salaam shows how the constraints of land availability, accessibility and usability in UA and can be resolved and workable options for integrating the practice with other economic activities. The starting point as pointed out earlier is official recognition of UA as a permanent activity in urban land use, linking a wide large of functions that need policy, facilitation, regulation and a specific agency to charged with responsibility of fostering it. For instance, Mlozi (2003) cites ten national polices supporting UA in Tanzania. In particular, the national human development policy of 2000 states that the government shall do the following to facilitate UA: designate certain areas in the city, set regulations, conduct research, review existing laws and establish infrastructure need to prevent or mitigate its possible negative effects. One of the first initiatives was the Urban Agriculture Working Group (UAWG) formed to address broad policy and structural concerns as explained earlier in section 2.5. It is instructive to policy makers in neighbouring cities like Nairobi to note that a major policy change was in acted because the group produced a strategic development plan framework designated special zones for UA on a permanent basis. Furthermore, the wide

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council in turn is required to give six months notice to the gardening organizations if and when the land is required for alternative development and assistance them to move to another place.

range of participants in the practice and their specific constraints was acknowledged. including special needs of small urban farmers (the focus of this study) and small livestock keepers (Mwalukasa, 2000). The group captured the essence of the transformation and integration process envisaged in Figure 1 because it included strategies to; pre-empt potential conflict, ensure sustainable resource use, increased profitability for individual farmers from intensive use of inputs and to contribute positively to the urban environment. They included: restructuring land access and land-use laws; popularising farming technique for intensive land use, floriculture and tree planting; moving large livestock to peri-urban areas where fodder production is viable, composting urban waste and biogas production; reclaiming previous quarry sites; irrigation from wells and boreholes; developing aquaculture where appropriate; and rehabilitating previously existing city horticultural gardens. The group also targeted various additional UA strategies. (1) Information campaigns through the mass media, workshops, seminars and reading material. (2) Additional economic incentives such as encouraging private land owners and institutions to allow temporary use of their land by UA, affordable livestock expense including insurance coverage, feeds, extension and veterinary services. (3) Long term investment as in processing of dairy products, irrigation and water storage facilities. (4) Enforcement of regulations in view of public concerns related to livestock keeping in densely built up areas, tariffs for water use in UA, urban waste management, as well as protection of water catchments and flood plains. The coordination of the stakeholders including the ministries mandated with use of the stated resources was underscored as crucial in the implementation of stated strategies (Mwalukasa, 2000) a function best carried out by a specific agency administering UA.

2.7 Financing UF

The foregoing account has emphasized lack of formal recognition and security of user rights for adequate duration as constraints in UF because they limit capital investment possible through financing among other problems. For instance, lack of user rights or brevity of their duration precludes substantive planning and financing in Accra (Mubvami, *et al.*, 2003). In Dar-es-Salaam, lack of financial services was highlighted as one of the main constraint to UA (Mwalukasa, 2000). In Kibera, Kenya, lack of inputs was noted as the most limiting factor for UF particularly for new residents. The Undugu Society initiative in a slum area in Nairobi succeeded because it combined access to land with the technical information and initial capital assistance. Similarly in some cities in West Africa, men dominate in city open space farming and specialize in the more profitable temperate vegetable production partly because, unlike women, they can afford the substantive capital investment required in external inputs, transportation and storage facilities (Kessler, *et al.*, 2004: Obuobie *et al.*, 2004). Therefore, for UF to be sustainable it must not only be officially recognized, but it must also have financial backing (Dubbeling and van Veehuizen, 2003).

UF is not the only activity limited by financing. The Habitat Agenda of 1996 acknowledged limited access to credit as a constraint to adequate shelter and income generating activities by the urban poor. Consequently, it sorts the commitment of governments in the activities of UN Habitat targeting sustainable urban land-use patterns. Appropriate gardening and UA were highlighted as examples of those activities. Some urban administrators like in the case of Ahmedabad city in India cited earlier, also acknowledge that partnerships with the private sector in programmes for greening the city required not only enough time but also secure tenure of adequate duration to leap returns on the investment made.

Lack of capital and financing jeopardizes sustainability and returns of UA particularly by resource poor farmers because they are unlikely to invest in farming technologies that conserve resources such as soil and water. In turn, they are unlikely to produce profitable high value crop and livestock products, with adequate returns for basic needs and savings to investment in UF. A vicious cycle of low productivity, low savings and investment and in turn low productivity is perpetuated by lack of capital.

Lack of information on the requirements for an effective credit scheme for UA is also a constraint in financing UA because the little information available is based on anecdotal evidence (Dubbleling, 2003). The Support Group on Urban Agriculture (SGUA) in New York made a similar observation in 2001 and concluded that information on credit and investment programmes for UA was needed because it was as key to more systematic focus on UA credit and financing globally.

To shed light on UA credit and investment needs, 11 case studies were undertaken globally in 2002, including four cities in SSA, Nairobi, Zimbabwe, Khartoum and Gaborone. Savings, subsidies and micro-credit were found to be the three main mechanisms best suited for UA financial support. Dubbleling and van Veenhuizen (2003) point out that if UA is viewed as part of the formal economy, then in principal, it should be self-supporting. This characteristic is envisaged in Stages II and III in the transformation of UF (Figure 10). However, if UA is understood as part of the social economy contributing to the environment and to the community, then these benefits justify external support or subsidy given to the activity. It could be done through municipal budgets for social support programmes involving UA and imparting public goods, benefits as explained earlier in an earlier section. The municipal governments also need to show their strong commitment to UA by facilitating credit, financial policies and instruments, tailored to its specific needs (Dubbleling and van Veenhuizen,

2003). This was one of the recommendations in the Quito Declaration of April 2000 signed in Ecuador by the Latin American City Working Group on Urban Agriculture and Food Security, representing 40 cities in the region.

2. 8 Gender in UA

The commonly held view is that more women than men engage UA because they still bear the responsibility of sustenance and well being of households, and their lower education status makes it more difficulty for them to find formal wage employment (Mougeot, 1996; Freeman, 1991). But Wilbers et al., (2004) in a review of gender and urban agriculture found that involvement of men and women in UA is country specific. For example, men dominated open space urban farming other than traditional vegetable production, in most West African cities (Obuobie *et al.*, 2004; Kessler et al., 2004). On the contrary in Eastern and Southern Africa, there are more women in UF than men. The crucial question addresses by this study is whether the constraints and difference in performance of UF are gender based reflecting different constraints in access to opportunities and resource in a particular context (Wilbers *et al.*, 2004 citing Hovorka,1998). Such differences might be important enough to warrant specific policies and programs to ensure the envisaged transformation and integration of UA by women.

The versatility of UF enables it to respond to different gender roles. For women UF enhances food security independent of market fluctuations. Within the household level, it increases their independence because a woman's money is spent on priorities of her choice. In West Africa cities women unlike men, specialize in marketing of temperate vegetable or in growing indigenous vegetables because they; require minimal capital investment, use skills and technology passed on at home through generations, allow them to cultivate less suitable pieces of land close to the residence where they can also sell and attend to chores, generate a

continuous stream of income thorough early and multiple harvesting, and requires less strenuous work (Kessler et *al.*, 2004; Obuobie *et al.*, 2004). UA also allows women to earn income from a culturally acceptable activity, which in turn improves their bargaining power in intra-household conflicts (Wilbers et al., 2004). In Addis Ababa, women as underprivileged heads of households could also join UF vegetable growing cooperatives since no special skills were needed (Egziabher, 1994). A study of farmers growing food on previous dumpsites in Kampala found that women were the majority on these sites with contaminated soils (Nabulo *et al.*, 2004). Men unlike women on these sites, grew crops with longer shelf life hence transportable over long distances. These examples illustrate that gender is one of the key tools in unravelling the complexity of UA. They support the conclusion by Wilbers et al., (2004) that research, policy and action should focus on both men and women with as view to harnessing both the differences between the two groups and the diversity within them, to design more appropriate and relevant interventions. One of the key questions in meeting this objective is how gender explains differences in profit and efficiency as hypothesised in this study.

In gender analysis there is need to separate access to and control over productive resources such as land, credit, labour and information, from access to and control over the benefits resulting from that production (Wilber *et al.*, 2004). Social–cultural and economic conditions control both components. They also control the type of risks women are able and are prepared to take and determine the roles and responsibilities of men and women within the households. These interactions can only be unravelled if gender analysis becomes mainstream in research possibly in two stages as suggested by Hovorka (2001). First, research is needed to obtaining information on who, what, when, where and how urban systems function with regard to gender dynamics. It will reveal the variety of experiences, needs, interests and access to opportunities and resources of both men and women. In the current study, the qualitative analysis based on

gender will address some of these questions. Second, research is needed to determine the factors influencing the differential opportunities and constraints for men and women at local, regional and global level, in order to identify the factors that keep women in disadvantaged position. The objective is to provide empirical basis for policy, plans programmes and support initiatives needed to enhance opportunities for women in UA. By identifying the factors influencing profit and efficiency of UF by gender, the current study will contribute towards the goal of the second stage of gender analysis in UA.

2.9 Public health risk and UA

Municipal authorities and state officials have remained wary and sometimes even hostile to UA due to actual and perceived health and environmental risks (Baumgarter and Belevi, 2001). The concerns are justified because the aim of public health is to promote well being, prevent diseases and disabilities, and to enhance quality of life. These constitute the physical, mental and environmental health concerns of communities and populations (Baumgarter, and Belevi, 2001).

It is instructive to consider the major sources of health risk emanating from UF with a view to suggesting possible ways of eliminating them. One source of health risk is uptake of heavy metals from contaminated soils, water and air. The main heavy metals include lead, cadmium, chromium, zinc, copper, nickel, mercury, manganese, selenium and arsenic. There are three main causes of soil pollution from heavy metals; (1) industrial refuse can contaminate fresh or wastewater used for irrigation in UA; (2) oil spills and industrial waste on previous industrial land will contaminate subsequent crops; (3) application of contaminated solid waste products to soils will contaminate crops grown. Some heavy metals for instance, precipitate in sewerage sludge resulting in relatively high concentrations (Lock and de Zeeuw, 2003). The heavy metals accumulate in the edible parts of the crops eaten by people and animals.

None-the-less, the uptake of heavy metals varies with different type of plants and soil pH, and different amounts accumulate in different parts of the plant. This feature avails opportunities of choosing the type of crop depending on the degree and type of potential contamination. For example, Lock and de Zeeuw (2003) point out that leaves have the highest accumulation of heavy metals whiles seeds have the least. Crops like beans, peas, melons, tomatoes and pepper show very little uptake of heavy metals.

In addition to crop selection and restriction, health risk problems can be addressed through; testing of agricultural soils and irrigation water for heavy metals, treatment of wastewater, as well as adoption of appropriate irrigation and management practices to control human exposure (Baumgarter, and Belevi, 2001). For instance, to reduce contamination of crops by lead and cadmium from exhaust fumes of vehicles, a minimum distance is recommended between crop fields and main roads. An alternative would be to plant boundary crops along the roads. Washing and processing of contaminated crops may effectively reduce heavy metal content such as lead in green beans, spinach, and potatoes. Some soil treatment, such as application of lime, increases the pH and in turn decreases the availability of metals. Application of farmyard manure reduces heavy metal content of nickel, zinc and copper. Plants such as Indian grass (Brassica juncea, L.) when planted in hydroponics beds can be used for biological remediation of polluted soils or streams. However, more research is needed on chronic health impacts of heavy metals.

It is imperative for policy to note that the pollutants of soil, water and air that find their way into UA products come from other processes of urban production and consumption and would exist and be harmful even without UA. In urban areas where environmental issues take centre stage from the pressure exerted by urban residents, industrialists do not discharge effluents into rivers and dump sites or spew effluent laden smoke into the air unbridled.

Pollution fines and standards prevent them from exploiting the urban commons as a free receptor for waste as argued in an earlier section. The upshot of this argument lack of regulations, inappropriate regulating mechanism or improper functioning of mechanisms established sustains some of the contaminants of UA produce. The issue has to be addressed with or without UA. Concerns from the urban resident will increase as the environmental health risks; sources of pollution and policy failure become commonplace. In an earlier section, environmental health in an urban area was noted as one of the features that tip the balance in competition for business investments.

Contrary to the alternatives outlined above, the common reaction to concerns of public health is to ban the UA. However, prohibiting laws do not seem to hinder people from engaging in UA (Baumgarter, and Belevi, 2001). On the contrary, practising UA without or with limited support can increase the health risks. It is therefore imperative that health and safety concerns be systematically integrated in UA. The result will be reduced risks particularly for urban farmers, their families and consumers. The envisaged transformation and integration of UA with the rest of the economy is based on consumer confidence in its produce, particularly on health risk concerns. One option would be to create an agency to oversee and facilitate the UA as an industry. It would act as watchdog for compliance with laid out standards on health risks. It would also spearhead research to inform policy in this area.

Lock and de Zeeuw (2003) point out a number of specific area that need more research to inform policy. (1) Environmental conditions under which health problems related to UA occur in terms of characteristics such as type of agriculture, farm management practices, and characteristics of location need to be identified. (2) The most vulnerable groups to those impacts and the socio-economic factors explaining their vulnerability have to be identified . (3) The factors restricting urban poor from engaging in less risky agricultural and food

practices need to understand. 4) Resources and technical capacity available in cities to implement mitigating policy measures for health risks require and accurate assessment. It is not clear if the farmers themselves perceive health risks as constraints in UA. It is easier to put appropriate measures in place to remove an already perceived constraint .

2.10 Irrigation in UF

In the last two decades or so, there has been considerable interest in the international community in developing sustainable resource management strategies for urban and peri-urban environments in developing countries. To this end, the FAO established an interdepartmental programme on the subject of urban and peri-urban agriculture in 1999. Cities Feeding People program of IDRC of Canada was started in 1993. Despite these interests, the supply of quantitative information to guide technical and policy decisions have been outstripped by demand. In particular, evidence on the nature of irrigated UA was lacking. The observation motivated the study by Hilde and Kimani (2000) to identify the nature and extent of peri-urban irrigation in Nairobi. Respondents were sampled from 20 km radius of the city centre. They found that over 3,700 farmers carry out irrigation on 2,000 hectares in over 55 separate locations. They concluded that the majority of the irrigation was truly peri-urban in nature because it was strongly influenced by the city in term of source and quality of water, land tenure, and marketing.

Sources of irrigation water used by farmers were varied; rivers and streams (56%), raw sewerage water (36%), and piped city council water (6%). Land was owned by 31% of the farmers, 19% were renters, while 39% squatted on government or city council land. The remaining 11% were also squatters but were reluctant to admit it. The primary constraint to irrigated UF was water. Availability of inputs, loss through crop damage and theft, including lack of labour were cited as additional constraints. Even though lack of land, credit and

markets were thought to be the major problems, they were ranked lowest relative to lack of water. This is instructive to policy because these farmers did not use any credit and they did not view access to land as a constraint even though about 50% of them were squatters. By focussing on the nature of urban farming, this study will find out if the conventionally perceived constraints to productivity and efficiency of low-income urban farmers, as basis bases for policy and programs, are refuted or supported by empirical evidence.

2. 11 Wastewater reuse in UA

Urban waste is considered as one of the most serious and pressing urban environmental problems (Baumgarter and Belevi, 2001). However, it appears that the main objective of most cities is to get rid of the waste giving little attention to the possibility of using it as an asset. Exceptions exist however, because it is estimated that 10% of the world's wastewater is currently used for irrigation. Some cities such Santiago (Chile) and Mexico City reuse 100% of their wastewater for irrigation. In South Africa, about 15-20% of the wastewater is reused in agriculture.

UA occupies a special niche in urban waste management because it has substantive potential of reusing urban solid and liquid waste thereby contributing to overcome the waste problem while saving resources (Baumgarter and Belevi, 2001). Wastewater use in UA is a step towards improved water management for sustainable agricultural production because competition for water with urban household and industrial use is reduced. For example, Tanzania's National Urban Water Agency is reported to have expressed strong opposition to UA because farmers illegally leak fresh drinking water estimated at about 35% of the total supply (Baumgarter and Belevi, 2001). It is noteworthy that about 80% of the land area in Kenya is arid or semi arid. Therefore, water is a constraint to sustainable livelihoods from agricultural production in these areas because it cannot be accessed in a cost effective

manner. In contrast, wastewater is available even during periods of droughts; its use would allow food production and the accompanying benefits, such as food security to continue through out the year.

However, if wastewater is not properly used it can be a threat to public health by contaminating soil and groundwater. In developing countries the biggest threat to public health from reuse of wastewater are diseases caused by helminths (roundworms, hookworms and guinea worm), followed by microbial pathogens, particularly when untreated wastewater is used to irrigate vegetables or salad crops eaten raw (Faraqui, 2002). Wastewater has also some toxic components, particularly sodium, chloride and boron. The main negative effects of wastewater use on soil are increased salinity and reduced permeability; pores are clogged by grease in the water. Contamination of ground water in shallow aquifers is likely from microbial pathogens and nitrates in wastewater. Thus, urban administrators are bound to incur cost of disposing-off wastewater safely whether or not it is used in UA. From this perspective UA can be a tool to achieve objectives of wastewater management and those of food security, jobs, income and sustainable urban environment.

The problems of wastewater reuse in UF are can be overcome because WHO in 1989 produced health guidelines suggesting ways of overcoming them. They guide policy makers in determining the appropriate wastewater treatment processes and in selecting suitable crops and irrigation methods (Blumenthal, 2001). For instance, the practice of restricted irrigation targets crops such as cereals, industrial crops, fodder, pasture or trees and excludes; crops likely to be eaten raw, sports fields and public packs. Irrigation should cease two weeks before date of picking and fruits on the ground should not be picked to reduce human exposure to contamination. In a similar manner, crops, soil, surface and groundwater areas most sensitive to contamination by wastewater need to be determined and excluded from this

specific source of irrigation water. Faraqui, (2001 p.21) stresses that *"Even the most stringent treatment levels in the WHO guidelines can be met by a series of wastewater-stabilization ponds"*.

These considerations would mesh well with the exercise of zoning urban land for specific types of UA as explained under land accessibility. The guidelines single out sprinkler irrigation as inappropriate irrigation method with wastewater. It may even be too capital intensive for farmers described in Stage I of UF transformation. It is not clear if farmers from low-income areas of urban Kenya are aware of the health risk of using contaminated water for irrigation. If they are aware, it is not clear if they have the incentive and the means to use safer alternatives. This is part of the nature and problems of UF practice as perceived by farmers targeted by this study. Determination of awareness and incentive precede evaluation of the options available for overcoming the problem in a manner affordable by the farmers. It is notable that majority of women found cultivating previous dumpsite with contaminated soils in Kampala stated that they were aware of the health risk. Thus, they did not consume the produce in their own homes but sold it and bought alternative foodstuffs for their households (Nabulo *et al.*, 2004).

2.12 Urban solid waste management and UA

Solid waste is also another of the serious and urgent environmental problems facing cities in developing countries. The ubiquitous garbage heaps in Nairobi for instance, underscores the problem and the inability of the municipal authority to cope for various reasons. Rapid urban population growth rate has overwhelmed existing infrastructure, which is not expanded or kept in repair because revenue collection is hampered by the informal unplanned congested settlements, and the little collected is used for more urgent expenditure, such as salaries for a bloated labour force.

Municipal solid waste (MSW) of large cities in developing countries typically consists of 35-70% organic waste (Furedy, undated). Organic waste represents a major challenge to MSW management for various reasons. They decompose, their nature and quantity has seasonal variation, they are usually mixed with non-biodegradable wastes, and there are practical difficulties in marketing compost products. Household kitchens generate the largest proportion of raw and processed waste. Other sources of MSW are gardening, urban agriculture, park and road maintenance, livestock keeping, and food processing. Bulk generators of raw wastes are green markets, parks, stables, and slaughterhouses and food processing industries, while large hotels and institutional kitchens are bulk producers of processed waste.

Baumgarter and Belevi (2001) point out that composting and reuse techniques, including use for animal feed, fuel and in construction, have been documented in Africa and Asia going back for a hundred years. Currently use of decomposed biomass in food and plant production in agriculture, horticulture, forestry and aquaculture is the means by which the greatest amount of urban organic wastes is reused. Therefore, UA has considerable potential in reusing MSW and in the process contribute to waste management and saving on resources. Peri-urban dairy and pig farmers around Nairobi and its environs for instance, constitute a high demand for raw and processed waste. This is an example of UA as a business contributing to urban waste management as envisaged in Stage II of the transformation process.

In low-income areas such as Maili Saba in Nairobi, livestock feed comes from farming activities and the local hotels. Since livestock farmers buy animal feed from farmers, sell milk to local families and finally sell manure to crop farmers, the nutrient cycle is complete (Richards and Godfrey, 2003). Thus, Maili Saba is likely to be one of the best examples of waste and nutrient recycling in an urban setting. However, in this case health concerns from

keeping livestock in close proximity to people has too be harmonized with the waste management benefits. The observation by Richards and Godfrey (2003) indirectly suggests crop productivity and hence UF returns to farmers keeping livestock is different from that of farmers not keeping livestock as hypothesized in this study.

Composting (the controlled decomposition of organics by numerous micro-organisms) is the preferred method of processing organic wastes. However, as pointed out by Furedy (undated), large scale composting of urban organic solid waste (UOSW) is constrained by various factors. For example, composting is expensive and therefore unattractive option relative to the low-cost open dumping currently used to dispose-off most UOSW in cities of developing. Small-scale compost plants run by nongovernmental organizations and community based organizations in some neighbourhoods, sometimes with the assistance of municipal councils in form of land, are financially unfeasible because they lack technical knowledge and the price for the small amount of compost produced is too high. In Nairobi, UNCHS has supported such a composting project. Success of composting UOSW in the long run depends on separating the organic waste from other waste at source, a task considered difficult and laborious. Households and institutions lack the incentive to do the separation and urban waste managers have not found incentives to motive them. It is also not clear if composting of organic wastes reduces the health risks substantially as asserted because decomposition needs high temperatures ($60^{O}C$), and several weeks of maturation to kill pathogens.

It is further argued that most cities in Africa have not developed the institutional context for management of urban solid waste. For example, Nairobi has experience an upsurge of private garbage collecting firms since the 1990s even though the city council still levies a charge for garbage collection in the monthly water bill. Is not clear where and how they dispose–off the

collected garbage. This tallies with the observation of Furedy (undated) that, rules governing competing actual and potential uses of UOSW are lacking, policies and programmes determining socially-responsible reuse are not in place, and stakeholders, such as urban and peri-urban farmers, are not recognized. This study will find out if composting of any scale characterise urban crop production by farmers from low-income areas and the contribution if any as an input in the activity, with a view to highlighting the potential role of UA in UOSW management.

2.13 Urban livestock keeping

In Nairobi, large livestock may be kept only with written permission, but small livestock can be kept unless someone complains of a nuisance (Lee-Smith, 1994). Livestock keeping is common in low-income urban areas. The example of Maili Saba given in the previous section underscores the important role livestock can play in completing the nutrient cycle through organic waste and nutrient recycling in an urban setting. A small portion of farmers in Maili Saba grew flowers for export and kept dairy cows, suggesting that farming can be a profitable activity in the area. These are the kinds of farmers in Stage I of UF transformation process depicting characteristics of moving to Stage II. The constraints delaying the transformations need to be backed by empirical evidence as challenge to policy.

A scoping study of livestock farmers in eight urban and peri-urban slum areas of Nairobi carried out in 2002 by Natural Resources International (NR International. 2002) found that the average age of livestock keeper was just below 40 years, one third had no formal education and none had reached university level. One third of them worked in the informal sector. Two thirds of the households were male headed and livestock was reported as jointly owned and controlled by both spouses. One third of the households were female-headed. Local goats and sheep were the most common because the initial investment required was low and therefore

affordable; they involved less work than pigs, which were perceived as "dirty"; and the returns were good since their demand was high.

The study identified a number of main constraints faced by poor urban livestock keepers likely to have impacts on urban residents and city management. (1) Health risks from inappropriate animal waste management will increase with increasing livestock numbers. (2) Competition for highly priced piped municipal water between animals and people prompt livestock keepers to use water from alternatives sources that are usually contaminated increasing risk to health. (3) Since the cost of vaccination and veterinary drugs are high their use is sub-optimal compromising animal health, productivity and returns. Chicken, pig and duck keeping is particularly vulnerable to disease (4) Low productivity is caused by lack of feed and control over what scavenging animals eat. It is compounded by poor and low quality management practices. Poor livestock farmers have limited knowledge of appropriate livestock husbandry practices. (5) They lack the skills to organize collective action to articulate their needs to urban authorities in a concerted manner. (6) They also lack access to information, research and extension services. The services that could be available are not focused on their unique situation and constraints. In particular, livestock keeping in these areas is challenged by secure land tenure, limited space, capital and feed, theft of livestock and unfavourable legal and institutional framework.

Since urban livestock practice has continued and increased in importance for the poor despite these challenges, NR International (2002) concluded that its positive effects on livestock keepers outweigh the negative aspects. The scope of this study does not include analysis of economics of livestock production. However, it will determine if returns and efficiency of urban crop production by low-income residents is different between those who keep livestock and those who do not.

2.15 Overall cost and benefit implication for UA

The underlying assumption in the notion of sustainable cities is that municipal authorities can spearhead the vision and implementation of a functional urban environment in all it components as explained in the foregoing explanation. and device incentive strategies for the urban residents to participate. This tallies with the economic principle that there are functions more efficiently carried out by the government as an economic facilitating agent while other are best left to the producers and consumers with appropriate incentive even in the era of liberalization. In the UA context as exemplified in the foregoing discussion, some of these functions are; zoning of the urban area, planning of the green space and for amenity component of the urban environment and above all wastewater and solid waste management. The response of the urban farmer as a producer would be invest private capital at different levels of technological sophistication to harness the opened up opportunities for food, income and employment, while for others it would be competitive business opportunities.

Carrying out these functions involves cost but ignoring them, as is often the case has cost as well in term of opportunity cost. The choice of the type of cost to incur among the two rests with municipal management. The cost incurred by not performing the functions is less manageable because it is indirect and incurred by the individual and the public in terms of more expenditure on health, loss of work from morbidity, and lower quality of life from poverty and deprivation. Indirect cost is incurred when potential investor are put-off by unsightly garbage heaps which reveal fundamentally dysfunctional urban centre unable to uphold a lead role in the region is often overlooked. On the contrary, the option of actively performing these functions means that the costs can be; planned and budgeted for, incurred in phases, and evaluated against accruing benefits. UA based activities and their synergies can develop to an industry that earns substantive tax revenue for the municipalities.

CHAPTER 3

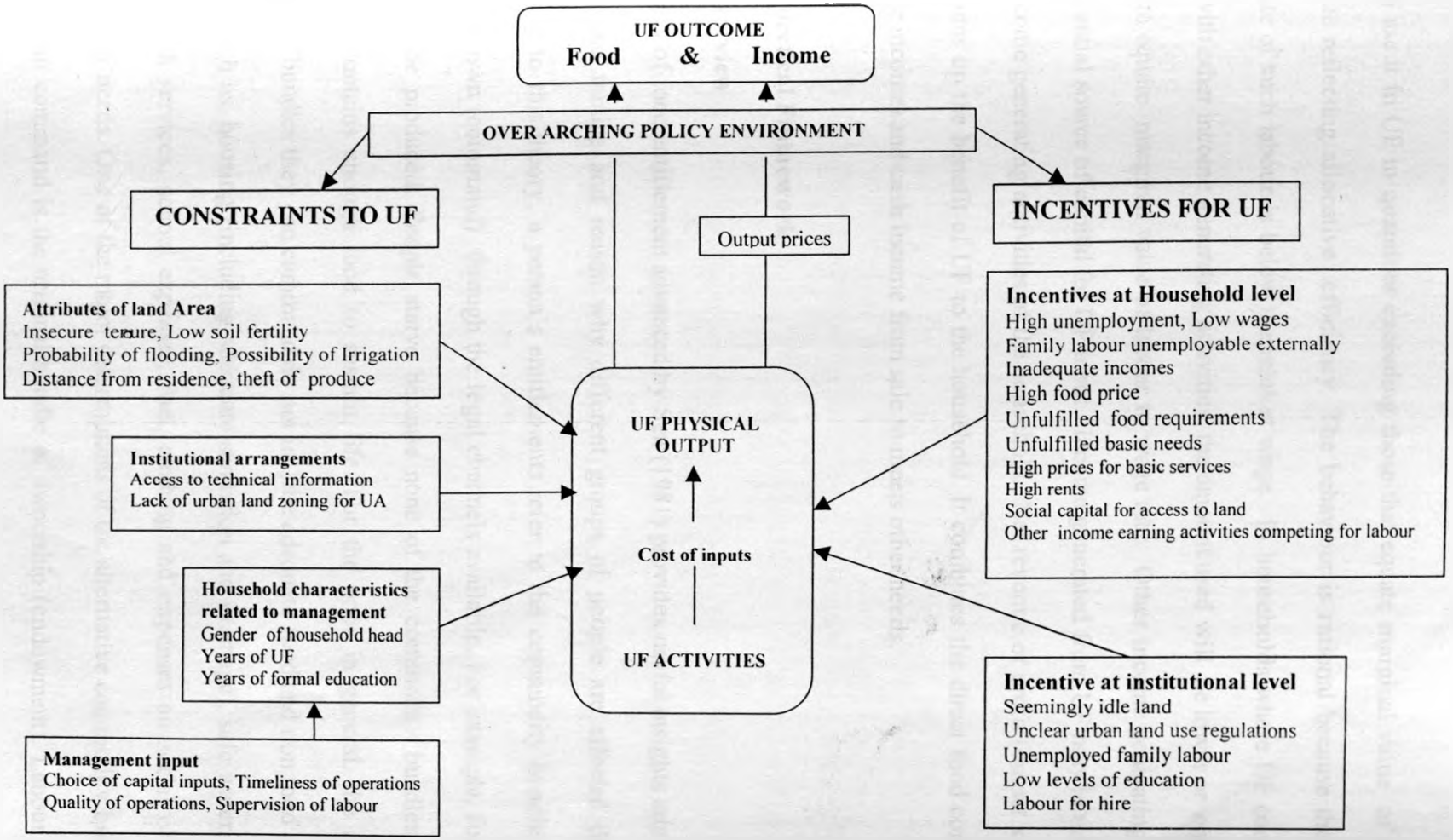
3.0 METHODOLOGY

3.1 Conceptual Framework

The conceptual framework shown in Figure 11 articulates the relationships among hypothesized variables in the economy of a low-income urban household engaged in UF. It underscores inadequate incomes, food and other unfulfilled basic needs, and seemingly idle land, as the factors prompting UF as a production activity of households. Access to land is mainly thorough social capital facilitating identification of exiting farmers or seemingly idle land deemed appropriate for cultivation. The effect of land on the physical output obtained from UF, and hence profit, goes beyond area cultivated to include characteristics of actual location of the land parcel, including security of tenure, inherent soil fertility, probability of flooding, access to water for irrigation, security of produce from theft, distance from the residence, which in turn influences length of time taken to walk to the land parcel, and ease of transporting harvested output. Competence in managing the activity works through choice of capital inputs, timeliness and thoroughness of field operations and supervision of labour. Institutional arrangements are likely to influence management through formal education and access to technical information. Years of urban farming, conjugal or non-conjugal type of household are other socio-economic characteristics of households likely to influence management and in turn technical efficiency.

UF coexists with self-employment and formal employment as other alternatives of generating income. These activities absorb labour and others like self-employment may compete for capital. Households with excess labour or labour not acceptable in alternative activities are

Figure 11: Conceptual framework of the economy for an urban farming household from low income areas[6]



[6]Descriptive analysis will be used for the interactions not represented in the mathematical model.

likely to use it in UF in quantities exceeding those that equate marginal value of labour to wage rate reflecting allocative efficiency. The behaviour is rational because the effective wage rate of such labour is below the market wage. In households where UF competes for labour with other income generating activities, the amount used will be lower or equal to that needed to equate marginal value of labour to wage rate. Other income generating activities are a potential source of capital for UF input. Income generated from UF may in turn support other income generating activities of the household. Net revenue or profit (output x price less costs) sums up the benefit of UF to the household. It combines the direct food consumption (fungible income) and cash income from sale to meets other needs.

3.2 Theoretical Framework

3.2.1 Overview

The theory of food entitlement advanced by Sen (1981) provides useful insights into causes of poverty and famine and reason why different groups of people are affected differently. According to this theory, a person's entitlements refer to the commodity bundles one can make their own (command) through the legal channels available. For example, food can be bought or be produced. People starve because none of the commodity bundles they can command contains enough food to sustain life. For the poor in general, the alternative commodity bundles they can command do not include adequate food and non food goods and services such as. housing (including adequate sanitation and drainage), safe water, transport costs, health services, school expenses, fuel, clothing and expenses on social obligations, among other needs. One of the major determinants of the alternative commodity bundles that a person can command is the original bundle of ownership (endowment). Labour power or ability to work is most basic endowment for people. However, if employment is not available, wages are not earned to buy food and other basic needs, then there is entitlement

failure. Other exchange entitlements are tradable goods, production, transfers, and inheritance. Own land for food production (or renting) is another type of endowment. If the endowments are not adequate for basic needs and alternatives social security arrangements such as unemployment insurance are not available, as is the case in most developing countries, the result is deprivation and chronic poverty as in the urban areas.

This study took the view that UA on the urban commons can therefore be viewed as one of the means households use to increase their initial endowment. By combining urban land with household labour (not absorbed by more lucrative activities), entitlement is increased in the form of own production for consumption or for sale. Part of the risk of cultivating the urban commons is that crops will be destroyed following municipal directives in a bid to discourage or even wipe out the activity, or even theft. It appears, at least in Kenya, that this is a business risk taken by those operating livelihood-generating activities on the urban commons, such as roadsides and other open spaces, but it does not deter them because they re-start their businesses almost immediately after the event. This study aimed at making a contribution by comparing income generated from UF with that from other activities, for possible evidence to guide policy on use of the urban commons for livelihood generating activities where other opportunities are scarce.

Transportation cost is one of the factors used to explain the economic rationale of location of specific types of production. One such theory, attributed to von Thuenen, maintains that location and accessibility of the site determines agricultural rent and land use. The notion of a market centre surrounded by concentric rings constituting the producing area, is used to underscore that transportation cost increase directly with the distance from the centre, determining the absolute and relative profitability of agricultural production in the

surrounding area. The net price farmers receive is market price less transportation cost from farm to market (Katzman, 1974). The von Thuenen theory is used to explain how improvement in transport infrastructure can spur agricultural development by expanding the production frontier in an existing area, even without change of production technology. For instance the opening of the Suez Canal and development of the steamship in the late nineteenth century, reduced transportation costs significantly between Europe and Asia. The result was a dramatic increase in rice production for exports from Southeast Asia, using existing surplus land and labour (Hayami and Ruttan, 1985). This theory supports the view that ready market for produce and low transport cost relative to similar produce from the rural areas are key incentives in UF. The cost saved on transportation is part of net revenue (profit) to the farmer and forms part of the entitlement. It is therefore instructive for policy to determine the constraints likely to hinder low income households from exploiting the potential offered by price differential, that otherwise works to their disadvantage in the form of high food prices.

In UA, land from the urban commons and unemployed family labour are unexploited resources which form part of the incentive to respond urban-rural price differential. It is likely to persist and increase for various factors. (1) Increasing urban population will be accompanied by increasing demand for food in the urban area. (2) Productivity in the rural area will also continued to decline as a result of low soil fertility and reduced use of external inputs, particularly improved seed and fertilizer. (3) Unfavourable institutional factors such as the collapse of cash crop processing and marketing cooperatives aggravated lack of external inputs in some areas. For instance, they used to provide credit as input-in-kind often benefiting production of food crops. With the collapse of the cooperatives, produce markets became more inaccessible to resource poor farmers. (4) Prices of basic foodstuffs in the

urban areas generally increased after removal of price controls in the 1980s disadvantaging urban consumers. (5) Transportation cost of food to urban areas can be as high as 90% of the overall food marketing margin due to factors such as: inappropriate handling and packaging, frequent stops and delays on the road for police checks, including arbitrary charges at check points, among others (Argenti, 2000). Poor quality roads increase transportation cost from frequent vehicle repairs and high maintenance cost, aggravated during the rainy season.

Technical efficiency by UF farmers partly determines the contribution of the activity to the quantity and quality of the bundle (food and non-food goods and services) they can command. Technical efficiency is the maximum attainable level of output possible from a specific quantity of inputs, given the range of alternative technologies available to the farmer (Ellis, 1988). Technically more efficient households produce more UF output than their counterparts from the same amount and quality of entitlement (labour, capital and land from the urban commons). Identifying possible sources of technical inefficiency in UF among the socio-economic groups is a step towards increasing the benefits of the activity.

In describing the objective of production by rural farmers, utility and profit maximization are viewed as competing hypothesis. But a divergent view is given by Upton (1973, p.92) pointing out that:

> *Indeed some would argue that the main objective of subsistence producers is survival rather than the maximization of the surplus of benefits over costs. However, the two are not necessarily in conflict; the greater the output a family produces with its limited resources or the lower the cost a family incurs in producing a given output, the more is that family able to survive poor cropping seasons and other catastrophes.*

Therefore this study took surplus of benefits over cost in UF (net return or profit) as the driving force in UF (and key variable in the analysis Figure 11) irrespective of its ultimate

use as food for direct consumption or cash income from sales or fungible income, through which the household accesses other goods and services.

Costs and benefits of UF to individual households are more tractable if expressed in money value. The prices ruling in the local markets can be used to attach a value to purchased inputs and opportunity cost of inputs provided directly by the farming family, including the produce it consumes, in all situation where opportunities of earning an income exist (Upton (1973). As stated earlier, UF has a ready market and opportunities exist for some UF households to earn income from other sources. As was stressed in chapter 1, increase in UF activities correlate with increase in grim economic conditions, often characterised loss of formal employment and higher prices for food and basic services. Therefore in this study, market wage rate were used to value labour input, and prices of food were used to value output sold or consumed by the household.

Use of the non-market channels to meet household needs is common in the rural areas and the concept of own production as household income has rather a wide range of application. For instance, Yang (1999) found that all rural households used firewood but only 24% of them purchased it. That is, nearly three quarters of households in rural Kenya depend on collected firewood. For 90% of these households firewood was obtained within a radius of two and a half kilometres or less meaning that they obtained it from their own farms or neighbouring sources including markets and the rural commons. The study concluded that "w*hen firewood is obtained via non-market channels it forms part of the household income"* (Yang, 1999 p. 201). Thus, food generated by UF and consumed by the household was considered as part of the household income and included as part of the benefit of the activity.

Profit is realised by the owner of the firm (farm) when revenue (benefits) exceed total costs. Profit is the return to the owner of the enterprise after paying for all the explicit costs (hired labour and purchased inputs), and all the implicit costs (labour and capital supplied by owners). This definition of profit makes the assumption that resources used in production are purchased or owned by the farmer. No reference is made to use of resources from the commons for production probably because unlike in UF (on land not owned by the farmer), land is the basic capital input provided by rural farmers. Profit can also be considered as the residual return to the owner of the firm (farm) for providing capital and for bearing risk (Pass and Lowes, 1988). Since most UF by low-income households is on land not owned by the farmer and rent is not paid, then the profit generated is essentially a reward for taking the risk by going into production. UF by low income households is on off-plot location implying that the usual risk from variation in weather and change in prices is aggravated by theft of produce or clearance from municipal authorities.

In rural farming, studies focusing on the role of risk in decision making are justified on the basis that attitudes to risk determine diffusion of innovations and in turn, the rate of rural development (Moscardi and de Janvry, 1977). These studies have sought to identify the specific determinants of risk behaviour and to quantify their effect on decision making. The objective was to contribute to developing technologies and development programs fitting different risk attitudes of groups of farmers. Safety-first rule is one of the economic models used to incorporate risk in decision making. Essentially, it stipulates that farmers manage resources at their disposal with the objective of ensuring that the returns generated are adequate to cover subsistence needs. However, the methods used to quantify risk aversion of individual small scale farmers are fraught with difficulties. Some researchers such as Dillon and Scandizzo (1978) used direct methods where farmers' risk attitudes were assessed by

asking them to choose between *"hypothetical but unrealistic farm alternatives involving risky versus sure outcomes"* p.427. This approach is criticized for various reasons (Moscardi and de Janvry, 1977). (1) The notion of gambling and probability cannot be assumed to be intuitively clear to small scale farmers. (2) Gambling is the method used to reveal risk preferences for the respondents. However, farmers are known to have different degrees of utility or disutility for gambling. It worthwhile to note that 80% of the sample farmers in the study by Dillon and Scandizzo (1978) had never entered a bet or a lottery and 30% regarded gambling as immoral. (3) The method is also very time consuming even for farmers familiar with the notion of probability Lin *et al.*, 1974). To overcome some of these problems Moscardi and de Janvry (1977) suggested a alternative specification of safety-first rule whereby the risk-aversion parameter can be empirically determined from production functions of specific crops. However, data are unlikely to be available for determining production functions for all the crops grown in UF. Since one of the objectives of the study is to characterize urban farmers from low income areas, risk aversion is one of those characteristics. Rather than ask farmers direct questions on risk preferences as in the study by Dillon and Scandizzo (1978), ranking of factors that generate losses in UF was used as a proxy of risk faced by individual households.

It was stated earlier that urban farming is combined with other livelihood generating activities, each of which contributes to ensure that the subsistence needs are met. Intuitively, farmers have to ensure that given the household constraints of labour and capital, they allocate them between these activities such that the sum of their individual contribution or net return covers as many subsistence needs as possible. For this reason maximizing surplus of benefits over cost, net return or profit, as the contribution from UF, is not contrary to targeting adequate return to cover subsistence needs. In any case it is one of the plausible behaviour

options for the household and justifies choice of the profit model for the analysis. How accurately it describes that behaviour is an empirical question and an implicit hypothesis in this study.

The safety-first rule as a guide for production decision-making in rural households assumes that subsistence needs are derived from farming, and that farming can meet these needs. However, results from a study of 1,540 rural farmers from 24 districts grouped into nine agro-ecological in Kenya for the 1996/1997 season, showed that 39% of the household income came from crops, 24% from livestock, and 39% from non-farm activities (Argwings-Kodhek at al., 1997). The same study showed that 61% of rural household were net maize buyers in spite of growing the crop. Intuitively, the incentive for rural households in combining farming and non-farm activities is not only to ensure net returns adequate for subsistence needs but also to earn livelihoods above subsistence level. It stands to reason that analysis of any one of those activities alone, using safety-first criteria, will not yield an accurate view of the household dynamics in earning livelihoods. A detailed analysis of other livelihood earning activities of low-income UF households was beyond the scope of this study but noted as a follow-up study. However for this study, income earned from non farming activities was hypothesized as influencing net returns from UF acknowledging their contribution in meeting the basic needs of the household.

3.2.2 The Profit Function

The two main models used to analyse economic efficiency in farm production are the profit function approach and the traditional or direct production function approach. There are number of advantages of the profit function over the production function. First, profit maximization is a testable hypothesis within the profit function framework but a basic

assumption in the direct production function approach. Therefore, the profit function model facilitates testing the hypothesis of profit maximization. Given a set of prices of the variable inputs and quantities of the fixed factors of production, profit maximization is one of the rules firms use to make decisions (Lau and Yotopoulos, 1971). An allocatively efficient farmer maximises profit by using the amount of variable input, which equates the marginal cost to marginal revenue. If it could be shown that some farmers do not maximize profit in UF because they use variable input such as labour, in amounts exceeding the optimal quantities, then it is plausible these households engaged in the activity to absorb labour that has limited alternatives to generate net cash and in-kind income. Therefore, the profit function framework facilitates evaluation of the different objectives of urban farming. The different objective would be part of the characteristics of the households and may, explain variation if any in the profit generated from the activity. Second, the profit function model can be used to analyse technical and allocative efficiency as components of economic efficiency. The traditional production function model on the contrary can only measure the technical efficiency component of relative economic efficiency (Yotopoulos and Lau, 1979). It is therefore less desirable for this study.

Third, the profit function framework facilitates analyses where farm output is composed of various commodities because profit may be computed as the weighted sum of the money value of different farm outputs. Since urban farmers in low income areas grow a variety of crops, it is anticipated that the total revenue from all the crops captures the output of the activity more accurately than the physical output of specific crops measured in different units.

Fourth, the profit function framework also allows composite inputs to be defined so that the specification of variables is a compromise between the ideal and the feasible (Yotopoulos and Lau, 1979). Therefore, the analyst can define the variable depending on data availability and institutional setting unique to the study. For instance, a variable input composed of seed and chemical fertilizer can be defined and its price computed as the weighted sum of the price of the two components. The fixed input Khan and Maki (1979) termed "capital" was the sum of the costs of fertilizer, seed, irrigation water and power. Since low income urban households in general use relatively small quantities of inputs and spend minimal amounts on specific inputs like fertilizer and pest control materials. It was rational to aggregate these costs to constitute a composite variable termed "capital".

The versatility of the profit function has been demonstrated by various studies. It has been used to determine efficiency in the allocation of variable factors such as labour, seed, fertilizer, herbicides, animal and mechanical input. It has also been used to compare relative efficiency among different groups of farmers such as those defined on the basis of socio-economic characteristics such as gender, farm size, technology, tenancy or socio-economic change over time. The same profit function framework has been used to determine: shadow prices of fixed factors of production such as land, capital and the optimal farm size as indicated by economies of scale (Adesina and Djato, 1997, 1996; Khan and Maki, 1979; Lau and Yotopoulos, 1971, 1972; Sidhu and Baanante, 1979; Aludavidhaya *et al.*, 1979; Somel, 1979; Lau *et al.*, 1979a and 1979b).

In particular, Adesina and Djato (1997, 1996) used the profit function to compare relative efficiency between men and women as farm managers, and the effect of farm size on efficiency among rice farmers in Côte d'Ivore. Since rice in West Africa is considered a

woman's crop, its production shares common objectives with UF, that is, generating food or money for food and cash income for other needs. The analysis based on farm size used five and ten hectares as thresholds to define small and large farms, because the available literature showed that the threshold area defining "small farm" varied depending on the study. Defining "small" and "large" plots in UF is likely to be more elusive. Since there is no previous research to provide *a priori* criterion, it cannot be determined before the actual area cultivated per household is known.

Somel (1979) used the profit model to compare relative economic efficiency between improved and traditional wheat production technologies in Turkey. The author notes that limits of cultivable land have been reached in Turkey particularly for wheat. It was the only study found in the available literature where land in rural farming was measured in decares (one decare = 0.1 hectares) attesting to relatively small farm sizes. For the same reason decares is a reasonable unit for area cultivated in UF. Increasing yield (per unit area which is a component of technical efficiency) in wheat farming in Turkey was stated as an urgent policy option. The author observes that Turkish farmers are more interested in increasing profit rather than increasing yield since they operate in a commercialised environment with increased use of purchased inputs. This means that the inputs, including labour, have an opportunity cost in alternative use. If urban farmers operate in a commercialised environment, it is plausible that their objective in farming is to maximize the net return (profit) rather than output. However if some labour available in the household cannot be absorbed in alternative use, then it is rational to use it to maximize UF output. These differences can be identified by testing for allocative efficiency for different socio-economic groups of farmers using the profit model.

Jamison and Lau (1982) used the profit function to analyse the effect of education on profit and how the effect was influenced by the interaction of farmer characteristics and education. The regression for the profit function was run *"for every possible combination of education and characteristic variables, such as education, age, sex, access to agricultural extension, and availability of credit,..."* p.105. The procedure was deemed necessary to guard against portraying only the empirical results of the particular regression somehow selected by the researcher as is commonly done. However, the basic independent variables stipulated by economic theory were included in all the regressions. The education variable was given alternative definitions. For example, average education for the household was defined as the average number of years of education of all farm household members between the age of 17 and 60 years. This was taken as an indicator of the quality of management. Seventeen years as the lower age cut off would be unrealistic because household members of less than 17 years participate in UF activities as is commonly the case in rural farming. Recalculating the average years of education with the head of household excluded from the group gave a proxy for the quality of the workforce. Clearly the two variables have a large component in common. Education was also defined as the maximum education of either head of household in years as a continuous and as a dummy variable with several categories. Following Jamison and Lau (1982), education of the household head and spouse in this study was defined both as a continuous and a dummy variable. In sum, the literature cited makes a strong case for using the Lau-Yotopoulos profit function model to determine the factors explaining variation in UF profit and to compare efficiency among different socio-economic groups of low income households in the activity.

3.2.3 Economic Efficiency in Farm Level Production

Differences in relative economic efficiency at farm level production can be split into three

components, which are: technical efficiency, price (allocative) efficiency and the set of effective market prices facing the individual producer (Lau and Yotopoulos, 1971). A firm is more technically efficient than another only if, given the same quantities of measurable inputs, it consistently produces larger output (Lau and Yotopoulos, 1971). A firm that is price-efficient by definition is one that maximizes profit, that is, one that equates the value of the marginal product of each variable input to its price. However, different farms may face different sets of effective prices. For example, some households may have additional sources of income enabling them to store own UF produce for off-season consumption when food prices are high. In this way, they realise higher effective prices for their output. Those cultivating large areas are less likely to incur complete losses from floods, pest attack or theft. Farmers who have been in the activity for a longer period are likely to have acquired over the years, more productive land parcels or those less prone to floods and theft of produce. In the UF context, the influence of these factors may be taken to illustrates some elements of the "socio component of economic efficiency".

3.2.4 The Functional Form of the Profit Model.

The theoretical basis for empirical profit model specification is given by Lau and Yotopoulos (1971, 1972). It assumes an underlying Cobb-Douglas production function with decreasing returns in variable inputs (Equation 1) Tests of alternative functional forms indicated that it was superior (Lau and Yotopoulos, 1971, 1972).

$$(1) \quad Y = A \prod_{i=1}^{m} X_i^{\alpha_i} \prod_{i=1}^{m} Z_j^{\beta_i}$$

where[7]

Y = output

X_i = quantities of variable inputs

[7] The definition of a variable will be consistent across all equations therefore variable definition once stated will not be repeated in subsequent equations

$\alpha_i > 0$ (output elasticity with respect to a variable input X_i)

Z_j = quantities of fixed inputs acting as a scale factor

$\beta_j > 0$ (output elasticity with respect to a fixed input Z_j)

The requirement for decreasing returns in variable input is given by

$$\sum_{i=1}^{m} \alpha_i < 1$$

For clarity of the general case, assume a production function

$$(2) \qquad V = F(X, Z)$$

Given the price of output (p) the profit maximizing firm equates the marginal value of output to price of the variable input (c_i). This can be shown by taking first-order conditions for profit maximization with respect to variable input (X_i)

$$(3) \qquad p \frac{\partial F(X, Z)}{\partial X_i} = c_i \qquad i = 1, \ldots, m$$

which can be written in the following manner after deflating (normalizing or dividing through) with output price (p)

$$(4) \qquad \frac{\partial F(X, Z)}{\partial X_i} = \frac{c_i}{p} = q_i \qquad i = 1, \ldots, m$$

where q_i is the normalized price of the i^{th} variable input. The demand for the variable input by a profit maximising farm can be solved for from the equation 3 as

$$(5) \qquad X_i^* = f_i(q, Z) \qquad i = 1, \ldots, m$$

X_i^* is the optimal quantity of the i^{th} variable input.

The restricted profit is written as the total value of output minus the total cost of the variable inputs of production; it is the net return to fixed factors of production. It should be note that the term "restricted" serves to emphasize that the profit is return to fixed inputs obtained after deducting *only those costs of the inputs defined as variable for that particular study. All other costs are lumped together as fixed costs.* For this reason it is sometimes referred to as the partial profit function. The restricted profit function can be written in the general form as

$$(6) \qquad \pi = p(F(X,Z) - \sum_{i=1}^{m} q_i X_i)$$

By substituting equation 5 into 6 the restricted profit function can be rewritten as

$$(7) \quad \pi(q,Z) = p\left[F\{f_i(q_i Z),..., f_m(q,Z),Z\} - \sum_{i=1}^{\bar{m}} q_i f(q_i,Z)\right]$$

The resulting normalized restricted profit function (π^*) is given as

$$(8) \qquad \pi^* = \frac{\pi}{p} = G(q, Z) \qquad i = 1,..., \quad m$$

According to Lau and Yotopoulos (1979), if the underlying production function assumed is Cobb-Douglas, the normalized profit function takes the same form that is

$$(9) \quad \pi^* = A^* \prod_{i=1}^{m} q_i^{\alpha_i^*} \prod_{j=1}^{m} Z_j^{\beta_j^*}$$

which on taking logarithm and simplifying gives

$$(10a) \qquad \ln \pi^*(q,Z) = \ln A^* + \sum_{i=1}^{m} \alpha_i^* \ln q_i + \sum_{i=1}^{m} \beta_i^* \ln Z_i$$

in general terms but if labour is the only variable input and capital and land the fixed input then Equation (9) can be written as

$$(10b) \qquad \ln \pi^{*}(q,Z) = \ln A^{*} + \alpha_1^{*} \ln q + \beta_1^{*} \ln K + \beta_2^{*} \ln T$$

Since the profit function is connected to the underlying production function, applying Hottelings-Shephard's Lemmas and differentiating the normalized profit function with respect the normalized price of the i[th] variable input gives the corresponding factor demand

$$(11) \qquad \frac{\partial \pi^{*}(q,Z)}{\partial q_i} = -X_i^{*} \qquad i = 1,\ldots, m$$

Multiplying both sides of equation (11) by $-q_i/\pi^{*}$ gives a series of *m* factor share equations corresponding to the number of variable inputs in the model

$$(12) \qquad -\frac{q_i X_i^{*}}{\pi^{*}} = \frac{\partial \ln \pi^{*} q_i}{\partial \ln q_i} = \alpha_i \qquad i = 1,\ldots, m$$

Equation (10b) and (12) are the basic estimating equations in the restricted profit model. The α_i in these two equations is crucial because absolute allocative (price) efficiency is established by showing that they are equal.

However, use of the restricted normalized profit function requires data on output prices to normalize prices of variable inputs. The data are often lacking or poor for example in the current study, maize output was measured in volume using cans available in the household and kale was measured in bundles. The weighted price for the combined output of these two commodities would be elusive. The flexibility of the profit function framework allows rewriting of the restricted normalized profit function in terms of restricted profit and wage rate expressed in money terms (Lau and Yotopoulos, 1972; Kahn and Maki, 1979) for

example shillings. Subsequently, the weighted unit price of the combined output is no longer needed for normalizing. It should be noted that the factor demand function (Equation 12) is independent of the output price. Equation 8 allows rewriting of the profit function as

(13) $$\ln \pi^*(q,Z) = \ln \pi - \ln p$$
$$= \ln A^* + \alpha_1^* \ln q - \alpha_1^* \ln p + \beta_1^* \ln K + \beta_2^* \ln T$$

or

$$\ln \pi^*(q,Z) = \ln A^* + (1-\alpha_1^*) \ln p + \alpha_1^* \ln q + \beta_1^* \ln K + \beta_2^* \ln T$$

If it is assume that different socio-economic groups of farmers may access different output price then a dummy variable is introduced in place of the expression $\{\ln A^* + (1-\alpha_1^*)\ln p\}$ which also allow the efficiency parameter to vary with the economic group. The function can be written as

(14) $$\ln \pi^*(q,Z) = \alpha_0 + \delta_i^* D_i + \alpha_1^* \ln q + \beta_1^* \ln K + \beta_2^* \ln T$$

Where

δ_i = economic efficiency parameters for socio-economic groups of farmers

D_I = dummy variables foe socio-economic groups of farmers

All other variables are as defined earlier

Khan and Maki (1979) specified the non-normalized profit to determine the effect of farm size on efficiency for two regions in Pakistan. Wage rate was defined as variable input and land and capital as fixed inputs. A dummy variable captured differences in large and small farms. Profit was defined in rupees (physical quantity of output x price of output) minus (number of man-days of labour used x wage rate per man-day), summed over all crop activities on the farm. Earlier studies of Lau and Yotopoulos (1971, 1972) applied the same specification to determine differences in relative efficiency between large and small farms, and to estimate profit, supply and demand functions for Indian Agriculture. Dummy variables were included to capture possible variation in prices of output across different states.

Deriving from these studies, the non-normalized profit function used in this study was specified in money terms. All inputs owned by the household were valued at market prices. The general specification of the estimating equation was the profit function (15) in the log-linear form and the labour demand function expressed as wage share equation (16) shown below:

$$(15) \quad \ln \pi = \alpha_0 + \alpha_1 \ln W + \alpha_2 \ln T + \alpha_3 \ln K + G_i D_{Ai} + e_1$$

$$(16) \quad -\frac{WL}{\pi} = \alpha_4 D_{Ai} + \alpha_5 D_{Bi} + e_2$$

where

α_0 = intercept of the profit function

α_1 = marginal value of labour in the profit function

W = weighted average wage rate in shillings per man-day computed as the weighted average of the wage rates reported for hired labour and family labour (W2W2) as explained in Appendix 1

α_2 profit elasticity with respect to land

T = area of land cultivate in square metres (the dimensions of the plots were physically taken)

α_3 profit elasticity with respect to capital

K = value of composite working capital in shillings, computed as the sum of the cost of seed, chemical fertilizer, manure and crop protection materials.

G_i = economic efficiency parameter for socio-economic groups of farmers for: area cultivated, access to technical information, type of households (conjugal or non-conjugal), years of formal education, years of UF, and other income earned, respectively

D_{Ai} dummy variables for socio-economic groups taking the value of 1, large area, access to technical information, non-conjugal households, seven or more years of formal education, above average years of experience in UF, other income exceeding average amount earned, respectively and zero for the counter part

e_1 = disturbance term in the profit function

L = units of labour input used, computed as sum of man-days of family and hired labour

D_{Bi} counter dummy variables for socio-economic groups taking the value of 1, respectively, for small area, no access to technical information, conjugal households, less than seven years of formal education, less than average years of experience in UF, less than average other income earned respectively and zero for the counter part

e_2 = the disturbance term in wage share function

The first objective of the current study was to characterize urban farmers from low income areas. An important characteristic of UF as a production activity is the profit households generate from it and the factors influencing it. The profit function (14) modified to exclude

the economic efficiency parameter as shown in equation (17) and estimated without the wage share equation (Model 1) contributed to achieving this objective.

$$(17) \quad \ln \pi = \alpha_0 + \alpha_1 \ln W + \alpha_2 \ln T + \alpha_3 \ln K + \sum_{i=1}^{n} \beta_i H_i + e_1$$

where π, K, T and W are specified as in Equation (14) and

H_i = variables describing different farmer's characteristics hypothesized to influence profit from UF

A similar model was used to analyse the effect of farmer's education on farm efficiency by Jamison and Lau (1982).

The profit function (15) estimated jointly with the wage share equation (16) - was used to test for differences in economic efficiency between households (Model 2). Each factor hypothesized to affect efficiency was taken at a time and the households were divided into two groups. For example, conjugal households were in Group A and non-conjugal households were in Group B. Tests of hypotheses were achieved by imposing restrictions to parameters in equations (15) and (16) and testing them as shown in Table 1.

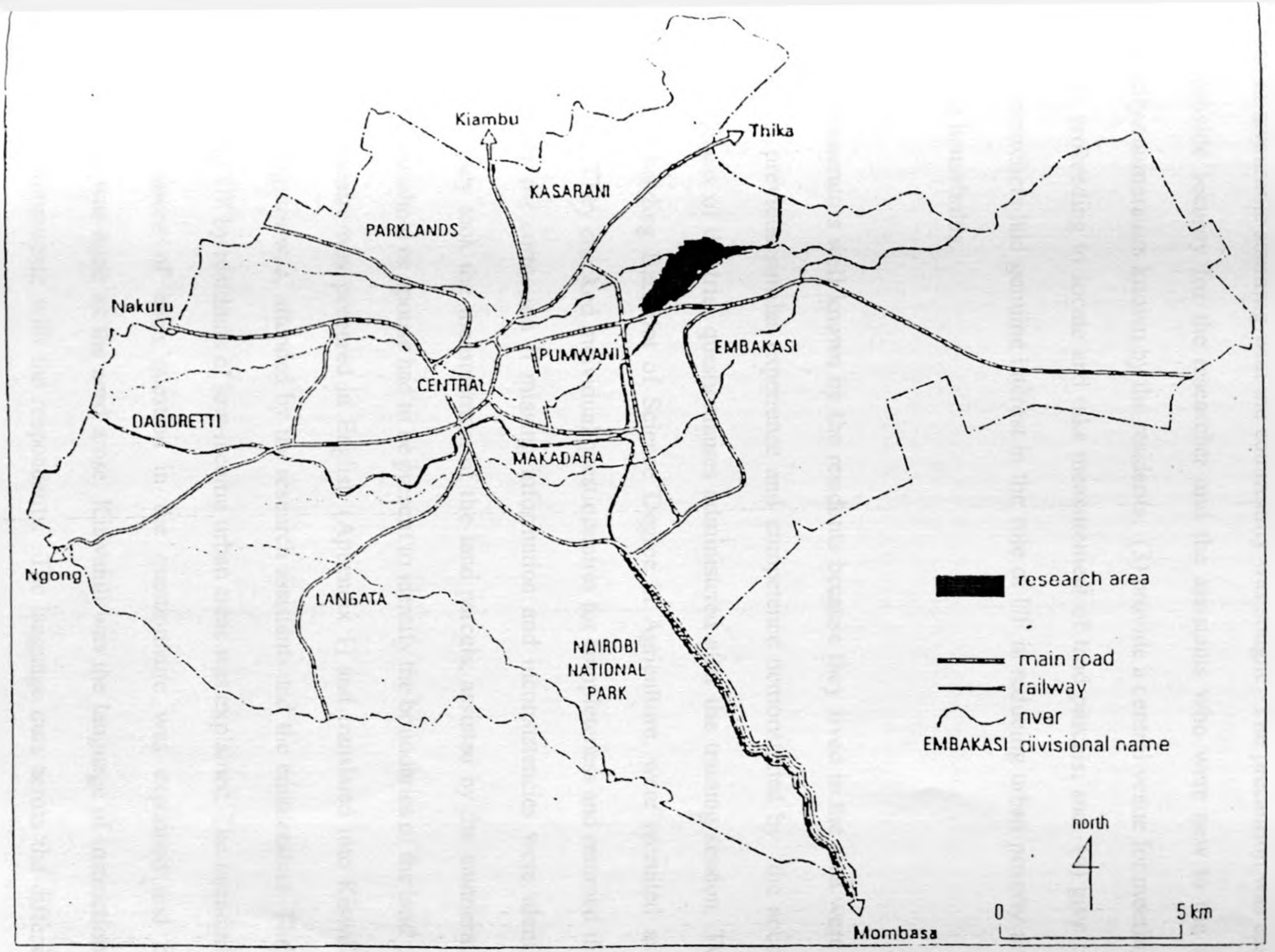
Table 1 Tests for differences in economic efficiency between hypothesized socio-economic groups of UF households.

Hypothesis No	Null hypotheses of differences between Group A_i and Group B_i	Restriction placed on parameters
1	Economic efficiency of Group A_i is equal to that of Group B_i ,that is, technical efficiency and price efficiency tested jointly are equal.	$G_1 = 0$
2	Price efficiency of Group A_i is equal to that of Group B_i, that is, the two groups equate the value of marginal product of labour to the wage rate to the same degree.	$\alpha_2 = \alpha_3$ that is $\alpha_2 - \alpha_1 = \alpha_3 - \alpha_1$
3	There exists equal relative technical efficiency and price efficiency (tested jointly) between the Group A_i and Group B_i	$G_1 = 0$ and $\alpha_2 = \alpha_3$
4	Farmers in Group A_i have absolute price efficiency, that is, they equate the value of marginal product of labour to wage rate.	$\alpha_2 = \alpha_1$
5	Farmers in Group B_i have absolute price efficiency, that is, they equate the value of marginal product of labour to wage rate.	$\alpha_3 = \alpha_1$

3.3 The Study Area

Korogocho is a low income area located eight kilometres from Nairobi's central business district (Figure 12). It borders Mathare/Githurai River and Kirindundu Estates to the north and Kariobangi North Estate to the west. To the east, it borders Nairobi River and to the

south, Dandora Estate (Mwangi, 1995). The dwelling structures are unplanned and very crowded. Most of them have walls made of mud, and the roofs made of iron sheets. The footpaths are very narrow and the main roads are not tarmacked, such that during dry weather they are very dusty and during the rains they are impassable with mud. Goats and chickens roam around freely. The city of Nairobi had 26 slum settlements by 1994 (Osiemo, 1994). Korogocho was selected among them for three main reasons: (1) Korogocho is considered a typical low income residential area in Nairobi (Mwangi, 1995); (2) Korogocho has a population of about 75,000 (World Vision, 1990 cited by Mwangi, 1995) therefore, its size and population is manageable for survey purposes compared to other more extensive low income areas such as Kibera, the largest low income residential area in Nairobi with over quarter million residents (Osiemo, 1994); (3) the study by Mwangi (1995) found a reasonable number of residents are urban farmers meaning that they had access to land, although it was not clear how land was accessed and where the plots were located. If Korogocho is considered a typical low income residential area in Nairobi, then nature of UF and the behaviour of UF households in the area is likely to be characterise low income household involved in the activity. It will shed light on the constraints limiting returns from the activity and possible relative differences in technical and allocative efficiency among different socio-economic groups likely to suggest ways of improving the contribution of the activity to the basic need of urban low income households in general. The focus of this study was the urban farming by the poor. Since low income residential areas are deemed to be occupied by the poor, it was rational to select the sample of respondents from such an area and let them reveal the diversity of the location of the land parcels they cultivate



Source: Matrix Development Consultants , 1993 cited by Mwangi, 1995

Figure 13 Map of Nairobi

3.4 Data Collection Procedure

Following the advice of researchers who had collected data from low-income areas in Nairobi, the assistance of a non-governmental organization, with on-going work in the area, and in favourable standing with the community was sought. The precaution was essential to: (1) provide security for the researcher and the assistants who were new to the area, (2) identify enumerators known by the residents, (3) provide a central venue for meeting farmers before proceeding to locate and take measurement of land parcels, and (4) give credibility that researchers had genuine interest in the role of UF in reducing urban poverty among low income households.

Five enumerators well known by the residents because they lived in the area were selected, based on previous similar experience and competence demonstrated by the accuracy and completeness of the trial questionnaires administered after the training session. Two recent graduates holding Bachelor of Science Degree in Agriculture, were recruited as research assistants. They checked individual questionnaires for completeness and returned them to the enumerator for correction if missing information and inconsistencies were identified. In addition, they took the measurement of the land parcels, assisted by the enumerators. The head of household or spouse had to be present to identify the boundaries of the land parcel(s). A questionnaire was prepared in English (Appendix 1) and translated into Kiswahili. The training program was, attended by the research assistants and the enumerators. The rationale of studying UF by residents of low-income urban areas was explained. The intended meaning and implications of each question in the questionnaire was explained and discussed. Rephrasing was done as the need arose. Kiswahili was the language of instruction and was used to communicate with the respondents. The language cuts across the different ethnic groups in urban areas of Kenya, and is the commonly used language in low-income residential areas of Nairobi.

Since urban farmers are not formally censored and listed, obtaining a sampling frame was a major challenge for this study as experienced by other researchers in the past. To overcome the problem, Freeman (1991) sampled respondents from people actually found carrying out farming activities in the open spaces of Nairobi. Since the focus of the study was UF by households in low income areas it is not clear if farmers identified by this strategy would have met the objective. Mwangi (1995) randomly selected 3 villages in Korogocho and listed all the households. Only 30% of the households were identified as farming households. Even though 70 farming and 70 non-farming households were randomly selected as respondents for the study, the final sample included only 48 and 67 households, respectively, owing to problems of inaccurate responses and high drop-out rate of respondents.

For this study, the approach used by Mwangi (1995) was applied in a modified manner guided by a number of concerns. A census was undertaken to identify the farming households (the sampling frame) in the eight villages constituting the low-income area known as Korogocho. Each enumerator was allocated a village where she was known by many residents and was familiar with the village layout. Roads, footpaths or open drains separate villages. Most of the housing in the area consists of dwelling structures built by individual owners on plots identified by plot numbers. Many of the structures are constructed around an open courtyard so that the doors are accessed through a common entrance. The enumerator visited each plot and established from the residents, the households cultivating land in Nairobi. Even with repeated visits, some households were not identified as farming or non-farming either because nobody was at home at the time of the visits or because they declined to disclose that information. In this manner, 404 farming households were identified. Two villages had the lowest number of identified urban farmers, each with 21 farmers, while the village with the highest number had 111 farmers. For the farming households, the residential plot number,

the house number and whether the household was headed by both father and mother (conjugal) or headed by mother alone (non-conjugal) were recorded.

One of the determinants of sample size in a study is the amount of variation of key variables in the population. The larger the variation, the larger the minimum sample size deemed adequate to capture the variability in the population (Casley and Lury, 1982). A priori basis was lacking from the available literature to estimate the extent of variation in key variables to guide determination of sample size. Therefore, for each village, the identified farming households were stratified according to whether the household was conjugal or non-conjugal as stated in the census. Then, a random number table was used to select approximately 1 out of every 4 households for each stratum. The result was an initial sample targeting approximately 102. Out of the 102 households targeted, 92 were successfully interviewed and measurements of land parcels cultivated taken to determine the area.

Training of enumerator and data collection, including taking measurement of land parcels, was carried out between May and August 1998. The interviews were conducted using a structured questionnaire (Appendix 1) detailing general household characteristics, motivation for UF including problems and constraints experienced. Farming inputs and yields details were listed for long and short rains seasons of 1999 including respondent estimated market prices to value crop yield. Other information bearing on UF included: type of assistance needed most by households in UF, methods used to stake a claim to land parcel(s), fall-back alternatives when money to buy food ran out, intensions of increasing land area cultivated and methods proposed for doing so, number and type of livestock kept, the time during the week when household head, spouse and other household members performed UF activities.

3.5 Problems Encountered During Data Collection

Taking measurements of the land parcels to determine the areas was the most challenging part of the survey for several reasons: many households had more than one parcel of land scattered in different locations, well away from the residential area; the boundaries between land parcels could not be identified without the help of the head of household or spouse; flooding from the El Niño made some entire land parcels and parts of others inaccessible; and the irregular shapes of the land parcels increased the time required to take measurements. Each land parcel was roughly divided into approximate rectangles and triangles and measurements taken using a measuring tape. Applying the fact that a triangle with a base and height of five meters is right angled, if the third side is made approximately seven meters, approximated appropriate right angles at corners. The measurements were used later to compute the area.

Identifying closely with a non-governmental organization in favourable standing with the residents facilitated convincing them that researchers from institutions of higher learning could have genuine interest in UF. Some residents reasoned that the ultimate aim of the investigation was to look for evidence to support efforts designed to frustrate UF. These residents did not own-up to cultivating urban land during the census, limiting the sampling frame. Some of them later identified themselves as urban farmers when the survey was already in progress. On the other hand, some residents, even from neighbouring low-income areas, believed that the exercise was a preamble to land allocation and considered it unfair that they were excluded from the sample. These concerns were taken very seriously because land is a very sensitive issue anywhere in Kenya, but more so in low-income urban areas, where negative association of strangers with land ownership by residents is a potentially volatile issue. The farmers had reason to be wary of strangers "eying" their land because beacons found in parts of Kasarani area, gave credence to farmers' claims that there had been previous attempts to subdivide the land they cultivated and ultimately sell it to individuals,

presumably for residential purposes. Moreover, quarrying (for building stone) in the same area was shrinking the land parcels of some farmers. Flooding from the El Niño[8] destroyed crops for the short rains season of 1997 for a substantial number of respondents. The data was therefore analysed for 1997 long rains season alone.

3.6 Determination of wage rate for family labour

To analyse efficiency in farm production using the profit model, at least one variable input and one fixed input have to be specified. Labour and land are the minimum variables required in the analysis of agricultural production (Yotopoulos and Lau, 1979). They are specified as variable and fixed factors respectively. Other factors such as mechanical input, can be specified as variable or fixed input. For instance, Aldulavidhaya *et al.*, (1979) included mechanical input as price per a hour (a variable input) while Kuroda (1979) treated it as fixed input (the stock of mechanical assets at the beginning of the crop year plus the cost of repairs and maintenance during the year).

The variable inputs in the restricted[9] profit function have to be expressed in terms of price per unit, for example, wage rate in shillings per day for labour. In this study, wage rate was available for households hiring labour, but a value had to be imputed for family labour. In farm production studies, wage rate for hired labour is generally used to impute a value for family labour. Khan and Maki (1979) deviated from this general treatment and asked the respondents to suggest a wage rate subsequently used to impute the value of family labour. In the current study however, some households did not hire labour. If wage rate for labour actually hired by the household was used to value family labour, some households would have

[8] One of the enumerators used to bring her baby named El Niño after the rains, to the initial part of the training program.

[9] Restricted profit is defined as current revenues less current total variable costs. Fixed costs are ignored because they do not affect the optimal combination of variable inputs (Lau and Yotopoulos, 1972, 1971).

been excluded from the analysis overlooking an important behaviour of urban farmers, likely to influence efficiency and profitability of the activity. An equivalent wage rate to approximate opportunity cost of labour was obtained by asking the respondents to state the type and remuneration of work, which they considered equivalent to operations carried out in UF. This estimation was considered rather subjective because the respondents need not have performed the tasks they stated as equivalent to UF activities.

An alternative for imputing value of family labour was prompted by the likelihood that some farming households also earned income from activities other than UF. The wage rate earned from these activities presented an alternative for imputing the value of family labour. However, using this method to estimate wage rate per day as the opportunity cost of family labour engaged in UF activities would exclude from the analysis, households which did not engage in income generating activities other than UF. A similar problem was faced by Senauer *et al.*, (1986) in estimating the effect of the value of time on food consumption patterns in developing countries, using data from Sri-Lanka. Only 14.9 % of the women covered by the sample had earnings from labour force participation during the survey period. Excluding approximately 85% of the women who did not have an observed wage (because they did not participate in the labour force), would distort the demand behaviour analysed. For the analysis of labour force participation by women in general, Berndt (1991) expressed the same caution.

The researchers solved the problem for Sri-Lanka data by estimating a probit model for two purposes: (1) to determine the characteristics that explained whether or not the primary woman participated in labour force, and (2) to generate a selection bias adjustment variable (inverse of Mill's ratio). Subsequently, ordinary least squares (OLS) wage determination equation, corrected for self selection, was used to reveal the characteristics influencing the

variation in wage rate of working women. The coefficients obtained in the wage determination equation were used to estimate individual woman's value of time. This method was applied in the current study to estimate the average wage rate per man-day of adult family labour for UF activities as explained in Appendix 2.

3.7 Assumptions made in estimating the models

To justify use of OLS estimation technique, possible violation of its assumptions were considered. The first assumption is that the explanatory variables are truly exogenous in that they are outside the control of the farmer. In the specified model, a farmer influences the quantity of output by adjusting the labour input. Therefore labour is not a truly exogenous variable. On the contrary the household did not determine wage rate and prices of capital inputs. A farmer might search for extra land before planting season but once sown the quantity of land for that season is fixed. Therefore, price of output, capital inputs and wage rate are predetermined and exogenous to the production system being analysed. Therefore, none of the variables on the right-hand side of equation (6), (7) and (8) were endogenous. In this situation OLS estimation would yield consistent estimators. This is satisfactory for equation (6) but for equations (7) and (8), the estimates though consistent would be inefficient because the coefficient α_i appearing in both equations would be ignored. Joint estimation of (7) and (8) yielded more efficient estimates. Each of the equations was assumed to have an additive error with zero mean and finite variance. For the same farmer, it was also assumed that the covariance of the error terms of the two equations were non-zero, while covariance of error terms of any of the equations for different farmers was zero. Guided by these assumptions and similar studies, Zellner's seemingly unrelated regression estimation method (SURE) was used resulting in asymptotically efficient estimates (Adesina and Djato, 1997, 1996; Khan and Maki, 1979; Judge *et al.*, 1988; Lau and Yotopoulos, 1979; Aludavidhaya *et*

al. 1979; Kuroda, 1979; Lau *et al.*, 1979b; Somel, 1979; Tamin, 1979; and Lau and Yotopoulos, 1971, 1972).

The second problem anticipated was multicollinearity. Simple linear correlation coefficient (r) was calculated between pairs of explanatory variables in the model. Generally a correlation coefficient of 0.8 or higher suggests strong linear association between two explanatory variables and potentially harmful collinear relationship (Griffiths *et al.*, 1993; Kennedy, 1979). All pairs of explanatory variables in equation (6) had $r < 0.8$.

The third concern in the analysis was heteroscedasticity. The problem is likely to occur where a variable such as income or farm size is used to divide the sample into two groups. For example, results obtained by Lau and Yotopoulos (1971) on the effects of farm size on efficiency of farm production in Indian agriculture were criticized by Maddala (1977), because the analysis overlooked the possibility that heteroscedasticity could be related to farm size. In the current study, heteroscedasticity was anticipated. Transforming the variables into logs is one of the methods recommended for dealing with the problem of heteroscedasticity (Maddala, 1977; Gujarati, 1978 and Johnston, 1972). As stated earlier the Cobb-Douglas production function underlies the profit function specified in double logarithmic form. It is therefore likely taking logs of the variables reduced the severe heteroscedasticity that might have existed in the original data. Nonetheless, the Breusch-Pagan (BP) test was used to test for presence of severe heteroscedasticity in all the profit functions estimated because the variance of the error term was expected to be related to more than one variable.

CHAPTER 4

4.0 RESULTS AND DISCUSSION

4.1 CHARACTERISTICS OF URBAN FARMING HOUSEHOLDS FROM LOW INCOME AREAS OF NAIROBI

The average low income urban farming household had seven people and was headed by a 47 year old person with only 5 years of education residing in Nairobi for 27 years and cultivating urban land for 13. An average of 1.4 decares of land was cultivated usually in one or two land parcels about three quarters walk from the residence. The majority (86%) did not use not external inputs such as fertilizer improved seed or manure. Therefore, family labour and own saved seed of uncertified quality were the main inputs in the activity carried out with the participation of most of the household's members (90%). Labour was hired by 42% of the households. Majority of the households "acquired" cultivation rights because land was seemingly idle and staked as claim on it by ensuring that it is tended to through out the year. Few of them keep livestock (18%) as expected from the congested high-density housing. About two fifth of the households were women headed. In over 75% of conjugal households, both spouses made the decision to embark on urban farming. In all households nearly members worked on the land parcels. Theft of produce was by far the most serious problem followed by small parcels of land and lack of money for inputs. The type of assistance needed most for the activity was stated as access to land and inputs and supplementary income to subsist on when the produce run out. The farmers cited crop cover as breeding grounds for mosquito and convenient hiding for thieves as the only negative externalities they inflicted on non-farming residents.

4.1.1 General Characteristics

The average family size was 7 persons (Table 2) which is higher than 5 persons recorded for the poor in urban households in 1997. It is similar to 6.5 recorded for the rural poor

Table 2 Selected characteristics of low income urban farming households

	Minimum	Maximum	Average	Std deviation
Number of persons in the household	2	16	6.61	2.83
Years in Nairobi	4	70	27.2	11.88
Years of urban farming	1	40	13.7	9.17
For 1997 long rains season per household:				
Area (decares)[1] cultivated	0.1	7.5	1.39	1.27
Expenditure on seed for the season	120	8,595	1,220	1,320
Combined expenditure on cost seed, hired labour and FMP[2]	120	9,155	1,5120	1546
Family labour (MD)[3]	3	165	45	31
Hired labour (MD)	0	100	3	10.95
Total labour (MD)	3	176	48	33.4
Time taken to walk from residence to plot (minutes)[4]	5	120	43	26
Total UF profit for the season	-2315	45,870	10,224	9,915
UF profit (long rains) per month[5]	-313	7,645	1,705	1651
Monthly income from sources other than UF by:				
Spouses (Ksh)	0	12,900	1,861	2,350
Other household members (Ksh)	0	7,500	343	1,181
Combined (Ksh)	0	12,900	2,204	2,840

[1]Decare = 0.1 hectares (1,000 square meters = 0.247 acres) is common plot size in urban Kenya

[2]FMP = chemical fertilizers, manure and pest control chemicals

[3]One manday (MD) of labour was taken to be 8 hours

[4] For more than one plot this was the average time

[5] Since there are two growing seasons in the year it was taken that the long rains output is used over a six month period.

Source: Author's analysis (In subsequent tables and figures the source is the author of this study unless otherwise specified)

households (Kenya, 1998). Heads of households had resided in Nairobi for 27, on the average, about twice the average years of cultivating urban land. The expenditure on inputs other than family labour (seed, hired labour, fertilizer, manure and pesticides) for the season averaged Ksh1,520, approximately one seventh of the profit for the season. Among them, seed was the main input contributing 80% of the cost. Therefore, UF as practiced by the sample farmers used minimal external inputs consistent with very low level of technology. Family labour was the main source of labour, averaging 45 man-days per household for the season. The land parcels cultivated were on the average 45 minutes walking distance from the residence.

The average total area cultivated per household was 1.4 decares within the range of 0.1- 7.5 decares. One of the respondent cultivated 19.7 decares (two and a half time larger than the next highest area). For other two respondents, the profit and profit per decare were 63 and 56 percent, respectively, higher than those of the next highest respondents. These values were deemed unusual and the respondents excluded from the analysis. Majority of households cultivated only one land parcel, did not keep livestock, use fertilizer, manure, pesticides (FMP) or hire labour (Figure 13). Most of the household heads had less than seven years of formal education and had no access to technical advice on farming. About 45% of them had cultivated urban land for more than 13 years and only 39% of the them were women.

Since formal education in general is positively associated with better management skills and improved opportunities of for employment, non-conjugal were disadvantaged because only 35% of male heads of conjugal households had not attained seven or more years of formal education compared to 78% of the women heading non conjugal households (Figure 14).

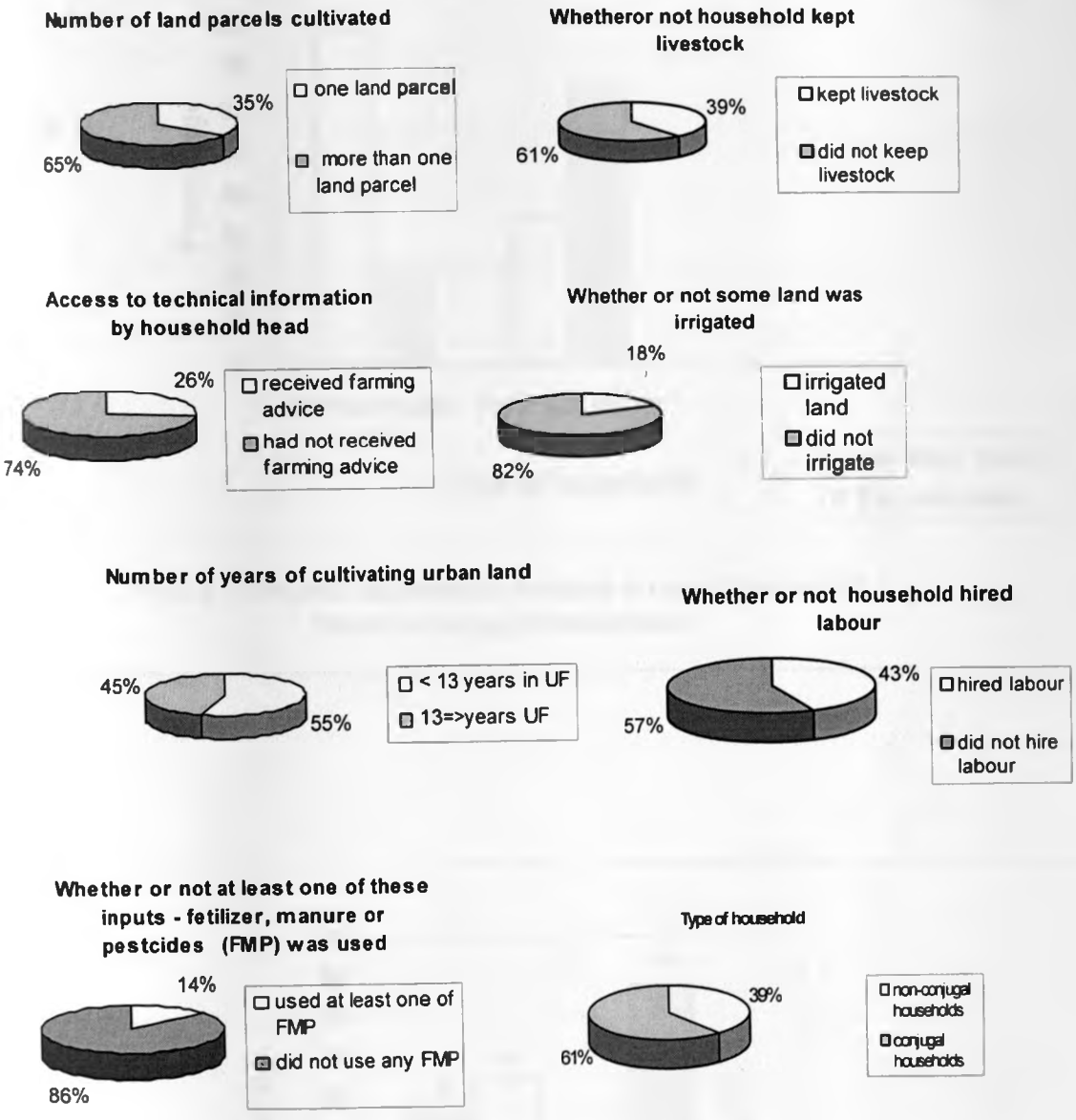


FIGURE 13. Characteristics of heads of urban farming households

In addition only 46% of the women as spouses in conjugal households had not attained seven years or more of formal education compared to 78% of those heading non-conjugal households (Figure 15).

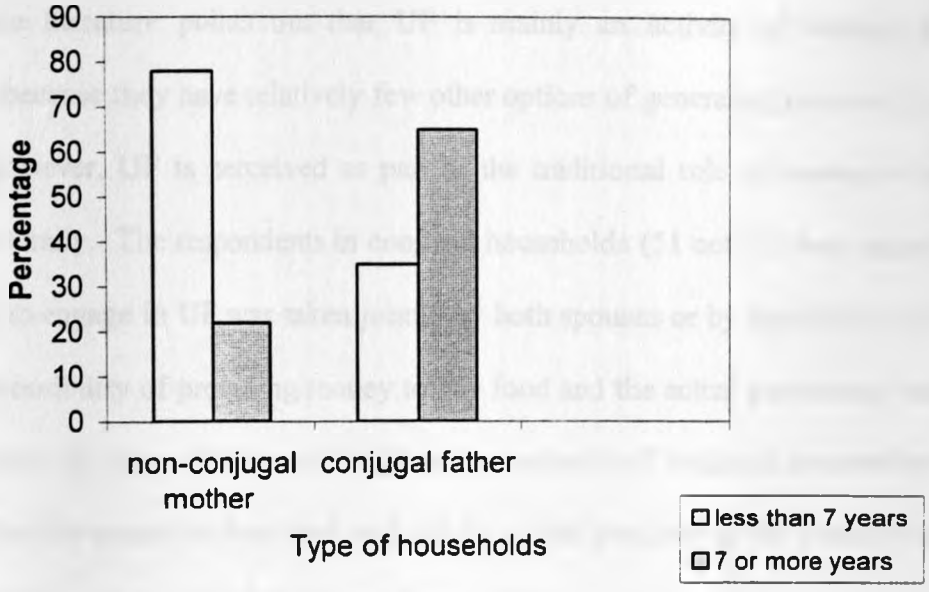


Figure 14 Formal education of mothers in non-conjugal and fathers in conjugal households

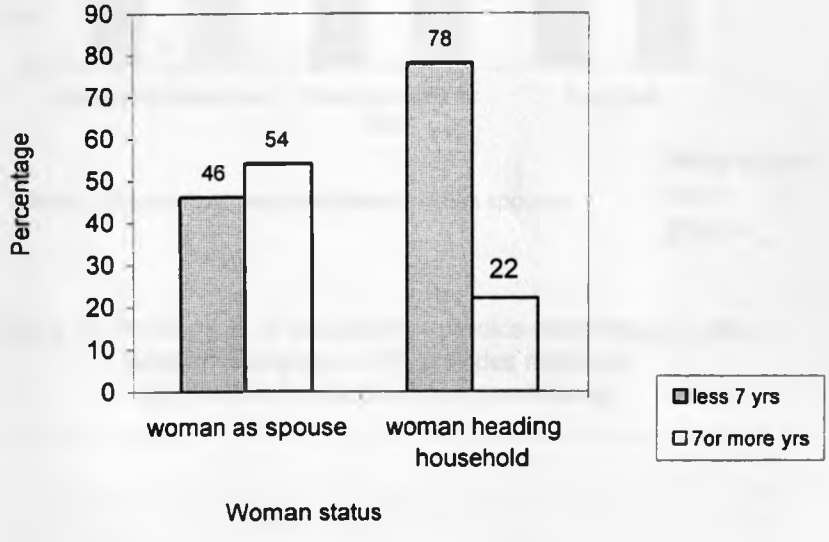


Figure 15 Formal education of women as spouse or head of household

4.1.2 Decision to Engage in Urban Farming and Responsibility of Buying Food.

The available literature points out that UF is mainly an activity of women who head households, because they have relatively few other options of generating income. In conjugal household however, UF is perceived as part of the traditional role of women of providing food for the family. The respondents in conjugal households (51 out 85) were asked whether the decision to engage in UF was taken jointly by both spouses or by individual spouses, and how the responsibility of providing money to buy food and the actual purchasing was shared. Results (Figure 16) show that even though in the majority of conjugal households the man alone provides the money to buy food and did the actual purchasing, the decision to embark on urban farming was jointly taken in most households.

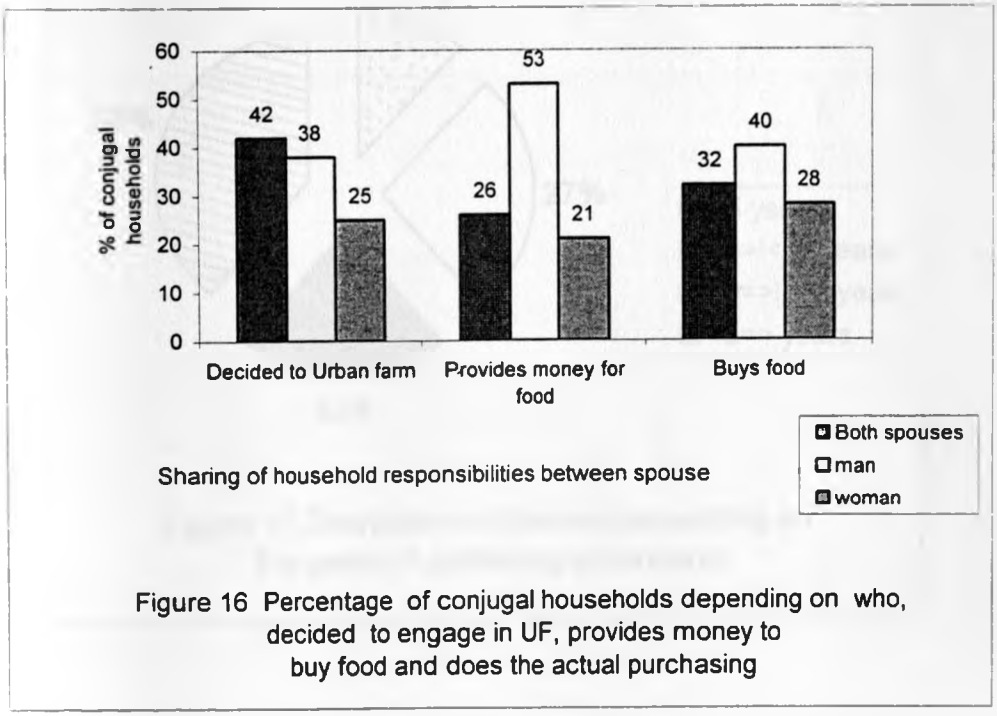


Figure 16 Percentage of conjugal households depending on who, decided to engage in UF, provides money to buy food and does the actual purchasing

Moreover in conjugal households, more men alone made the decision to start UF than women alone did. This suggest that the problem of providing food in low income urban households goes beyond the traditional role of women and is not left to them alone. Making decisions

jointly on activities such as UF, is one way of effecting the joint responsibility and soliciting for family labour. The joint decision by most households also suggests that the activity has a high ranking among alternative means of earning livelihood.

4.1.3 Number of Years of Engaging in Urban Farming

Three important features of the number of years households had been farming urban land are noteworthy. First, 51% of the respondents had been farming for 10 or more years while 39% had in the activity for 15 years or more (Table 17). Second, the number of years in UF had statistically significant positive effect on the total area cultivated. The classification

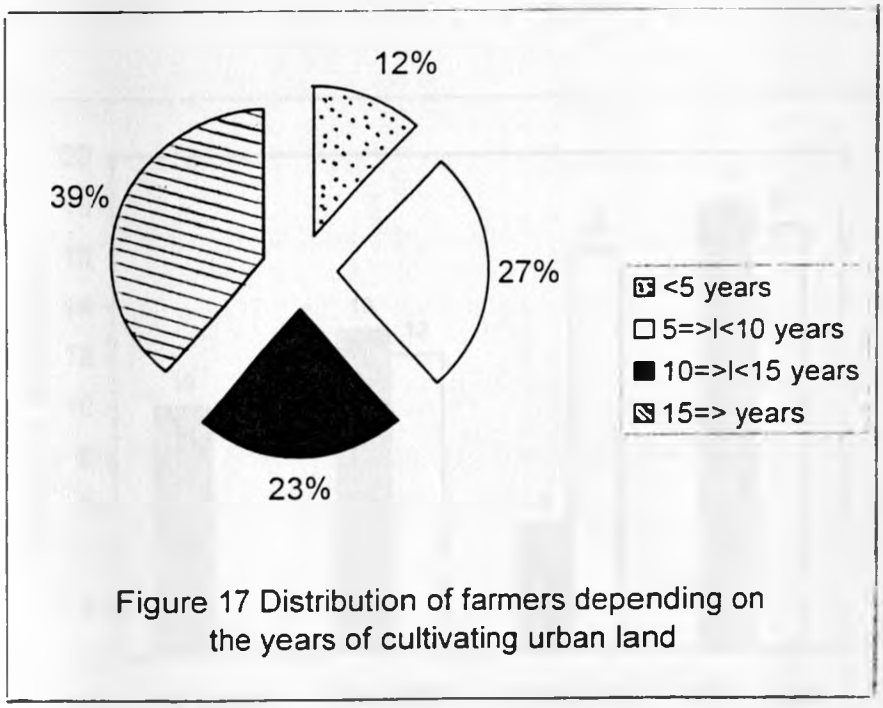


Figure 17 Distribution of farmers depending on the years of cultivating urban land

of households into five groups depending on the number of years of cultivating urban land (Figure 18) showed that households cultivating land area of more than one decare were those that had been in the activity longer. The relationship was significant at 5% level. The average

profit for the season generated by those with 10 or more years of UF was significantly higher than those with fewer years. These results give evidence to refute the notion that UF is a temporary activity carried over from rural areas and dies off as the resident becomes increasingly urbanized. The notion is commonly used to sideline the activity, denying it support and recognition. The result is additional evidence that farmers tend to increase both the amount of land cultivated and the returns generated over the years. An activity with theses characteristics is unlikely to die out with time and therefore merits consideration along side other informal generating livelihoods activates in urban areas. The objective would be identify options for transforming them into activities integrated into the urban economy as a source of viable thriving livelihoods.

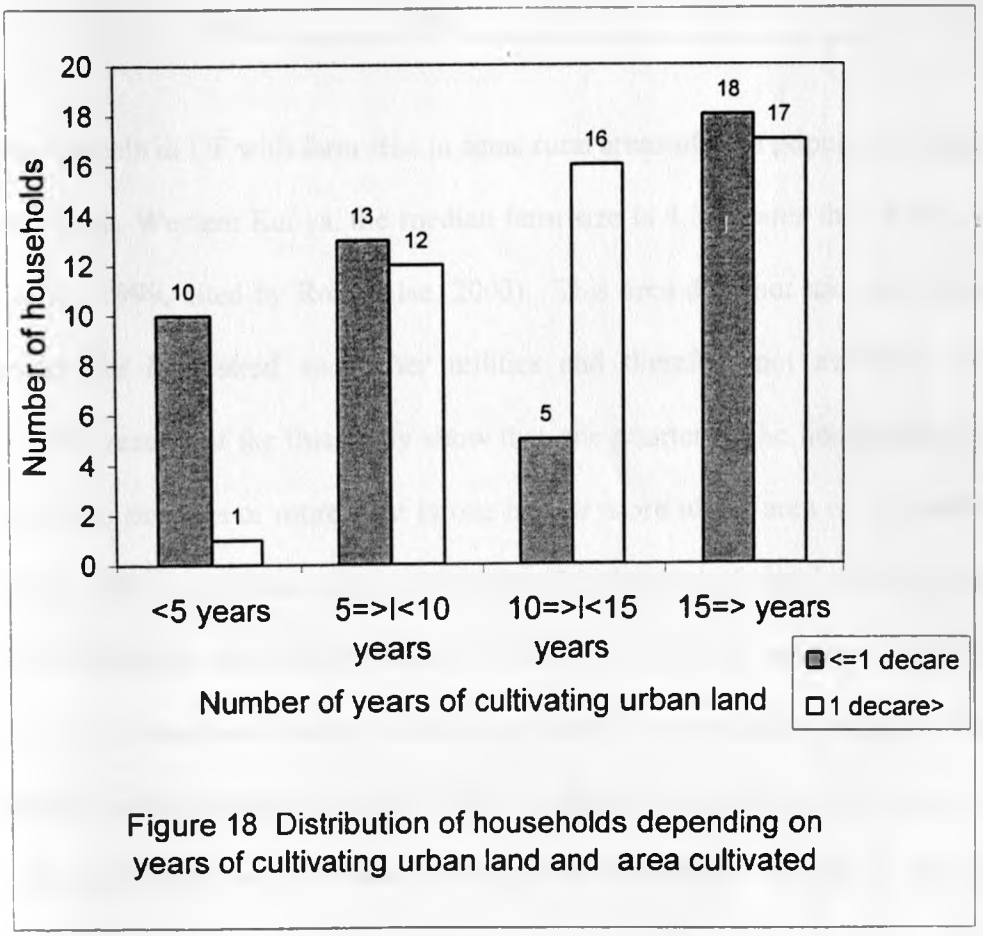


Figure 18 Distribution of households depending on years of cultivating urban land and area cultivated

4.1.4 Area of Land Cultivated and Types of Enterprises

The number of land parcels cultivated varied from 1 to 5 (Table 3). An equal percentage (35%) cultivated one or two. The total area cultivated and the profit generated were positively correlated with the number of land parcels cultivated ($r_{spearman} = 0.4$ for both variables). The correlation was significant at 1% level. It is instructive for policy to

Table 3 Percentage of households depending on the number of land parcels cultivated and average total area.

No of land parcels	% of households	Average total area per household (decares)
1	35	0.89
2	35	1.60
3	24	1.58
4	5.6	2.53
5	1	1.10
Total	100	

compare land parcels in UF with farm size in some rural areas of high population density. For example in Vihiga, Western Kenya, the median farm size is 4.5 decares that is 0.45 hectares (De Wolf *et al.*, 1999, cited by Rommelse, 2000). This area does not take into account the area taken by the homestead and other utilities and therefore not available for actual cultivation. The results of the this study show that one quarter of the households cultivated urban land of two decades or more, that is one half or more of the area of the median farm size in Vihiga. The comparison refutes the notion that the area of land in UF per household is too small to be taken seriously by policy. The actual cultivated area per rural household will continue to decrease as a result of subdivision fuelled by population pressure. Therefore, the challenge of cultivating small pieces of land profitably can no longer be ignored and UF provides an opportunity to start understanding the constraints unique to this type of production.

On the average seed expenditure and labour input per decare for farmers cultivating 1.4 decares or less was significantly higher than that of farmers cultivating large area (Table 4). It is therefore not surprising that those cultivating smaller area generated two and half times more profit per decare than those with larger area even though on the average, the latter had higher total profit. The conclusion is that profit generated from UF is constrained more severely by intensity of input use than by area of land cultivated. The policy implication is that facilitating access to external inputs targeting increased intensity of cultivation per unit area and in turn profitability takes priority.

Table 4. Average seed cost, labour and profit per decare for farmers cultivating more than 1.4 decares and those cultivating less

	1.4 decares or less	More than 1.4decare	Level of Significance (%)
Number of farmers	53	36	
Total Profit (Ksh)	8,940	12,114	0.14
AVERAGE			
Seed expenditure/decare(Ksh)	1,491	740	0.0
Family and hired labour (MD)/decare	70	31	0.0
Profit /decare (Ksh)	15,299	5,332	0.003

Thirteen different crops were grown by the respondents but the six grown by most households are listed in Table 5, in descending order of their popularity. These crops constitute the bulk of diets of households in low income urban areas and have a ready market. The three most popular crops; maize, beans and cowpeas, contributed to fungible income because they can be stored for long periods when dry, and cowpeas has the added versatility of producing leaves used as vegetable early in the season and multiple harvesting.

Table 5 Main crops in urban farming and source of seed (or planting material)

Crop	Households growing the specific crop out of 89 %	Source of seed used by households growing the crop %		
		Own saved	Purchased	Own saved or purchased
Beans	96	18	80	1
Maize	94	21	76	1
Cow peas	76	9	91	0
Potatoes	43	26	74	0
Kale	18	6	94	0
Arrow root	9	50	50	0

Based on respondents from all income groups, Lee-Smith *et al.*, (1987) found the kale was the crop grown by most farmers in Nairobi compared to maize in other towns. The current study found that other crops grown in descending order of their popularity were: arrow roots, sugarcane, cassava, sweet potatoes, millet, tomatoes, peas and spinach. For the four most popular crops, seed was purchased by 74% or more of the farmers. A negligible number of farmers used both purchased and own saved seed.

4.1.5 Cultivation rights in Urban farming

The survey identified 181 land parcels and the owners of 168 of them disclosed how they acquired them: 61% of the land parcels were acquired because land was seemingly idle, while 20% were passed on to the current farmer by the previous farmers without any form of monetary compensation. The person who first cleared the bush was deemed to be first "owner" of the land parcel and had the right to pass-it-on to another farmers. Only 9% of the land parcels were acquired by payment of a certain amount of money to the original "owner"

or those cultivating them previously, while 6% were bought or hired. Thus 84% of the land parcels were acquired for cultivation without any form of monetary compensation underscoring the strong incentive vacant land gives to some low income households to embark on farming. Farmers used three main methods to stake a claim to a land parcel: (1) 36% ensured that the land did not appear idle by growing crops at all times, (2) 35% planted early and (3) 22% ensured that weeding was regularly done. Anecdotal discussions with the respondents revealed that disputes of ownership for purposes of cultivation were some times sorted out by the area chief, implying some recognition of cultivation rights.

Intentions of increasing area of urban land cultivated were stated by 58% of the respondents. Among these, 29% said they would do so by searching for unused land, while 17% said they would look for exiting farmers to "transfer" cultivation rights to them without any payment. Only 15% stated that they would increase area cultivated by hiring land from the actual owner, while an equal another 15% intended to obtain cultivation rights from the land owner without payment. The policy insight is that UF as an urban activity is unlikely to decrease in the foreseeable future, therefore planners of urban land use need to harmonize it to fit better with other activities of generating livelihoods in low income households. A starting point would be to make an inventory of urban land and identify zones where different types of UF can be carried out on specified terms. Other areas are unsuitable for alternative development to edge out UF. Green orderly planned areas contribute to aesthetics value of the urban setting and organized groups growing certain crops can serve this goal.

4.1.6 Inputs used in Urban Farming

Seed as the only variable input besides labour used by most farmers. In this study, 85% of the farmers reported not using chemical fertilizers, manure or pesticides. Even the few who used these inputs applied minimal quantities averaging Ksh420 per household for the

season. Therefore UF is characterised by low external input just like rural farming where cash constraints and low output prices severely limit use of external inputs particularly in food crop production (FAO, 2001). Continuous cropping relying on inherent soil fertility without substantive measures to maintain and improve soil nutrients, is not sustainable Yield per unit area continue to decrease because soil nutrients, the basic resource in production, diminishes. Similar practices in rural farming have resulted in reduced livelihoods, increased pressure on more fragile lands and added incentive to migrate to urban area in search of employment. Many do not find the anticipated jobs but they increase the pressure on urban service leading to increasing urban poverty. Alternative land of any quality for cultivation in urban areas is limited, underscoring the need to improve and maintain soil fertility of the land under cultivation. Though seed was the main input, it rarely was improved good quality seeds. Own saved seed was used by 18 and 21% of farmers growing maize and beans, respectively. The rest of the farmers purchased seed locally from supplies sold for normal consumption. Only two farmers reported buying maize in packets which could be taken to mean certified seed. The main input in UF is seed of uncertified quality. Use of low technology therefore partly explains why the activity is stuck in Stage I in the process of transformation. Households are not able to invest adequate capital in the activity and in turn the activity does not generate enough for reinvestment, perpetuating the cycle of low input, low output and subsequent poverty. Without an intervention to break the cycle productivity will decline even further as the natural resource base is mined to exhaustion.

However, in UF as in smallholder rural farming, the relative income invested in seed either by cash purchase of by forgone consumption was substantive relative to the income of these households. For example, 43% and 63% of those households earning income from other sources (63/89) incurred cash cost on inputs other than family labour for the season equivalent to 50% and 25%, respectively or more on other income earned per month. These

levels of expenditure on seed and planting material as the basic capital investment in UF, show not only the commitment of urban farmers to the activity, in spite of the cash income constraints facing them, but also their expectations of positive returns. Therefore, efforts to sideline UF or frustrate it are counter productive and wasteful of the scarce resources farmers invest in it, and contradict the policy of encouraging households to save and invest within their capabilities. The challenge to policy is to device ways of making the minimal individual household capital investment build up over time and become a means of climbing out of poverty. Facilitating UF by groups of farmers is a possible strategy.

4.4.7 Labour input in urban farming

The bulk of UF activities were carried out by household members spending an average of 45 mandays for the season. Over 90% of all household members, with the exception of young children, participated in UF activities. Extensive involvement of family members underscores that UF can absorb different types of labour available in the household. Most other income generating activities found in urban areas do not offer this flexibility. For all households, the bulk of UF activities were carried out during normal working hours (Monday to Friday), both by heads of households and other members. A substantive amounts of the activities were performed at the end of the week particularly by members of household attending school during the week (Figure 19 and 20). This was also the pattern for households reporting income earned by head and spouse from activities other than UF (36 conjugal and 26 non conjugal households). Since some for their time is taken up by other income generating, they would be expected have a different time pattern for UF (Figure 21) The results suggests a relatively high ranking of UF among the feasible alternatives of absorbing low income households labour during normal working hours either because the alternative income generating activities were scarce, those available underemployed labour or most family labour

did not qualify for such employment. Figure 20 also shows that women heading non-conjugal households spent more hours during the week on UF activities compared to men heading

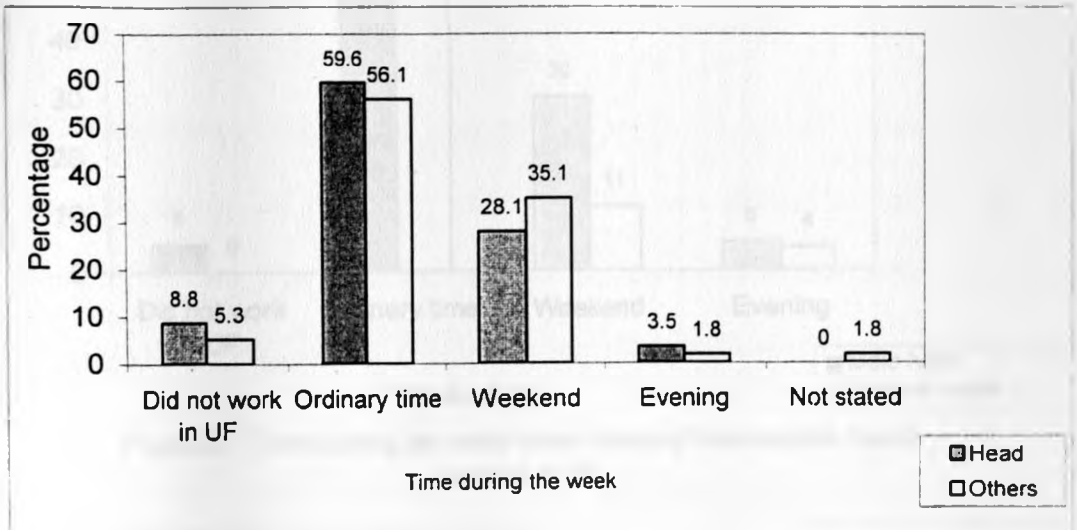


Figure 19 Time during the week when UF activities were carried out

households suggesting that they have fewer alternatives in other income generating activities as concluded form the result that they have lower levels of formal education.

The result that 42% of the households hired labour for UF activities is instructive to policy on two accounts. (1) In Kenya, the informal sector ("Jua Kali" industries) is officially recognized and supported because since the 1980's it has increasingly been acknowledged as the sector creating the bulk of new jobs even as the economy continued to decline. For example in 1997, new jobs created by the economy as a whole decreased by 20% relative to 1996. In that period, most of the new jobs created were in the informal sector (Kenya, 1988). Even though UF shares most characteristics with activities in the informal sector, it appears there is a reluctance to officially count it among the informal sector activities and support it accordingly. It is likely that if similar recognition and support were given to UF, it would not

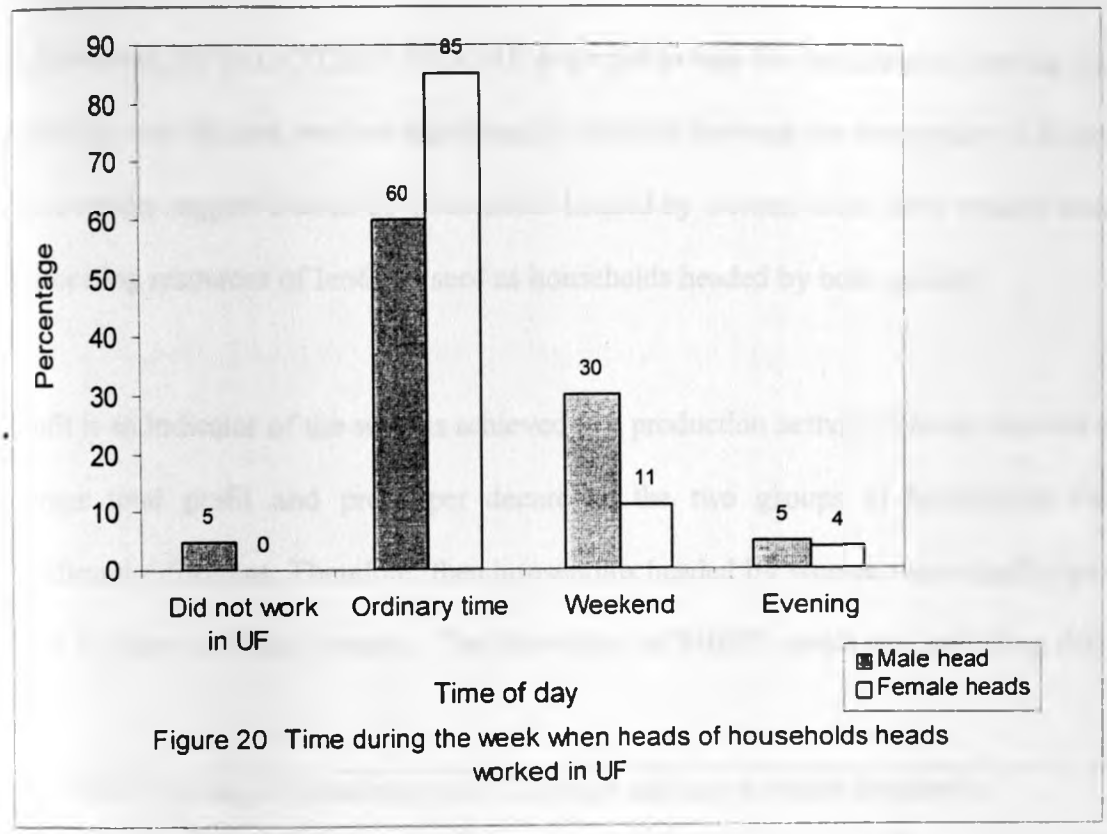


Figure 20 Time during the week when heads of households heads worked in UF

only absorb more family labour but also hire labour from low income urban residents. (2) Wages earned by labour hired would be one of source of income for non-farming households, contributing positively to their household income and food security. Therefore, supporting UF would also benefit non-farming households. This is envisaged in Stage II (Figure 10) of the process of transforming UF. In this stage the activity generating thriving livelihoods to households investing in it and it would need labour input beyond that available from family labour.

4.4.8 Women Headed Households in UF

Women as farmers are said to face daunting constraints limiting their productivity caused by limited access to technology, capital markets and extension. It is also argued that they are less efficient than male farmers (Adesina and Djato, 1997). This study, found that women as heads of households and urban farmers had no significant differences in total area of land cultivated or expenditure on seed per decare, than households headed by both spouses (Table

6). Moreover, TOTAL OTHER INCOME expected to ease the constraint of buying inputs by providing cash income, was not significantly different between the two groups of households. These results suggest that in UF households headed by women alone were equally successful in accessing resources of land and seed as households headed by both spouses.

Profit is an indicator of the success achieved in a production activity. Results showed that the average total profit and profit per decare of the two groups of households were not significantly different. Therefore, then households headed by women were equally profitable in UF as those with both spouses. The percentage of MIHPL needs met, including the

Table 6 Average characteristics of Conjugal and non conjugal households

	Head of household Mean values		Level of significance
	Non-conjugal	Conjugal	%
Number of households	35	51	
Household size in AEU	4.9	4.9	96
Area (decares) cultivated	1.3	1.5	15
Seed expenditure /decare (Ksh)	1,235	1,154	69
Total labour MD/decare	62	49	18
Profit /decare (Ksh)	10,859	11,544	80
Total Profit for long rains 1997(Ksh)	9,563	10,673	61
TOTAL OTHER INCOME (Ksh)	1,972	2,344	55
OTHER INCOME 1 (Ksh)	411	303	68
OTHER INCOME 2 (Ksh)	1,561	2,040	36
Total income (UF & other activities) / MIHPL need met) %	32	35	71
UF income / MIHPL need met (%)	13	15	61
Other activities income/MIHPL need met (%)	19	20	85

contribution from either UF or other activities were also not significantly different between conjugal and women headed households. Results from this study give no evidence that the

performance of women headed households in UF is any different from that of households headed by both spouses.

4.1.10 Problems and Causes of Losses in Urban Farming

In general, theft of produce was the leading problem followed by small size of land parcels (Figure 21). Lack of money for inputs was ranked third while draught was fourth in

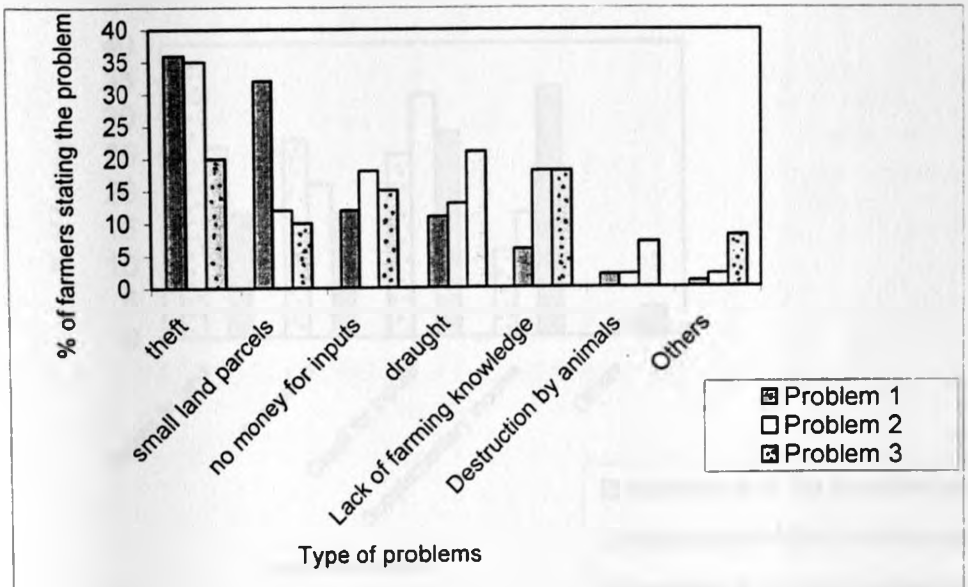


Figure 21 Type of problems experienced by farmers in urban farming and their ranking in severity

severity, surpassing lack of farming knowledge as a problem. It is therefore not surprising that facilitating access to land and credit for inputs were stated as the two types of assistance needed most in UF (Figure 22). Availing some sort of supplementary subsistence income subsist on while waiting for crops to mature was the third type of assistance cited suggesting that the earlier result that the combined income from UF and other activities was not

subsist on while waiting for crops to mature was the third type of assistance cited suggesting that the earlier result that the combined income from UF and other activities was not adequate to met the minimum needs implies the deprivation is such that food needs are not meet through the year. It is noteworthy that technical farming knowledge or extension advice were not cited among leading problems of types of assistance needed most in the activity respectively.

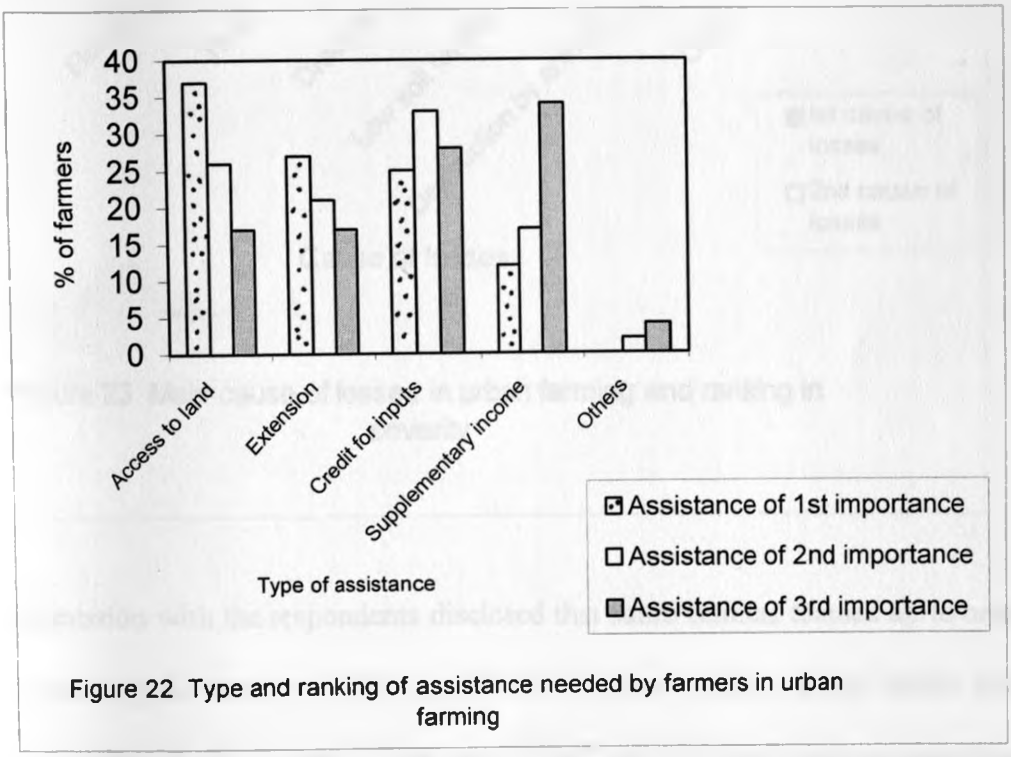


Figure 22 Type and ranking of assistance needed by farmers in urban farming

The losses incurred in UF were attributed to small sizes of land parcels, lack of money to buy inputs and draught were cited by 32%, 12% 11% of the farmers, respectively, (Figure 23). Investing more money in UF inputs increases the risk of loss from natural causes, which is aggravated by theft of produce. In these circumstance it is rational for most farmers to minimize the risk of loss by investing on minimal amounts of inputs.

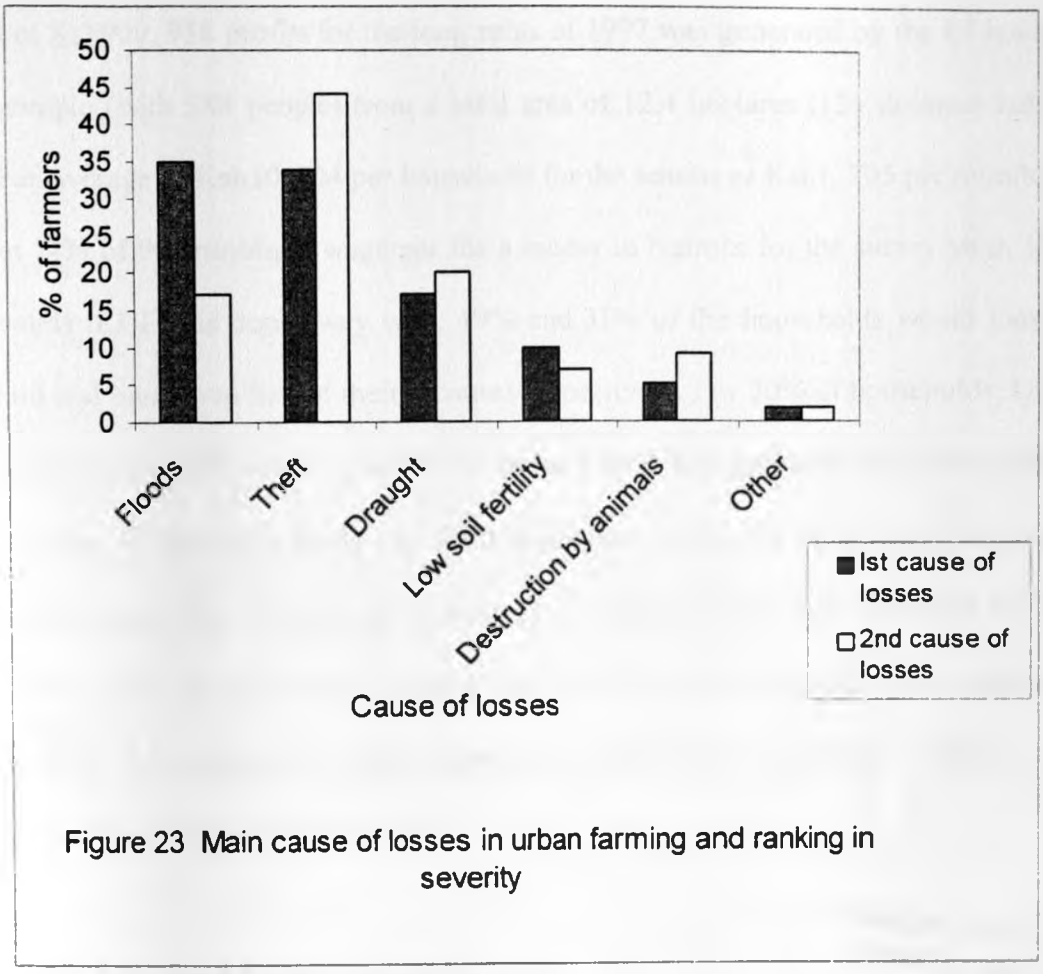


Figure 23 Main cause of losses in urban farming and ranking in severity

Anecdotal discussion with the respondents disclosed that some farmers teamed up to organize vigilante groups or paid some people to guard the crop, particularly maize before harvest, when it is given time to dry properly. Low use of FMP and improved seed was noted as the main characteristic of UF. It is likely that the illegal status of UF encourages theft of produce from the land parcels and intimidates the farmers from taking more effective measures to protect their crops. An appropriate policy response as stated earlier would be to take an inventory of land use in Nairobi with a view to establish zones and specifications of the type of UF that can be carried out, as has been done in Dar-es-Salaam and Gaberone. In Durban, land for UF is leased with specification of the type of crops that can be grown given the aesthetic concerns by the city authorities and methods of cultivation to pre-empt undesirable effects like soil erosion.

4.2 FACTOR DETERMINING PROFIT AND ECONOMIC EFFICIENCY

A total of Ksh909, 938 profits for the long rains of 1997 was generated by the 89 households in the sample (with 588 people) from a total area of 12.4 hectares (124 decares) cultivated. This is an average of Ksh10, 224 per household for the season or Ksh1, 705 per month, which is about 74% of the minimum wage per for a labour in Nairobi for the survey year, 1997. In other words if UF was done away with, 49% and 31% of the households would loose more than third and more than half of their incomes respectively. For 50% of households, UF profit was higher than other income earned by household head and spouse from sources other than UF. In terms of the basic needs per adult equivalent, only 4% of the households earned combined income from UF and other activities to be above poverty line. The other households earned only 28% of the average income needed to be above poverty line signifying the magnitude of deprivation. UF profit contributed half of the available minimum average income, against 15% from other sources.

4.2.1 Profit Level and Factors Determining it

4.2.1.1 UF profit as returns to household labour and management

The profit generated from UF can be considered as the return to the household inputs of labour and management. It was calculated as gross revenue (crop yield x price per unit) less the total cost of buying seed, chemical fertilizers, manure and pesticides as well as hiring labour. Market prices were used to impute the value inputs owned by the households. Only 2 out of the 89 households realized negative profits for 1997 long rains season.

Insights into the contribution of UF to household income can be further demonstrated by comparing it to other income generating activities available. For the comparison, it is assumed

that UF profit for 1997 long rains season was used over a six-month[10] period. Most of the respondent households (71%) earned income from sources other than UF (OTHER INCOME). The household head and spouse or by one of them earned part of this income (OTHER INCOME 1). Sons, daughters and other members of the household earned the other part (OTHER INCOME 2). The relative size and importance of UF profit to the households can be evaluated by comparing it to these incomes. For 49% of the households, profit per month exceeded half OTHER INCOME and for 31% of them, it was higher than the total OTHER INCOME. In other words if UF was done away with, 49% and 31% of the households would loose more than third and a more than half of their incomes respectively. For 50% of households, UF profit was higher than OTHER INCOME 1. Therefore UF makes significant contribution to household income in spite of lack of official support, relative to other income generating activities available and explains its persistence in spite of its illegal status.

4.2.1.2 Relative contribution of UF income to household welfare

The 89 households (with 588 people) cultivated a total area of 12.4 hectares (124 decares) generating Ksh909, 938 for the long rains of 1997. This is an average of Ksh10, 224 per household for the season. To determine the contribution of an activity such as UF to the welfare of a household it is necessary to determine the relative needs of the household in a more accurate manner than can be achieved from a straight count of the number of household members. One of the methods used is to determine relative household consumption needs in terms of the adult equivalent units (AEU). According to FAO recommendation the reference is 20-29 year old adult male, estimated to need 2,960 kcal per day and deemed to be one AEU. All household members are expressed as a ratio to this unit. A nutrition based

[10] Since farmers grew crops in two seasons in a year, it was assumed that the output was used over a six-month period.

weighting of household members is considered an appropriate approximation of the overall requirements, because it takes into consideration the requirements of the individual based on factors such as age, sex and physical activity. In any case, food requirement is a major part of the welfare of an individual.

A table showing the AEU conversion factor for different age and sex (WHO, 1985 cited by Hoorweg *et a.l,* 1991, p.189) was used to determine the respondent households size in adult AEU (Appendix 3). The minimum income needed in urban Kenya to be above the poverty line in 1997 was Ksh2, 648 per AEU (Kenya, 2003). The figure was used to calculate the minimum income each household needed to be above the poverty line (MIHPL). Only 4% of the households in the sample earned combined income from UF and other activities to be above poverty line. By this criteria therefore, 96% of the respondent households were poor implying that the majority of urban farmers from low income such as the study area, are poor. Further analysis was carried out on the 96% of the sample constituting poor households (n = 85). On the average, a household needed a monthly income of Ksh13, 400 to be above poverty line. Only 28% of that income (Ksh3, 634) was available. UF and other activities contributed in about equal shares (see Table 7). This is additional evidence that these households are very poor because they generate only slightly more than a quarter of the income they need to just be above poverty line. For policy purposes, it worth noting that even though the activity is not supported income generated from UF is equally important as that generated from other sources.

Table 7 Contribution of UF to household income needed to be above poverty line (MIHPL) relative to income from other activities

	Minimum	Maximum	Mean	Std deviation
Poor household (n = 85)				
Household size in AEU	1.5	10	5	2
Minimum income per month (Ksh) needed by household to be above poverty line (MIHPL)	3,972	26,480	13,371	5,417
Total Income earned/month (UF & other activities) Ksh	-313	13,683	3,634	3,071
% total income earned / MIHPL need met	0	93	28	22
UF income per month (Ksh)	-313	7,645	1,717	1,680
% share of UF income in MIHPL need met	0	74	14	14
Income from other activities per month	0	12,900	1,917	976
% share of income from other activities in MIHPL need met	0	75	15	22

4.2.1.3 Factors Determining Profit

Profit functions were estimated using the variables defined in Table 8 to determine the factors explaining variation in profit level. The outlier respondents identified in Table 2 were excluded in these functions. The respondents deemed not to be poor as described in reference to Table 7 were also excluded. To ensure that the effect of formal education received by household head and spouse was duly considered, two functions were estimated separately. One was estimated for conjugal households where head and spouse participating in UF activities and who reported their level of formal education (see Table 9). A profit function with similar restrictions was estimated for non-conjugal households.

The existence of severe multicollinearity in the profit functions was ruled out because no two pairs of explanatory variables had a simple correlation coefficient (r) greater than r = 0.5. The

Table 8 Definition of the variables used in the profit functions

VARIABLE NAME (ACRONYM)	VARIABLE DEFINITION
DEPENDENT VARIABLE	
Restricted profit (LNP80H1)	Ln of restricted profit (total revenue less weighted average wage rate[11] x total labour in man-days (family and hired labour).
BASIC EXPLANATORY VARIABLES	
Wage rate (LNWW8OH1)	Ln weighted average wage rate of labour
Cost of physical input (LNIN)	Ln total cost of seed, chemical fertilizers, organic manure and pesticides[12]
Land LNT	Ln of total land parcel area in square metres
OTHER CONTINUOUS EXPLANATORY VARIABLES (hypothesised to have positive effect on profit)	
Education of father (YREDDAD)	Years of formal education of father in conjugal households
Education of mother (YREDMOM)	Years of formal education of mother in conjugal households
Education of mother (YREDMOMM)	Years of formal education of mother in non-conjugal households
OTHER EXPLANATORY DUMMY VARIABLES	
Access to Technical information (INFOSCM)	Access to technical information by the head of the household; 1 = if information was accessed, 0 otherwise
Other income (YALL3099)	OTHER INCOME; = 1 if OTHER INCOME was equal or greater Ksh3099 per month (average of those earning OTHER INCOME), 0 otherwise
Years of UF (YRUF13)	Number of years the household head has been in UF; = 1 if 13 or more years (average period of engaging in UF), 0 if less.
Land area grouping (DECA14)	Total area of land parcel(s) cultivated in 1997; = 1 if more than 1.4 decares (average area cultivated), 0 otherwise
Irrigation (ANYIRR)	Irrigation; = 1 if at least one land parcel was irrigated, 0 otherwise
Hiring labour (DD1)	Hiring of labour; = 1 if household hired labour, 0 otherwise
Other physical inputs (DC1)	Use of at least one input (fertilizer, manure or pesticides); = 1 if households used at least one of them, 0 otherwise. (Number of farmers using anyone of these inputs were few and the quantities very small to have a meaning full continuous variable)

[11] Computation of the weighted average rate was explained in Appendix 2
[12] The market price was used to impute the value of inputs owned by the households.

Table 9 Factors determining UF profit generated by low income conjugal and non conjugal households

Dependent variable= Restricted profit (LNP8OH1)

	Coefficient and std error (in brackets)		
	Conjugal	conjugal	None - conjugal
CONSTANT	0.281	1.558	0.593
	(2.146)	(2.038)	(1.828
LNWW80H1	-0.266	-0.186	0.014
	(0.300)	(0.297)	(0.251)
LNIN	0.884***	0.829***	0.836***
	(0.299)	(0.285)	(0.222)
LNT	0.445*	0.286*	0.363
	. (0.260)	(0.236)	(0.289)
YREDDAD	0.098*	-	-
	(0.057)		
YREDMOM	-	0.091*	-
		(0.051)	
YREDMOMM	-	-	-0.092**
			(0.041)
DECA14	-0.576	-0.239	-0.386
	(0.513)	(0.512)	(0.502)
DC1	-0.756	-0.742	-0.768
	(0.493)	(0.516)	(0.476)
INFOSCM	0.546*	0.501*	0.171
	(0.297)	(0.283)	(0.350)
YRUF13	0.205	0.188	0.501*
	(0.359)	(0.350)	(0.266)
ANYIRR	-0.367	-0.465	0.618*
	(0.631)	(0.535)	(0.324)
YALL3099	-0.532	-0.783	0.371
	(0.248)	(0.571)	(0.315)
DD1	-0.297	-0.297	-0.486
	(0.324)	(0.324)	(0.348)
N	46	46	32
F	1.96*	1.96*	6.02*
(df)	(11, 34)	(11, 34)	(11, 20)
R^2	0.39	0.39	0.77
Adjusted R^2	0.19	0.19	0.64
$BP\chi^2_{(df)}$	31.6(11)	27.9(11)	Not needed

Critical $BP\chi^2_{(11)}$ for 5% and 10% level of significance are 19.7and 17.3, respectively
Asterisks indicate significance at the following levels :*** 1%; ** 5%; and * 10%.

null hypothesis of homoscedasticity was rejected at 5% level for functions describing conjugal households. Therefore, OLS estimates given in Table 9 were adjusted for heteroscedasticity using White estimator. The explanatory variables taken jointly were significant in explaining variation in restricted profit. The coefficients for wage rate was not significantly different from zero conforming to theoretical expectation that profit is non-increasing in variable input price (Chambers, 1988). The coefficients for land and capital were significantly different from zero and had the expected positive sign. The adjusted R^2 for the conjugal households were low compared to that of non-conjugal households, suggest that the model more accurately described the latter, and that relevance and importance of the hypothesized explanatory variable vary with the household type.

Capita (LNIN) was the only factor significant at 1% level in explaining variation in profit, in both conjugal and non-conjugal households. Since use of external inputs was negligible, seed of low quality was the main capital input was as stated earlier. An increase of 1% in capital input resulted in about 83 to 88 % increase in profit. The return is not directly comparable with rural farming where land parcels are much larger such that a farmer cultivating 1.4 decares would be considered practically landless. The result supports farmers' suggestion that lack of access to inputs is an important problem, and access to credit for inputs is one type of assistance needed most in the activity. The discussion of the specific factors on profit will precede the evaluation of its effect on relative efficiency in the following sections.

4.2.2 Factors Determining Economic Efficiency

4.2.2.1 Effect of land area cultivated on profit and economic efficiency

To test the hypotheses that total area of land did not have any effect on profit and efficiency, land was included in the model both as a continuous variable (LNT) and as a dummy variable (DECA14) distinguishing "large" and "small" farmers. "Large" farmers (61) cultivated total

area of land of more than 1.4 decares (average land area per household) while "small" farmers (31) cultivated 1.4 decares or less.

For conjugal households, the effect of land area on profit was positive and significant (see Table 9). The effect of land on profit for non-conjugal households was not significant. Descriptive analysis of conjugal households showed that on the average total profit for "large" farmers was not significantly different from that of "small" farmers. However, on per decare basis, "small" farmers on the average generated three times more profit by spending about twice the amount of seed and labour per decare, relative to "large" farmers (see Table 10). These differences in seed expenditure, labour and profit per decare were significant. A similar analysis of conjugal households support similar conclusion. The results suggest that the profit generated from UF is constrained more severely by intensity of input use than by area of land cultivated. The policy implication is that facilitating intensive cultivation of the available land is a priority. A starting point would be to make an inventory of the seemingly idle public land in the urban area and determine the type of UF it can support and the tenure arrangements feasible. The result would zones specifying the type of UF crop that can be practiced. As outlined in the literature review, zoning for UF has been completed in Dar-es-Salaam. In Durban, South Africa, similar zoning is used to guide systematic leasing of land to groups of farmers, who grow specified crops in a manner consistent with regulation stipulated urban land use. The municipality management benefits because it would have to spend money to trim bush and vegetation in these areas according to stringent city regulations. Access to land in a systematic officially sanctioned manner is a prerequisite for investment in intensive use of inputs.

The profit function jointly estimated with the wage share function to test for difference in efficiency between hypothesized groups (see Table 10). To ensure that dummy variables for socio economic group did not result in heteroscedastic error variance, the Breusch-Pagan (BP)

test was repeated. The null hypothesis of homoscedastiticy for the profit function failed to be rejected at 1% level[13]. OLS estimates are included for comparison with the unrestricted joint estimation but are not used for any of the relative efficiency tests. In all OLS estimated profit functions, the coefficients for capital were positive and significant. The effect of land on profit was not significant. Improvement in joint estimation of the profit function was shown by relative to OLS was shown by the lower standard errors of the coefficients.

The hypotheses on differences in efficiency were tested from the unrestricted estimation and the restrictions imposed. Hypothesis H1.1 (see Table 11) states that relative economic efficiency (technical and allocative or price efficiency) of "large" and "small" farmers is equal ($ß_2 = 0$). It failed to be rejected implying that economic efficiency did not vary between "large" and "small" farmers. Hypothesis H1.2 states that relative allocative (price) efficiency with respect to labour demand of "large" and "small" farmers is equal, that is, they equate the value of marginal product of labour to wage rate to the same degree ($ß_6 = ß_7$). The test is more easily conceptualised as $B_6 - B_3 = B_7 - B_3$. The hypothesis failed to be rejected implying that there was equal allocative efficiency with respect to labour demand by "large" and "small" farmers. They equated the value of marginal product of labour to wage rate to the same degree. Hypothesis H3.3 states that there is equal level of technical *and* allocative efficiency between

"large" and "small" farmers ($B_2 = 0$, $B_6 = B_7$). Given the result of testing hypothesis H3.2, the essence of hypothesis H1.3 was to test for technical efficiency differences between the two groups of farmers. Technical efficiency cannot be tested for directly in the profit function model. Hypothesis (H1.3) failed to be rejected leading to the conclusion that technical

[13] The calculated BP $\chi^2_4 = 7.19$ was lower than the critical BP $\chi^2_4 = 13.3$ with degrees of freedom (df) = 4. The equivalent hypotheses for all profit functions specified to include dummy variables for the other hypothesized socio-economic characteristics also failed to be rejected

efficiency between "large" and "small" urban farmers was not significantly different. On the average, land parcels in rural farming are much larger than

Table 10. Profit function jointly estimated with wage share equation to test for differences in efficiency between "large" and "small" farmers

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
			Seemingly unrelated regression estimation (SURE)						
Variable	Para meter	OLS	No Restriction	RESTRICTED					
		Single equation		$\beta_2 = 0$	$\beta_6 = \beta_7$	$\beta_2 = 0$ $\beta_6 = \beta_7$	$\beta_3 = \beta_6$	$\beta_3 = \beta_7$	$\beta_2 = 0$ $\beta_6 = \beta_7$ $\beta_4+\beta_5=1$
Constant	β_1	2.762* (1.486)	2.534** (1.109)	2.811*** (0.970)	2.560** (1.108)	3.079*** 0(.901)	2.590** (1.107)	2.828*** (1.095)	2.171*** (0.525)
"large" farmers	β_2	-0.014 (0.394)	--0.171 (0.332)	0 (0)	-0.236 (0.293)	0 (0)	-0.072 (0.310)	-0.329 (0.318)	0 (0.)
Wage rate	β_3	-0.171 (0.198)	-0.090 (0.147)	-0.091 (0.147)	-0.09 (0.147)	-0.092 (0.147)	-0.110 (0.145)	-0.137 (0.145)	-0.115 (0.146)
Capital	β_4	0.754*** (0.171)	0.581*** (0.127)	0.590*** (0.126)	0.581*** (0.127)	0.597*** (0.125)	0.583*** (0.127)	0.584*** (0.127)	0.681*** (0.105)
Land	β_5	0.190 (0.234)	0.362** (0.174)	0.303** (0.131)	0.362** (0.174)	0.258** (0.116)	0.353* (0.174)	0.363* (0.174)	0.319*** (0.105)
Wage Share Equation									
"large" farmers	β_6		-0.840 (0.900)	-0.670 (0.838)	-1.125* (0.572)	-0.110* (0.146)	-0.68 (0.88)	-0.840 (0.900)	-1.125* (0.572)
"small" farmers	β_7		-1.319* (0.74)	-1.434* (0.708	-1.125* (0.572)	-1.319* (0.742)	-1.32* (0.74)	-0.137 (0.145)	-1.125* (0.572)

The values in parentheses are the corresponding standard errors for the estimated parameters.
Asterisks indicate significance at the following levels: *** 1%; ** 5%; *10%.

those in UF making the two activities not directly comparable. Nonetheless, it is instructive to consider farm-size productivity debate in rural farming available in the literature. In rural high potential farming areas such as Nyeri and Kakamega in Kenya, plot size was negatively related to yield per unit area in regressions used to determine the effect of land tenure on productivity. The result was consistent for all the cropping patterns considered (Migot-

Adolla, Place, and Oluoch-Kosura, 1994), and was attributed to intensive use of labour in small plots that decreased substantially in large plots, without compensation by more intensive use of capital inputs. This also applies in UF despite the small land parcels as described in reference to Table 10.

Table 11. Tests of hypotheses for relative economic efficiency between farmers with over 1.4 decares of land and those with less

Hypothesis tested and restriction imposed	Computed χ^2(df)	Critical χ^2(df)	Level of significance
(H1.1) $B_2 = 0$	0.266(1)	3.841	0.606
(H1.2) $B_6 = B_7$	0.169(1)	3.841	0.681
(H1.3) $B_2 = 0, B_6 = B_7$	0.818(1)	5.991	0.664
(H1.4) $B_3 = B_6$	0.676 (1)	3.841	0.411
(H1.5) $B_3 = B_7$	2.640(1)	3.841	0.104
(H1.6) $B_4 + B_5 = 1$	0.124(1)	3.841	0.725
(H1.7) $B_2 = 0, B_6 = B_7, B_4 + B_5 = 1$	2.352(3)	7.815	0.503

The inverse relationship between productivity and farm size is also supported by evidence from Indian agriculture. Deolalikar (1981) using district level data for 272 districts concluded that in general, small farms had higher yield per unit of land compared to large farms. However, the yield advantage of small farms was only found in traditional agriculture, which is similar to low income UF. The trend actually reversed with technical change particularly with use of chemical fertilisers and improved seed.

This study found minimal use of chemical fertilizer and improved seed both in "large" and "small" farms. Therefore, although on the average small farmers had significantly higher labour input and seed expenditure per decare resulting in higher profit per unit area, the same low input technology was used irrespective of the area cultivated. The practice is essentially

mining soil of nutrients and is widely used in rural farming in Kenya and much of Sub-Saharan Africa (Pender, 2000; FAO, 2001). Lack of significant differences in technical efficiency between "large" and "small" farmers may also imply that the timing of input application and the skills of operations of the two groups were not significantly different. It was therefore concluded that the knowledge and technical skills relevant to UF for the two groups of farmers were unlikely to be significantly different.

Hypothesis H3.4 states that "large" farmers have absolute allocative efficiency with respect to labour demand ($ß_3 = ß_6$). The hypothesis failed to be rejected implying that "large" farmers maximized profits by using the amount of labour that equated the value of marginal product to wage rate. Hypothesis H3.5 states that "small" farmers have absolute allocative efficiency with respect to labour demand ($ß_3 = ß_7$). The hypothesis could only be rejected at 10.4% level of significance meaning that "small" farmers too used the optimal amount of labour. The result suggests that allocative and technical efficiency of UF as practiced by the sample farmers was not limited by size of land parcels cultivated. Therefore relatively large parcels did not carry any advantage in profitability per unit area of in allocative and technical efficiency.

Hypothesis H3.6 states that there are constant returns to scale in use of capital and land ($B_4 + B_5 = 1$), while hypothesis H3.7 states that there are constant returns to scale jointly with equal relative technical and allocative efficiency ($B_2 = 0$, $B_6 = B_7$, $B_4 + B_5 = 1$). Both hypotheses failed to be rejected implying that UF is characterized by constant returns to scale in capital and land as fixed inputs. This means that if *both* capital and land inputs are increased by 50% for example, the profit would increase by 50%. Therefore, availing larger land area per household without introducing new inputs or improved technology will not lead to significant increases in UF productivity. The result is encouraging because it gives empirical grounds for

seeking alternatives other than access to more land area per household to boost benefits of UF. The emerging evidence underscores increased use of capital inputs as the logical alternative.

4.2.2.2 Differences in profit and efficiency between conjugal and non-conjugal households

Capital (mainly as expenditure on seed) was the most limiting factor to profit for conjugal and non-conjugal households (Table 9). This was expected considering the very low level of technology applied by the sample farmers. As explained in reference to Table 6, there were no significant differences in inputs used per decare between conjugal and non-conjugal and the average profit generated. The policy implication is that addressing constraints limiting intensive use of inputs is a priority. Irrigation as an input positive had significant effect on profit in non-conjugal households but not in conjugal ones. Irrigation intensifies production and may partly explain the result that in non-conjugal households, land area was not significant in explaining differences in profit. Irrigation in UF is a contentious issue as explained in the literature review, but is key to intensive use of capital inputs suggested by this study. Majority of those irrigating (76%) used water from the river, sewerage (14%) and (10%) piped water. Sewerage provides nutrient reducing or eliminating the need for fertilizers. Therefore, further research is needed to identify the economic constraints hindering different types of irrigation in UF, and the factors prompting irrigation practices that are a health risk to farmers and to consumers with view to addressing them.

For tests of efficiency, the coefficient for conjugal households was not significant different form zero in the five functions estimated without restricting the corresponding coefficient to zero (see Table 12). Therefore, non-conjugal households did not generate significantly less profit than households with both spouses. Descriptive statistics led to a similar conclusion.

The hypothesis of equal economic efficiency of conjugal and non-conjugal household (H2.1: $ß_2 = 0$) failed to be rejected implying that their economic efficiency (technical and allocative

Table 12 Profit function jointly estimated with wage share equation to test for differences in efficiency between conjugal and non-conjugal urban farming households.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Seemingly unrelated regression estimation (SURE)					
Variable	Para meter	Single equation OLS	No Restriction	RESTRICTED				
				$ß_2 = 0$	$ß_6 = ß_7$	$ß_2 = 0$ $ß_6 = ß_7$	$ß_3 = ß_6$	$ß_3 = ß_7$
Constant	$ß_1$	2.743** (1.209)	3.086*** (0.903)	3.130*** (3.896)	2.489*** (0.898)	3.080*** (0.895)	3.237*** (0.899	3.140*** (0.883)
Conjugal Households	$ß_2$	0.142 (0.258)	0.096 (0.248)	0 (0)	0.256 (0.191)	0.0 (0.0)	0.302 (0.224)	0.063 (0.220)
Wage rate	$ß_3$	-0.197 (0.203)	-0.138 (0.150)	-0.128 (0.148)	-0.138 (0.150)	-0.092 (0.146)	-0.197 (0.1477)	-0.145 (0.148)
Capital	$ß_4$	0.770*** (0.170)	0.623*** (0.126)	0.617*** (0.125)	0.623*** (0.126)	0.597*** (0.125	0.629*** (0.126)	0.624*** (0.126)
Land	$ß_5$	0.177 (0.156)	0.246** (0.116)	0.249** (0.116)	0.246** (0.116)	0.258** (0.115)	0.247** (0.116)	0.246** (0.116)
Wage Share Equation								
Conjugal Households	$ß_6$		-1.589** (0.731)	-1.702** (0.670)	-1.125** (0.570)	-1.125** (0.570)	-0.197 (0.147)	-1.589** (0.731)
Non-conjugal Households	$ß_7$		-0.409 (0.909)	-0.233 (0.789)	--1.125** (0.570)	-1.125** (0.570)	-0.409 (0.909)	-0.145 (0.148)

The values in parentheses are the corresponding *t*- values for the estimated parameters.
Asterisks indicate significance at the following levels: *** 1%; ** 5%; * 10% .

significantly different (see Table 13). The hypothesis of equal relative allocative efficiency of conjugal and non-conjugal households (H2.2: $ß_6 = ß_7$) failed to be rejected implying that in their demand for labour, both types of households equated the marginal value of labour to wage rate to the same degree. The hypothesis that there is equal relative technical *and* price efficiency jointly between conjugal and non-conjugal households, (H2.3: $ß_2 = 0$ and $ß_6 = ß_7$)

failed to be rejected as was expected, given the conclusions from hypotheses H2.1 and H2.2. Therefore, households headed by women were not technically less efficient in UF than those headed by both spouses, and the commonly used argument from rural farming that women are less efficient than men (FAO, 1985) is not supported by observation from this study. On the average, area of land cultivated, expenditure on seed and number of man-days of labour per decare (family and hired) for both groups of households (see Table 6) were not significantly different suggesting that they were also equally able to access land, capital and labour.

Table 13 Tests of hypotheses for relative economic efficiency between conjugal and non-conjugal urban farming households

Hypothesis Tested and Restriction Imposed	Computed χ^2(df)	Critical χ^2(df)	Level of Significance
(H2.1) $ß_2 = 0$	0.152(1)	3.841	0.697
(H2.2) $ß_6 = ß_7$	1.023(1)	3.841	0.312
(H2.3) $ß_2 = 0$ and $ß_6 = ß_7$	2.820 (2)	5.991	0.244
(H2.4) $ß_3 = ß_6$	3.78 (1)	3.841	0.052
(H2.5) $ß_3 = ß_7$	0.086 (1)	3.841	0.769

This is also another observation in UF that is not shared by rural farming where women heads of households have less access to production resources, for example land (Quisumbing *et.al.*, 1995).

The hypothesis that conjugal households have absolute price efficiency (H2.4: $ß_3 = ß_6$) was rejected at 5% level of significance implying that conjugal households did not use optimal amount of labour. The marginal value of labour exceeded wage rate ($ß_6 > ß_3$, Table 4.2.7 column 4) suggesting that they allocated the activity more labour than the amount required to maximize profits. A likely reason is that they do not engage in UF to maximize profits but to

supplement income generated from other activities by absorbing excess labour or giving alternative employment to labour that would otherwise be idle. The hypothesis that non-conjugal households have absolute price efficiency, that is they maximize profits by equating the value of marginal product of labour to wage rate (H2.5: $ß_3 = ß_7$) failed to be rejected implying that in UF, women heads of households make efficient decision in labour allocation, unlike heads of conjugal households. This is not surprising because labour is their main resource. It is likely that absolute efficiency in labour demand did not translate in to higher economic efficiency because better technical options were not available. The result underscores that these two groups of households engage in UF for different main objectives.

Empirical gender-disaggregated results on efficiency are generally lacking from the literature available, and more so for UF to allow comparison with the results of this study. A similar problem often faces researchers focussing on rural farming for several reasons pointed out by Adesina and Djato (1997). First, only few studies have examined whether men are more efficient than women in farm production in Africa are, even though the issue is said to be a passionate debate. Second, the available studies for Africa give variable results. Third, the studies are criticised because of the problem of simultaneity bias common in production function methods used to test for allocative and economic efficiency. Failure to address the problem convincingly casts some doubts on the results obtained. In one of these studies, Moock (1976) found that in Vihiga, Kenya, women were technically more efficient maize producers than men were, because the coefficient of women managers in the production function was positive and significant at 10% level. Fourth, studies, which have used profit or cost function to overcome the problem of endogeneity, have not used the approach to examine the efficiency differences between men and women because of lack of gender-disaggregated data. This gap calls for gender-disaggregation in future studies of efficiency in resource use, both in urban and rural farming.

4.2.2.3 Effect of years of formal education of conjugal and non-conjugal household heads on profit and efficiency

In conjugal households (Table 9), more years of formal education of head of household and spouse were associated with significantly higher profit. Higher levels of formal education are likely to improve management in a production activity leading to improved performance. In non-conjugal households on the contrary, the effect of education on profit was negative and significant. As shown in Figure 15, only 22% of women heading households had seven or more years of formal education compared to 54% among women as spouse in conjugal households. It was pointed out in the literature review that in West African cities, women with higher levels of formal education were less likely to embark on UF unlike men, because they preferred less strenuous and more prestigious activities of earning livelihoods. On the contrary for men, returns earned rather than the prestige status determined the activities they engaged in irrespective of their level of formal education. This study take the view that higher profit by women with less formal education heading non-conjugal households indicates that they pay more attention to UF because they know that they cannot compete effectively for the available jobs. The policy insight is that support given to UF will benefit some of those who have limited alternative employment opportunities because of low levels of formal education.

Seven years or more of formal education (more education) was used as the cut-off point dividing both conjugal and non-conjugal households into two groups. The differences in the average profit, profit per decare, expenditure on seed, labour input per decare and income from other sources between the groups were not significant. The effect of more education did not have significant effect on profit in any of the estimated function shown in Table 14. The hypothesis that in conjugal households there was no difference in economic efficiency

Table 14 Profit function jointly estimated with wage share equation to test for differences in efficiency in urban farming between conjugal household heads with seven or more years of formal education and those with less

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variable	Para Meter	OLS	Seemingly unrelated regression estimation					
		Single equation	No Restriction	$\beta_2 = 0$	$\beta_6 = \beta_7$	Restricted $\beta_2 = 0$ $\beta_6 = \beta_7$	$\beta_3 = \beta_6$	$\beta_3 = \beta_7$
Constant	β_1	3.653*	3.874**	3.989***	4.164***	4.104**	3.887*	4.500***
		(2.055)	(1.360)	(1.348)	(1.348)	(1.346)	(1.357)	(1.328)
ED7HH	β_2	0.299	0.249	0	-0.212	0	0.275	-0.225
		(0.412)	(0.390)	(0)	(0.269)	(0)	(0.349)	(0.322
Wage rate	β_3	-0.362	-0.262	-0.256	-0.262	-0.274	-0.267	-0.319
		(0.321)	(0.209)	(0.209)	(0.209)	(0.209)	(0.206)	(0.208)
Capital	β_4	0.785***	0.604***	0.611***	0.604***	0.592***	0.605***	0.610***
		(0.256)	(0.167)	(0.167)	(0.167)	(0.166)	(0.167)	(0.167)
Land	β_5	0.117	0.207	0.203	0.207	0.215	0.207	0.209
		(0.256)	(0.167)	(1.667)	(0.167)	(0.167)	(0.167)	(0.167
Wage Share Equation								
With information	β_6		-0.457	-0.814	-1.717*	-1.717*	-0.267	-0.457
			(1.269	(1.140	(1.008)	(1.008)	(0.206)	(1.269)
Without information	β_7		-3.865**	-3.256**	-1.717*	-1.717*	-3.865**	-0.319
			(1.658)	(1.356)	(1.008)	(1.008)	(1.658)	(0.208)

The values in parentheses are the corresponding standard errors for the estimated parameters.
Asterisks indicate significance at the following levels: *** 1%; ** 5%; *10% .

between farmers with more education and those with less (H3a.1: $B_2 = 0$) failed to be rejected (see Table 15). Therefore more education was not associated with higher economic efficient. The hypothesis that allocative (price) efficiency of the two groups farmers was equal (H3a.2: $B_6 = B_7$) could only be rejected at 10.3%. Therefore, both groups were equally efficient in allocating labour meaning that they equated the value of marginal product of labour to wage rate to the same degree. Similarly, the hypothesis of equal technical *and* price efficiency of both groups of household (H3a.3: $B_2 = 0$, $B_6 = B_7$) failed to be rejected leading to the conclusion that technical efficiency of these groups of farmers was not significantly different. The finding supports the earlier result that the average profit per decare for conjugal

heads of household with more education was not significantly lower than that of more educated farmers. The hypothesis that conjugal household heads with more education had absolute price efficiency (H3a.4: $B_3 = B_6$) failed to be rejected implying that they made optimal use of labour in UF. However, the equivalent hypothesis for those with less education (H3a.5: $B_3 = B_7$) was rejected at 5% level of significance. They used more than labour in UF than is optimal. with wage rate exceeding marginal revenue of labour ($B_7 > B_3$, see Table 14 column 4). This is consistent with a strategy of using UF to absorb labour with limited alternatives to generate livelihoods.

Table 15 Tests of hypothesis for relative efficiency in urban farming between conjugal heads of households with seven or more years of formal education and those with less

Hypothesis tested and restriction imposed	Computed χ^2(df)	Critical χ^2(df)	Level of significance
(H3a.1) $ß_2 = 0$	0.408	3.841	0.523
(H3a.2) $B_6 = B_7$	2.665(1)	3.841	0.103
(H3a.3) $B_2 = 0, B_6 = B_7$	3.284(2)	5.991	0.194
(H3a.4) $B_3 = B_6$	0.023(1)	3.841	0.880
(H3a.5) $B_3 = B_7$	4.650(1)	3.841	0.031

In non-conjugal households, the effect more education had negative and significant effect on profit in all the five functions estimated without restricting the accompanying coefficient to zero (Table 16.) For these households, the hypothesis of no difference in economic efficiency between farmers with more education and those with less (H3b.1: $B_2 = 0$) was rejected at 1% level of significance (see Table 17). It implied that the less educated farmers are more efficient (economically). The hypothesis that allocative (price) efficiency of the two groups farmers was equal (H3b.2: $B_6 = B_7$) failed to be rejected demonstrating that both groups equated the value of marginal product of labour to wage rate to the same degree. The hypothesis of equal technical *and* price efficiency of both groups of household heads (H3b.3:

$\beta_2 = 0$, $B_6 = B_7$) was rejected leading to the conclusion that technical efficiency of the two groups of farmers was significantly different. Women of less education heading non-conjugal household had were technically more efficient probably because the very low level of technology used by the sample farmers did not availed an opportunity to apply knowledge and skills imparted by formal education. On the contrary, more formal education is likely to make the recipient aspire to more prestigious and less physically strenuous activities of

Table 16 Profit function jointly estimated with wage share equation to test for differences in efficiency between non-conjugal heads of households with seven or more years of formal education and those with less

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variable	Para meter	OLS	Seemingly unrelated regression estimation					
		Single equation	No restriction	RESTRICTED $\beta_2 = 0$	RESTRICTED $\beta_6 = \beta_7$	RESTRICTED $\beta_2 = 0$ $\beta_6 = \beta_7$	RESTRICTED $\beta_3 = \beta_6$	RESTRICTED $\beta_3 = \beta_7$
Constant	β_1	2.737* (1.334)	2.738*** (0.814)	2.630*** (0.802)	2.875*** (0.812)	2.562*** (0.799)	3.635*** (0.779)	3.867*** (0.728)
ED7HH	β_2	-0.664*	-0.692** (0.312)	0 (0)	-0.439** (0.202)	0 (0)	-0.245 (0.273	-0.863** (0.304
Wage rate	β_3	-0.118 (0.253)	0.111 (0.153)	0.114 (0.153)	0.111 (0.153)	0.115 (0.153)	-0.187* (0.115)	-0.216*** (0.084)
Capital	β_4	0.708*** (0.230)	0.622*** (0.139)	0.622*** (0.139)	0.622*** (0.139)	0.622*** (0.139)	0.664*** (0.138)	0.667*** (0.138)
Land	β_5	0.227 (0.185)	0.174 (0.112)	0.193* (0.111)	0.174 (0.112)	0.202* (0.111)	0.175 (0.112)	0.175 (0.112)
Wage Share Equation								
With information	β_6		-0.568*** (0.173	-0.315** (0.130	-0.408** (0.086	-0.408** (0.086)	-0.187* (0.115)	-0.568*** (0.173)
Without information	β_7		-0.355*** (0.100)	- 0.440*** (0.092	-0.408*** (0.086)	-0.408*** (0.086)	-0.355*** (0.100)	-0.216*** (0.084)

The values in parentheses are the corresponding *t*- values for the estimated parameters.
Asterisks indicate significance at the following levels: *** 1%; ** 5%; *10% .

earning livelihoods and hence give UF less attention. The hypothesis that more educated farmers have absolute allocative efficiency with respect to labour demand (H3b.4, $\beta_3 = \beta_6$) was rejected implying that more educated farmers did not use the optimal amount of labour

in UF. The wage rate was higher than the marginal value of labour ($B_6 > B_3$, Table 16 in column 6). The corresponding hypothesis for farmers with less education (H6.5, $ß_3 = ß_7$) was rejected ($B_7 > B_3$, table 4.2.9 in column 6). Therefore for non-conjugal households heads, irrespective of the level of education, the wage rate was higher than the marginal value of

Table 17 Tests of hypothesis for relative efficiency in urban farming between non-conjugal heads of households with seven or more years of formal education and those with less

Hypothesis tested and restriction imposed	Computed χ^2(df)	Critical χ^2(df)	Level of significance
(H3b.1) $ß_2 = 0$	4.923	3.841	0.027
(H3b.2) $B_6 = B_7$	1.134(1)	3.841	0.287
(H3b.3) $B_2 = 0, B_6 = B_7$	5.856(2)	5.991	0.054
(H3b.4) $B_3 = B_6$	8.637(1)	3.841	0.003
(H3b.5) $B_3 = B_7$	6.505(1)	3.841	0.011

labour in UF. For both groups, wage rate exceeded the marginal value of labour (Table 16, column 4, $B_6 > B_3$ and $B_7 > B_3$) suggesting that non-conjugal households irrespective of the level of education of the head have more labour not employed in alternative activities and is absorbed in UF to maximise output and earn livelihood.

4.2.2.4 Effect of Access to Technical Information on Profit and Economic Efficiency

A dummy variable (INFOSCM) was specified to distinguish between the 26% of the farmers who had access to technical farming information and those without access. Access to technical information (INFOSCM) had positive and significant effect on profit (Table 9) in conjugal households but not in con-conjugal households. Extension service as one of the type of assistance needed was ranked second in importance even though lack of farming information was ranked fifth as a problem. Among the conjugal heads of households 26% had access to

technical advice compared to 30% in non-conjugal households. The most important source of technical information in conjugal households (60%) was agricultural staff who visited them at the land parcel cultivated (36%) or through on going projects in the area (36%). On the contrary for non-conjugal heads of households, accessed technical information from friends (50%), and agricultural staff (40%) mainly through on going projects in the area (40%), by being visited at the land parcel cultivated (27%) or by the recipient searching for the source of advice (20%). Further research is need to confirm that agricultural extension staff as one of the main

Table18. Profit function jointly estimated with wage share equation to test for differences in efficiency between farmers with access to technical information and those without access

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variable	Para meter	OLS	Seemingly unrelated regression estimation					
		Single equation	No restriction	$ß_2 = 0$	$ß_6 = ß_7$	Restricted $ß_2 = 0$ $ß_6 = ß_7$	$ß_3 = ß_6$	$ß_3 = ß_7$
Constant	$ß_1$	2.920** (1.313)	3.362*** (0.972)	3.375*** (0.939)	3.403*** (0.970)	3.228*** (0.928)	3.372*** (0.971)	3.696*** (0.955)
With information	$ß_2$	0.034 (0.301)	0.015 (0.289)	0 (0)	0.136 (0.222)	0 (0)	0.042 (0.44)	-0162 (0.272)
Wage rate	$ß_3$	-0.226 (0.210)	-0.150 (0.155)	-0.150 (0.154)	-0.150 (0.155)	-0.144 (0.154)	-0.153 (0.153)	-0.209 (0.151)
Capital	$ß_4$	0.758*** (0.178)	0.591*** (0.131)	0.590*** (0.131)	0.591*** (0.131)	0.596*** (0.130)	0.591*** (0.131)	0.595*** (0.131)
Land	$ß_5$	0.189 (0.164)	0.253** (0.121)	0.252** (0.120)	0.253** (0.121)	0.264** (0.120)	0.253** (0.121	0.255** (0.121
Wage Share Equation								
With information	$ß_6$		-0.359 (1183)	-0.392 (0.989)	-1.180** (0.614)	-1.180* (0.614)	-0.153 (0.153)	-0.359 (1.183)
Without information	$ß_7$		-1.482** (0.718)	-1.470 (0.677)	-1.180** (0.614)	-1.180* (0.614)	-1.482** (0.718)	-0.209 (1.151)

The values in parentheses are the corresponding *t*- values for the estimated parameters. N= 78
Asterisks indicate significance at the following levels: *** 1%; ** 5%; *10% .

sources of technical advice because the available literature suggests that the service does not target UF by low-income households. The quality of the technical information received was

difficult to verify in a survey of this nature, making it impossible to gauge its potential to affect profits positively.

A slightly similar finding was obtained by Adesina and Djato (1996), who found that extension contact had insignificant effect on profit of rice farmers in Côte d'Ivoire. In this study, inclusion of access to technical farming information variable in the profit function was motivated by a study done in Kenya, which concluded that the Train and Visit Extension Programme had positive influence on farmer's management capability and technical efficiency (Bindlish and Evenson, 1993). But Jamison and Lau (1982) found a negative relationship between profitability and availability of agricultural extension among Thai farmers. They suggested that the negative relationship was likely because extension agents were interested in increasing physical output rather than profit. Lack of sufficient research input to guide agricultural extension service could also result in negative association of profit and availability of extension advice (Schultz, 1965 cited by Jamison and Lau, 1982).

All the functions estimated without restricting the corresponding coefficient to zero showed that access to technical information had no significant effect on profit (Table 18). As stated earlier, other researchers have reported comparable results. The null hypothesis of no difference in relative economic efficiency between households with access to technical information and those without access (H4.1: $ß_2 = 0$), failed to be rejected implying that economic efficiency of the two groups of farmers was not significantly different (Table 19). Similarly, the hypothesis of equal allocative efficiency in labour demand by farmers with access to technical information and those without access (H4.2: $ß_6 = ß_7$) failed to be rejected. This implied that in their demand for labour, the two groups of farmers equated the value of marginal product of labour to wage rate to the same degree. The hypothesis of equal technical *and* allocative efficiency between farmers with access to technical information and

those without access (H4.3: $ß_2 = 0$ and $ß_6 = ß_7$) failed to be rejected. Equal technical efficiency means that given the same quantity of inputs, farmers with access to technical information did not consistently produce significantly higher output than those without access to technical information.

Table 19. Tests of hypotheses for relative economic efficiency between urban farming households heads with access to technical information and those without access

Hypothesis Tested and Restriction Imposed	Critical χ^2(df)	Critical χ^2(df)	Level of Significance
(H4.1) $ß_2 = 0$	0.003(1)	3.841	0.959
(H4.2) $ß_6 = ß_7$	0.658 (1)	3.841	0.417
(H4.3) $ß_2 = 0$ and $ß_6 = ß_7$	1.033(2)	5.991	0.597
(H4.4) $ß_3 = ß_6$	0.031 (1)	3.841	0.861
(H4.5) $ß_3 = ß_7$	3.289 (1)	3.841	0.070

Access to technical information is intended to instruct farmers on skills of input use, appropriate crop management practices and to demonstrate their positive contribution to yield. Therefore, access to technical information was expected to result in higher technical efficiency for a given set of inputs and in turn to higher profits. Adesina and Djato (1996) included an extension variable in the profit function of rice farmers in Côte de' Ivoire anticipating positive influence on profit. The specification was prompted by Bindlish and Evenson (1993) who found positive influence of extension on management ability and technical efficiency of rice farmers. The effect of extension on profit was found to be insignificant suggesting that extension did not have positive influence on management ability and in turn technical efficiency of rice farmers.

However, availability or even access to technical information is likely to be an inadequate proxy of retention and effective application of technical information received. The current study did not attempt to verify the quality of technical information accessed, its relevance to UF, the extent to which the information was retained by the recipient, and ability to acquire the inputs suggested by the information. These are some plausible explanations for insignificant differences in technical efficiency between farmers with access to technical information and those without access. They prompt for more detailed follow-up analysis. The hypothesis that farmers with access to technical information had absolute allocative efficiency in their demand for labour (H4.4: $ß_3 = ß_6$) failed to be rejected implying that they equated the value of marginal product of labour to wage rate by using the optimal amount of labour to maximize profits. On the contrary, the hypothesis that farmers without access to technical information had absolute price efficiency in labour demand (H4.5: $ß_3 = ß_7$) was rejected at 10% level of significance. For these households, the wage rate was significantly higher than the marginal value of labour (Table 18 column 4, $ß_7 > ß_3$) indicating that they used significantly more labour than the amount required to maximize profits.

One of the main results of this study is that low-income UF households are very poor because the earn incomes adequate to only meet 28% of the minimum requirement on the average. UF contributes 14% of the income. The implication is that the large deficit in income to for basic needs makes it rational to apply a much of the family labour in UF as is available unless there is competing use with higher marginal return. The modes of accessing technical information stated earlier seem to suggest that access is by active involvement of the farmer, for instance by searching for information source, through membership to on-going projects or from friends. Such farmers are also more likely to come up with more alternatives for absorbing labour to generate livelihood so that the amount applied in UF is not more than optimal. The

result suggests that farmers without access to technical information was another group of urban farmers who operated the activity mainly for survival value because it absorbed household labour that had few other alternatives.

4.2.2.5 Effect of the number of years of cultivating urban land on profit and economic efficiency

In the literature review it was note that UF is not an activity easily under taken by people newly arrived in urban areas, because access to land involve social network to identify exiting farmers or to point out areas where cultivable seemingly vacant land can be found. Over the years, farmers also make adjustments to cultivate crops that are more suited to the soil conditions and other constraints like seasonal flooding or theft of produce. They are also likely to target locations unattractive to competing development unlikely to displace them. Therefore, the number of years of engaging in UF can be taken as a proxy of the experience gained and the success achieved in making appropriate adjustments enhancing efficiency, so that the activity achieves its objectives more effectively.

To test the hypotheses that the number of years the farmer had cultivated urban land had no effect on profit and economic efficiency in UF, a dummy variable (YRUF13) was specified by dividing the sample into two groups using the average years of cultivating urban land (13 years) as the cut-off. The average profit and profit per decare of those cultivating urban land for 13 or more years (more experience) was significantly higher than of those cultivating urban land for fewer years. The average area cultivated by the two groups or seed expenditure was not significantly different. On the average, the percentage contribution by UF to total income needed by household per month to be above poverty line was higher in the group with more experience and the difference was significant. The results support the hypothesis of better performance of UF with more years of experience. However the profit function (Table

9) showed that more experience had positive and significant effect on profit for non-conjugal but not for conjugal households .

The effect of more years in UF was positive and significant in two out of the five profit functions estimated without restricting the corresponding coefficients to zero (Table 20). More experienced farmers had 52 to 57% more profit than less experienced farmers. The hypothesis that economic efficiency (price efficiency plus technical efficiency) of more

Table 20 Profit function jointly estimated with wage share equation to test for differences in efficiency between farmers who have cultivate urban land for 13 years or more and those who have cultivated for fewer years

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		OLS	Seemingly unrelated regression estimation (SURE)					
Variable	Para meter	Single equation	No Restriction	RESTRICTED				
				ß2 = 0	ß6 = ß7	ß2 = 0 ß6 = ß7	ß3 = ß6	ß3 = ß7
Constant	ß1	2.712** (1.203	3.014*** (0.871)	3.143*** (0.866)	2.927*** (0.868)	3.093** (0.866)	3.165*** (0.869)	3.133)*** (0.852)
13 or more years	ß2	0.252 (0.254)	0.333 (0.243)	0 (0)	0.516*** (0.183)	0 (0)	0.565** (0.219)	0.256 (0.213)
Wage rate	ß3	-0.121 (0.203)	0.015 (0.146)	-0.023 (0.144)	0.015 (0.146)	-0.879 (0.142)	-0.041 (0.144)	-0.003 (0.144)
Capital	ß4	0.727*** (0.170)	0.533*** (0.122)	0.554*** (0.121)	0.533*** (0.122	0.590*** (0.120)	0.539*** (0.122)	0.535*** (0.122)
Land	ß5	0.180 (0.155)	0.254** (0.112)	0.257** (0.112)	0.254** (0.112)	0.262** (0.112)	0.256** (0.112)	0.254** (0.111)
Wage Share Equation								
13 years or more	ß6		-1.801** (0.824)	-2.342*** (0.724)	-1.125** (0.569)	-1.125** (0.569)	0.024 (0.180)	-1.801** (0.824)
Less than 13 years	ß7		-0.510 (0.786)	-0.019 (0.700)	-1.125** (0.569)	-1.125** (0..569)	-0.510 (0.786)	0.003 (0.144)

The values in parentheses are the corresponding t- values for the estimated parameters.
Asterisks indicate significance at the following levels: *** 1%; ** 5%; *10% .

experienced farmers and those with less experience (H5.1: ß2 = 0) failed to be rejected (Table 21). Therefore, both groups of farmers were equally efficient economically. The hypothesis that relative allocative efficiency of the two groups of farmers was equal (H5.2: ß6 = ß7) failed to be rejected implying that both groups of farmers were equally efficient in making decisions in the use of labour. They equated the value of its marginal product to wage rate to the same degree. The hypothesis stating that technical and allocative efficiency of the two groups of farmers were equal (H.5.3: ß2 = 0 and ß6 = ß7) was rejected at 1% level of significance. Since allocative efficiency was shown not to be significantly different, rejecting hypothesis H5.3 implies that technical efficiency of more experienced farmers was significantly higher than that of less experienced farmers. An activity of this nature is unlikely to be transitory in nature, a view commonly use to justify lack of substantive policy

Table 21 Tests of hypotheses for relative economic efficiency between farmers who had cultivated urban land for 13 or more years and those who had cultivated for fewer years.

Hypothesis Tested and Restriction Imposed	Computed $\chi 2(df)$	Critical $\chi 2(df)$	Level of Significance
(H5.1) ß2 = 0	1.875(1)	3.84	0.171
(H5.2) ß6 = ß7	1.286(1)	3.84	0.257
(H5.3) ß2 = 0, ß6 = ß7	9.267(2)	5.99	0.010
(H5.4) ß3 = ß6	4.708(1)	3.84	0.030
(H5.5) ß3 = ß7	0.4311)	3.84	0.511

addressing the activity. The hypothesis that more experienced farmers had absolute allocative efficiency, that is, they maximize profits by equating the value of marginal product of labour to wage rate (H7.4: ß3 = ß6) was rejected at 5% level of significance. The unrestricted

estimation (Table 20, column 4) showed that they used more than the optimal amount so that wage rate exceeded the value of marginal product of labour (ß6 > ß3). This is yet another group of farmers who allocate UF more than the optimal amount of labour to maximise output and earn livelihood from households labour lacking alternative employment. These farmers have longer experience in comparing UF contribution to household income relative to the dwindling alternatives available over the years. The equivalent hypothesis for farmers with less experience (H7.5: ß3 = ß7) failed to be rejected suggesting that they used labour optimally in UF.

Use of years in UF as a proxy for experience in the activity prompts further clarification in view of potential correlation with other variables likely to be related to experience. As expected, age and years of UF of household head were positively correlated (r = 0.51 and significant at 5% level), however years of formal education and years of UF were negatively correlated (r = -0. 3 and significant at 5% level). The average age of household heads was 47 years. Age of the household head could also be considered as a proxy for experience accounting for differences in UF performance. However, the suggestion is not supported by evidence because the average profit, profit per decare and area cultivated of older (47 years or more) and younger farmers were not significantly different. Similarly the seed expenditure, labour input per decare and the percentage contribution by UF to total income per month needed to be above poverty line were not significantly different.

4.2.2.6 Effect of income earned from other sources on profit and economic efficiency

Seventy one percent of the respondent households earned income from activities other than UF at an average of Ksh3,099 per month. In rural farming non-farm income can complement farm production by reducing capital constraint in use of external inputs and hired labour thus increasing efficiency by enabling the external inputs to be used when they have optimal

returns. To determine if a similar relationship existed in UF, Ksh3099 was used as the cut-off for two groups, those earning the average or more (high other income) and those earning less. The profit function showed that the group earning high other income (YALL3099) did not have significant effect on profit generated (Table 9). On the average, they also did not cultivate significantly larger area, use more labour or seed expenditure per decare. Furthermore, other income per month was also not positively correlated with overall profit, seed expenditure, labour input or profit per decare. Therefore, farmers with high other income did not use more inputs or generate higher profit from UF.

The effect of other income on profit was not significant in any of the five profit functions estimated without restricting the corresponding coefficients to zero (Table 22). The hypothesis that there was no difference in economic efficiency between the two groups of households (H6.1: B2 = 0) failed to be rejected (Table 23). The hypothesis that allocative efficiency of the two groups was equal (H6.2: B6 = B7) could only be rejected at 10.1% implying that in labour demand both groups were equally able to equate the value of marginal product to wage rate. The hypothesis that there is equal relative technical and allocative efficiency jointly between households earning high other income and those earning less (H6.3: B2 = 0, B6 = B7) failed to be rejected. Therefore, higher other income did not translate into with higher technical efficiency as would be expected if it enabled result more efficient use of external inputs. As pointed out in an earlier section, purchased improved seed was hardly used and only 14% of the farmers used fertilizer, manure or pesticides in minimal amounts. It is therefore likely that the limiting factor was the quality and the amounts used rather than time of application. The hypothesis that households earning high other

Table 22 Profit function jointly estimated with wage share equation to test for differences in efficiency in urban farming between households earning high other income (Ksh3,099 per month or more) and those earning less.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Profit Function								
	Para meter	OLS	Seemingly unrelated regression estimation (SURE)					
Variable		Single equation	No Restriction	RESTRICTED				
				ß2 = 0	ß6 = ß7	ß2 = 0 ß6 = ß7	ß3 = ß6	ß3 = ß7
Constant	ß1	2.633** (1.215)	3.181*** (0.915)	3.246*** (0.912)	3.114*** (0.914)	3.078*** (0.904)	3.303*** (0.913)	3.326*** 0.897)
High other income	ß2	-0..263 (0.296)	-0.238 (0.286)	0 (0)	0.059 (0.221)	0 (0)	0.131 (0.237)	-0.301 (0.275)
Wage rate	ß3	-0.152 (0.198)	-0.096 (0.149)	-0.107 (0.148)	-0.096 (0.149	-0.092 (0.148)	-0.139 0.148)	-0.123 (0.145)
Capital	ß4	0.768*** (0.168)	0.595*** (0.126)	0.588*** (0.126)	0.595*** (0.126)	0.598*** (0.126)	0.598*** (0.126)	0.597*** (0.126)
Land	ß5	0.193 (0.156)	0.256** (0.117)	0.251** (0.117)	0.256** (0.117)	0.258** (0.117)	0.257** (0.117)	0.256** (0.117)
Wage Share Equation								
High other income	ß6		-2.837* (1.186)	-2.289** (0.986)	-1.125** (0.564)	-1.125** (0..564)	-0.139 (0.148)	-2.837** (1.186)
Low other income	ß7		-0.625 (0.641)	-0.785 (0..612)	-1.125** (0.564)	-1.125** (0.564)	-0.625 0.641)	-0.123 (0.145)

Ksh3,099 per month was the average income earned by the 23% of households engaged in other income generating activities other than UF
The values in parentheses are the corresponding standard errors for the estimated parameters. N=84
Asterisks indicate significance at the following levels: *** 1%; ** 5%; *10% .

income had absolute price efficiency (ß3 = ß6) was rejected. Since wage rate exceeded the marginal value of labour (Table 22 column 4, ß6 > ß3) they used more than the optimal amount, suggesting that in UF it contributed more to livelihood than it would in alternative activities. The equivalent hypothesis for those earning low other income (H6.4: B3 = B7) could not be rejected implying that they maximized profits in the use of labour in UF.

Table 23 Tests of hypothesis for relative efficiency in urban farming between households earning high other income (Ksh3,099 per month or more) and those earning less.

Hypothesis tested and restriction imposed	Computed $\chi 2(df)$	Critical $\chi 2(df)$	Level of Significance
(H6.1) ß2 = 0	0.689 (1)	3.841	0.406
(H6.2) B6 = B7	2.693 (1)	3.841	0.101
(H6.3) B2 = 0, B6 =B7	2.764 (2)	5.991	0.251
(H6.4) B3 = B6	5.257(1)	3.841	0.022
(H6.5) B3 =B7	0.644 (1)	3.841	0.422

suggesting that in UF it contributes more to livelihood than it would in alternative activities. It also likely that alternative activities are not available or they do not absorb this type of labour type of labour.

4.2.2.7 Economic efficiency in UF depending on the main objective for engaging in the activity

Generating cash income (saving money by not buying food or generating income from sales of UF produce) was stated as the first objective of UF by 28% of the households. These were among those who did not generate enough income (from UF and other activities) to be above poverty line (based on the household size in adult consumer units). For other households, accessing food when short of money (47%), generating self- employment (20%), facilitating other household business activities (2%), and landlessness in the rural by 2%, were the main objectives for engaging in the activity.

To determine if generating cash income as opposed to alternative objectives for the activity explained variation in efficiency, the households were divided into two groups: those whose main objective was to generate cash income (UFCASH) and those with other main objectives

(NONCASH). The UFCASH group had significantly higher profit than their counter parts in five of the equations estimated without restricting the corresponding coefficient to zero (Table 24).

The hypothesis that there was no difference in economic efficiency between the two groups of households depending on main objective of engaging in UF (H7.1: B2 = 0) was rejected at 1% level (Table 25). The hypothesis that allocative efficiency of the two groups was equal

Table 24 Profit function jointly estimated with wage share equation to test for differences in efficiency in urban farming between households with the main objective of generating cash income and those with other objectives

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Para Meter	OLS	Seemingly unrelated regression estimation (SURE)					
Variable		Single equation	No Restriction	RESTRICTED				
				ß2 = 0	ß6 = ß7	ß2 = 0 ß6 = ß7	ß3 = ß6	ß3 = ß7
Constant	ß1	3.095*** (1.179)	3.289*** (0.878)	3.162*** (0.876)	3.331*** (0.877)	3.071*** (0.877)	3.298*** (0.876)	3.626*** (0.861)
UFCASH	ß2	0.618** (0.278)	0.686*** (0.266)	0 (0)	0.533*** (0.206)	0 (0.)	0.712*** (0.226)	0.508** (0.250)
Wage rate	ß3	-0.143 (0.193)	-0.070 (0.143)	-0.088 (0.142)	-0.070 (0.143)	-0.094 (0.143)	-0.073 (0.142)	-0.129 (0.140)
Capital	ß4	0.643*** (0.171)	0.506*** (0.127)	0.580*** (0.123)	0.506*** (0.127)	0.602*** (0.121)	0.506*** (0.127)	0.511*** (0.127)
Land	ß5	0.212 (0.152)	0.280*** (0.113)	0.261** (0.112)	0.280*** (0.113)	0.256** (0.112)	0.280** (0.113)	0.281*** (0.113)
Wage Share Equation								
UFCASH	ß6		-0.274 (1.090)	-1.786* (0.919)	-1.125** (0.570)	-1.125** (0.570)	-0.073 (0.142)	-0.274 (1.090)
NONCASH	ß7		-1.446** (0.669)	-0.876 (0..632)	-1.125** (0.570)	-1.125** (0.570)	-1.446** (0.669)	-0.129 (0.140)

The values in parentheses are the corresponding t- values for the estimated parameters.
Asterisks indicate significance at the following levels: *** 1%; ** 5%; *10% .

Table 25 Tests of hypothesis for relative efficiency in urban farming between households with the main objective of generating cash income and those with other objectives

Hypothesis tested and restriction imposed	Computed $\chi 2$(df)	Critical $\chi 2$(df)	Level of significance
(H7.1) ß2 = 0	6.669(1)	3.841	0.010
(H7.2) B6 = B7	0.840(1)	3.841	0.359
(H7.3) B2 = 0, B6 =B7	7.511(2)	5.991	0.023
(H7.4) B3 = B6	0.035(1)	3.841	0.851
(H7.5) B3 =B7	4.047(1)	3.841	0.044

(H7.2: B6 = B7) failed to be rejected implying that in labour demand both groups were equally able to equate the value of marginal product to wage rate. The hypothesis that there is equal relative technical and allocative efficiency jointly between the two groups of households (H7.3: B2 = 0, B6 = B7) was rejected at 5% level. Given the previous two hypotheses this means that differences in the objective of engaging in UF as stated above resulted in differences in technical efficiency. The hypothesis that households with the objective of generating cash income had absolute price efficiency (ß3 = ß6) failed to be rejected implying that they used optimal amount of labour consistent with generating maximum profit in UF and with availability of other alternatives of absorbing labour and generating income. The equivalent hypothesis for those with non-cash income objective for engaging in UF (7.4: B3 = B7) was rejected. Since B7>B3 (Table 24, column 4) wage rate exceeded the marginal value of labour which is not inconsistent with the main objectives of UF stated by this group, that is, accessing food when the households was short of money generating self employment (20%).

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY

Rapid urbanization is a global feature of the twenty-first century. It raises concern in developing countries and in SSA in particular, because it is accompanied by increasing poverty and urban environmental threat to life and health. Urbanization in driven by factors which over the years have made it increasingly difficult to earn a living in rural areas. Urbanization in Kenya as elsewhere in developing countries, is characterised by increasing number of people who are food insecure, unemployed and poor, living in unplanned, overcrowded structures in slum areas, which are unrecognised by city planners and lack adequate potable water, sewerage, drainage, garbage collection, roads, schools and health services, and have high crime rate. Poverty and waste management are therefore the two main problems common to most cities of developing countries. UA is one of the many activities poor urban residents use to earn livelihoods, but it is unique because it can contribute to solving the problems of poverty and waste management. However, for the contribution to be realised, UA by low-income households has to be transformed into an efficient activity that is integrated into the entire economy. The factors constraining the possible transformation and integration are not clear, and facilitating policies and programs are lacking. Therefore the objectives of the study were to characterise urban farming households, determine the profit level and factors influencing it, and compare allocative, technical, and economic efficiency among different socio-economic groups of households.

A random sample of 92 UF households, stratified by gender, was selected in Korogocho, one of the low-income areas in Nairobi, in 1998. Sampling was preceded by a census to identify households, which cultivated urban land in 1997. A semi-structured questionnaire was used to collect demographic data on household members as well as labour, capital inputs and output of UF, for 1997 long rains cropping season. Land parcels cultivated by each household were

measured to estimate the total area cultivated. Seven socio-economic factors, likely to explain incentive for the activity and variation in access and control of resources, were hypothesized to affect efficiency. These factors were: area of land cultivated, access to technical information, number of years of cultivating urban land, income earned from activities other than UF, formal education in years of household head, in conjugal and non-conjugal households, and generating cash as the main objective of the activity. Cross tabulation facilitated descriptive analysis, while the profit function model was used to determine factors explaining variation in profit. Joint estimation of the profit and wage share functions was used to test for economic, allocative (price), and technical efficiencies differences between groups of farmers based on these factors.

5.2 CONCLUSIONS AND RECOMMENDATIONS

Characteristics of UF households

- The average farmer had resided in Nairobi for 27 years, with 61 and 39% cultivating urban land for over 10 and 15 years, respectively. The land area cultivated increased with the number of years of cultivating urban land, and profit per household was higher for those who had been in the activity for 10 years or more. The results refute the notion that UF is a transitory activity, which fades away as the resident becomes more urbanized and sheds rural ways of life. They suggest that the performance of the farmers improves gradually and therefore, policy is needed to incorporate UF in urban planning because the activity is not transitory.

- The average cultivated land was 1.4 decares per household, mainly in one or two land parcels. Own saved seed of unknown quality and family labour were the main inputs, because 57% of the households did not hire labour, and only 14% of them used fertilizer, manure or pesticides. Therefore, low-level technology as commonly used in rural farming, is applied in UF in spite of smaller land parcels. On the average, seed expenditure and labour input per decare for farmers cultivating 1.4 decares or less was

significantly higher than for farmers cultivating larger area, resulting in two and a half more profit per decare than obtained with larger area. However, profit was positively correlated with area cultivated as is expected of extensive farming. A total of 13 different food crops were grown but the three most popular (grown by 76% or more farmers) were maize, beans and cowpeas.

- The decision to embark on UF was made jointly by spouses in 42% of conjugal households. The task of providing money to buy food and the actual purchasing of food was not a responsibility exclusive to women - they performed these duties alone in only 21% and 28% of the conjugal households, respectively. Therefore, UF was not the prerogative of women as implied by their traditional role of feeding families, suggesting that its contribution in generating livelihoods goes beyond the concerns relegated exclusively to women. It therefore merits fostering policy with a view to including it in land use urban planning, along side other livelihood generating activities, considered permanent.

Access to inputs

- It was found that 61% of the land parcels were acquired because land was seemingly idle, while 20% were acquired from exiting farmer without any form of monetary compensation. Only 9% of the land parcels were acquired by payment of a certain amount of money to the exiting farmer, while 6% were bought or hired. The result underscores vacant land as a major incentive for UA, suggesting that the activity will continue, fueled by seemingly idle land and unfulfilled basic needs. Frequent tending of the land parcel was the means used to stake a claim on cultivated land. However, disputes over cultivation rights were presented to the area chief indicating some sort of informal recognition of the activity.

- The majority of farmers (58%) declared intentions of increasing area cultivated, mainly by looking for seemingly idle land. This means that the activity is unlikely to disappear in the foreseeable future. The incentive to increase area cultivated suggests that farmers are likely to be receptive to strategies that ensure increased benefits to the farming households. The challenge to urban authorities is to ensure that the identified strategies also benefit the urban residents at large.

- Even though seed was the main input, it rarely was improved good quality seeds because 18 and 21% of farmers growing maize and beans, respectively, used own saved seed. The rest purchased seed locally from supplies sold for normal consumption. Only two farmers reported buying maize in packets that could be taken to mean certified seed. The main input in UF is therefore seed of uncertified quality. Thus, use of low technology partly explains why the activity is stuck in Stage I in the process of integration with other sectors. Households are not able to invest adequate capital in the activity and in turn, the activity does not generate enough for reinvestment, perpetuating the cycle of low input, low output and subsequent poverty. Without appropriate intervention to break the cycle, productivity will decline even further as the natural resource base is mined to exhaustion.

- Expenditure on seed even though of low quality, represents substantive income forgone from consumption. For instance, 43% and 63% of households earning income from other sources (71%), incurred cash cost on inputs for the season, excluding family labour, equivalent to 50% and 25% or more, respectively, of income earned from other sources per month. The challenge to policy is to device ways of making the low individual household capital invested build up over time, and become a means of climbing out of poverty. Facilitating UF by groups of farmers is a possible strategy.

Performance of UF

- Only 2 out of the 89 households realized negative profits for 1997 long rains season. The returns from the activity compared favourably with those of other activities. For instance, 29% of the households stated that UF was their only source of income. However, most of the respondent households (71%) earned additional income from sources other than UF. For 31% of these households, UF profit was higher than income earned from other sources, and for 49% of them it was more than half that other income. That is, if UF were done away with, 31% and 49% of the households would loose more than half and more than a third of their incomes, respectively.

- It was found that over 90% of all household members participated in UF activities during normal working hours (Monday to Friday), showing that different types of labour available in the household can be absorbed. Most other income generating activities found in urban areas do not offer this flexibility. Women heading non-conjugal households spent more hours during the week on UF activities compared to men heading households. This suggests that women have fewer alternatives in other income generating activities. UF therefore can be facilitated among strategies of fighting poverty targeting vulnerable households such as those headed by women.

- The result that 42% of the households hired labour for UF activities is instructive to policy on two accounts. (1) The informal sector is officially recognized and supported because since the 1980s, it has increasingly been acknowledged as the sector creating the bulk of new jobs even as the economy continued to decline. Similar recognition and support is lacking for UF, even though it contributes to livelihoods by combining labour and household capital with seemingly under utilized land to generate self-employment.

2) Wages earned by labour hired would be one of source of income for non-farming households, contributing positively to their household income and food security.

Therefore, supporting UF would also benefit non-farming households. This is envisaged in Stage II in the process of transforming and integrating UF with the rest of the economy. In this stage the activity would generate thriving livelihoods to households investing in it, and it would require labour input beyond that available from family labour.

- This study, found that women as heads of households and urban farmers had no significant differences in total area of land cultivated or expenditure on seed per decare, than households headed by both spouses. Profit is an indicator of the success achieved in a production activity. Results showed that the average total profit and profit per decare of the two groups of households were not significantly different. The percentage of the minimum income per adult equivalent the household needed to be above poverty line earned or the contribution from either UF or other activities, were also not significantly different between conjugal and women headed households. Therefore, results from this study give no evidence that the performance of women headed households in UF is any different from that of households headed by both spouses.

Profit generated by UF

- In 1997, the urban farming households in Korogocho were estimated at 4050 supporting a population of about 26, 563 people. Assuming they practiced the activity as shown by the sample farmers, they generated slightly over Ksh4 million of profit for the long rains reason or about Ksh8.25 million profit for the year. Similar estimates show that the activity generated about 37,000 employment (at eight hours a day, 28 days per month)

for family and hired labour. In other words, UF generates the equivalent of about 1,250 full time jobs in the year (eight hours per day for 11 months). Since the activity generated substantive jobs and income in spite of lack of support, use of very low technology, including insecurity of produce and cultivation rights, the potential of the activity in generating livelihoods is largely untapped.

- Even though the households engaging in the activity have diverse characteristics, the most limiting factor to profitability in UF is capital inputs. Land was the next most limiting factor, at least for conjugal households, supporting farmers' view that access to more land was the assistance needed most. Increased intensity of cultivation by use of external inputs is an alternative to extensive cultivation. However, the underlying assumption is secure access to land and in turn security of produce. A credible authority such as a municipal authority is necessary to provide and back security of access to land through self-organized groups of farmers. Groups already organized for guarding crops against theft can be facilitated to take up complementary role, for instance, holding user rights to land under lease, accessing group credit for inputs, participating in research tailored to the need of UF, organizing farmers market for high value fresh produce and enforcing public health standards in production.

- Formal education and access to technical information had positive effect on profit in conjugal but not in non-conjugal households. Higher education generally creates expectation for prestigious jobs. If UF can be transformed to yield competitive returns, it can attract farmers more able to experiment with evolving technology suited to the practice such as irrigation with minimal amounts of water. They are also likely to be

articulate and organized enough to negotiate for the needs of the activity with the municipal authority. UF may also provide the opportunity needed to adapt available technology to cultivation of small land parcels because intensity of crop production has to increase even in the rural areas, to keep pace with increasing population and land subdivision. In conjugal households, irrigation had positive and significant influence on profit, probably compensating for land area that did not have any effect for these households. Years of experience in the UF had positive effect on profit for these households probably indicating that with low level of production technology, elements acquired with longer experience improve returns. For instance, land parcel more likely to retain inherent fertility longer like those located at the valley bottom can be targeted over time.

Efficiency in UF

- Differences in economic, allocative and technical efficiency were analysed for different groups based on the seven variables hypothesized. There were no differences in efficiency between farmers cultivating more than 1.4 decares and those cultivating less. The groups of farmers maximizing profits were those who had cultivated urban land for less 13 years, earned less than Ksh3099 from other activities, had no access to technical information, and those whose main objective in embarking on the activity was to earn cash income, unlike their counterparts. Conjugal households heads with seven or more years of formal education also maximized profits while non-conjugal households irrespective of the level of education did not. Integration UF with other activities is likely to be facilitated by households allocating optimal variable inputs to production because they are more likely to respond to incentive for more inputs needed in Stages II and III.

- The groups of households found to be more technically efficient were those who had cultivated urban land for 13 or more years, were headed by a woman with less than seven years of formal education, and operated the activity with the objective of generating cash income unlike their counterparts. Technically efficient groups of farmers are more likely to facilitate the envisaged integration of UF because their operations make the activity compete favourably for available resources with alternative activities.

The recommendations that immerge from this study can be summarized as follows:

(1) The evidence given in this study adds further weight towards persuading urban policy makers to accept UF as one of the legitimate forms of land use and include it in the land use policy. The incentive for municipal authorities to focus on UF is its potential contribution to wastewater and organic waste reuse, open space management and aesthetic value, apart from food and income and employment generation.

(2) An inventory of land existing in the urban area will facilitate zoning to specify where UF can be practiced pending development or as permanent use of land. Such zoning has been done in Dar-es-Salaam, Kampala, and Kumasi. Provision of green space and orderly well-kept grounds in and around the city is one of the urban management duties that can be combined with food production. The zoning would specify the type of farming that can legally take place in designated areas. The case of eThekweni (Durban) illustrates workable leasing arrangements between urban management and farmers organized in groups. Lease arrangement would specify the obligations of both parties, type of crop and method of cultivation allowed, as well as the procedures to be followed when farmers have to vacate the site.

3) Farmers organized in groups backed by recognized use rights can then focus on innovation, technical extension services and research, including access to group credit. The

vigilante groups organized to reduce theft of produce can serve as springboard for further group action. Municipal management can create incentives through licensing orderly farmers markets. Since producer education is crucial in mitigating potential health risks of UA, farmers groups have additional value because they can facilitate addressing health risk concerns from irrigation with contaminated water or production on contaminated soils. The objective should be to address health risk concerns so that livelihood needs particularly for the poor can be combined effectively with wastewater and organic waste reuse. Municipal authorities can set clear quality standards for urban grown products and facilitate introduction of "green" or "safe food" labels. Consumers' confidence in UF produce would be increased, opening up more lucrative markets. Farmers in groups can be trained on how to achieve the expected quality standards by availing information and instructing them on how to select crops and irrigation techniques, depending on the condition of water and soil available for UF. For instance, farmers groups can undertake simple and affordable periodic soil and water quality testing for UF. Similar efforts are underway in some parts of rural Kenya where farmers themselves undertake simple soil and plant material tests, to determine the fertilizer regime for specific fields.

4) UF needs a specific facilitating agency, but more flexible than the traditional organization of ministries like those of agriculture. It would ensure that UF is legally recognized as a prerequisite to integration in the overall urban planning. The agency would facilitate self-organization of farmers into groups and coordinate initiatives targeting UF. For instance, it would facilitate formation of retail markets outlets, promote and certify "green" or "safe food" labels to increase consumers' confidence, train farmers to undertake appropriate soil and water quality testing to ensure that standards for health risk are met. The micro-financing needs for UF require an articulate agent to back farmers' applications for funding. The agent may also solicit funds as seed money for farmers groups. The agency would also promote participatory, site specific and interdisciplinary field research, to

develop technologies adapted to urban production and also expose the local farmers to innovative practices and experiences of UF from other cities.

The study prompts the following concerns for further research:

1) Comparison of efficiency between groups of UF farmers could be enhanced by including at least one more variable input in addition to labour. One possibility would be to determine the price of seed as an independent variable input. The major problem would be to impute a price for the large number of different crops grown from own saved seed and other planting material from previous season.

2) The survey for this study was based on a single visit per household to collect data for two cropping seasons of the previous year. The long recall period limited the accuracy of the data obtained. A follow-up study can improve the accuracy by repeat visits to interview farmers immediately after planting, at the end of the last weeding and after the main crop, for example maize, is harvested. Accuracy of data would improve because quantities and values of inputs used would be easier to recall. Family and hired labour used in various farming activities and employment alternative available during the year would be more accurately recorded for more accurate determination of wage rate. The variation in the urban market prices of fresh produce such as green maize consumed from UF before the main harvest would be captured. Therefore, cash and in-kind revenue derived from fresh produce sale and home consumption, would be recorded more accurately.

3) The current study did not attempt to verify the quality of technical information accessed, its relevance to UF, the extent to which the information was retained by the recipient and ability to acquire the inputs suggested by the information. These are some plausible explanations for insignificant differences in technical efficiency between farmers with access to technical and those without access. It calls for more detailed analysis in follow-up studies.

4) By focusing on the low income farmers, the study concentrated on the bottom end of the integration process envisage in time. But that process appears to exist in cross section because farming in done in the urban and peri-urban Nairobi by residents of all income groups using varied levels of technology, capital investment, and market access. However it is not clear how the farmers at different level of sophistication operate and the entire industry is integrated with other activities. A study to catalogue the different types of farming, as they exist is likely to reveal constraints at different levels and suggest more efficient strategies for the integration process. The study would take a wide interpration of the activities that constitute farming to include even those who cut and sell fodder from the urban commons for a living.

5) Irrigation is one of the inputs which can be used to boost intensity of production per unit area but only 18% of the farmers used it. Concerns on the possible effect of the quality of water used on human health neeed to be taken into account. However, the major part of urban farming produce is grown without irrigation of any kind and therefore unlikely to be contaminated from that source. While14% irrigating farmers used sewerage compared to 76% using water from the river, even water from the rivers in the area appeared murky and polluted and some crops were grown right next to open stagnant sewerage ponds. Clearly, there is need for research to articulate the factors prompting the practice with a view to facilitating intensive, efficient and profitable urban farming. Even without UF the municipal authorities have a daunting task of safe handling and disposal of sewerage. be it in the laid out formal piped system or the in the one that finds its way in to rivers and dams in and around the city, from slum and informal settlements. Increasing organic waste compound sewerage problems and they can only become worse with increased unplanned urban expansion. A possible strategy would be for the municipal authorities and central government to pre-empt the crises by investing in a large scale sytem of managing wastewater and organic waste. Some types of UA can be applied in purifying the

wastewater. UA would also make use of the "cleaner" wastewater for nutrients and irrigation needs as it generates food, jobs and income in urban and peri urban areas. A project combining poverty reduction waste management and sustainable reuse of urban resource for one of the main urban centres in the region is likely be a cost-effective investment.

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APPENDIX I

QUESTIONNAIRE

Name of enumerator.....
Date of Interview ..... House No.....
Date questionnaire was received in the office.....

1. Of the people living in this household, who is the head of household?
   a.....Father & mother b..... Mother c .....Others (Specify)

2. Name of the household head .....
3. Name of Village .....
4. No of persons who lived in the household in 1997 .....
5 Did this household cultivate any land within Nairobi city last year (1997)
   ... ...Yes ....No

6 ..... Which year did the head of the household come to live in Nairobi?
7. ..... Which year did the head of the household start farming in the city?
8. ..... How many land parcels did he/she cultivate the first year?
9. ..... How many land parcels did he/she cultivate the last year (1997)?
10 .....Which was the last year of schooling completed by the head of household?
11 .....Which was the last year of schooling completed by the spouse (if present)?

12. In this household, who made the decision whether or not to cultivate urban land?
   a.....Father & mother b..... Mother c .....Others (Specify)

13. Who does the actual buying of food?
   a.....Father & mother b..... Mother c .....Others (Specify)

14. Who provides the money to buy food?
   a.....Father & mother b..... Mother c .....Others (Specify)

15. For this household which are the THREE most important reasons for farming in the city?

a ..... Obtain food when money is short	Ranking of reasons
b..... Save money which could have bought food	1 = most important
c..... Earn money by selling farm produce	2 = second in importance
d..... Assist in my other business (Specify)	3 = third in importance
e..... Generated self employment	
f..... Others (Specify)	

16. What is the THREE main uses of money saved from buying food?

a..... no money is saved	Ranking of reasons
b..... rent	1 = most importance
c..... school fees	2 = second in importance
d..... matatu/bus fare	3 = third in importance
e..... medicine	
f..... fuel (cooking & lighting)	
g..... others (Specify)	

17. What THREE main consequences would your household experience if it was forced to stop farming?

a..... no consequences	Ranking
b..... starve	1 = most important
c..... buy food	2 = second in importance
d..... less money to spend	3 = third in importance
e..... others (Specify	

18. Which are the main problems that you experience when farming in the city?

a..... small pieces of land
b..... lack of money for seed/fertilizer
c..... lack of farming knowledge
d..... drought
e..... infertile soils
f..... lack of labour
g..... others (Specify

Ranking
1 = most important
2 = second in importance
3 = third in importance

19. Since you started farming in the city have you received any advice on farming?
..... NO ..... YES. If YES the TWO IMPORATANT sources were

a..... members of the family
b..... friends
c..... .neighbours
d..... Government extension agent
e..... Church (specify)
f..... others (specify)

Ranking
1 = most important
2 = second in importance
3 = third in importance

20. If farming advice was received from non family members, how was the source of advice met?

a..... They visited the shamba[1]
b..... I met them through the church
c..... Others (specify)
d..... They visited the residence
e..... I met them at the chief's baraza

21. What THREE types of assistance do you feel should be given to your household to benefit more from farming in the city?

a..... be given free idle land for cultivation
b..... ..be taught better farming methods
c..... be given credit to buy inputs
d.. .... provide a way of making a living awaiting harvest
e..... others (Specify)

Ranking
1 = most important1
2 = second in importance
3 = third in importance

22. How do you make sure your shamba(s) is not taken by someone else?

a.....keeping it weeded all the time
b..... ensure there are crops all the time
c.....planting at the start of rains
d.....others (Specify)

Ranking
1 = most important
2 = in second importance
3 = third in importance

23 .What does your household do when it runs out of money to buy food?

a.....borrow money
b..... borrow food
c.....do odd job (washing cloths/utensils
d.....send children to stay with relatives
e..... .take goods(g/nuts[2]/simsim) on credit and sell
f..... . receive help from relatives (money or food)
g.....others (Specify)

Ranking
1 = most important
2 = in second importance
3 = third in importance

24. Did you cultivate any land out of Nairobi ?
... Yes..... No.

25 If you cultivated land out of Nairobi , the land is located in

a .... Rural home
b..... Others (specify)

---

[1] "Shamba " in this questionnaire is used to mean land parcel for cultivation.
[2] Roasted groundnuts

26. If you cultivated land out of Nairobi , the uses of the food grown was
a..... to feed my family in the city b..... to sell and then buy food in the city

27. Table 1: I would like to ask you some questions about the people who lived in your household last year (1997)

Number of Males				Number of Females			
Age in years	Relationship to household head	Occupation - Too young - Schooling - Worked for pay (no months /12)	Worked on urban shamba Yes /No	Age in years	Relationship to household head	Occupation - Too young - Schooling - Worked for pay (no months /12)	Worked on urban shamba Yes /No

28.Table 2 : Let us talk about the shambas you cultivated here in the city last year (1997)

Plot number	1	2	3	4	5
a. Where located					
- by the river					
- by the road side					
- by the railway line					
- next to Kasarani stadium					
- next to a factory					
- elsewhere (specify)					
b. Area in sq. ft					
c. Cultivated short rains					
d. Cultivated long rains					
e. Main soil type					
f. Irrigated short rains					
g. Irrigated long rains					

29. The source of irrigation water was
a..... river b..... tapwater c..... other sources (specify)

30. Now I would like to ask you questions about the labour your household used to cultivate your shambas last year (1997)

Table 3a: Short rains April 1997

	Number of hours an adult person from your household can normally take to complete stated activities in each shamba														
PARCEL	Land preparation			Planting			1st Weeding			2nd weeding			Pest control		
	No of days	Time		No of days	Time		No of days	Time		No of days	Time		No of days		
		Start	End		Start	End		Start	End		Start	End		Start	End
1															
2															
3															
4															
5															

31. Table 3b: Long rains October 1997

	Number of hours an adult person from your household can normally take to complete stated activities in each shamba														
PARCEL	Land preparation			Planting			1st Weeding			2nd weeding			Pest control		
	No of days	Time		No of days	Time		No of days	Time		No of days	Time		No of days		
		Start	End		Start	End		Start	End		Start	End		Start	End
1															
2															
3															
4															
5															

32. Table 3c: Short rains April 1997

Now I would like to ask you questions about the labour from your household that was used to harvest your shambas last year (1997)

	Number of hours an adult person from your household can normally take to complete harvesting the following crops from each land parcel														
PARCEL	MAIZE			BEANS			COWPEAS			ENGLISH POTAOES			OTHER CROPS (SPECIFY)		
	No of days	Time		No of days	Time		No of days	Time		No of days	Time		No of days		
		Start	End		Start	End		Start	End		Start	End		Start	End
1															
2															
3															
4															
5															

33. Table 3d: Long rains October 1997

	Number of hours an adult person from your household can normally take to complete harvesting the following crops from each shamba														
PARCEL	MAIZE			BEANS			COWPEAS			ENGLISH POTAOES			OTHER CROPS (SPECIFY)		
	No of days	Time		No of days	Time		No of days	Time		No of days	Time		No of days		
		Start	End		Start	End		Start	End		Start	End		Start	End
1															
2															
3															
4															
5															

34. Table 4 : Now I would like to ask you how you travel to shambas		
Parcel Number	No of minutes taken to walk (one way)	Matatu charge
1		
2		
3		
4		
5		

35. Did you hire labour for farm work in 1997?
a..... NO/YES If YES specify

b..... Land preparation
c..... Planting
d..... Weeding
e..... Others (specify)

36. What amount of labour equivalent (to an adult person) was hired for farm work
a..... Number of days for Shot rains b..... Wage in Ksh/day
c..... Number of days for Long rains d..... Wage in Ksh/day

37 What do you consider as appropriate wage rate for shamba work by family members?
.....
..... Short rains Wage in Ksh/day
..... Long rains Wage in Ksh/day

38. When does the head of household mainly works on the shamba ?
a..... Does not work on shambas d..... Weekends
b..... Normal working hours e..... Others (specify)
c..... After normal working hours

39. When do the other members of the household mainly work on the shamba?
a..... Normal working hours b..... Weekends
c..... After normal working hours d..... Others (specify)

40. What are the main causes of crop losses from the urban shamba cultivated by your household?
a..... Destruction by animals b..... Theft of crop
c..... Destruction by askaris d..... Flooding
e..... Lack of rain f..... Others (specify)

Ranking
1 = most severe
2 = second in severity
3 = third in severity

41. Let us talk about the inputs you used in your shamba (s) last year (1997)

Table 5a: Short Rains 1997

Name of Input	Own or Bought	Units	Price per Unit	Total cost
Seeds				
Seedling				
Fertilizer				
Manure/compost				
Chemicals/dusts				

42 Table 5b. Long Rains 1997

Name of Input	Own or Bought	Units	Price per Unit	Total cost
Seeds				
Seedling				
Fertilizer				
Manure/compost				
Chemicals/dusts				
Others (specify)				

43. I would also like to record the yield of crops grown in ALL the shambas in 1997

Table 6a. Short rains 1997

Name ALL the crops growing in the Shambas	Units of Yield	No of units	Price per unit	Ksh Total value of yield
1.				
2.				
3.				
4.				
5.				
6.				
7.				

44. Long rains				
Name ALL the crops growing in the shambas	Units of Yield	No of units	Price per unit	KshTotal value of yield
1.				
2.				
3.				
4.				
5.				
6.				
7.				

45. Let us talk of how your household used the produce from the urban shamba(s) you cultivated					
Table 7a: SHORT RAINS 1997					
	Value in shillings of yield used as follows				
Name of crop	Eaten at home	Sold	Given to friends & relatives	Others (Specify)	Total Value Of Yield
1.					
2.					
3.					
4.					
5.					
6					

45. Let us talk of how your household used the produce from the urban shamba(s) you cultivated					
Table 7b: LONG RAINS 1997					
	Value in shillings of yield used as follows				
Name of crop	Eaten at home	Sold	Given to friends & relatives	Others (Specify)	Total Value Of Yield
1.					
2.					
3.					
4.					
5.					
6					

47. Do you keep some livestock here in the city
a….. YES…….. NO . If YES specify

b …. number of cows
c….. number of pigs
d …. number of goats/sheep
e….. number of chicken
f….. number of rabbits
g …. number of geese
h….. number of others (specify)

28.Table 2 : Let us talk about the actual owners of the land of the shamba(s) you cultivated here in the city last year (1997)

Parcel number	1	2	3	4	5
Land owner					
-Our own					
-Government					
-City council					
-Private Owner					
-Company					
-Owner not known					
How was parcel acquired					
-Bought form owner					
-Hired from owner					
-Given free by owner					
-Looked for idle land					
-Handed on with payment					
-Handed on without payment					
-Other ways (Specify)					

49. Did you have other source of income last year (1997- this is money made available for household use)
…..YES …… NO. If YES

50. Table 9: Other sources of income last year (1997) were

	Source and form of payment payment per month				
Members of household who earned the income	Business (Cash income)	Casual employment paid for in-kind	Employment		Total Ksh
			Casual	Monthly	
Household head					
Spouse					
Male members					
Female members					
Others (Specify)					

51. In your opinion, what are the problems other city residents suffer because of cultivation (growing crops) of urban land?

....
....

52. Do you have intentions of increasing the land you cultivated in the city. .If yes how will the land be acquired?

a.....YES ..... NO. If YES specify

b..... buy land
c..... hire land from owner
d.....be given land by owner
e..... hand -on without payment
f..... hand -on with payment
g..... look for idle land
h..... Other (Specify)

.....

APPENDIX 2

1.1 Determination of wage rate for family labour

An alternative for imputing the value of family labour was prompted by the observation that some households earned income from activities other than UF (OTHER INCOME). In all households, part of this income was earned by household head and by the spouse in some conjugal households (OTHER INCOME 1). The other part was earned by sons, daughters and other members of the household (OTHER INCOME 2). OTHER INCOME 1 was generated by 66 out of the 92 households. These sources were; casual and monthly employment paid in cash, work paid for in-kind, and running businesses. This income was made available for general household use and therefore different form that reserved for individual use. The wage rate earned from these sources presented another alternative of imputing the value of family labour. However, using this method to estimate wage rate per day as the opportunity cost of family labour engaged in UF activities, would exclude from the analysis 26 households whose heads or spouses, did not engage in income generating activities other than UF.

A similar problem was faced by Senauer *et al.*, (1986) in estimating the effect of the value of time on food consumption patterns in developing countries, using data from Sri-Lanka. Hourly wage rate of the primary woman in the household was one of the main regressors in the demand functions, explaining the differences in per capita annual quantity of bread and rice consumed, and their ratio. The study tested the specific hypothesis that other things being equal, urban households in Sri-Lanka will decrease rice consumption and increase bread consumption, as the opportunity cost of time of the primary woman rose. However, only 14.9 % of the women covered by the sample had earnings from labour force participation during the survey period. Excluding approximately 85% of the women

who did not have an observed wage (because they did not participate in the labour force), would distort the demand behaviour analysed. The same caution is expressed for the general case by Berndt (1991) in the analysis of labour force participation by women.

The researchers solved the problem in the following manner: First, the probit model was used to determine the characteristics which explained whether or not the primary woman participated in labour force, and to generate a selection bias adjustment variable (inverse of Mill's ratio). The latter was necessary because the decision by the individual to work outside the home resulted in self-selection. The primary woman was defined as a woman heading a household or the spouse of head of household and in the age bracket of 15 to 65 years. Second, ordinary least squares (OLS) wage determination equation was used to reveal the characteristics which influence the variation in wage rate of working women. The inverse of Mill's ratio was included in the OLS equation to correct for self selection. Finally, the coefficients obtained in the wage determination equation were used to estimate individual woman's value of time. The method used by Senauer, Sahn and Alderman (1986) was applied in the current study to estimate the average wage rate per man-day of adult family labour[3] from UF activities as follows. A wage rate per day (WAGEOTH) was calculated in the following way. First the different incomes constituting OTHER INCOME 1 per month were added up. Second, if the income was earned by both spouses the average was taken by dividing by two. Third the monthly OTHER INCOME 1 was divided by 30 days to give WAGEOTH. A dummy variable (WAGE10) was specified to take the value of 1 if OTHER INCOME 1 was earned and therefore has a positive value for

[3] During the survey the amount of time required to perform the different UF activities for each land parcel was estimated in hours by asking the respondent to state the time when the activity usually began and stopped, and the number of days an adult member of the family would require to complete the task. Thus, labour input was based on adult labour input even though children also performed UF tasks.

WAGEOTH and 0 otherwise. Based on the examples given by Heckman (1979) to illustrate selection bias, WAGEOTH from households which earned OTHER INCOME 1 was not a reliable estimate of the amount households not earning OTHER INCOME 1 would have earned if they had opted to engage in those activities. In addition, the decision to earn OTHER INCOME 1 resulted in sample selection bias. In view of these concerns the probit analysis was used to determine the factors explaining the probability that a household will generate OTHER INCOME 1, that is, WAGE10 = 1, and to generate the inverse of Mill's ratio for overcoming the problem of sample selection bias. The inverse of Mill's ratio was included in the equation estimated with OLS to determine the wage rate per day (WAGEOTH), for those households which earned OTHER INCOME 1, thus eliminating the selection bias. In the current study the dependent variable in the probit analysis of the likelihood of a household generating OTHER INCOME 1 was the binary variable WAGE10. The explanatory variables were defined as shown in Table A1:

The activities generating OTHER INCOME 1 and UF not only complement in ensuring survival of the household, but also compete for resources such as family labour and cash income, invested as capital in some of these activities. Therefore the effectiveness of UF in ensuring survival of the household was likely to have some effect on the probability of engaging in activities generating OTHER INCOME 1, as well as the amount generated. Thus, the explanatory variables hypothesized to influence this effectiveness and in turn

Table A1. Definition of variables used in the binomial probit analysis and OLS wage determination equation

Variable	Variable description	Acronym
AGE	Average age of the two spouses in conjugal household and age of mother in non conjugal households[4].	AVAGE
PROFIT	Units of physical crop yield multiplied by unit price, summed over all crops less cost of seed, fertilizer, manure, pesticides and hired labour.	PROF
OTHER INCOME2	The sum of income per month earned from sources other than UF per month by sons, daughters and others members of the household.	Y246
HOUSEHOLD TYPE	Dummy variable for type of household; = 1 for conjugal households, 0 for non conjugal households.	HHBM
HIRING LABOUR	Dummy variable for hiring labour; = 1 if labour was hired , 0 otherwise.	HILAB
DEPENDENCY BURDEN	Dependency burden ratio, that is, the number of children aged 5 years or less divided by the number of household members above the age of 18 years.	R5T18
AREA OF LAND	Total area of land parcel(s) in square meters.	SQME
EDUCATION	Average years of formal education of the two spouses in conjugal households and years of formal education of mother in non conjugal households.	AVED
FAMILY LABOUR	Amount of family labour in mandays (with 8 hours = 1 MD).	MD8FA
LIVESTOCK	Dummy variable for keeping livestock; = 1 if household kept livestock, 0 otherwise.	ANIMA
YEARS OF UF	Number of years the household head has cultivated urban land in Nairobi.	YRSUF
YEARS IN NAIROBI	Number of years the household head has lived in Nairobi.	YRNRB
AGE SQUARED	Average age in years squared of the two spouses in conjugal household and age of mother in non conjugal households.	AVAGE2
TYPE OF ACTIVITY GENERATING OTHER INCOME 1	Dummy variable for type of activity generating OTHER INCOME 1; = 1 if monthly employment was one of the activities and 0 for other ways of generating OTHER INCOME 1.	JOB TYPE
ONE OR TWO SPOUSES EARNING OTHER INCOME 1	Number of spouses earning OTHER INCOME 1; = 1 if earned by two spouses, 0 if earned by one spouse.	IN20R1
INVERSE MILL'S RATIO	Self selection adjustment variable	LAMBDA

influence the likelihood of generating OTHER INCOME 1 were those likely to indicate the availability of physical resources, and the capacity of the household to exploit them. These were; the average age and average years of formal education of the spouses, the number of years the household head has been an urban farmer and also resident in Nairobi, amount of family labour availed for UF activities, whether or not labour was hired and the dependency burden ratio. In addition, the amount of profit from UF and OTHER INCOME 2, were used as proxies of the amount of income which can be expected to supplement OTHER INCOME 1. They were therefore hypothesized to affect the probability of engaging in the activities which generating OTHER INCOME 1.

The chi-square test for the overall significance of the probit function showed that it was significant at 5% level (Table A2). The goodness-of-fit measure for the probit model is given by the percentage of the correct predictions. The predicted outcome had maximum probability, that is, 100% correct predictions for households with OTHER INCOME 1 and for those without. Six factors were significant at 10% level or higher in explaining the probability of earning OTHER INCOME 1. Higher dependency burden (R5T18) increased the probability of earning OTHER INCOME 1. It is plausible that the pressure on adult members to meet basic needs of the household increased with increase in dependency burden. The profit generated from UF (PROF), total area of land (SQME) and keeping livestock (ANIMA), also increased the probability of engaging in generating OTHER INCOME 1. Higher values for these three variables might indicate higher incentive and ability of the household to generate income from the opportunities accessible to low income urban residents. Households availing higher amounts of family labour to UF

Table A2. Results of binomial probit analysis on whether or not household head (and spouse) earned income other than from urban farming.

Independent Variable	COEFFICENT	t-ratio	Significance level
CONSTANT	1.813	1.813	0.0698*
AVAGE	-0.018	-1.101	0.2708
PROF	0.00003	1.828	0.0675*
Y246	0.0002	1.310	0.1903
HHBM	-0.455	-1.201	0.2297
HILAB	-0.609	-1.784	0.0744*
R5T18	1.064	1.933	0.0532*
SQME	0.0004	2.261	0.0237**
AVED	-0.021	-0.360	0.7188
MD8FA	-0.025	-3.304	0.00095***
ANIMA	0.652	1.749	0.0803*
YRSUF	0.025	1.117	0.2641
YRNRB	-0.011	-0.627	0.5306

N = 92

Dependent variable is WAGE10 (= 1 if household head and spouse earned income from activities other than urban farming, 0 otherwise).

Asterisks indicate significance at the following levels: *** 1%; ** 5%; 10% .

(MD8FA) and those hiring labour (HILAB) had lower probability of engaging in activities generating OTHER INCOME 1. The probit model generated the inverse of Mills' ratio (saved as variable LAMBDA) to be included in the wage determination equation. In the current study, the dependent variable is the wage determination equation (Table A3) for the 66 out of 92 households earning OTHER INCOME was specified as the natural logarithm of the wage rate per day (LNWAGOTH), as suggested in the literature (Senauer *et al.*, 1986; White and Bui, 1991).

The overall explanatory power of exogenous variables in the function was significant at 1% while five out of the eight explanatory variables were significant at 10% level or higher in explaining variation in the wage rate per day are discussed. The average age (AVAGE) had positive effect on wage rate as implied by higher experience in activities generating OTHER INCOME 1. However, the square of the same variable (AVAGE2) had negative

effect suggesting that the positive effect of age has a non linear component and tends to diminish with increase in the number of years. The number of years of UF had negative effect on wage rate probably suggesting that the households whose heads had been in the UF longer attached less importance to activities generating OTHER INCOME 1. Wage rate was also significantly higher for households where monthly employment (JOBTYPE) was one of the activities of generating OTHER INCOME 1. The inverse of Mill's ratio

Table A3: Ordinary least squares results of wage rate determination equation for households where the head and spouse earned income from activities other than urban farming

Dependent Variable - LNWAGOTH

Independent Variable	COEFFICENT	t-ratio	Significance level
CONSTANT	-1.622	-0.826	0.4121
AVAGE	0.257	3.018	0.0038***
AVAGE2	-0.003	-2.898	0.0053***
YRSUF	-0.034	-2.364	0.0215**
AVED	0.006	0.119	0.9058
JOBTYPE	0.672	2.506	0.0150**
YRNRB	-0.002	0.128	0.8984
IN2OR1	0.033	0.644	0.5219
LAMBDA	-0.755	-1.742	0.0869*

$N = 66$; $R^2 = 0.30$; $F_{(8, 58)} = 3.15$;
Overall significance level of the equation = 0.0045
Asterisks indicate significance at the following levels: *** 1%; ** 5%; 10%.

(LAMBDA) was significant implying that its inclusion was necessary to avoid sample selection bias (Senauer *et al.*, 1986). These authors considered the coefficient of multiple determination $R^2 = 0.45$ obtained for wage determination equation for women remarkably high for an estimation using cross-sectional data. They noted that the $R^2 = 0.23$ obtained for wage determination equation for men was close to the values of $R^2 = 0.20$, 0.25 and

0.31 cited in the literature. Therefore $R^2 = 0.30$ obtained from the wage rate determination equation in the current study was deemed satisfactory.

The regression coefficients in Table A3 were subsequently used to derive an estimated wage rate in Ksh per day for family labour (W2W2) for each household in the sample. Estimating the wage rate for family labour for only those households not earning OTHER INCOME 1 would introduce asymmetry in the variable (Senauer *et al.*, 1986). The weighted average wage rate per day for labour was computed using the estimated wage rate (W2W2) to value family labour.

Appendix 3
Consumer units by age and sex

Age in years	Male	Female
0	0.3	0.3
1	0.4	0.4
2-4	0.5	0.5
5-7	0.6	0.6
8-10	0.7	0.7
11-16	0.8	0.7
17-19	0.9	0.7
20-29	1.0	0.8
30-39	1.0	0.8
40-59	0.9	0.9
60+	0.7	0.6

Source: WHO 1985 cited by Hoorweg *et a.,l* (1991) p.189