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Crop cultivation in Nakuru town, Kenya: Practice and potential

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Foreword

The underlying paper is based on surveys carried out in the context of the Nakuru Urban Agriculture Project (NUAP). NUAP is a research project on farming by urban dwellers in Nakuru town, Kenya, and is a joint undertaking by the University of Nairobi (Department of Geography, Department of Urban and Regional Planning, Centre for Urban Research) and the African Studies Centre, Leiden, The Netherlands. The bulk of the contents of the paper is based on the data obtained during a general survey among almost 600 households in June-July 1999. Additional information collected during a second (in-depth) survey in October-November 2000 is also used. The present paper is a deepening of the chapter on crop cultivation in an earlier report written by the same authors and that is entitled *Urban farmers in Nakuru, Kenya* (2000).

Many people were, directly or indirectly, involved in the 1999 survey. We would like to thank first of all the representatives of the local officers who were, in one way or the other, helpful with the realisation of the work, in particular Mr. S.C. Kiarie (Public Health Officer), Mr. Paul G. Chege (Town Planner), Mr. N. Githire (Municipal Architect), Mr. J. Michoma (Director of Housing and Social Services), Mr. J.T. Muchoki (District Agricultural Officer), and Mr. H. Musoga (Provincial Physical Planning Officer). Our special gratitude goes to Ms. Miriam Muthoni Ngotho (SENVINET: Schools Environmental Network) and Mr. William N. Keyah (Catholic Diocese of Nakuru, Agricultural & Rural Development Programme) who were very helpful with designing the questionnaire and providing assistants while the former played a crucial role as co-supervisor during the 1999 survey. Half of the assistants were provided by the Provincial Statistical Officer, Ms. Pamela Audi, for which we are very grateful.

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Finally, we want to express our gratitude to Ann Reeves for the English correction.

Abstract

Urban poverty is increasing dramatically in Kenya. In Nakuru town, two out of each five households were living in conditions of absolute poverty in 1997. Farming in town is one of the ways people employ to cope with this problem. Based on survey held in 1999 among a representative sample of almost 600 households, it is estimated that about 30% of the Nakuru population is engaged in crop cultivation in town, although the real figure is likely to be higher. In 1998, they produced an estimated 8 million kilograms of crops, which covered about 30% of their energy requirements.

Although over 40 different types of crops were established, maize, kale and beans were by far the most common ones, indicating that crop cultivation is mainly done for self-consumption. What types of crops are cultivated is to some extent related to the location of the plot: on plots further away from the house, mainly maize, beans and Irish potatoes were grown. Hence, distance is a limiting factor regarding the choice of which crops to grow and is related to the perishability of the crop, the risk of theft and the use of inputs including labour.

A wide range of inputs were used, including chemical inputs, organic inputs like manure and crop residues, and irrigation. Chemical inputs were used more on plots located *outside* people's compounds, somewhat further away and relatively large in size. There is a marked difference between men and women as far as the use of certain inputs is concerned: men were more inclined to use chemical inputs than women, while women irrigated more often. Female heads of household showed by far the most 'input-poor' type of cultivation. This applied particularly to chemical inputs, which is related to the low welfare level of these households.

Yields are relatively low: on average 0.3 kg per square metre. However, yields vary enormously with plot size: the smaller the plot the higher the productivity. This is to some extent related to the use of inputs and to the amount of labour used. In households where a man is responsible for the crop cultivation, higher yields were realised than in households with a woman being in charge.

Although it is clear that crop cultivation is beneficial for the people involved (food supply, income, employment), its potential is much bigger given the low average productivity. However, some conditions have to be fulfilled then. Constraints that the people face have to be removed, including theft and the legal uncertainty regarding access to land and which crops can be cultivated.

Of particular importance is the environmental aspect of urban crop cultivation. In some areas of Nakuru town crops grow on very polluted sites, while in other areas untreated sewage water is widely used for irrigation. The use of chemical inputs should be discouraged, if only to protect the fragile ecosystem of Lake Nakuru National Park. The active propagation of environment-friendly (i.e. organic) farming may also help to change the

rather negative attitudes among *non*-farming Nakurians as well as officials towards farming in town.

Urban farming is a fact of life in Nakuru. Hence, the best policy of the local authorities is one of legalising it, be it within clearly defined legal conditions. In other words, urban farming should be integrated into urban planning exercises. In Nakuru, the *Localising Agenda 21* programme forms the ideal framework for doing so. The next step is to actively promote organic farming within this legal framework, so that not only the people directly involved but also other economic sectors — and hence the town as a whole — can benefit.

Introduction

Travelling from Nairobi along the New Nairobi Road the visitor hardly notices that he has crossed the Nakuru town municipal boundary. The landscape is largely rural on both sides, with the exception of the Kenya Pipeline Oil Depot on the left-hand side of the road and Stem's Hotel on the right. After crossing the railway line, however, the landscape soon changes and becomes more urban as one nears the town centre. A long avenue, fringed with jacaranda trees, runs parallel with the railway line on the left. But during the growing season in years with sufficient rainfall, the railway is barely visible because of the maize growing on the *shambas*[1] between the road and the railway. Going from the town centre to the residential areas, be it in the low-income areas in the south or the high-income areas in the north, maize can be seen rising above the fences around people's compounds or in open spaces that seemingly belong to nobody. And if the visitor goes into one of these compounds, he will see a wide range of crops being cultivated, mostly meant for home consumption although some may be sold as well.

Urban poverty is increasing dramatically in Kenya. In the four years from 1994 to 1997, the percentage of people living in absolute poverty[2] increased by 15 to 20%. In 1997, the prevalence of absolute poverty in Nakuru town was 41% compared to about 30% in 1994 (Kenya 2001). Most of these people live in slums or slum-like areas with limited access to basic services such as adequate water, schools and health services. Many of the urban poor have no regular work and, hence, no regular income. Moreover, a relatively large percentage of their income is spent on rent and food. As a result of their poverty, these people are excluded from credit facilities with which some kind of small business might be set up.

People's responses to (urban) poverty are twofold: first, they try to raise or at least maintain their income level and, secondly, they reduce their expenses. Raising or maintaining one's income can usually only be done by diversifying income sources, mainly in the informal sector. Livelihoods have become increasingly dependent on the informal sector and on casual work. Expenses may be cut in areas like education and health (all the more so because under structural adjustment these services have become virtually unaffordable for many of the poor), and cuts can be made on material expenses, as well as on consumption and dietary patterns.

Growing numbers of the urban poor engage in illicit income-generating activities. Hawking without a license and in forbidden areas is common. Women in particular engage in brewing prohibited liquor and in prostitution, in spite of the health risks involved. Drug

[1] *Shamba* is the Swahili word for agricultural plot.

[2] The 'absolute poverty line' is the income needed to obtain basic food and non-food items. For urban areas, this was Ksh 2,648 per month per person in 1997 (Kenya 2001: 11). This is equal to the official minimum wage as set by the government. Recently, on May 1st, 2002, the minimum wage was raised to Ksh. 3,500, which means that the number of people below the poverty line increases automatically as these official measures usually have little impact on the wages paid by the employers to their employees.

dealing and peddling is on the increase as well (Kanji 1996). Another illegal activity that has become widespread is growing food within the city limits. This is now an important coping mechanism in the context of cuts in food subsidies, increases in the cost of living and decreasing household purchasing power.

Crop cultivation (as well as livestock keeping) is very common in Nakuru town. This paper explores this practice in some detail. What crops are cultivated and on what types of plots? Who cultivates? What types of inputs are used and on which plots? Do different people use different inputs? What yields are being realised? Do harvests vary with types of plots, with household characteristics and with types of inputs? Why do people cultivate crops? What problems do they face? Who benefits and in what ways? How can crop cultivation in town be improved? What role does the municipality play? The paper tries to find an answer to these questions and follows the sequence of the questions raised. First, however, a general discussion of crop cultivation in Sub-Saharan Africa and more particularly in Kenya is presented, followed by a brief description of Nakuru town, some methodological considerations and a short presentation of the characteristics of the plots on which the crops are cultivated.[3]

Urban crop cultivation in Sub-Saharan Africa

Farming in town is a common feature of Sub-Saharan Africa (Obudho & Foeken 1999). It is estimated that as much as 40% of the urban population in Africa is involved in urban agriculture (Mougeot 1994). Studies have been carried out across the continent,[4] and in Kenya,[5] and from these, the following picture arises.

Farming is undertaken wherever land is available. In built-up areas, this can be in one's own compound ('backyard farming' or 'on-plot farming') or on land belonging to someone else ('off-plot farming'), the owner being either the government or a private person.

[3] This paper deals solely with crop cultivation. For livestock keeping in Nakuru town, see Foeken & Owuor 2000a and 2000b.

[4] See e.g. Atakunda & Maxwell 1996 on Kampala (Uganda); Baxter 1994 on South Africa; Brock 1999 on Cotonou (Benin); Byerley 1996 on Gaborone (Botswana); Diallo 1993 on western Africa; Dongus 2000 on Dar es Salaam (Tanzania); Drakakis-Smith *et al.* 1995 on Harare (Zimbabwe); Drescher 1996 on Lusaka (Zambia); Eberhard 1989 on Cape Town (South Africa); Egziaber 1994 on Addis Ababa (Ethiopia); ENDA-Zimbabwe 1996 on Harare (Zimbabwe); Gbadegesin 1991 on Ibadan (Nigeria); Gefu 1992 on Zaria (Nigeria); Gumbo & Ndiripo 1996 on Harare (Zimbabwe); Lourenço-Lindell 1996 on Bissau (Guinea-Bissau); Maxwell 1994 and 1995 on Kampala (Uganda); Mbiba 1995 on Zimbabwe; Mianda 1996 on Kinshasa (Congo DR); Mlozi *et al.* 1992 on Tanzania; Mlozi 1996 on Dar es Salaam (Tanzania); Mosha 1991 on Tanzania;, Obosu-Mensah 1999 on Accra (Ghana); Rakodi 1988 on Lusaka (Zambia); Rogerson 1994 on South Africa; Sanyal 1985 on Lusaka (Zambia); Sawio 1993 and 1994 on Dar es Salaam (Tanzania); Schilter 1991 on Lomé (Togo); Sheldon 1991 on Mozambique; Tricaud 1987 on Ibadan (Nigeria) and Freetown (Sierra Leone); Vennetier 1961 on Pointe Noire (Congo); Villien 1988 on Bangui (Central African Republic).

[5] See e.g. Dennery 1996; Foeken & Mwangi 2000; Freeman 1991; Gathuru 1993; Lado 1990; Lee-Smith *et al.* 1987; Lee-Smith & Memon 1994; Memon & Lee-Smith 1993; Mwangi 1995; and Mwangi & Foeken 1996.

Farming is particularly common on the outskirts of urban centres, on formerly rural land that has now become part of the urban centre due to boundary extensions. In these zones, both small-scale and large-scale farming can be found. However, as the urban centre grows, these areas gradually lose their rural character and farming becomes increasingly of the other two types.

Farming in towns has increased enormously over the past two decades due to the economic crisis that prevailed in most African countries. For the poor, increasing their food security is usually the main motivation for farming in town, and for some it is even a survival strategy. Nevertheless, many of the poor also sell some of their produce, partly to be able to pay for other basic household needs, but also because some crops are perishable and cannot be stored and/or because storage space is unavailable. For middle-income and high-income households, commercial considerations are usually of more importance than among the poor, although the consumption of self-produced vegetables and milk is often highly valued. But for most of these households, the basic reason to do so is the same as for the poor, namely, as is often stated by the farmers themselves, "to subsidise my income".

The majority of African urban farmers are women. In most parts of Africa, women have traditionally been responsible for household food provision and farming is relatively easy to combine with the care of children. Women also often have lower educational levels than men, so it is difficult for them to compete in a shrinking labour market. Farming may, thus, be the only option left to them in a situation of unemployment and poverty. Several studies have found that the number of female-headed households is disproportionately high among urban farmers. It has also been shown that recent migrants often do not practise urban farming. A person has to be settled and have access to the right networks in order to be able to gain access to a plot of land.

The crops grown are mostly basic food crops such as maize, beans, cassava, sorghum, rice and yams. A wide range of vegetables is also cultivated, some of which are often sold because of their perishability and because there is a ready market available. Some urban farmers grow crops such as tomatoes, spinach and lettuce solely for commercial purposes but this is more common in western Africa than in eastern and southern Africa. Tree crops are not very commonly found due to the uncertainty of land tenure that many urban farmers experience.

Urban farmers face various constraints such as irregular rainfall, drought, flooding, water logging, poor soils, pests and disease, and the destruction of crops by animals, all of which are no different from the problems faced by rural farmers. Other problems, however, are more specifically related to the urban context and particularly confront the poor who practise off-plot farming. Examples include uncertainty regarding land tenure, theft of crops, lack of capital and inputs, the threat of eviction and the possible destruction of crops.

In many African countries, urban farming is illegal. By-laws frequently date from colonial times and forbid all agricultural activity within the boundaries of urban centres. However, as the practice has become increasingly widespread over the last two decades, a change in policy has occurred. During the 1960s and 1970s, policies were restrictive in the

sense that harassment and the destroying of crops were common measures taken by the local authorities. In the 1980s, however, a gradual shift in attitude took place and nowadays, urban farming is usually permitted as long as it does not become a nuisance. As far as crop cultivation is concerned, the height of a crop, particularly maize, is important because it is said that criminals can hide in it and mosquitoes are assumed to breed in the axils. In some urban centres, for example Dar es Salaam, the local authorities are encouraging the practice of urban farming in order to raise food-supply levels.

Urban agriculture is considered by many as an environmental hazard. It can cause soil erosion, contaminated water can be used for irrigation purposes and crops cultivated along the road sides are prone to air pollution. Since urban farming tends to be more intensive than rural farming, the use of chemical fertilisers, pesticides and insecticides can have an impact on the urban environment, causing pollution in not only the plants but also the soil and groundwater. The recycling of sewage and urban solid waste and turning it into compost is often put forward as a kind of panacea for both urban crop production and the improvement of the urban environment. Although environmental awareness is growing in Africa, such measures have not (yet) been put into practice.

Urban agriculture is attributed a potentially beneficial role in terms of the urban economy, urban food supply and urban development in general (Smit *et al.* 1996). Although largely an informal economic activity, urban farming provides employment as well as an income for those involved. This income can be directly realised through the sale of crops or indirectly as a result of the need to purchase less food (fungible income). At the town or city level, urban farming contributes positively to the provision of affordable food for poorer urban dwellers. However, because of its usually low productivity, the sector's potential in terms of food supply and employment is much higher than presently appreciated, as various studies have indicated (for an overview, see Nugent 2000).

Food producers in town, especially those in vulnerable groups, benefit directly in terms of increased food security (Armar-Klemesu 2000). In Nairobi, Mwangi (1995) found that farming households in a slum area were better off in terms of both energy and protein consumption when compared with non-farming households. Moreover, growing food also helps improve the quality of people's diets by providing fresh fruit and vegetables.

Finally, urban agriculture can play an important role in improving the urban environment and thus in urban development and planning. "Urban farming can help to create an improved micro-climate and to conserve soils, to minimise waste in cities and to improve nutrient recycling, and to improve water management, biodiversity, the O_2-CO_2 balance, and the environmental awareness of city inhabitants" (Deelstra & Girardet 2000: 47).

This is a very concise and general summary of some of the findings of studies undertaken to date. Although the studies are numerous (see Obudho & Foeken 1999), the knowledge of urban agriculture in Africa is still fragmentary because most studies focus on one or two aspects of urban farming only and mostly in one specific urban centre (usually the national capital) or even a specific part or project within that centre. As Mougeot (1994) rightly observed, particularly lacking are studies in which urban farmers and non-farmers

Map 1 Kenya and location of Nakuru town

are compared, as well as studies in which various aspects and effects of urban agriculture are analysed. Although the present paper deals with crop cultivation only, a variety of aspects are covered. Moreover, the study did not take place in a national capital but in a medium-sized town (Nakuru), of which there are so many in Africa. Finally, the results are based on a general survey so that an overview of crop cultivation in Nakuru is obtained.

Nakuru town

Nakuru is located in the heart of the Great East African Rift Valley, 160 km northwest of Nairobi. With an average annual rainfall of about 950 mm, the town has a dry sub-humid equatorial climate. There are two rainy seasons: the long rains from March to May and the short rains from October to December.

Nakuru came into existence in 1904 as a railway station on the great East African Railway (or Uganda Railway) between the Indian Ocean (Mombasa) and Lake Victoria. Being located in the so-called 'White Highlands' (the area of large farms owned by European settlers), Nakuru soon developed into an important regional trading and market centre and became the capital of a district with the same name and of Kenya's largest province, Rift Valley Province.

Over the past 30 years, the population of Nakuru town increased fivefold from 47,000 in 1969 (Kenya 1970) to 239,000 in 1999 (Kenya 2000). At present, Nakuru is the fourth largest town in Kenya. The average annual growth rate between the censuses of 1989 and 1999 was 4.3%, which was much lower than the figure of 6.5% from the previous decade.

Important economic sectors of Nakuru are commerce, industry, tourism, agriculture and tertiary services. Because of its rich agricultural hinterland, Nakuru is called the 'farmers capital' of Kenya and is famous for its agro-based industries. There are over 100 agro-industrial establishments in town ranging from food processing to farm machinery assembly plants (MCN 1999).

Besides being the 'farmers' capital', farming *within* the boundaries of the municipality is widespread. Three forms of farming can be distinguished. First, there is large-scale farming at the fringes of the town. These are the huge farm of the Rift Valley Institute of Technology in the west and the Prison Farm in the northwest. Second, there is a lot of small-scale farming in the peri-urban areas (i.e. the areas between the built-up area and the town boundaries), particularly but not exclusively in the southwestern part of the town, which was incorporated after the 1992 boundary extension. With the growth of the town's population, many of these small farms have been subdivided into smallholder or urban residential plots. Nevertheless, farming is still the dominant activity. Third, there is the less visible form of intra-urban agriculture, i.e. within the built-up area. Though very common, compared with the farming activities in the peri-urban areas, intra-urban farming is generally a more modest activity ('micro farming'), largely due to lack of space. It is the latter type of urban farming the paper deals with.

Method

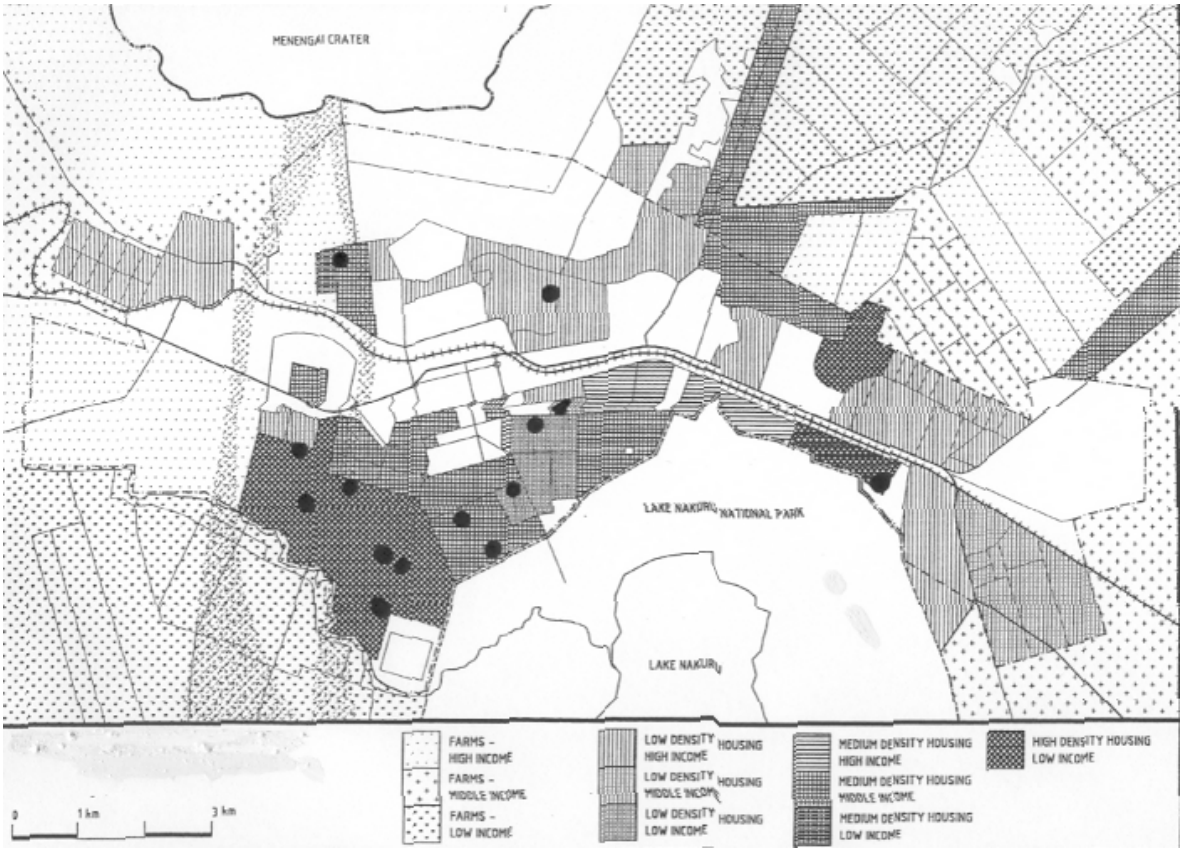
In June-July 1999, a survey among 594 households in the built-up areas of Nakuru town was carried out. To obtain a representative sample, the 15 clusters of the Kenyan Central Bureau of Statistics were used (see Map 2). Together, the clusters counted about 1,400 households; hence, from each cluster a 43% random sample was drawn. A largely structured questionnaire was used (for more details on the methodological aspects, see Foeken & Owuor 2000a). Information was collected on demography, migration history, economic activities, urban crop cultivation, urban livestock keeping, rural farming activities and general food-security issues. The information regarding crop cultivation covered the 1998 growing period. The large majority of the respondents were household heads (40%) or spouses (47%), with the rest being other household members.

Urban farming is defined here as any agricultural activity within the boundaries of an urban centre. Moreover, a lower plot size limit of one square metre is employed. Of the 594 households, 209 (35%) could thus be classified as urban farmers. Of these, 160 (27%) cultivated crops, while 121 (20%) kept livestock in town. In September-October 2000, a more detailed questionnaire was administered to 30 urban farmers. They consisted of 10 crop cultivators, 10 livestock keepers and 10 mixed farmers (i.e. engaged in both crop cultivation and livestock keeping), all randomly selected from the same three farming categories of the 1999 survey. The questionnaire used in this second survey was of a semi-structured nature, with many open questions concerning urban farming activities. Hence, there is additional information on crop cultivation from 20 households.

Five examples

● David and Susan came from Migori to Nakuru in 1982 when David was 30 years old. They started to grow crops in town in 1998 on a 1/4-acre plot given to them by David's employer. They tried maize and potatoes for self-consumption but the crops failed. In 1999 they tried again, this time maize, beans and sweet potatoes, again for self-consumption only. Despite the drought that year, they managed to harvest one bag (90 kg) of maize and four 2-kg tins of beans because they were able to use tap water for irrigation. They also used chemical fertiliser, and pesticides against stalk borers. The fertilisers and pesticides were bought in a shop for Ksh 750 (about US$10) and Ksh 50 respectively. The farming activities were carried out by David and sometimes Susan, and they also received some assistance from a friend. Susan spent part of the year in their 'home area', on the farm of his family, from where they also got food. They did not sell any of their urban crop but did give some of it away and the crop residues were given to someone with livestock. Farming is important for them as it provides food for six months of the year (December to June). If they had a higher income from their non-farming activities, they would not stop cultivating crops in town. On the contrary, they would cultivate more in order to raise their income.

Map 2 Distribution of the research clusters
(Map from MCN 1999, Fig. 3.6, p. 37)



They feel that using more chemical inputs could increase their yields, but lack of cash is a major constraint.

● Samuel and Pauline came from Bomet to Nakuru in 1987 and settled in Rhonda Kaptembwa, where they still live today. They have always cultivated crops and keep cows in the compound on a plot about 200x100 feet. In 1999 they grew maize and beans solely for self-consumption, as well as Napier grass for their cows. They weeded twice and used chemical pesticides. Due to the drought and because they did not irrigate, their harvest was modest: some maize cobs were picked raw and roasted, while only two 2-kg tins of beans were harvested. The dried maize stalks were fed to the cows. Napier grass is cut whenever it reaches a certain height. They did not sell anything but gave away some of their crops to friends. Pauline is responsible for the crops and at peak times she works on the *shamba* all day, with some assistance from a nephew. One day she also hired a local person for weeding, which cost her Ksh 300. The crop residues were used as fodder for the cows and the animal dung as manure for the crops. Farming activities are important for her because "it subsidises". She would not stop cultivating even if the household had sufficient income for a decent standard of living. Pauline is convinced that she could produce more crops if she was able to irrigate. The local government could assist by providing a water supply.

● Margaret came to Nakuru in 1974 because she was transferred there as a teacher. She has always cultivated crops in her compound located in Kabachia. It started as a hobby but nowadays it is important for her own food supply as well as for providing some extra income. In 1999 she cultivated kale, onions, spinach and tomatoes. She successfully used a pesticide on the tomatoes to avoid rust and blight and she irrigated the crops with tap water. She harvested about 35 kg of tomatoes when they were ripe, but was not able to estimate the amounts harvested of the other crops. Her son assisted her in the *shamba*. Part of the crop was sold, as it was too much for her to consume and some was also given away. She left the crop residues to rot as fertiliser.

● John and Mary came to Nakuru in 1971 and settled in Lakeview, where they still live today. They have always cultivated maize and beans for home consumption in town on a plot measuring 100x50 feet. In 1999, they had some kale and arrowroot as well. They used no chemicals and did not irrigate the crops. There was little harvest in 1999, partly because of the drought and partly because baboons from the adjacent national park came over the fence from the park (where it was also very dry) and ate part of the crop. She dug up some arrowroot each month. She did not sell anything but gave away a few cobs of maize to her children. Mary is the one responsible for farming and does it all on her own, spending on average two hours per day on the *shamba* all year round. The main impact of the drought was that she had to spend more money on the purchase of food than in normal years. Cultivating crops in town is important for her because "it helps in feeding my family". It has become more important for her over the years because "now food is expensive but I'm

able to cater for that with what I harvest". She gets something from it throughout the whole year. So she would never stop with the activity as "it helps in my budget". In general, she is satisfied with the yields she realises and does not know how they could be further improved.

● Charles and Rose came to Nakuru in 1965 and have cultivated crops ever since on a half-acre plot in Lanet. They started with kale, but nowadays they cultivate tomatoes, *dhania* (parsley), beans, spinach and kale. They plant twice a year, use chemicals for weeding and irrigate with tap water. The tomatoes and the *dhania* are mainly sold to local middlemen. When the tomatoes are ripe, they harvest about eight crates per week. The *dhania* gave them an income of about Ksh 18,000 in 1999. Moreover, six bags of beans can be harvested each year, of which four are sold. Some of the crops are given away. The remaining beans, as well as the spinach and the kale, are mainly for home consumption. The income from sales is being used to build a house. Charles and Rose are jointly responsible for their farming activities but have to hire labour for planting and picking. The crop residues are used as fodder for the livestock they keep in the same compound (cows, goats, sheep and rabbits, partly for milk, partly for income and partly as an insurance in case they need money) and the animal dung fertilises the *shamba*. Their farming activities are beneficial throughout the year as they can sell crops and milk all year round. Over the years, urban farming has become increasingly important to them, so they would never stop it. On the contrary, they would like to expand.

The five households described above cultivated crops in 1999 and were among the households interviewed in the more detailed survey. They should be considered as examples and not as a cross-section of all the crop cultivators in Nakuru town. Nevertheless, they do represent many of the features characteristic of the crop cultivators in the town in general.

Urban plots

The 160 crop cultivators cultivated 180 plots or 1.1 plots per household, but the plots were not equally distributed over town (Table 1). Plots for crop cultivation were particularly over-represented in the medium and low-density housing areas. Many dwellings in the high-density areas have no compound and between the houses there is less space than in the less densely housed areas. Theoretically, it is possible for households in high-density areas to practise crop cultivation on plots in other, less densely inhabited areas. This could not be deduced from the data, however.

Table 2 presents information on various characteristics of the urban plots. Most of the 180 plots used for crop cultivation were located in the farmers' own compounds (61%). This is the category of 'on-plot' farmers. Hence, almost four out of ten plots were located *outside* the homesteads ('off-plot'): on the respondent's estate (17%), along a railway (8%),

Table 1 Geographical distribution of plots (%)

housing density	households in sample (N=594)	plots (N=180)
high	39.7	19.4
medium	58.9	76.7
low	1.3	3.9
Total	100	100

Source: 1999 survey

on another estate (6%), along a road (4%) or in various other locations (5%) such as along a river, under a power line, in a school compound or next to a cemetery, a park or a sewage outlet. The percentage of plots in the cultivator's own compound was somewhat higher in lower-density estates. Nevertheless, over half of the plots in the high-density areas were also in the people's compounds.

Table 2 Characteristics of urban plots (%)

location		*plot size (m^2)*	
in own compound	60.6	<10	13.4
within own estate	16.6	10-99	26.2
elsewhere	23.8	100-999	28.5
Total	100	1000+	31.8
		Total	100
distance to plot			
<10 minutes on foot	70.0	*ownership of plot*	
10-30 minutes on foot	12.2	own land	33.0
>30 minutes on foot	17.8	landlord	45.8
Total	100	government	14.0
		other	7.3
cultivated plot since		Total	100
before 1990	23.3		
1990-1994	25.6		
1995-1998	51.1		
Total	100		

Source: 1999 survey

The ten plots of the households in one of the medium-density areas (Ziwani) were all located outside the estate itself because the landlord (the railway company) did not allow farming inside the estate, despite there being space to do so. The plots are located along the railway to Nairobi, a zone to which the residents of the railway estate have easier access than others. Because the estate is located some distance south of the railway itself, Ziwani

is also the only area where the majority of the plots were located at a distance of more than half-an-hour's walk from the house. In most other areas, the majority of the plots were within ten minutes walking (Table 2), except for the medium-density Flamingo I where one third of the plots were located at a distance of more than an hour's walk. This has to do with the back-to-back construction of the houses and the resulting absence of backyards.

Crop cultivation in Nakuru on the present scale seems to be quite a recent phenomenon. About half of the plots have been put under cultivation since 1995 (Table 2). Only 13 of the 180 plots (7%) were being cultivated before 1980. This suggests a general decrease of the purchasing power of the population during the last decade.

The average plot measured 964 square metres.[6] This means that in 1998 roughly 5,200 acres of land were under crops in the built-up areas. However, there is a wide range of sizes (Table 2). The smallest plots encountered were one square metre while the largest was a plot in Lanet measuring 16,000 square metres (1.6 hectares). Plots in people's compounds were generally smaller than those located elsewhere. For instance, half of the plots in the compounds were smaller than 100 square metres against less than a quarter of those located elsewhere. One would expect plots to be bigger where housing density is lower. However, the percentage of small plots (less than 100 square metres) in the medium-density areas was much higher (45%) than in the high-density areas (23%). Since the percentage of plots within the compounds is only slightly higher in the medium-density areas, there is no obvious explanation for this.

One third of the plots used for crop cultivation were owned by the cultivators themselves (Table 2), another 46% of the plots were owned by a landlord, while 14% of the plots were on government land. Three respondents did not know who the owner of their plot was. Plots owned by landlords were generally smaller (54% were smaller than 100 square metres) than those owned by the cultivators themselves (28%). Plots owned by the government were relatively large (54% were more than 1,000 square metres).

Crops

A wide range of crops was cultivated in Nakuru in 1998. Appendix 1 offers a full list of all the crops cultivated on the 180 plots. Both from Appendix 1 and from looking around in the field it is clear that mixed and inter-cropping was common, though the majority of the plots (58%) had no more than three crops. In eight cases, ten or more different crops were found on one single plot. On about a dozen plots, only one crop was being cultivated.

There is no relationship between plot size and the number of crops per plot. For instance, on about two-thirds of both the smallest plots (<10m^2) and the largest plots (1,000+m^2) one to three crops were being cultivated. The largest variety of crops was found on the plots measuring between 100 and 1,000 square metres.

[6] For comparative purposes: 1,000 square metres is one tenth of a hectare or a quarter of an acre.

The three crops that stood out as by far the most important in terms of the number of households cultivating them were kale (*sukuma wiki*), maize and beans. Kale and maize were grown by about two-thirds of the crop cultivators and beans by almost 60%. Onions, spinach, tomatoes and Irish potatoes were cultivated by 20 to 30% of the cultivators and cowpeas, bananas and spider plant (*saget*) by less than 20% (for exact figures, see Table 5).

To some extent, the type of crops cultivated depends on the location of the plot. The variety of crops cultivated in the homesteads was much larger than on the plots located elsewhere. 'Typical' compound crops were kale and bananas and to a lesser extent spinach, onions and tomatoes. Kale was grown on 80% of the compound plots and on 32% of the other plots. Bananas were almost exclusively found in compounds. Maize and beans were found on about half of the compound plots and on 75% and 68%, respectively, of the plots elsewhere.

It is remarkable that even on the smallest plots (<10m^2) all ten of the major crops were represented, even the more bulky ones. For instance, maize was found on more than half of these tiny *shambas*. On the larger plots (1,000+m^2), maize and beans were more common (77% and 72% respectively), but most other crops were less extensively cultivated. Kale, for instance, was found on only 32% of these plots. This is related to the fact that these larger plots are often somewhat further away from the house: over half of the plots of 1,000 square metres or more were at least half an hour's walk away. On the 14 plots even further away (at least an hour's walk), maize, beans and Irish potatoes were over-represented while the other crops were either under-represented (kale and cowpeas) or not found there at all. In other words, distance is a limiting factor regarding the choice of which crops to grow and is related to the perishability of the crop, the risk of theft and the use of inputs including labour.

Land ownership is another limiting factor. All crops could be found on plots owned by either the cultivator or by a landlord because over 70% of these plots were located in people's own compounds. Growing crops on government land or on land where the user does not know who it belongs to is much riskier. Hence, on these plots mainly maize and beans and to a lesser extent kale and cowpeas could be found.

The choice of what to grow is also to some extent determined by the person responsible for cultivation. Men were more inclined to grow staples like maize and beans than women,[7] while women, on the other hand, more often cultivated vegetables such as spinach, onions and *saget*.[8] In other words, women are more inclined to grow a greater variety of crops. This is related to their traditional function as the household's food provider, attempting to achieve a more balanced diet.

[7] Maize was cultivated by 73% of the male heads and 56% of the female heads and spouses. The figures for beans were 71% and 49% respectively.

[8] Spinach: 10% of the men, 23% of the women. Onions: 10% of the men, 30% of the women. *Saget*: 4% of the men, 12% of the women.

Inputs

Inputs in crop cultivation include such factors as labour, tools, material inputs, farming techniques, information etc. No reliable data exist on all these input types. As far as *labour* is concerned, the 1999 survey was too general to produce reliable answers as to how much labour was invested during the whole growing season. Only the question as to whether any hired labour had been used was asked. As for *tools*, most of the plots are simply too small to allow for any machinery to be used. The tools used by nearly everybody are the hand-hoe and the cutlass. Only in exceptional cases was a tractor used. The bulk of the data concerns *material inputs* such as fertilisers, pesticides, irrigation, etc., although amounts were not asked for during the 1999 survey. Finally, *farming techniques* and *information* can to some extent be translated into the question as to whether any 'assistance' had been given during the growing period. During the 2000 survey more detailed questions on the various types of inputs were asked but this concerns a limited number of cases only.

Table 3 shows the percentages of crop-cultivating households using certain material inputs during the 1998 growing season. Ten respondents said they used no inputs at all. Almost all crop cultivators used at least one type of fertiliser. Most fertiliser was of the traditional (i.e. organic) type: manure, crop residues, urban waste and (in two cases) ash. The manure came either from people's own farm (mixed farming in town) or from a neighbour. Crop residues almost always came from the farmer's own (urban) farm. Chemical fertilisers were used by about one third of the crop cultivators. The use of (chemical) pesticides and insecticides was not widespread: about 30% and 10% of the cultivators respectively. Most farmers used local (traditional) seeds and seedlings, although more than half used improved materials as well. Finally, irrigation was practised by almost half of the cultivators. All except two obtained their water from a tap (even though the use of domestic water for irrigation purposes is illegal). One of the latter two used sewage water for irrigation and the other applied cattle urine.

Table 3 Material inputs for crop cultivation in town (% of households; N=160)

type of input	%	type of input	%
no inputs	6.3	chemical pesticides	29.4
		chemical insecticides	8.8
chemical fertiliser	35.6		
manure as fertiliser	53.1	local seeds/seedlings	70.6
crop residue as fertiliser	35.0	improved seeds/seedlings	57.5
urban waste as fertiliser	3.1		
ash as fertiliser	1.3	irrigation	44.4

Source: 1999 survey

Inputs can be classified in various ways. An initial division is between traditional and modern inputs. Manure, crop residues and local seeds can be considered as traditional inputs, while the three chemicals plus improved seeds can be seen as modern inputs. The question behind this classification is whether the use of modern inputs leads to higher yields. A second classification is between chemical inputs and non-chemical inputs, which is important for environmental reasons. In this context, one can also distinguish so-called sustainable (or environmentally friendly) inputs that are organic and can be recycled and may lead to reasonable yields: manure, crop residues and improved seeds. Finally, irrigation is an input that stands on its own: without sufficient water no harvest is possible. The relationship between these categories of inputs on the one hand and crop yields on the other is dealt with below.

Table 4 shows that most crop cultivators (86%) used at least one traditional input, while over half used two or three. Modern inputs were less frequently used: almost 30% of the cultivators used no modern input at all and another third only one. Chemical inputs were used even less: over half of the farmers did not use these types of inputs, while only eight used all three types. The picture of the sustainable inputs resembles that of traditional inputs, as two of the three types of inputs categorised under sustainable inputs are traditional. The average number of inputs used in each category (Table 4, right-hand column) confirms the general picture that crop cultivation in Nakuru town is quite traditional in nature.

Table 4 Number of inputs by category of input (%; N=160 households)

	number of inputs:						average no.
category	0	1	2	3	4	total	of inputs
traditional inputs	13.8	35.0	30.0	21.3		100	1.6
modern inputs	29.4	32.5	20.6	12.5	5.0	100	1.3
chemical inputs	51.9	27.5	15.6	5.0		100	0.7
sustainable inputs	16.3	37.5	30.0	16.3		100	1.5
irrigation	55.6	44.4				100	0.4

Source: 1999 survey

Only ten (6.3%) of the 160 crop cultivators had received technical assistance in 1998. Three had been visited by an extension officer and one by an officer from the Agricultural & Rural Development Programme of the Catholic Diocese of Nakuru. The others had received assistance from neighbours and/or relatives. During peak periods, labour is sometimes hired, as was the case with 27.5% of the cultivators.

It is hypothesised that the use of inputs varies with certain plot characteristics (size, location, distance, ownership), household characteristics (income, size) and characteristics of the person responsible for crop cultivation (sex, marital status, educational level, age). To simplify matters, three mutually exclusive categories of material inputs are compared: chemical inputs, sustainable inputs and irrigation, after which 'hired labour' and 'assist-

ance' are considered.

Since location and plot distance and, to some extent, size are interrelated, it is not surprising that these characteristics show the same tendencies as far as the use of inputs. Chemical inputs were used more on plots located *outside* people's compounds, somewhat further away and relatively large in size. However, for the use of sustainable inputs, these characteristics showed no differences. Sustainable inputs were more commonly used on plots owned by the users themselves and that have been in use for longer. Irrigation was more often practised in compounds, which is not surprising as most of the water came from people's taps.

Despite the costs involved, the use of chemical inputs is not related to household income. However, richer households did use sustainable inputs and irrigation more often. As households increased in size, more chemical and sustainable inputs were used. This could be expected since there are more mouths to feed. Irrigation shows no relationship with household size and its use is more dependent on the presence of a tap than on anything else.

As for the person responsible for the household's crop cultivation, the large majority were either the male head (on 27% of the plots), the spouse (49%) or the female head (13%). In the remaining cases it was another household member (10%) or a paid labourer (2%). One of the clearest differences regarding the use of inputs concerns the sex of the person responsible. Men were more inclined to use chemical inputs than women, though women irrigated more often.[9] A further differentiation of the women into spouses and female heads shows that it is particularly the latter category that practised a relatively 'input-poor' type of crop cultivation. Whatever category of inputs is considered, the female heads used it less frequently. However, this applies in particular to chemical inputs: only 10% of female heads used any chemical input as opposed to 63% of male heads and 50% of spouses. This is likely to be due to the usually low welfare level of female-headed households. Other characteristics of the person responsible, such as educational level, occupational status and age, showed few differences in the use of inputs.

Usually, crop cultivation is not a full-time job, though 14% of the crop cultivators interviewed said it was. More than a quarter of the crop cultivators had also used hired labour. This appeared to be more common on plots that had been in use for longer and on plots owned by the cultivator him/herself. Richer households and bigger households were more inclined to hire additional labour while female heads rarely employed hired labour.

Receiving assistance was not common in Nakuru town but occurred somewhat more frequently on larger plots (perhaps more visible to the extension officers?) and on plots only recently given over to cultivation. The latter might be related to the finding that younger crop cultivators as well as more educated ones received more assistance than older cultivators and less educated ones. Perhaps, the young and relatively well-educated are better able to find ways of gaining assistance than the older and the less-educated.

[9] Chemical fertilisers are used by 57% of the men and 27% of the women. The figures for chemical pesticides are 48% and 25% respectively. Irrigation is practised by 51% of the women, compared with 28% of the men.

Yields

Crop yields are determined by various factors but by far the most important is the weather, and in particular the amount of rainfall and its distribution throughout the growing season(s). For instance, harvests were quite bad in 1999 and 2000 because of drought. The data presented here concern the 1998 harvests, which was a fairly normal year in terms of rainfall. Other determinants include such factors as labour inputs, material inputs as defined above, farming techniques, etc. The data available are mainly on the types of inputs used, whether additional labour had been hired and whether any assistance had been received.

Table 5 shows the average amounts harvested per crop-cultivating household and per crop type (i.e. the 10 most commonly cultivated crops). At first sight, the harvests of the various crops (column 3, in kg) appear modest. Nevertheless when looking at, for instance, maize, the 101 households cultivating this crop harvested about 22,600 kg in 1998, which amounts to some 2.7 million kg *for the built-up area* of Nakuru as a whole (based on the assumption that there were about 70,000 households in 1999 (see Appendix 3, Table A3, footnote e). Likewise, the Nakuru crop cultivators produced about 1.1 million kg of kale, 0.8 million kg of beans, 140 tons of onions, 390 tons of spinach, 60 tons of tomatoes, 330 tons of Irish potatoes, 220 tons of cowpeas, 13 tons of bananas and 70 tons of spider plant. If the other 30 less important crops (Appendix 1) were also included, it is estimated that total crop production in Nakuru town in a normal year would amount to about 6 million kg. If the peri-urban areas of Nakuru town were to be included, this figure would be even higher.

Table 5 Harvests of major crops cultivated in Nakuru town

crop type	(1) % households cultivating (N=160)	(2) N	(3) average amount harvested (in kg)*
kale (*sukuma wiki*)	68.1	109	84
maize	63.1	101	224
beans	58.8	94	75
onions	28.1	45	26
spinach	22.5	36	92
tomatoes	21.9	35	15
Irish potatoes	20.0	32	88
cowpeas	17.5	28	67
bananas	16.9	27	4
spider plant (*saget*)	11.9	19	33

* Only households cultivating that crop (see column 2). During the survey, harvests were given in many different units. To make the figures unequivocal and hence comparable, all units have been translated into kg. As this method implies an element of speculation, the presented average harvests have to be considered as indications only.
Source: 1999 survey

The average harvest from all crops was almost 300 kg per plot (Table 6). With an average plot size of almost 1,000 square metres, the productivity, i.e. the average amount harvested per square metre, was a modest 0.3 kg.[10] However, there are important differences between the various plot size classes. In general, productivity is higher as plots are smaller. Of course, one could expect a relatively higher output from the smaller plots as many were located in the people's own compound where one is inclined to pay more attention to them than to plots further away.[11] But since many of the plots of the other size categories were also located in the households' compounds,[12] the figures in Table 6 strongly suggest that plot size is an important determinant of crop yield.

Table 6 Mean harvest (all crops) by plot size

plot size (m^2)	N (plots)	mean harvest (kg)	mean plot size (m^2)	harvest per m^2 (kg)
<10	18	121	6	20.17
10-99	47	175	37	4.73
100-999	50	191	373	0.51
1000+	53	578	2670	0.22
All plots	168	301	964	0.31

Source: 1999 survey

One explanation for the higher output as plots decrease in size can be the use of material inputs. However, on the whole, the different types of inputs mentioned in the previous section were not used more often on smaller plots than on larger ones. Nevertheless, when comparing the productivity of plots where a certain type of input was used with plots where that input was *not* used, the use of certain inputs does seem to have a (modest) effect on crop yield. For instance, on plots where chemical fertilisers, chemical pesticides or improved seeds were used, yields per square metre were higher. It is also possible that the amounts of each input used are higher as plot size decreases, but this cannot be determined from the data available.

Few households used only one type of input or no input at all. Thus inputs are grouped together in Table 7. 'All inputs' includes the eight different types distinguished in this

[10] In Tables 6, 7 and 8, eleven cases (plots) had to be deleted. Four of these were outliers, i.e. unrealistically high yields on very tiny plots. In the other seven cases, the respondent had indicated "no harvest", either because s/he did not know or the plot still had to be harvested or the plot had been left idle. Due to the way of obtaining the data (hindsight information), the figures should be seen as no more than indications. What matters are the tendencies.

[11] The average harvest from the plots in the households' own compounds was twice as high as from the plots elsewhere (0.49 and 0.24 kg/m^2, respectively).

[12] For instance, 87% of the plots in the 10-99 m^2 category, 64% of those in the 100-999 m^2 category and 38% of the 1,000+ m^2 category were located in compounds.

study. They are then regrouped into chemical inputs, sustainable inputs and irrigation, i.e. three categories that exclude each other. The table shows that the use of *more* inputs in general seems to lead to higher yields. The figures also indicate that the use of one chemical input does not make a difference but that the use of two or three does. The number of sustainable inputs has no direct influence on productivity level. Finally, and hardly surprising, irrigation, has a positive effect on crop yields.

Table 7 Mean harvest (all crops) by use of material inputs

inputs	N (plots)	mean harvest (kg)	mean plot size (m^2)	harvest per m^2 (kg)
no. of inputs				
0-2	52	96	466	0.21
3-4	68	292	1247	0.23
5-8	48	536	1103	0.46
no. of chemical inputs[1]				
0	85	135	549	0.25
1	45	248	1153	0.22
2-3	38	736	1669	0.44
no. of sustainable inputs[2]				
0	28	123	426	0.29
1	57	207	845	0.24
2-3	83	426	1227	0.35
irrigation				
no	92	253	1313	0.19
yes	76	359	541	0.66

Notes: 1. Chemical fertilisers, chemical pesticides, chemical insecticides.
2. Manure, crop residues, improved seeds/seedlings.
Source: 1999 survey

Another factor to account for the high yields of small plots concerns labour. For instance, the smaller a plot, the more frequently the cultivator will be inclined to weed it as it is not so time-consuming. Moreover, it was surprising to find that hired labour was used much more frequently on the *smallest* plots *and* on the *largest* plots (42% and 40%, respectively, against 19% and 14% on the plots of the 10-99 and 100-999 square metre categories). The average harvest of the plots where hired labour had been used was twice as high as that of plots where no additional labour had been hired.[13]

Farming techniques also determine how much is produced. No direct observations have been made, but who received technical assistance and who did not was recorded. Although

[13] Namely 0.42 and 0.24 kg/m^2 respectively.

there were only ten crop cultivators who had received assistance, it is conspicuous that their productivity was almost three times higher than all other cultivators put together.[14]

Table 8 shows mean harvests and productivity for some household characteristics. As far as household income is concerned, yields per square metre were somewhat higher in the lowest income group and even more so in the highest income group. The former could be explained by the fact that the poor rely more on urban farming for their livelihood than those who are better off. The relatively high yields of the rich households may be caused by the fact that irrigation is more common in this group than in the other ones.

Table 8 Mean harvest (all crops) by household characteristics

household characteristic	N (plots)	mean harvest (kg)	mean plot size (m^2)	harvest per m^2 (kg)
household income (Ksh/month)				
<5,000	45	357	930	0.38
5,001-10,000	62	228	972	0.23
10,001-20,000	39	237	1003	0.24
20,001+	18	608	859	0.71
household size				
1 member	7	137	179	0.77
2-4 members	55	257	1157	0.22
5-7 members	74	256	651	0.39
8+ members	32	516	1529	0.34
person responsible				
male head	42	401	936	0.43
female head	22	137	688	0.20
spouse	85	241	1071	0.23
other household member	17	483	677	0.71

Source: 1999 survey

One could expect larger households to realise bigger harvests because, in theory, they have more labour at their disposal. This seems to some extent to be confirmed by the figures in Table 8. The largest households (8+ category) had a relatively low productivity but given the large average plot size in this group and the fact that they realised about the same yields as the 5-7 members category (with less than half the average plot size), their productivity can be viewed from a different perspective. The relatively high yields of the seven single-person households is conspicuous, but is probably more closely related to the relatively small plot size than to the labour factor.

Finally, it seems to make a difference as to who is responsible for crop cultivation. In general, men obtained higher yields than women.[15] This is related to the men's higher level

[14] Namely 0.76 and 0.28 kg/m^2 respectively.

of inputs, especially chemical fertilisers and chemical pesticides. Female heads in particular had very poor yields (Table 8), not only compared with male heads but also with the spouses of male heads, because the spouses cultivate much larger plots. 'Other household members' include children, a brother or sister of the head, or a parent. The fact that they obtained quite high yields is possibly due to higher labour inputs.

Benefits

In assessing the benefits of urban crop cultivation, different levels and aspects can be distinguished. How much does it contribute to the food supply of the households concerned? How much does it contribute to household income? How much does it contribute to the food supply of Nakuru town as a whole? How many people find employment in this sector? These questions are dealt with below.

It is possible to assess the contribution of the food produced to the energy requirements of the producers themselves and of the Nakuru population as a whole. (Because of various assumptions on which such calculations are based, these figures can be no more than cautious indications.) From the calculations presented in Appendix 3, it can be concluded that in 1998 the six million kilograms of crop production (in the built-up area) constituted about 8% of the total energy requirements of the population of Nakuru. If the producers consumed all of it themselves, it would constitute about 30% of their energy requirements. However, of the ten main crops in Table 5, about 75% of the harvest was consumed in the producers' households.[16] Hence, the contribution to the producers' energy requirements would amount to about 22%.

Roughly a quarter of all produce is sold. This implies that an estimated 1.5 million kilograms of crops produced within the built-up area of the town were marketed locally. Thus, many other households benefit from urban food production by obtaining food at prices that are likely to be lower than normal market prices.

The importance of crop cultivation in Nakuru can also be measured in a more subjective way, namely by the relevance attached to the activity by the people concerned. First, crop cultivators were asked why they practised this type of activity. For the majority, the extra food produced was mentioned as one of the main reasons (Table 9). For some, income was more important, while for five respondents the cultivation of crops was more of a hobby.

Interestingly, there were hardly any differences between the income groups as far as the reasons for crop cultivation were concerned. If the lowest and highest income groups are compared, the percentage of households mentioning the need for food was high in both groups. On the other hand, none of the higher-income households mentioned the need for

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[15] Namely 0.46 and 0.24 kg/m^2 respectively. The difference cannot be explained by differences in plot size, as the average sizes are not very different (861 m^2 for the male heads and 1033 m^2 for the female heads and spouses together; see Table 8).

[16] For the calculation of the percentages self-consumed, see Appendix 2.

additional income as their major reason for cultivating crops. And not surprisingly, those mentioning 'hobby farming' were almost all from this same category.

Table 9 Reasons for cultivating crops in town (%; N=160)

	reasons (total>100%)	major reason
needed food	97.5	90.0
needed income	15.0	3.3
income diversification	9.4	3.3
hobby/custom	9.4	3.3
other reasons	2.5	-.-
Total		100

Source: 1999 survey

The question regarding the extent to which urban crop cultivation contributed to household food consumption can also be answered in more qualitative terms. Forty-two per cent of the crop cultivators in Nakuru said that it constituted half or more of the food they consumed. For another 51% it added between 'less than half' and 'a small portion'. Only a small minority stated that urban crop production was of negligible importance in terms of household food consumption. As could be expected, the contribution of urban crop cultivation to household food consumption, as perceived by the respondents, was larger among low-income households than among high-income households.[17]

Crop cultivators were also asked about the general importance of this activity. For the large majority, urban crop cultivation formed at least an 'additional food and/or income source'. For about a quarter it was a 'major source'. Some (7%) even stated that they 'could not survive without it', while only five said the opposite. These percentages show no marked differences for the four income groups. For poor and rich households alike, crop cultivation is both a food and income source. Only the percentage of households stating that they 'could not survive without urban crop cultivation' was higher in the lowest income group (14%) than among the other groups (4.5%).

It is difficult to assess the importance of urban crop cultivation in terms of employment. In Nakuru as a whole (i.e. in the built-up area), some 19,000 persons in the town were directly involved in the cultivation of crops in 1999.[18] For 14% of the persons responsible for their household's crop cultivation in the sample (i.e. some 2,650 people in the town), it

[17] For 60% of the poorest crop cultivators (i.e. those with a monthly household income of Ksh 5,000 or less), the self-produced crops constituted at least half of the food consumed in the household. This applied to 23% of the highest income group (over Ksh 20,000/month).

[18] Calculated as follows: 27% of the sampled households cultivated crops. Assuming that there were about 70,000 households in Nakuru town in 1999 and that one person per household is the one doing the work, the total number of people directly involved is 18,900.

was a full-time job. The 19,000 persons are those household members who participate in the cultivation process. In reality, this number may be higher as in many households more than one person may be involved. Although for all these people it is unpaid labour, urban farming generates income as about one quarter of all produce is sold. In addition, in more than a quarter of the crop-cultivating households hired labour was used. In other words, for about 5,200 persons urban farming constituted a form of paid labour.[19] For these people, working in urban crop cultivation is an income-generating activity, albeit of an irregular and seasonal nature.

Potential

It has already been noted that the average crop yield was quite low (0.31 kg per square metre) and that the productivity of small plots was much higher than that of larger plots. Consequently if the productivity of the small plots could be realised by *all* plots, a much larger harvest would be possible. It is unrealistic to take the high productivity of the very small plots (20 kg/m^2) as a starting point, but even if the targeted productivity level were a modest 1 kg/m^2, the total crop harvest would be three times higher than it was in a fairly normal year like 1998. Given that the production in that year contributed an estimated 8% to the total energy requirements of the Nakuru population, it would mean that urban crop cultivation (in the built-up area) could contribute at least 25%. In theory, if the productivity of the plots in the 10-99 square metre category could be realised (4 kg/m^2), a town like Nakuru could be self-sufficient as far as crops are concerned, at least in years with sufficient rainfall.

Constraints faced by farmers

However, a number of limitations have to be overcome to increase current yields. From the perspective of the farmers, various problems were encountered affecting yields. Table 10 presents the most frequently mentioned problems (see Appendix 4, Table A4 for a complete list of problems mentioned by crop cultivators). The respondents were asked to mention any problems they had encountered in 1998 (middle column) as well as the main problem (right-hand column). Although a wide range of problems was mentioned (see Table A4), it is notable that one sixth of cultivators said that they had encountered no problem.

Many problems are not specific to the urban setting, for example pests/insects, destruction by animals, inadequate rainfall, disease, poor soil, etc. However, the most frequently mentioned constraint is typically urban: the theft of crops. This has been found to be a major problem in many other studies as well. Only a few respondents mentioned other urban constraints such as harassment and lack of space/land. The same applies to such

[19] Calculated as follows: 27.5% of the crop-cultivating households used hired labour = 44 households or 7.4% of the total sample. For 70,000 households in Nakuru as a whole, the figure is then 5,185 persons.

problems as a lack of inputs, capital and labour. Three respondents mentioned a specific problem (grouped under 'other problems' in Table A4), namely poor seasonal timing, a sewage burst (apparently spoiling the crops) and too much rainfall (whereas 56 others complained of inadequate rainfall). Answers to the question as to which of the problems was seen as the most important (Table 10, right-hand column) are comparable with all the problems mentioned.

Table 10 Most frequently mentioned problems with crop cultivation in town (%; N=160)

	mentioned as a problem	mentioned as the main problem
theft of crops	36.6	24.4
inadequate rainfall	35.0	24.4
destruction by animals	23.8	10.0
pests/insects	22.5	8.8
lack of water for irrigation	12.5	9.4
disease	9.4	2.5
lack of inputs/capital	6.9	1.9
no problem	16.3	16.3

Source: 1999 survey

Not all problems can be easily solved. Rainfall will always be a critical factor. Raising yields implies that more inputs and capital are needed, but these are serious constraints for many farmers. Other problems, however, can be tackled more easily, for example, theft, destruction by animals, pests/insects, disease, etc. The fact that only few urban crop cultivators received any assistance may be significant in this respect.

Uncertainty regarding access to land is another limiting factor. Forty per cent of the plots were located outside the people's own compounds. More than 20% of the plots were either owned by the government or the owner was unknown. And indeed, yields were relatively high on the *shambas* in compounds and low on plots owned by the government or where the owner was unknown. Hence, if the cultivator could be certain that s/he could use a plot undisturbed for a period of perhaps five years, s/he would undoubtedly be more inclined to invest in farming activities that in turn would result in higher yields.

Environmental impact

Urban farming is often considered a menace for towns in terms of the environment and the health of the people, even though crop cultivation is usually considered less harmful than livestock keeping. Nevertheless, crops cultivated on polluted sites or irrigated with untreated water or polluted with exhaust fumes are thought to be unhealthy. This is to some extent confirmed by a study by Nyandwaro (forthcoming). The soil on the dumpsite, where

maize and beans are extensively cultivated, showed high concentrations of heavy metals such as zinc, lead, cadmium and mercury. Concentrations of heavy metals, particularly cadmium, in sewage water, which in some areas is widely used for irrigation, were also high. Soils in these areas were quite heavily polluted with zinc and lead. As a result, plants cultivated in the area of Rhonda Sewage showed high concentrations of zinc. Plants growing near roads and prone to exhaust fumes appeared *not* to contain higher concentrations of heavy metals than plants grown at a greater distance from traffic. [20]

Attitudes among *non*-farming Nakurians as well as officials regarding urban farming were quite negative (Nyandwaro forthcoming). In general, farming in town is considered to be unhygienic. And although attitudes towards urban livestock keeping are more negative than towards urban crop cultivation, the quality of crops grown in town was generally thought to be lower than that of crops from rural areas. More specifically, crops grown on dumpsites and those irrigated with sewage water were widely felt to be contaminated and to constitute a health risk. About half of the respondents had a similar opinion about crops cultivated near large industrial complexes or along roadsides.

Among farmers, there appeared to be an awareness of the potentially negative environmental and health impact of crop cultivation in town, particularly because of the use of chemical inputs (Nyandwaro forthcoming.). Soil, groundwater and crop pollution were all mentioned. Some of the farmers indicated that they intended to stop using chemical inputs and use alternatives instead.

A positive environmental observation is that most livestock waste in town, and especially that of large livestock, is being reused for local crop cultivation (Foeken & Owuor 2000b). Still, there is an opportunity here for the local authorities to cooperate further with local community groups (although there are already good examples of this type of cooperation in Nakuru).

Legal aspects

Other limitations lie at the level of the municipality. According to municipal by-laws, farming is forbidden within the town's boundaries. The problem for the municipality is that enforcing such rulings is difficult and thus farming in town has become a common phenomenon. Nowadays, the municipality allows crop cultivation as long as the crop is less than one metre high. Maize is thus forbidden, the argument being that thieves and other criminals can hide on plots growing that crop. Nevertheless, maize can be seen growing everywhere and although crop slashing has hardly ever occurred recently - and indeed, very few of the respondents mentioned harassment as a constraint - cultivators cannot count on being 'spared'.

[20] That does not mean that growing crops along (major) roads is without risks. In Dar es Salaam, relatively high accumulations of lead and cadmium were found in the topsoil along one of the major roads compared with locations at some distance of roads, even though these levels were (still) below any critical threshold (Amend & Mwaisango 1998).

Improvements

Despite the finding that average yields are quite low, the perception of most farmers is different. Of the 20 respondents in the crop-cultivating households in the in-depth survey, only two were *not* satisfied with their yields. Nevertheless, most respondents did admit that yields could be improved. Money is often an important constraint. Several farmers indicated that if they had sufficient money they would be able to irrigate their crops better or buy chemicals, fertilisers and certified seeds or materials to fence their plot to keep out loose animals. The government could come in here by providing credit facilities. One respondent, saying she "could do better", indicated an alternative way of obtaining credit, namely by joining a farmers' savings and credit society.

Only three farmers said they would be able to improve their yields if they had more space. Others stressed technical improvements on their existing plots, such as crop rotation, applying manure to increase soil fertility or using more chemical inputs. One respondent, David in Lanet, came up with an innovative idea showing his resourcefulness as well as his environmental awareness. By keeping chickens on his plot, he said he could improve his crop yields "by shifting the chicken house to various parts of the plot, so that I can use that part as a seed bed because it has manure from the chicken droppings".

It should be noted that when asked about possible improvements to their urban farming practices, many respondents referred in their answers in the first instance to their livestock-keeping activities. Livestock generate more income than crops, which are grown mainly for subsistence. Investing in livestock is seen as more profitable than investing in crop cultivation.

Conclusions

The increase of crop cultivation in Nakuru town can only be assessed in the context of decreasing household purchasing power and increases in the cost of living. Most plots have been put under cultivation since 1990 when the economic recession began to be seriously felt in Kenya, especially in urban areas. The reasons given for turning to this activity confirm that for most people it is a way to secure their food supply and reduce costs on food purchases. Nowadays, almost 30% of the Nakuru households are engaged in crop cultivation in town. However, this estimate may be too low, as many people do not consider the growing of crops in their compounds to be a form of agriculture. Altogether, an estimated eight million kilograms of crops were produced in 1998. This covered some 30% of the energy requirements of the households involved or eight per cent of the energy requirements of the town's entire population.

The importance of these figures speaks for itself, all the more so because yields could, at least potentially, be much higher. Plot size proved to be a major determinant of productivity: the smaller the plot, the higher the yield. In other words, if larger plots could be as productive as smaller plots, Nakuru could produce a substantial part of the food crops it

needs within its own boundaries. However, as shown by this study, more irrigation, more inputs, more labour and more technical assistance are required. In general, this involves more capital, which is a major constraint for low-income households, and for female-headed households in particular. More research on the technical aspects of farming in town is necessary in order to obtain detailed knowledge about the present farming practices and to be able to raise the productivity.

How productive the sector can be is shown by the example of Havana (see Gonzalez Novo & Murphy 2000). Faced with a serious economic crisis, the government started to actively encourage urban farming, based on the slogan *Production by the Neighbourhood for the Neighbourhood*. An urban agriculture programme was launched integrating access to land, extension services, research and technology development, new supply stores for small farmers, and new marketing schemes and the organisation of selling points for urban producers. Particularly successful are the so-called *organopónicos* and *huertos intensivos* (intensive gardens): raised beds on which horticultural crops are produced in an entirely organical way. In 1999, the 773 units covered an area of 386 hectares and produced over 50 million kilograms of crops (i.e. 14 kg/m^2). By comparison, the 2,000 hectares of land used for crop cultivation in the built-up area of Nakuru town only produced some 8 million kilograms of crops in 1998 (a 'normal' year in terms of rainfall). Closer to home, in the Tanzanian cities of Dar es Salaam, Arusha and Dodoma, trials have shown that yields of leafy vegetables can be raised substantially to a level much higher than at present in Nakuru (Jacobi 1997).

Urban planners tend to consider urban farming as a temporal feature. According to the *Strategic Nakuru Structure Plan*, this vision prevails in Nakuru as well: "Economically, urban agriculture is a transitory activity which eventually gives way to more traditional urban functions" (MCN 1999: 44). Besides the fact that agriculture has always been part of any urban economy (and in that sense can be seen as a traditional urban function), it should be realised that "although some forms of urban agriculture are based on temporal use of vacant lands, urban agriculture as such is a permanent feature of many cities in developing (…) countries and is thus an important component for sustainable city development" (de Zeeuw *et al.* 2000: 162).

How urban agriculture can be integrated into urban planning policies was the subject of a five-day workshop held in Havana in October 1999 (Bakker *et al.* 2000). The following recommendations were formulated (de Zeeuw *et al.* 2000). First, urban agriculture should be integrated in urban land use policy by removing legal restrictions and by integrating agriculture in urban development planning (urban zoning, promotion of urban agriculture as a temporal use of vacant public and private lands, promotion of multi-functional land use and encouragement of community participation in the management of urban open spaces, and inclusion of space for individual or community gardens in new public housing projects and private building schemes). Secondly, urban agriculture should be integrated in urban food security and health policy by improved access of urban farmers to agricultural research, technical assistance and credit services, by improved systems for input supply and

product distribution, and by creating awareness of health risks through urban agriculture. Finally, urban agriculture should be integrated in environmental policy by promotion of safe re-use of urban organic wastes and waste water by urban farmers, and by promotion of ecological farming methods.

All this may sound rather utopian in the Sub-Saharan African context. However, in the case of Nakuru town some preconditions for successful policy formulation and implementation are fulfilled. First, there is a generally positive attitude towards urban agriculture on the side of the local authorities as well as the population. Secondly, in the context of *Localising Agenda 21*, Nakuru town strives for sustainable urban development; hence there is the political will to integrate urban agriculture in the urban planning process. Thirdly, among the Nakuru farmers there is a general awareness of the environmental dangers of their activities. And finally, community-based organisations in the fields of urban agriculture and environmental management do exist in Nakuru and, moreover, have good working relations with the local authorities.

Appendix 1
Crops cultivated in Nakuru town, 1998

Table A1 Crops cultivated in Nakuru (% of plots; N=180)

1	maize	61.7	22	black night shade (*managu)*	2.8
2	kale	61.1	23	cucumber	2.8
3	beans	56.1	24	parsley (*dhania)*	2.8
4	onions	25.0	25	oranges	2.2
5	spinach	20.0	26	sweet potatoes	2.2
6	tomatoes	19.4	27	arrowroot	1.7
7	Irish potatoes	17.8	28	egg plant (*mbiriganya*)	1.7
8	bananas	15.6	29	*mavaki* (local vegetable)	1.7
9	cowpeas	15.6	30	millet	1.7
10	spider plant (*saget)*	11.1	31	passion fruit	1.7
11	pepper	7.2	32	American herb	1.1
12	sugarcane	7.2	33	mango	1.1
13	cabbage	6.1	34	capsicum	0.6
14	carrots	6.1	35	guava	0.6
15	pawpaw	6.1	36	lettuce	0.6
16	pumpkins	5.6	37	loquats	0.6
17	green peas	5.0	38	mushrooms	0.6
18	avocado	3.9	39	pineapple	0.6
19	Napier grass	3.9	40	strawberries	0.6
20	cassava	3.3	41	water melon	0.6
21	amaranth (*terere)*	3.3			

Appendix 2
Crops: Calculation of 'percentage self-consumed'

The amounts self-consumed (%) were calculated by translating the qualitative values of the amounts self-consumed as indicated in Table A2 below into percentages as follows:

all: 100%	about half: 50%	small portion: 10%
most: 75%	less than half: 30%	none: 0%

The percentages are at best only indications.

Table A2 Crops: Amounts self-consumed by crop type (N)

amount self-consumed:		all	most	about half	less than half	small portion	none	total	calculation (%)
1	kale	48	34	10	8	6	3	109	75
2	maize	45	35	11	2	4	4	101	77
3	beans	51	22	7	3	2	3	94	77
4	onions	22	15	2	2	2	2	45	78
5	spinach	11	12	2	3	5	3	36	62
6	tomatoes	20	8	2	1	-	4	35	78
7	Irish potatoes	19	9	1	-	1	2	32	82
8	cowpeas	16	3	2	-	3	4	28	70
9	bananas	13	3	3	-	-	8	27	62
10	*saget*	8	5	1	2	1	2	19	68

Appendix 3
Calculation of energy from urban crop production

Table A3 Calculation of energy from urban crop production

		no. of h'holds[a]	kg. harv-ested[a]	aggregate kgs	kcal/kg as purchased[b]	aggregate kcal.
1	kale	109	84	9,156	384	3,515,904
2	maize	101	224	22,624	3,630	82,125,120[c]
3	beans	94	75	7,050	3,390	23,899,500
4	onions	45	26	1,170	187.2	219,024
5	spinach	69	92	6,348	384	2,437,632
6	tomatoes	35	15	525	196	102,900
7	Irish potatoes	32	88	2,816	637.5	1,795,200
8	cowpeas	28	67	1,876	3,400	6,378,400
9	bananas	27	4	108	777.2	83,916
10	saget	19	33	627	224	140,448
11	other crops	[d]	32.7	4,184	2,308	9,656,672
12	total energy produced (1+2+...11)	160				130,354,716
13	daily energy requirement per capita					2,200
14	annual energy requirement per capita (13x365 days)					803,000
15	annual energy requirements per household (14x3.4 persons/h'hold)[e]					2,730,200
16	annual energy requirements 160 households (15x160 households)					436,832,000
17	annual energy requirements 594 households (15x594 households)					1,621,738,800
18	contribution of urban crop production to energy req'ments 160 h'holds (12/16x100%)					29.8%
19	contribution of urban crop production to energy req'ments 594 h'holds (12/17x100%)					8.0%

Notes:
a. From Table 3
b. See Platt 1962
c. Assuming that weight figures refer to dry mature kernels (100% edible).
d. From Appendix 1. As other crops include 31 items, the aggregate number of households is not meaningful.
e. Based on an estimated total number of households in Nakuru Municipality of 70,000 in 1999, calculated as follows. The 1989 population of Nakuru Municipality was 164,000 and the number of households 46,741 (Kenya 1997). Hence, the average household size in 1989 was 3.5. The 1999 population was 239,000 (Kenya 2000). With an unchanged average household size, the number of households in 1999 would have been about 68,000. Assuming, however, that the average household size has decreased to 3.4 (which may be a conservative estimate as average household size is likely to be somewhat lower), the number of house-holds then becomes about 70,000.

Appendix 4
Problems with crop cultivation in town

Table A4 Problems with crop cultivation in town (%; N=160)

	mentioned as a problem	mentioned as the main problem
theft of crops	36.6	24.4
inadequate rainfall	35.0	24.4
destruction by animals	23.8	10.0
pests/insects	22.5	8.8
lack of water for irrigation	12.5	9.4
disease	9.4	2.5
lack of inputs/capital	6.9	1.9
harassment	2.5	-.-
poor quality seeds	1.9	-.-
poor soil	1.3	-.-
lack of space/land	1.3	1.3
lack of labour	0.6	0.6
weeds	0.6	0.6
too much rainfall	0.6	-.-
poor seasonal timing	0.6	-.-
burst sewage pipes	0.6	-.-
no problem	16.3	16.3
Total		100

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