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Building Urban Resilience

Assessing Urban and Peri-urban Agriculture in Kampala, Uganda

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START
global change SysTem for Analysis, Research & Training
UNEP

Preface

Food production in and around cities is an integral part of the urban fabric in much of the developing world. In these regions, urban and peri-urban agriculture (UPA) plays an important role in helping to provide diverse urban diets and environmental services. As such, there is growing interest in UPA as a strategic component of urban resilience and climate change adaptation planning. However, advocacy for UPA in this capacity is outpacing the body of evidence regarding important stressors and drivers that act on UPA. Such knowledge is especially critical in the developing world where urban areas are experiencing rapid growth and transformation. In these regions, UPA is facing intensifying pressures from urban encroachment, waste disposal, pollution, and climate change that may undermine the sector's long-term viability.

The need to better understand these critical sustainability dimensions provided the impetus for city-level knowledge assessments of UPA, whose main findings are contained in nine underlying assessment reports including this one. The assessed cities were Dakar (Senegal), Tamale (Ghana), Ibadan (Nigeria), Dar es Salaam (Tanzania), Kampala (Uganda), Addis Ababa (Ethiopia), Dhaka (Bangladesh), Kathmandu (Nepal) and Chennai (India). All of the reports and the synthesis report can be found at [*specific URLs for START and UNEP here*]. The assessments were conducted in 2012, with initial stakeholder engagement beginning in 2011. The assessments were led by city-based teams, the composition of which varied, with some of the teams being comprised predominately of researchers and other teams comprising of a mix of researchers, city officials and urban NGO representatives.

The assessments seek to better understand the changing nature of UPA systems, and the critical interactions at the land-water-climate nexus that influence resilience of UPA in rapidly growing developing-country cities. The audience for these assessments includes national and city-level policymakers, sectoral experts and city planners, the research community, and non-governmental organizations (NGOs) that interface with urban farmers and other actors within the broader UPA sector.

The UPA assessments are part of a larger project on strengthening understanding of critical links between climate change and development planning in West Africa, East Africa and South Asia. The premise for the project is that progress towards undertaking effective action to address climate change risks in these regions is hindered by low levels of awareness of global climate change, lack of understanding of the findings of the Intergovernmental Panel on Climate Change (IPCC) and other sources of scientific information, lack of location and sector specific knowledge, and the need for strengthening capacities to undertake integrated assessments that support decision making. This multi-year project has been a collaborative effort between the World Meteorological Organization (WMO), the United Nations Environment Programme (UNEP), START, the University of Ghana, the University of Dar es Salaam, and the Bangladesh Centre for Advanced Studies (BCAS).

Jon Padgham
Deputy Direct
International START Secretariat

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The overall project and the associated UPA assessments were made possible in large part thanks to funding provided by the European Commission (through project ENV/2008/149690 '*Understanding the Findings of the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report "Climate Change 2007" – Integrating Climate Change Adaptation and Mitigation in Development Planning*'), as well as by the United Nations Environment Programme (UNEP), and the Global Climate Change Programme at the US Agency for International Development (USAID). The editors of this series wish to thank these organizations for their financial support.

In addition to the numerous authors listed in each of the separate reports, we are grateful to the following people for providing useful insights and feedback during the early conception of the knowledge assessment, and helpful review comments on the various manuscripts: Rafael Tuts, Anna Skibevaag, Stephen Twomlow, Elizabeth Migongo-Bake, Trang Nguyen, Volodymyr Demkine, Anna Kontorov, Richard Munang, Jesica Andrews, Fatoumata Keita-Ouane, Jacqueline McGlade, Keith Alverson, Stuart Crane, Martina Otto, Beverly McIntyre, and Tom Downing. We would also like to express our sincere appreciation for the generous support of colleagues at the University of Cape Town's Climate Systems Analysis Group who with the climate projections for six African cities.

Acronyms and abbreviations

AISRGD	African Institute for Strategic Research Governance and Development
ARDC-Kajjansi	Aquaculture Research and Development Centre, Kajjansi
CAES	College of Agricultural and Environmental Sciences
CBO	Community-based Organization
CIP	Climate Information Portal
CGIAR	Consultative Group on International Agricultural Research
DFID	Department for International Development
DJF	December, January and February
DSIP	Development Strategy and Investment Plan
FAO	Food and Agriculture Organization (of the United Nations)
FGD	Focus group discussion
GDP	Gross domestic product
GoU	Government of Uganda
IDRC	International Development Research Centre
IPCC	Intergovernmental Panel on Climate Change
JJA	June, July and August
KDDP	Kampala District Development Plan
KDMP	Kampala Drainage Master Plan
KCC	Kampala City Council
KCCA	Kampala Capital City Authority
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MAM	March, April and May
MFPED	Ministry of Finance Planning and Economic Development
NAADS	National Agricultural Advisory Services
NARO	National Agricultural Research Organization
NDP	National Development Plan
NGO	Non-governmental organizations
NRM	National Resistance Movement
PEAP	Poverty Eradication Action Plan
PMA	Plan for Modernization of Agriculture
SON	September, October and November
START	System for Analysis, Research, and Training
UBOS	Uganda Bureau of Statistics
UCSUA	Uganda Centre for Sustainable Urban Agriculture
UDM	Uganda Meteorological Department
UNCHS	United Nations Centre for Human Settlement
UNEP	United Nations Environment Programme
UPA	Urban and peri-urban agriculture
VEDCO	Volunteer Efforts for Development Concerns
WMO	World Meteorological Organization

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Executive summary

This report presents the findings of a knowledge assessment on urban and peri-urban agriculture (UPA) for the city of Kampala, Uganda, that was conducted in 2012. It examines the state of UPA in the city through the lens of intensifying urban pressures and increasing climate risks with the objective of identifying how these and other drivers potentially interact to affect the long-term sustainability of UPA, and what response options are needed to address existing and emerging challenges. The assessment is intended to:

1) examine the current state of knowledge and identify key knowledge gaps;
2) explore the array of stressors that contribute to vulnerability of UPA systems to climatic and other environmental changes; and
3) identify critical areas for strengthening policies and institutional capacities that contribute to sustaining the UPA sector within the larger context of resilient cities and food systems.

Urban farming in Uganda was born out of the political and economic crises of the 1970s and is widely practiced in Kampala today. Vegetable production and livestock keeping—primarily poultry, dairy cattle and pigs—are the dominant components of UPA systems, along with the cultivation of cassava and other staple crops in peri-urban areas. The UPA sector has deep roots into the urban food system and is practiced across low- to high-income classes, and has strong participation from women in the production arena. The sector contributes to nutritional and food security, and the vitality of the informal market, as well as helping to reduce the urban waste stream through productive reuse of organic waste as livestock feed and an input to vegetable production.

Despite its important role, UPA is subject to many constraints, which mostly revolve around a lack of adequate space for agriculture in the urban core and loss of valuable cropland to urban expansion in peri-urban areas. Other critical concerns include accessing adequate quantities of animal feed, managing animal waste, zoonotic diseases associated with urban livestock keeping, and vulnerability of crops and livestock to flooding.

Urban agriculture has begun to receive policy support through recent actions by the Kampala Capital City Authority to develop regulations and supportive by-laws. However, in order to more effectively serve the needs of UPA, these legal and administrative frameworks need considerable strengthening, for example in support of urban waste reuse in livestock production, and better enforcement, such as in protecting peri-urban land for food production as the city expands onto current agricultural lands. Such efforts would be most effective if embedded within a future-focused city-planning framework that considers emerging challenges from rapid urban growth and climate change. Comprehensive, integrated land-use planning to better cope with flood risks is an essential adaptation strategy for Kampala, and one in which land-use allocation for UPA can play a strong role.

Key findings

Peri-urbanization processes are exerting significant development pressures on agricultural land. The recent emergence of an informal land market in the face of an inefficient formal one has resulted in the exclusion of some social groups, particularly the poor, and has increased competition for land between agricultural and non-agricultural users. These challenges are exacerbated by a lack of progress towards developing an urbanization policy, weak government policies and laws, lack of qualified urban planners and managers, and weak institutions and structures, all of which contribute to a continued pattern of haphazard development.

Flooding is exacerbated by the city's rapid urban growth and changing land-use patterns and heavy rainfall events. Over the past two decades, Kampala has faced recurrent flooding problems, with attendant damage to infrastructure, disrupted livelihoods, reduced access to clean water, and increased risks of human and livestock disease outbreaks. The risk of flooding in Kampala is amplified by haphazard land-use planning, poor waste handling, and construction that encroaches on environmentally sensitive areas. Flood risks are likely to intensify as rapid and unplanned urban expansion increases the area under impermeable surfaces, thus triggering high runoff and flooding, and warming of the atmosphere increases the likelihood of heavy rainfall events. Informal settlements, many of which are located in flood-prone zones adjacent to wetland areas, are particularly susceptible to flooding.

In-depth assessments are needed to estimate the extent to which flood risks could increase with current and future pressures on land-use conversion in sensitive areas, such as in wetlands areas and urban agricultural lands, and projections of changes in rainfall characteristics. A comprehensive assessment would take into account the changing nature of flood risks to UPA production.

Urban livestock rearing is increasingly moving towards zero-grazing systems because of reduced land and fodder availability; this has important positive implications for managing urban waste stream. Diminished availability of open spaces for urban livestock grazing, due to rapid development and infilling, has increased the use of zero-grazing and tethering approaches for cattle and pig rearing. Crop and food waste are becoming a primary feed resource for zero-grazing for livestock keepers who acquire the wastes at a nominal cost; such waste reuse is helping provide livelihoods for the urban poor who otherwise have little engagement in UPA. Use of organic by-products for feed has positive implications for solid waste management and nutrient recycling in the city; however, health risks associated with contamination is a constant concern. A comprehensive assessment of solid waste potential for UPA productivity and livelihoods is needed to inform planning and management of waste reuse so that benefits can be optimized and risks minimized.

The informal market is important for food accessibility and convenience, but lacks recognition and support from city authorities. UPA producers typically sell their products in the informal markets, including to individual households, illegal or semi-illegal stalls and street/pavement retailers. The informal market provides accessible, relatively low-cost products and saves time and transport costs, which has particular implications for poor urban households. Despite the importance to consumers, the informal market for food products is regarded as a security threat to city officials who cite congestion, poor product quality, and lack of proper handling, storage, and processing.

Evictions are a constant concern. The informal food market needs recognition and investment by city authorities to meet the needs of citizens with hygienic, high-quality yet reasonably priced products. Organization and cooperation across informal food-outlet actors and urban farmers, coupled with a comprehensive assessment of their impact on food access by the poor, can inform city authorities of the importance of informal markets for food accessibility in the city.

Addressing threats to UPA's long-term sustainability requires strengthening the position of UPA in urban and agricultural planning at the national level. Kampala's urban farmers lack a strong presence in the agricultural development priorities of the country, which reduces their visibility in urban land-use decisions and access to extension services and other government support. However, progress has been made at the city level since 2006 when the Kampala Capital City Council (KCCA) enacted several ordinances for the regulation, registration, and licensing of urban agriculture, livestock and companion animals, milk production, and fish farming. However, lack of awareness has hindered the implementation of these ordinances, as farmers distrust how the ordinances have been enforced. More recent national policies suggest potential opportunities for urban agriculture development through the National Agricultural Advisory Services (NAADS) and the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF); however, their implementation is yet to be realized.

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1 Introduction

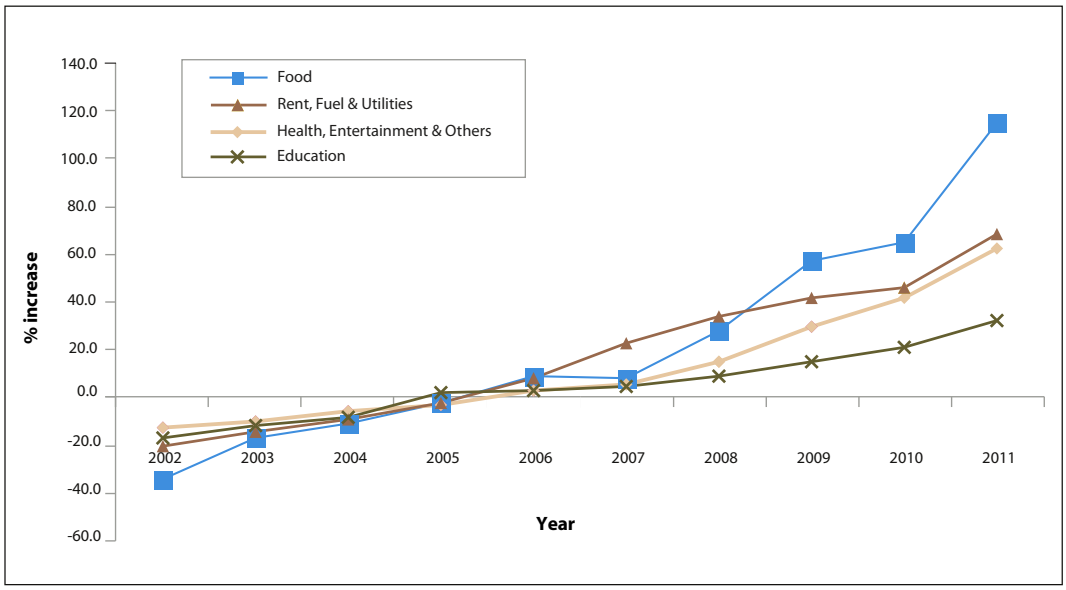
The vibrant Urban and peri-urban agriculture (UPA) sector in Kampala dates back to the Idi Amin regime (1971–1979) when the formal economy was severely damaged by the regime's "war of economic independence" initiated with the expulsion of the Indian minority from Uganda in 1972 (Maxwell, 1995). The crisis in government gave rise to a highly informal economy dominated by smuggling and illegal currency transactions and by state appropriation of private property (Banugire, 1985). Idi Amin's dictatorship was followed by a guerrilla war in the early 1980s, which brought the current President Yoweri Kaguta Museveni's National Resistance Movement (NRM) government into power. The guerrilla war was centred on the outskirts of Kampala, which further weakened the urban economy. The value of wage labour drastically declined, resulting in still further informalization of the city's economy (Bigsten and Kayizzi-Mugerwa, 1992).

The period of civil unrest (1971–1985) was followed by the implementation of an ambitious programme of macroeconomic adjustments and structural reforms, which were characterized by drastic cuts in jobs and public expenditures, trade liberalization, increased interest rates and currency devaluation. During this period, unemployment increased and real incomes fell, while at the same time prices rose and welfare services declined. The urban poor were particularly hard hit (Tinker, 1994; Drakakis-Smith *et al.*, 1995). As a result, many urban households resorted to income generating activities in the informal sector. Farming in urban areas was one such option.

Urban agriculture can be both a response to a crisis and means for opportunity. Today, beyond Uganda's crises period, urban agriculture remains vibrant and is critical to the well-being of many households in Kampala. The demand for a wide range of food products is growing in Kampala as a result of the increasing urbanization (Aliguma, 2004; Semwanga, 2005; Nyapendi *et al.*, 2010). This rising demand, combined with close proximity to markets, conversion of vacant into productive lands, income enhancement and a supportive local environment, creates a new window of opportunity for UPA crop and livestock production (Atukunda *et al.*, 2004; David *et al.*, 2010; Nyapendi *et al.*, 2010; Katongole *et al.*, 2011). Despite the importance of UPA to the city's food system, however, the viability of the sector is increasingly at risk from urban encroachment onto agricultural lands, declining water quality, high feed prices for urban livestock, and negative loss of productivity associated with flooding.

Beyond UPA as a food and livelihood procurement strategy, the rapid growth in demand for food resulting from high urban population growth and inflationary pressures on food, fuel and other basic commodity prices has made access to food in Kampala a pressing concern. In 2000, the Government of Uganda launched its Plan for Modernization of Agriculture (PMA), a holistic framework with the mission of "*eradicating poverty by transforming subsistence agriculture to commercial agriculture*" (MAAIF and MFPED, 2000). Through this plan the government put the focus of agricultural development on rural areas with the view that the expanding urban population would stimulate

FIGURE 1.1
Price increases for selected basic goods and services in Kampala over 10 years, 2005/2006 = 0
Source: Consumer Price Indices for Kampala



food markets, and help to eradicate poverty among the rural population who are the predominant producers of food.

However, PMA and like strategies are becoming increasingly shortsighted as the face of poverty and food insecurity takes on progressively urban features. Most of the staple foods consumed in Kampala are brought in from rural areas, whereby the cost of fuel for transport is one of the major factors that directly and indirectly influences food prices in Kampala. The increase in food prices in Kampala, however, can be attributed to factors beyond the cost of moving food from rural to urban areas. According to the Uganda Bureau of Statistics, food prices underwent the sharpest increase compared to all the other basic items in Kampala over the period of 2007–2011 (Figure 1.1); some of the upward pressure on food prices is likely attributable to the global food price crisis. The monthly headline inflation rate, for example, shot up almost three-fold over a period of 24 months, from 8.8 per cent in January 2010 to 27 per cent in December 2011.

2 Objectives and methods

This assessment explores the dynamics of Kampala's urban and peri-urban food system, within larger, ongoing change processes. Its objectives are to:

1) collect and synthesize knowledge on the state of UPA in and around Kampala;
2) identify where insufficient knowledge exists and highlight where additional research and assessment efforts are needed;
3) provide relevant information that informs decision making and policy formulation concerning agriculture and climate-aware development planning in Kampala; and
4) identify scientists and others who can undertake assessments and create communities of practice around UPA and resilient urban food systems.

The information on which this assessment is based was obtained from both primary and secondary sources. Primary information collection was done through a participatory urban appraisal, which included a stakeholders' inception workshop, focus group discussions (FGDs), key informant interviews, personal observations and questionnaire interviews. The secondary data collection involved an extensive review of literature and policy documents on the status of urban agriculture in Kampala over the past several years. The document review targeted literature on UPA and its contribution to the livelihoods of people, as well as the impact on UPA farmers of extreme weather events.

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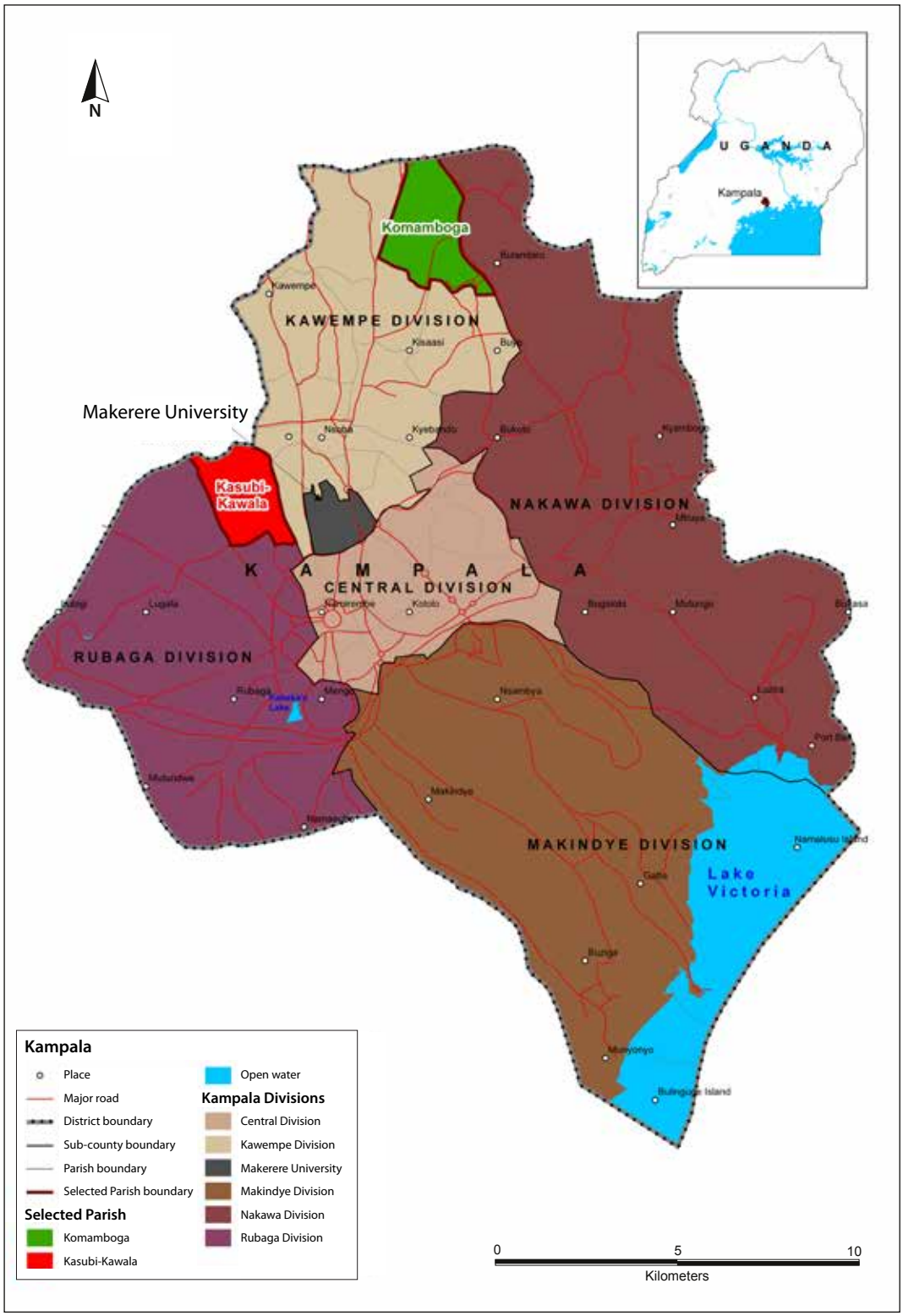
FIGURE 2.2
Location of study parishes
Source: NFA 2005; UBOS 2010



To identify potential changes in climate parameters, analyses of rainfall and temperature data for the 1993–2010 period, obtained from the Uganda Meteorological Department for the Makerere University and Entebbe weather stations, was analysed. Missing data, around two per cent of total data, were estimated using long-term monthly means, in accordance with World Meteorological Organization (WMO) recommendations (WMO, 1986). Climate projections were obtained from the Climate Information Portal (CIP) administered by the University of Cape Town's Climate Systems Analysis Group.

An inception workshop to kick off the assessment was conducted in Kampala in May 2011, and involved over 60 participants, which included urban farmers, agricultural extension agents, researchers, politicians and local leaders, and representatives of governmental institutions, the Kampala Capital City Authority (KCCA), non-governmental organizations, community-based organizations, and the private sector. The main objectives of the workshop were to gather input from a diverse mix of stakeholders, agree on priority themes to be included in the final assessment and other relevant aspects deemed important to the stakeholders.

As part of this assessment, key informant interviews were conducted with eight agricultural extension officers (crop and livestock extension officers from four divisions of Kampala: Kawempe, Makindye, Nakawa and Rubaga), officials of two non-governmental organizations (Environmental Alert and Volunteer Efforts for Development Concerns) and one community-based organization, the Uganda Centre for Sustainable Urban Agriculture (UCSUA).

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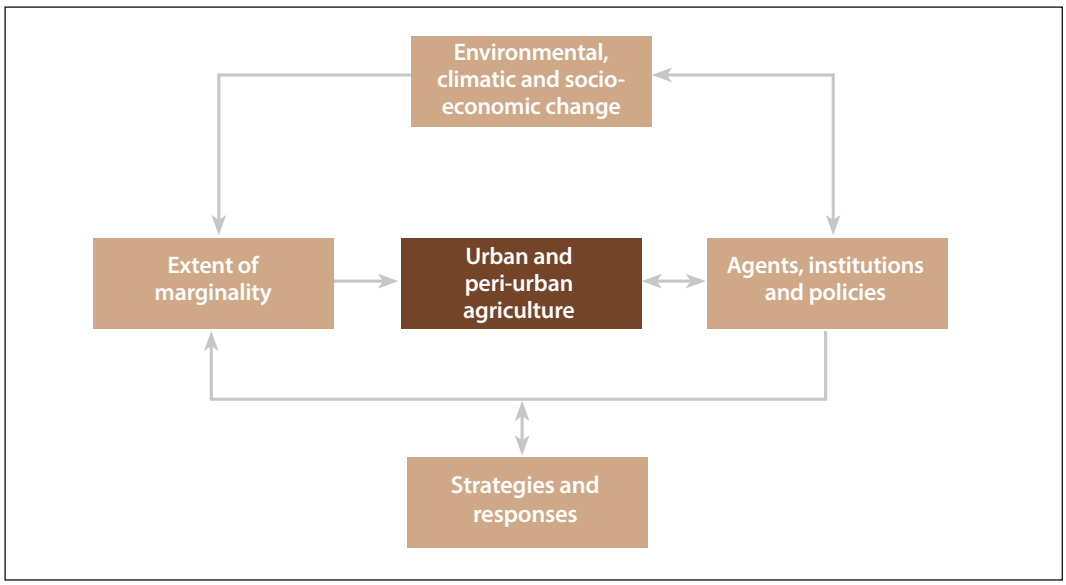
Focus group discussions were conducted in two divisions of Kampala—Kawempe and Rubaga (Figure 2.1). From each division one parish was selected: Komamboga and Kasubi-Kawaala parishes for Kawempe and Rubaga Divisions, respectively. Komamboga is one of the 19 parishes of Kawempe Division, which, according to the population projections of 2012, has a population of 379 900 people (Kampala District Development Plan, 2010). It is located on the periphery of Kampala and has a mixture of rural and peri-urban characteristics. It is also among the areas in the periphery of the city that are increasingly being settled by middle- and upper-income groups. Some of the original inhabitants still depend on agriculture because the arable land there is not prone to flooding. Kasubi-Kawaala is one of the 16 parishes of Rubaga, which, according to the population projections of 2012, has a population of 427 700 people (Kampala District Development Plan, 2010). It is located in a peri-urban area of Kampala that is low lying. Kasubi-Kawaala was selected as one of the study sites because of its agricultural production activities despite the area's vulnerability to flooding. From each parish, participants of the FGDs were a mixed group of female and male farmers, aged 40 years and above. All had long-term experience in UPA, which enabled them reflect about the past 30 years.

The assessment's conceptual framework illustrates the key drivers and stressors, development factors and urban and peri-urban products and services. The assessment framework is presented in Figure 2.1.

FIGURE 2.1
Conceptual framework



3
Profile of Kampala

Kampala, the capital city of the Republic of Uganda, is located near the northern shore of Lake Victoria, and is surrounded by both hills and wetlands. Nyakaana *et al*., (2007) describe Kampala as having gone from a city of seven hills (8 km^2) at independence from Great Britain, to a city of more than 25 hills (approximately 195 km^2) today. Kampala derives its name from the Lugandan word *Mpala*, an antelope species (*Aepyceros melampus)* that once roamed the area. Its history can be traced back to the 1600s when it was established as the capital of the tribal kingdom of Buganda, and it served as a political and administrative capital until 1893, when the British declared Uganda a protectorate and transferred the capital to Entebbe. In 1962, when Uganda gained independence from Britain, Kampala resumed its status as capital.

Administratively, Kampala is divided into five divisions—Central, Kawempe, Makindye, Nakawa and Rubaga—each headed by a mayor. According to the Structure of Local Government System in Uganda, the lowest administrative unit is the village, cell or zone (Local Council I), several of which constitute a parish or ward (Local Council II), and several parishes are assembled into sub-county councils, town councils or municipal division councils (Local Council III), or city division councils for districts with city status. The Kampala Capital City Authority (KCCA) is the governing body of the capital on behalf of the central government and subject to the KCCA Act 2010.

Kampala is the largest commercial and industrial centre in Uganda and is the centrepiece of Uganda's economic, political and social transformation, with most organizations—governmental, non-governmental and international—having their headquarters there. Kampala alone contributes a quarter of Uganda's economy, and its expansion raises the national GDP growth by 0.7 percentage points each year (Dorosh and Thurlow, 2009). The city has both small industries, such as metal fabrication, pottery and carpentry, and large-scale processing and manufacturing industries, which are primarily located in southeast Kampala.

Uganda's definition of an urban area has changed over time. The 1969 and 1980 censuses considered a population concentration of 100–400 people as an urban centre. The 1991 census considered all gazetted cities, municipalities, town councils, town boards and trading centres with a population of over 1 000 as urban areas. The 2002 census defined urban areas as gazetted cities, municipalities and town councils as per the *Local Government Act 2000*. This definition of the *Local Government Act 2000* does not provide the minimum level of population concentration like the previous definitions. It is under this act that Kampala was made the only city in Uganda.

Kampala's vibrant economy acts as a magnet for settlement from other areas of the country. The urban population of Uganda has increased from less than 1 million in 1980 to the current estimate of 5 million, of which approximately 35 per cent live in Kampala (UBOS, 2012). The population of Kampala has grown from around 458 500 in 1980 to the present estimate of about 1.72 million

(Table 3.1), representing a growth rate of about 5 per cent a year. The city is projected to nearly double by 2020, reaching 3.03 million (UBOS, 2006). Rural to urban migration is an important factor behind the growth, as evidenced by the 2002 Uganda Population and Housing Census, which determined that the net migration rate to Kampala from the countryside was 11.7 per cent (UBOS, 2006). Persistent rural poverty is an important factor in causing people to migrate to Kampala in search of improved livelihoods (Mukiibi, 2011). The population of Kampala is dominated by 0–18-year-olds (44.9 per cent), to just 1.7 per cent are above 60 (2002 Population and Housing Census).

TABLE 3.1
Population growth in Kampala, 1980–2012

	1980	1991	2002	2012
Kampala	458 503	774 241	1 189 142	1 720 000
National Total	12 636 179	16 671 705	24 442 084	34 100 000
Kampala's Share of National Total	3.6%	4.6%	4.9%	5.0%

Source: UBOS (2006 and 2012)

According to the African Institute for Strategic Research Governance and Development (AISRGD, 2012), the level of urbanization in Uganda is projected to increase to 20.7 per cent by 2015 and it is estimated that about half of the country's total population will be living in urban areas by 2050. Like many African countries, rapid urbanization in Uganda is happening in the face of poverty, shrinking peasant economies and a straining of already inadequate resources for managing growth in rapidly expanding urban areas.

The KCCA is persistently under pressure to deliver a large range of services demanded by Kampala's expanding population. However, the KCCA is unable to effectively deliver these services owing to inadequate grants from the central government, insufficient local revenues, inadequate and under-resourced managerial competencies and systems (e.g., information technologies, accounting and budgeting systems and equipment), and a lack of staff motivation resulting from of poor terms, salaries and compensation packages (Makara, 2009).

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4

Urban and peri-urban agriculture in Kampala

As described in this section, UPA in Kampala play important roles with respect to food and nutritional security, employment and livelihoods, and resource-use efficiency through productive use of household and municipal waste streams as inputs for food production.

Description of UPA systems

Crops

The most commonly grown crops in Kampala city are banana (cooking, beer and sweet types), cassava, maize, beans, vegetables (leafy greens, cabbage, tomatoes, onions, bitter Tomatoes, etc.), spices, sweet potatoes, potato, cocoyam, sugarcane, mushrooms and fruit (jack fruit, avocado, pawpaw, mango, etc.) (Development Consultants International Ltd., 1997).

According to the Uganda Census of Agriculture 2008/2009, crop production in Kampala generally contributes very low percentages to the total national crop production (Table 4.1). Given that crop production occurs on a very limited land base in urban areas, and the availability of other economic opportunities in the city, the district that encompasses Kampala is ranked among the bottom five crop-producing districts. Nonetheless, UPA systems play an important role in providing access to nutrient-dense foods—vegetables, meat, eggs and dairy products—that cannot be readily transported from rural locations because of inadequate transport and cold storage facilities.

TABLE 4.1
Total area and production of major crops in Kampala

Crop	Area (ha)	Production (tonnes)	Contribution to total national production (%)
Banana (cooking - matooke)	649	2 879	0.072
Banana (beer type)	14	50	0.021
Banana (sweet type)	23	75	0.205
Cassava	184	1 054	0.036
Maize	137	245	0.010
Beans	124	67	0.007
Sweet potatoes	112	796	0.044
Ground nuts	*	2	0.001
Leafy green vegetables	**	**	**

*No area was reported against the corresponding production; **The growing of leafy green vegetables is common in Kampala; however, production data is not available
Source: UBOS and MAAIF (2011)

The size of cultivated areas in and around Kampala varies from 5m^2 up to 10 ha (Development Consultants International Ltd., 1997). According to Azuba (2002), 83 per cent of the farming households in Kampala do so through backyard gardens, in most cases of less than 0.4 hectares; 10 per cent, chiefly urban farmers, cultivate 1–3 ha; while 7 per cent, which includes institutions and households, mainly in peri-urban areas, farm on two or more hectares. Most crops are grown for home consumption, while livestock production is mainly undertaken for income generation (Sebastián *et al.*, 2008; David *et al.*, 2010; Katongole *et al.*, 2011).

Livestock

Urban livestock keeping is an important economic activity in Kampala that cuts across income groups, and one that has increased substantially in the past decade. Poultry rearing is the most widespread livestock activity in Kampala, followed by cattle, pigs, goats, sheep and rabbits, in that order (Katongole *et al.*, 2011). The predominance of poultry rearing is consistent with earlier studies (Maxwell, 1995; Gbadegesin, 2001) on urban livestock keeping in developing countries, which found that readily available market opportunities and quick returns on investments were important motivators for poultry and egg production. Also there are fewer social tensions associated with keeping poultry in urban centres compared to other livestock (Katongole *et al.*, 2011). The efforts of the National Agricultural Advisory Services (NAADS) have also contributed to the high numbers of chickens reared within Kampala. NAADS is a government programme put in place to increase the efficiency and effectiveness of agricultural extension services, which distribute chicks to youth groups and women farmers as well as to disabled people. According to the National Livestock Census of 2008 (MAAIF and UBOS, 2009), the number of chickens in Kampala was estimated at just over 1 053 000.

Vendor in Nakasero Market in Kampale displaying his merchandise to the customers © FrankvandenBergh

The number of livestock in Kampala has increased significantly since 1995, particularly for goats, cattle and sheep (Figure 4.1) (data on the number of poultry in 1995 are available). It is interesting to note that dairy cattle ownership is popular among urban farmers in Kampala, despite the fact that they are large animals, and thus require more space and feed. This can partly be attributed to the efforts of charitable NGOs, which have distributed dairy cows to various vulnerable groups—female-headed households, widows and the elderly—since the early 1990s (Kabi and Bareeba, 2004). Additionally, the farm gate price and reliable demand for milk has made it increasingly attractive to keep dairy cows. Katongole (2009) attributed the drastic increase in the goat population in Kampala partly to the rising interest and demand for goat meat in urban areas as well as the social development initiatives (by government and NGOs) that have recommended the introduction of goats to urban resource-poor farmers.

Data on livestock production are inadequate; hence it is not possible to give statistics on the specific contribution of urban livestock to the aggregate supply of all the livestock products in Kampala. Available data are limited to eggs and poultry, where according to Mpinga (1999), approximately 70 per cent of all poultry products consumed in Kampala are produced within the city. Updated studies are needed to estimate the economic and alimentary importance of urban livestock keeping.

Urban livestock keeping is much more closely associated with small-scale commercial enterprises (milk, egg and meat sales) than is crop production, which tends to be for household consumption (Sebastián *et al.*, 2008; David *et al.*, 2010; Prain and Lee-Smith, 2010; Katongole *et al.*, 2011). Livestock production is dominated by smallholder producers (Table 4.2), both in terms of farm and herd size, and tends to be associated with higher-income households (Katongole *et al.*, 2012).

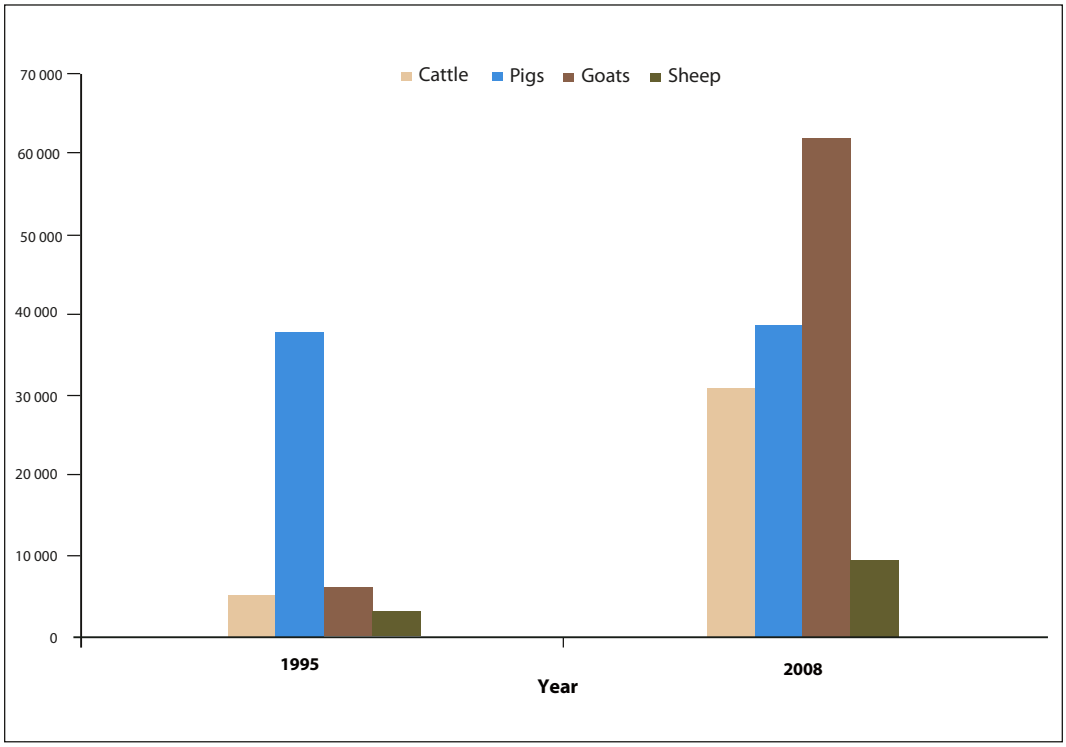

FIGURE 4.1
Population growth of major livestock species in Kampala
Source: MAAIF 1998; MAAIF and UBOS 2009

TABLE 4.2
Farm characteristics of livestock-rearing households in Kampala

	% of households	Average
Total landholding		
0.125 acres or less	63.3	-
Number of livestock species*		
One	61.7	-
Two or more	38.3	-
Livestock holding size		
Cattle		
1–5 heads	87.3	2
Chickens		
5–80 indigenous heads	76.9	36
30–500 exotic heads	73.2	283
Pigs		
1–22 heads	76.9	8
Goats		
2–10 heads	77.5	4
Dairy cattle breeds		
Friesians crossed with undefined breeds	53.6	-
Pure Friesians	25.0	-
Indigenous (Ankole and Nganda)	14.3	-
Pig breeds		
Landrace	22.5	-
Landrace crossed with undefined breeds	47.5	-
Indigenous	10.0	-
Goat breeds		
Indigenous breeds	56.0	-
Indigenous crossed with undefined exotics	48.0	-
Chicken breeds		
Exotic	78.8	-
Exotic and indigenous	18.2	-

*Only cattle, chickens, pigs and goats
Source: Katongole *et al.* (2012)

Aquaculture

A small proportion of farmers are engaged in fish farming, largely due to the fact that aquaculture remains capital-intensive, requiring considerable up-front investment (Hyuha *et al.*, 2011). According to the inventory and database of aquaculture in Uganda compiled in 2011 by the Aquaculture Research and Development Centre, Kajjansi (ARDC-Kajjansi), there are about 50 fish farmers in Kampala, with two farms producing fish seed (hatchlings or fry) for sale. Seventy per cent of the fish farms in Kampala are family owned, probably because they are small in terms of number of ponds and total pond area. Close to 60 per cent of the farms have one or two ponds with an average total pond area of 404 m^2. The main reason for the small pond area is limited access to land for expansion.

Although fish farming is not carried out by many people, fish ponds are found throughout Kampala except in the Central Division. Groundwater supplies for more than 50 per cent of the ponds, while other ponds receive water from streams. All the fish farmers surveyed for this assessment confirmed having reliable access to water throughout the year except for a few instances during dry periods when the water level is reduced. Some of the ponds are located in wetlands despite the fact that wetland reclamation is not allowed by the National Environment Management Authority (NEMA).

The Nile tilapia (*Oreochromis niloticus*) and African catfish (*Clarias gariepinus*) are the predominant fish species produced in Kampala. According to the inventory and database of aquaculture in Uganda compiled by ARDC-Kajjansi, fish production in Kampala is generally low. The database shows that from the 17 farmers (out of 34 who kept production and sales records during 2009 and 2010), a total of 4.5 tonnes of fish were harvested from a total area of 2.9 ha. Of the 4.5 tonnes of fish, 45.4 per cent and 36.4 per cent were sold on-farm and at the nearest trading centres, respectively, confirming that the demand for farm-raised fish is quite high despite the supply from the nearby Lake Victoria. Due to the high demand for fish and the fact that fish from aquaculture is of better quality than fish from the capture fisheries and are usually sold live, direct sales to consumers often take place at the pond site. Only the few farmers who harvest significant volumes sell the fish to vendors.

Description of producers

The majority of UPA farmers in Kampala are female, and are primarily engaged in vegetable, poultry and pig production (Nabulo *et al*., 2004 and 2006; Katongole *et al*., 2011; FGD of this assessment). According to Maxwell (1998), men's involvement in UPA centres around pig and cattle keeping, which augments trading activities. The youth are largely involved in commuter motorcycle transport (*boda boda*) and brick-making as well as cocoyam cultivation. According to FAO (2007), women represent an important portion of urban farmers since they tend to have most of the responsibility of feeding households, while men tend to seek other urban employment. However, the gender dimension is often more diverse, and in some African cities men are the predominant producers. A study of Kampala's urban agriculture by Maxwell (1995) indicated that the longer someone had been in the city, the more likely he or she would be engaged in farming, which goes against a popularly held myth that urban farmers are recent emigrants from rural areas.

According to Lee-Smith (2008), extensive studies have categorized Kampala's farming households into four types: commercial farmers, food self-sufficiency farmers, food security farmers and survival farmers. These groups have the following characteristics:

- *Commercial farmers* are very few in number, are generally well-off and are found mostly at the peri-urban periphery. They produce almost entirely for the urban market.
- *Food self-sufficiency farmers* are also mostly well-off, and are found in all areas except the inner urban core. They produce food primarily for household consumption.
- *Food security farmers* are among the middle-income or well-off households in the urban areas but among the poor in peri-urban areas. These households practice UPA as a secondary form of employment as well as a source of food. They have other sources of income with farming helping them to save or supplement urban lifestyles.
- *Survival farmers* include a very large number of people. The majority are female-headed households—recently widowed or abandoned by their husbands—with very limited economic options, few resources and barely the ability to make ends meet. Such households are found in urban areas where people realize meager harvests from small plots of land (David *et al*., 2010).

In addition to these four categories, Semwanga (2005) reported another category of UPA practitioners in Kampala, those who belong to institutions such as schools, health centres, prisons and police barracks.

Distribution of urban/peri-urban agriculture

Urban and peri-urban agriculture in Kampala is practised in diverse locations including home compounds, along roadsides, in undeveloped plots, in wetlands/swamps, under power lines, on waste dumpsites, and on other public and private land. Free-roaming livestock scavenging around the city are a common sight. Public lands—roadsides, open spaces, wetlands, and around power lines and infrastructural projects—are used illegally, with no or informal tenure arrangements. In 2001, KCCA (then KCC) classified areas in which agriculture occurs as: urban old; urban new (dense slum); peri-urban transition (transition from peri-urban to urban) and peri-urban (peripheral) (Table 4.3). The criteria used to categorize the areas include population density, land availability, and the prevalence of crop and livestock production.

According to Prain and Lee-Smith (2010), these categories differ with respect to natural capital assets, specifically the amount of land available for farming and access to water. For instance, occupants of new slum areas of Kampala can access nearby wetlands for farming, whereas three-quarters of cultivation in the inner city is done on very small plots around homesteads. In peri-urban areas, plots are bigger and there is a greater choice of location. Local breeds of livestock are likewise more common on peri-urban areas where they can be kept free-range or grazed, whereas zero-grazing and bird cages are essential in space-constrained urban areas.

Similarly, according to David *et al.* (2010) and Katongole *et al.* (2011), the categories also differ in their systems of production. There are more farmers growing only crops in the peri-urban areas, and these mainly grow sweet potatoes and cassava. In urban areas, farmers mainly grow bananas and cocoyams. Vegetable growing is much less common in urban than peri-urban areas, which is positively associated with land accessibility. In urban areas, some farmers are forced to grow vegetables in tins, pots, sacks and plastic bags as a way of coping with the space constraint. Chicken, cattle and pig keeping are common commercial activities for peri-urban households. Urban farmers mainly keep poultry, with only a few keeping dairy cows. Pig keeping is much less common in urban compared with peri-urban areas.

TABLE 4.3
Classification of agricultural areas in Kampala

	Urban agriculture categorization			
	Peri-urban	**Transition from peri-urban to urban**	**Urban new**	**Urban old**
Average population density (persons/km^2)	8	11	49	124
Prevalence of crop production	High	Medium	Low	Low
Prevalence of local livestock	High	Low	Low	Low
Prevalence of improved livestock	Low	High	High	Medium
Land availability	Very good	Moderate	Limited	Limited

Source: Adopted from Atukunda *et al.,* (2004)

Livestock feeding practices: solid waste management implications

Rapid infilling of open spaces suitable for grazing in Kampala has precipitated a shift towards tethering and zero-grazing of cattle. Katongole *et al*., (2012) estimate that only 39 per cent of households owning cattle combine stall-feeding and tethering with communal grazing and/or free roaming, while 52.5 per cent and 8.5 per cent, respectively, rely solely on stall-feeding and tethering.

Until recently, elephant grass *(Pennisetum purpureum*) was the major feed resource for cattle farmers in Kampala (Ishagi *et al*., 2003), but elephant grass has largely disappeared as the urban space has become more intensively settled. Consequently, farmers have turned to using crop wastes and other sources for animal feed (Katongole *et al*., 2012; Lumu *et al*., 2013).

Feeding livestock with crop and food waste is complemented by forage growing naturally on roadsides, undeveloped plots, in wetlands/swamps, etc. The wastes are composed of by-products generated during food production—agricultural residues after harvesting, peelings, leaves and stalks from processing, market crop wastes and food leftovers. Banana peels, sweet potato vines, food leftovers, sweet potato and cassava peel are the most common. The predominance of banana peels can be attributed to its abundant supply, as banana is a basic staple for many people in Kampala. These wastes are sourced from markets, households, restaurants and hotels, homesteads, food processing plants and garbage dumps. The use of concentrates is limited mostly to chickens and, to some extent, pigs.

The conditions under which the farmers get organic wastes vary, depending on the type of waste. Banana peels and sweet potato vines are predominantly purchased, whereas other crop wastes, such as maize stover and bean pods, can be obtainable for free. The transactions chiefly involve market vendors, who are the direct producers of the wastes, and dealers who collect the wastes. The fees charged per sack of banana peels, cabbage leaves and sweet potato vines is UGX 1 000–2 500 (US $0.50–1.50), while a heap of sweet potato vines costs UGX 8 000–12 000 (US $4–6). The majority of urban livestock farmers in Kampala recognize cost of transport as the most serious limitation to the use of market crop wastes (Katongole *et al*., 2011). Other important constraints are contamination of the wastes with mud, plastic, glass and metal objects, and a lack of knowledge about their proper use. According to Katongole *et al*. (2011) nearly half of the livestock keepers in Kampala have at some time used crop wastes obtained from markets to feed their animals.

Urban agriculture, particularly livestock keeping, provides a good opportunity to address solid waste management and nutrient recycling challenges facing Kampala. Approximately 1 000 tonnes of solid waste are generated each day in Kampala, with the estimated daily per person generation ranging between 0.5 kg and 1.2 kg (Ekere, 2009). However, unlike cities in the industrialized countries, which mostly generate waste low in organic material (Hoornweg, 1999), Kampala generates solid waste rich in vegetable matter (Table 4.4).

In addition to its use as animal feed, organic municipal waste is also used as a soil amendment in backyard gardens and for cooking fuel (Sabiiti *et al*., 2005; Katongole *et al*., 2011; Semwanga, 2005). Therefore, urban agriculture has an important, positive contribution to make in reducing the solid waste stream in Kampala, and should be recognized as a waste-management resource by city planners and other authorities. A full assessment of the "waste-into-wealth" situation is needed in order to understand UPA's potential to meaningfully address the city's waste disposal challenges, key enabling factors to optimize the system, and implications for livestock productivity.

Urban farmers scavenging for leftover food for pigs in a Kampala suburb © Constantine Katongole

Challenges facing urban livestock in Kampala

Urban livestock production is constrained by lack of space for expansion, the risk of zoonotic disease and the challenges of managing livestock waste. A recent zoonotic-disease risk assessment carried out in Kampala identified four zoonoses related to livestock farming in the metropolitan area. These were animal sourced food-borne gastroenteritis, brucellosis, *Taenia solium* (neuro-cysticercosis) and *Mycobacterium bovis* (tuberculosis; Makita *et al.*, 2011). Exposure to these diseases appears to be linked to common practices associated with urban poultry keeping, the consumption of raw milk, and a lack of meat inspection.

TABLE 4.4
Composition of solid waste generated in Kampala and London

	Percentage	
Material	**Kampala**	**London**
Vegetable matter	73.8	38.0
Paper	5.4	18.0
Tree cuttings	8.0	5.0
Others	**12.8**	**39.0**
Street debris	5.5	
Metal	3.1	
Saw dust	1.7	
Plastic	1.6	
Glass	0.9	

Source: Kampala: KCC (2003) and London: Parfitt (2002)

These, among other challenges, need to be addressed by KCCA in order to enhance management of urban agriculture (Nambuubi, unpublished data). Findings from in-depth interviews and FGDs by Nambuubi listed a number of problems and challenges faced by urban livestock keepers:

- strong smells from livestock enterprises due to poor waste management, and noise associated with pig and chicken keeping;
- health risks such as the transmission of zoonotic diseases to livestock producers and consumers;
- social conflicts due to roaming animals destroying other people's property, including crops;
- obstruction of traffic by roaming animals;
- lack of appropriate technologies for confined livestock production; and
- poor veterinary services provided by the government, and the high cost of private veterinary services.

UPA and household food provisioning

In the early 1990s, it was estimated that 25–36 per cent of households in Kampala engaged in UPA (Azuba, 2002), while a decade later David *et al.* (2010) placed that figure at 49 per cent. This includes as many as 20–25 per cent of the residents of densely populated urban areas, and more than 50 per cent in peri-urban areas of the city. Semwanga (2005) reported that of urban households engaged in UPA, 89 per cent produce food for household provisioning, while nearly 53 per cent also farm to supplement their income. Similarly, Maxwell and Zziwa (1992) reported 40 to 60 per cent of food consumption in low-income households came from own production. Findings of the survey conducted for this assessment revealed that farmers in Kampala engage in crop production mainly for household food provisioning. Seventy per cent of the farmers surveyed said their main objective in farming was to contribute to household food security and they only sell the surplus to neighbours.

Involvement in UPA can improve household nutritional outcomes. According to studies by Maxwell (1999), children in Kampala under the age of five in low-income farming households, were found to be significantly better off nutritionally (less stunted) than counterparts in non-farming households. This finding is confirmed by a more recent study by Yeudall *et al.*, (2008) which found a significant positive correlation between household food security and number of tropical livestock units, with consumption of animal-source foods positively associated with weight for age score among 2 to 5 year olds in livestock keeping households.

Waste situation in an open-air food market in Kampala © KCDN/Nyanza

Box 1. Responses to limited land accessibility for agriculture

Given the tremendous pressures from urban encroachment, limited land accessibility ranks among the most critical challenges facing UPA. Kampala's intra-urban farmers cope with space constraints by carrying out intensive vegetable production in backyards (compound gardens), along roadsides and swamps, and in tins, pots, sacks and polythene bags or by renting and borrowing land anywhere they can find it. According to Atukunda et al. (2004), the use of sacks is a common practice among vegetable growers: they mix small stones, to ensure good aeration, and manure or compost are added to the soil to improve its fertility. Space-constrained livestock production systems have also become more common in recent years. These include zero-grazing as well as tethering in home compounds, and the keeping of poultry, both in cages and free range, on verandas.

Container and sack gardens

Compound garden © S. Nambuubi

A storied zero-grazing unit that responds to the challenge of limited land availability in Kampala © C. Katongole
A slum dweller in Kampala city rearing chickens on her veranda

These studies point to the positive role that UPA plays in household food security of low-income households. However, such studies are relatively few in number and most are a decade or more old. Updated, comprehensive studies are needed to assess the changing nature of urban food security in Kampala and the role of UPA, and to more fully estimate the percentage contribution of UPA to household food provisioning and income across different economic strata.

Such studies would also help to ascertain whether recent food and energy price spikes are having any bearing on whether urban households have changed their level of engagement with urban food production. It is noteworthy that farmer participants of the focus group discussions (FGDs) held in conjunction with this study cited the contribution to household food provisioning in response to high food prices as one of the key reasons for engaging in UPA. In the urban parish of Kasubi-Kawaala where the livelihood study was undertaken, UPA was ranked second in livelihoods importance and was estimated to contribute about 25 per cent to household economic well-being. In Komamboga parish, UPA was ranked first in livelihoods importance and was estimated to contribute about 60 per cent to the total household food requirements.

UPA and informal markets

Most of the UPA producers in and around Kampala are smallholders who do not sell through formal market channels as they cannot guarantee supply in the right quantities, at the right time. Secondly, farmers do not incur any expenses when they sell to informal buyers who find them at their homes. The exception to this is mushroom production: mushrooms are sold through the formal market, particularly to supermarkets. Findings of the survey conducted for this assessment revealed that about 64 per cent of the mushrooms are sold fresh and 36 per cent dried and packaged before being sold to supermarkets and retail shops.

All the dairy cattle farmers interviewed in urban and peri-urban areas of Kampala for this study reported that they sold their milk through the informal market, particularly to individual households in their neighbourhood. A few of them also sold to small restaurants in the village market and to mobile milk vendors. There are several reasons to explain why milk produced in urban and peri-urban areas of Kampala ends up into the informal market. They include the high demand for milk at the village level, lower expense incurred when farmers sell their milk through local market channels, a better price received from informal buyers, and the lack of cold storage facilities for smallholder dairies.

A significant share of the fruits and vegetables consumed in Kampala comes from informal food retail outlets such as stock shops, illegal or semi-illegal stalls, hawkers and street/pavement retailers. Fresh produce sold through these informal channels are purchased either from open-air food markets (then resold to urban consumers) or from urban producers. However, it is not known how much contribution each source makes to the informal market. Informal food retail outlets provide convenient access to food as there are many of them across the city offering any quantity that the consumer chooses at relatively low cost. They save consumers time and transport costs, play an important role in satisfying the food needs of poor urban households, and provide employment and income to the resource-poor households.

Operators of informal food outlets face a constant threat of eviction by city authorities, who regard them as a security threat to the city (*pers. comm.* KCCA Executive Director). According to the Executive Director, the evictions are also part of a wider plan to ensure orderly trade within the city, in accordance with the Trade Order Ordinance, 2006, by reducing congestion, especially during peak hours, and protect consumers from fake products. Officials further justify removal of the outlets by citing a lack of facilities for the proper hygienic handling, storage and packaging of fresh food. The informal food-outlet actors lack an organizational structure and cooperation between themselves, so they are unable to effectively convince city authorities that their continued existence is important for food access by lower- and middle-income urban consumers.

Formal food markets in Kampala

The formal food market in Kampala consists of open-air markets such as Bugoloobi, Kalerwe, Kibuye, Nakasero, Nakawa, Nateete and St. Balikuddembe shops, and more recently, supermarkets. Although supermarkets are growing and steadily spreading out within Kampala and its suburbs, information on their market share is not available. Studies on the growth of supermarkets in Kampala and other major towns in Uganda (Elepu, 2006) indicate that fresh food comprises a tiny fraction of all foodstuffs handled by most of them. The most frequent customers in supermarkets are young, educated consumers with small families. They are typically medium- to high-income earners and have acquired assets such as refrigerators, cars and houses. Despite the allure of supermarkets, most of their customers, according to Elepu (2006), regard open-air markets as their major source of fresh food, implying that open-air markets are still more important than supermarkets for fresh-food retailing.

Supermarkets in Kampala, as elsewhere, source most of their food products globally, especially processed foodstuffs because of their guaranteed availability, quality and safety (Elepu, 2006). Supermarkets could potentially present an opportunity for urban and peri-urban farmers, as they could have an advantage over global suppliers in terms of delivery and reduced supply costs. However, getting a toehold in supermarkets requires an ability to ensure regular, consistent supplies and to guarantee product quality and safety. With the exception of poultry production and mushroom cultivation, as described above, the majority of urban farmers in Kampala have low-input small-scale holdings and would find it difficult to meet the demands of supermarkets.

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Surveys carried out in conjunction with this study revealed that the bulk dairy consumers, such as hotels/restaurants and supermarkets, have contracts with formal milk processing companies, with none of that milk originating from dairy UPA farmers in Kampala. Similarly, all the milk collection centres visited during this study sourced the milk from outside Kampala.

Live pigs reared in Kampala are mainly sold to middlemen/traders. Kampala has only one licensed slaughterhouse dealing in pork, the Wambizzi abattoir in Nalukolongo. Production in urban/peri-urban areas of Kampala was estimated to account for only about 5 per cent of the pigs slaughtered in this abattoir. In spite of the law providing for the licensing, control and regulation of slaughter of any animal or bird intended for sale to the public or for public consumption (the Local Governments [Kampala City Council] Meat Ordinance of 2006), the pork sold to many butchers in Kampala comes from informal or illegal slaughter. Production in urban/peri-urban areas of Kampala is the major source of pigs slaughtered in these illegal places, which makes it difficult to estimate the market share of pork produced in urban/peri-urban areas of Kampala.

Eggs and poultry meat produced by UPA farmers in Kampala are sold into both the formal and informal markets and are the only livestock products from urban and peri-urban areas of the city that make a significant contribution to the formal market. Mpinga (1999) estimates that approximately 70 per cent of all poultry products consumed in Kampala are produced from within the city. In

the formal market, the majority of farmers sell live birds to slaughterhouse companies, particularly Ugachick Poultry Breeders Ltd., the largest poultry breeding company in the country, under out-grower contract arrangements. The companies then dress the chickens, package them and sell to supermarkets and hotels. In the informal market, farmers sell eggs and live chickens to individual households, passers-by, middlemen/traders, retail shops, supermarkets and roadside sellers of roasted chicken meat and boiled eggs.

5
Policies influencing UPA in Kampala

Official attitudes towards urban agriculture in Kampala are evolving from hostility towards acceptance. Although UPA in Kampala has steadily increased since Uganda's independence in 1962, the prevailing laws worked against UPA, and studies and documentation about its existence were minimal. For many years, city authorities and state officials considered UPA as an illegal practice, economically insignificant and a threat to public health (David *et al*., 2010; Maxwell and Zziwa, 1992). For instance, livestock keeping in and around Kampala was considered a health risk for residents due to air pollution and offensive smells, road accidents caused by roaming livestock, and forage acting as a breeding ground for mosquitoes and rodents (Maxwell *et al*., 1998). There was also a fear that accidents could occur in the city due to reduced visibility caused by tall crops such as maize and cassava being grown, especially near road bends. Other perceived risks included the indiscriminate drainage of swamps, leading to the loss of their function in wastewater purification, and the destruction of green belts within the city (Matagi, 2002). While many of these problems could be solved, city authorities often resorted to evicting urban farmers from public land and destroying their crops (Maxwell, 1995). Indeed, the 1964 Town Planning Act provided the basis for city enforcement officials to harass those engaged in urban farming, as the act viewed farming as an activity at odds with urban standards.

According to Lee-Smith (2005), it was in the early 1990s that Uganda's government appointed the first officer in charge of agriculture in Kampala, though the officer did not have extension staff, resources or a budget. Maxwell (1994) strongly argued the case for legitimization of urban farming and a review of municipal by-laws, basing his argument on the evidence of the improved nutritional and food security of households that had some access to farming land in the city. However, it was not until 2005 that John Ssebaana, then Mayor of Kampala, announced new ordinances on urban agriculture, livestock and companion animals, meat, milk, and fish. Currently, there is official recognition and support for urban agriculture from government programmes and city authorities—government programmes under the Poverty Eradication Action Plan (PEAP), particularly the NAADS programme, no longer only target rural areas for agricultural development, and Kampala has an Agricultural Advisory Services Officer who is in charge of the NAADS programme in the city.

The city's Urban Agriculture Unit was established within the city's Department of Production and Marketing to support and guide urban farmers and to ensure household nutrition and food security. Under the Local Government Act (1997), Sections 39 and 41 empower local authorities to enact by-laws for regulating all activities within their areas of jurisdiction. Accordingly, KCCA (KCC by then) enacted a number of ordinances:

The *Local Governments (Kampala City Council)* Urban Agriculture Ordinance, 2006, provides for the licensing, control and regulation of urban agriculture and related matters. According to this law, a person shall not engage in commercial urban agriculture without an urban agricultural permit and valid license issued by the council (KCCA). The ordinance also prohibits commercial urban agriculture in certain areas including road reserves, wetlands, greenbelts and parks gazetted by the Council, abandoned land fills or any other area designated by the Council as a toxic area, areas less than 10 feet (3 m) from open drainage channels, and any other area that council may specify. It also prohibits the use of untreated human waste as manure for agricultural purposes.

The *Local Governments (Kampala City)* Livestock and Companion Animals Ordinance, 2006, provides for the control, regulation, registration and licensing of livestock and companion animals. The Ordinance seeks to control nuisance animals and prohibits grazing of animals in road reserves, public parks, and greenbelts gazetted by the Council, and dumping grounds. It also stipulates that stray livestock will be impounded and fees levied on the owner of the impounded animal.

The *Local Governments (Kampala City Council)* Milk Ordinance, 2006, regulates the sale of milk and milk products. Under this Ordinance, artisanal dairy persons or livestock keepers are required to apply for an urban agricultural permit and license, for which the applicant has to produce a certificate from the medical officer of health attesting that the operation meets health and safety requirements. Similarly, the *Local Governments (Kampala City Council)* Meat Ordinance, 2006, provides for the licensing, control and regulation of slaughterhouses and butcher's shops, and stipulates that the Ordinance prohibits slaughter of animals or birds intended for sale to the public except in a licensed slaughterhouse.

The *Local Governments (Kampala City Council)* Fish Ordinance, 2006, regulates fish farming including processing and selling of fish. As with the other Ordinances, this one requires an urban agricultural permit and license, and certification by health inspectors.

Despite these various ordinances meant for the control and regulation of urban agriculture in Kampala, the majority of the households engaging in UPA are unaware of them, for instance the requirement for a permit and license to practice urban agriculture. Whenever KCCA officials try to enforce the regulations, farmers complain of harassment.

According to Lee-Smith and Prain (2010), KCCA allocated funds to inform the population about the new ordinances as part of the 2008 Environmental Alert. However, rather than presenting a positive view of urban agriculture, the posters mainly focused on prohibitions and penalties (Lee-Smith, 2008). Nonetheless, evidence that the changing policy environment for UPA is having a positive effect on official attitudes can be seen in the direct engagement by city authorities in instituting the above ordinances. KCCA (KCC by then) also leased out land for its Edible Landscape Project, which is intended to demonstrate the value of including urban agriculture as a permanent feature in city planning and low-income housing design. This lends further support for the changing policy environment for UPA in Kampala.

Additionally, NAADS, the government programme for agricultural development, has mainstreamed UPA in its implementation framework and has rolled out its programme activities in Kampala. This has been done by rezoning Kampala into urban agricultural production zones, namely the core zone, intra-urban and peri-urban zones. The Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) is also in the process of formulating a National Urban Agriculture Policy, which is expected to be the basis for providing urban farmers with appropriate information services. The Development Strategy and Investment Plan (DSIP) of MAAIF (2010) also provides an opportunity for the consideration of UPA. The strategy aims at transforming subsistence farming to commercial agriculture and has recognized and included UPA in its investment strategy.

Though these gains in policy recognition are critically important, serious policy roadblocks remain, in particular those related to access to land for UPA activities. The National Development Plan (NDP) of 2010 offers potential to begin addressing the issue and stipulates Uganda's medium-term strategic direction, development priorities and implementation strategies. Objective 1 of the plan provides for enhancing agricultural production and productivity, providing an opportunity for UPA if mainstreamed into subsequent policies and strategic plans. Additionally, Objective 4 of the NDP-2010 targets enhancement of productivity of land through sustainable land use and management of soil and water resources.

6 Climate trends and projections for Kampala

Rainfall and temperature trends in Kampala

The region that encompasses Kampala has a bi-modal rainfall pattern with peaks in March–May (long rains) and September–November (short rains) (East African Meteorological Department, 1963), with June–August and December–February being predominately dry seasons. Rainfall in Kampala averages between 1 200–1 700 mm per year. The city has a mean annual temperature of 22.8°C, and its temperatures vary from a mean minimum of 17.1°C in August to a mean maximum of 29.2°C in February (Uganda Meteorological Department, 2011).

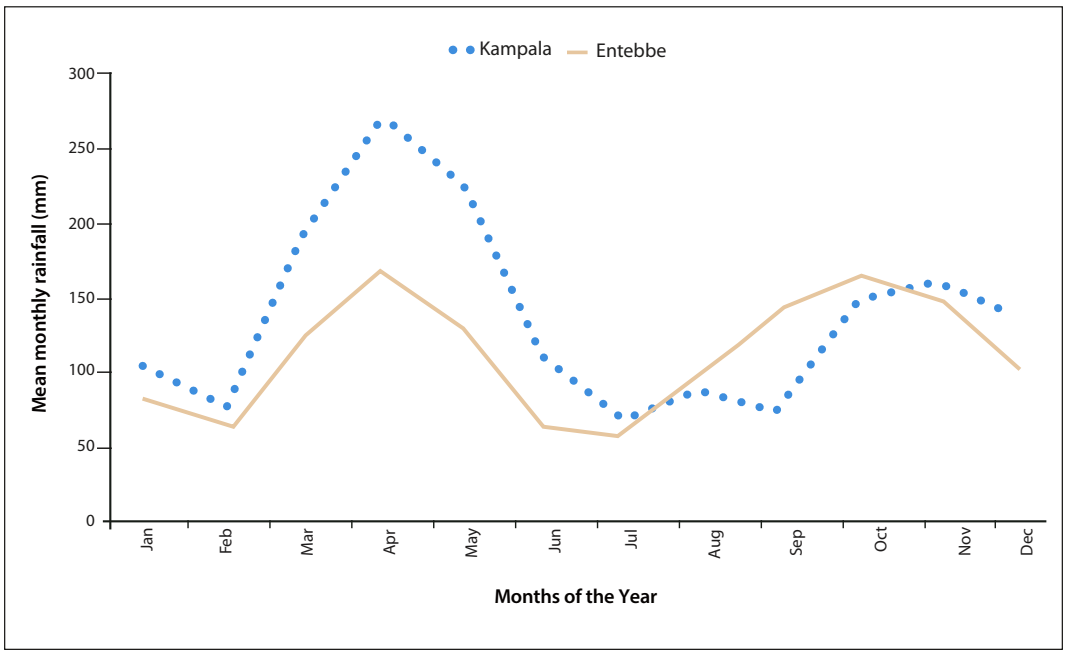


FIGURE 6.1
Mean monthly rainfall distribution for Kampala and Entebbe (1993–2010)
Source: Makerere University Weather Station (for Kampala) and Entebbe Weather Station

Rainfall

Rainfall trends analysed for this assessment were derived from weather data collected at the Makerere University and Entebbe weather stations. Entebbe is adjacent to the Kampala metropolitan area and has comparable climatic conditions. The mean annual rainfall distribution for Kampala between 1993 and 2010 is shown in Figure 6.1. Over this period, there has been a slight though statistically insignificant decline in the total annual rainfall (Figure 6.2). The number of rainy days per year has not decreased.

Evidence of shifts in rainfall characteristics become apparent when broken down by season rather than annually declining; as indicated in Figure 6.3, December-February (DJF) rainfall increased slightly while March-May (MAM) rainfall decreased slightly.

FIGURE 6.2
Annual rainfall for Kampala, 1993-2009
Source: Makerere Weather Station

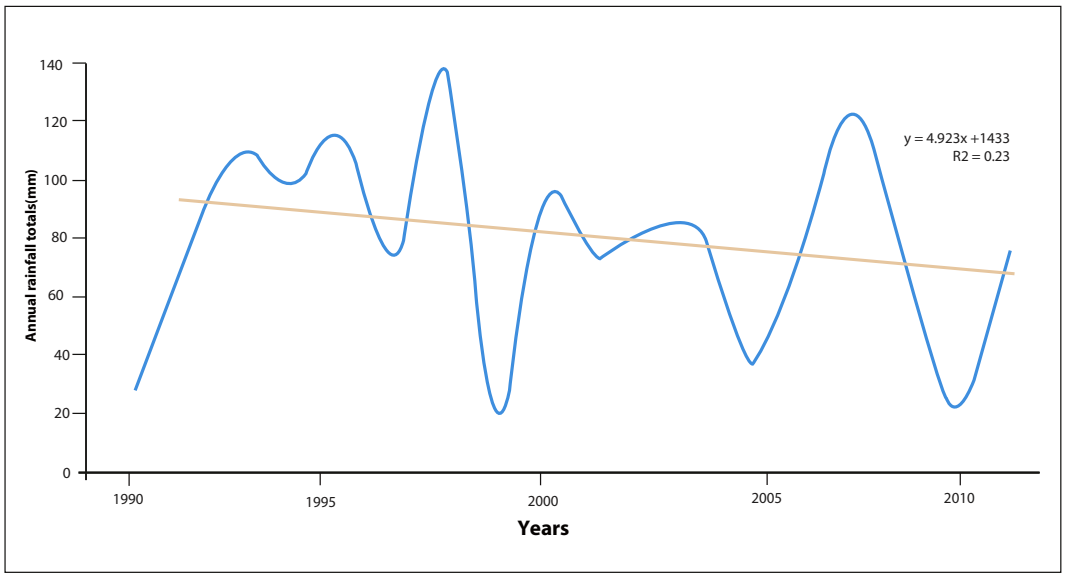
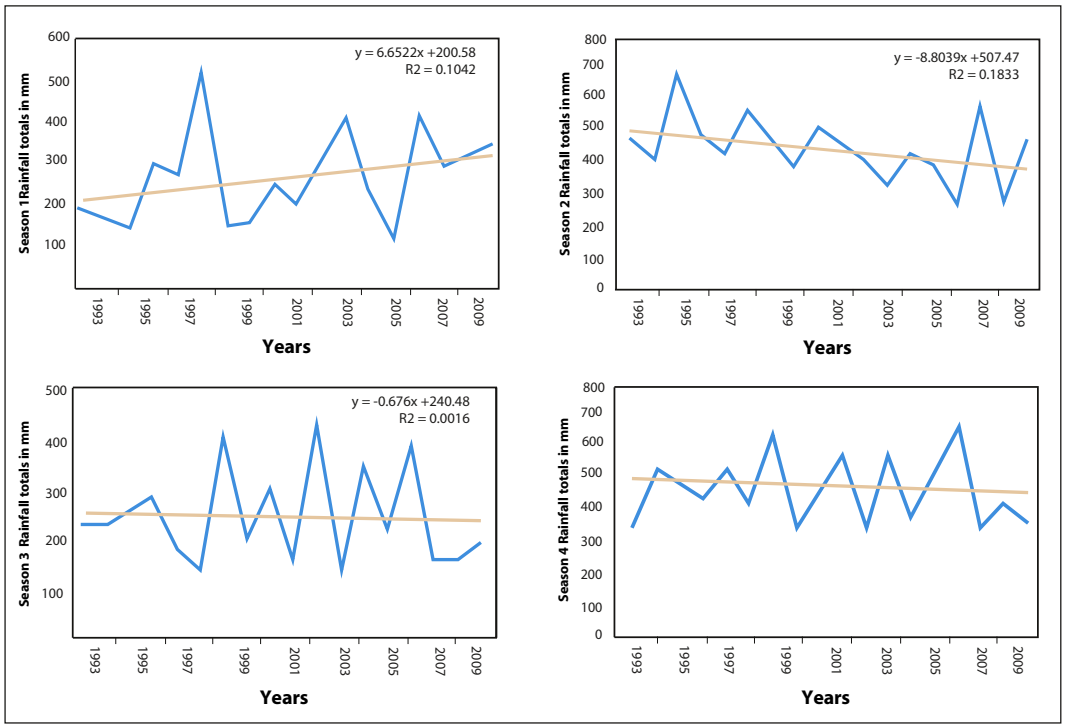


FIGURE 6.3
easonal rainfall for Kampala, 1993-2009
(Season 1 = DJF; Season 2 = MAM; Season 3 = June–August (JJA) and Season 4 = September–November (SON), 1993–2010
Source: Makerere Weather Station



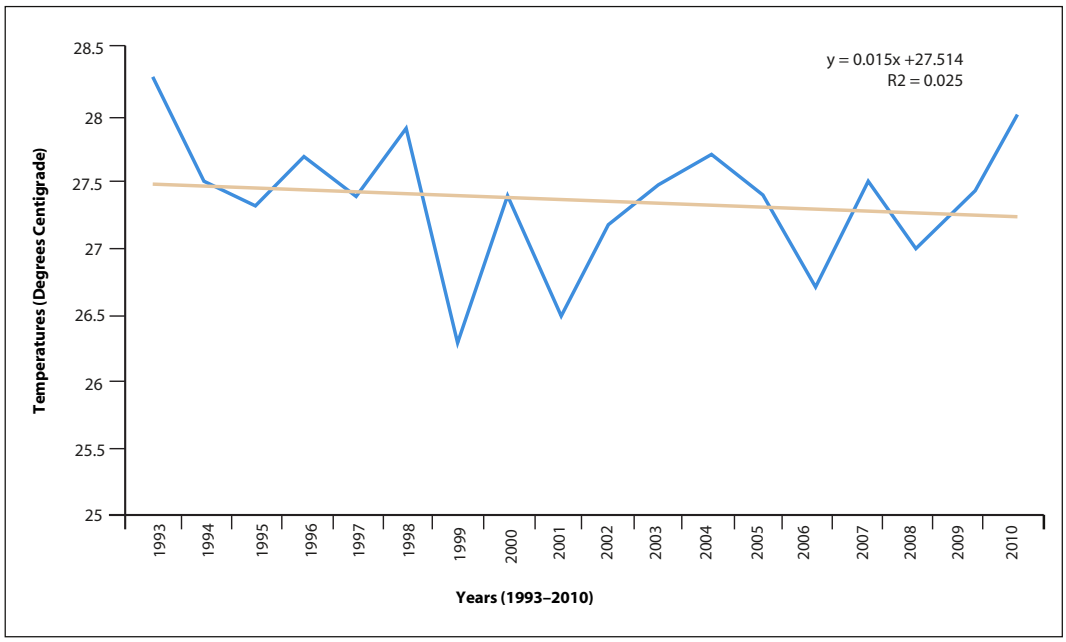


FIGURE 6.4
Mean annual maximum temperature for Kampala, 1993-2010
Source: Makerere Weather Station

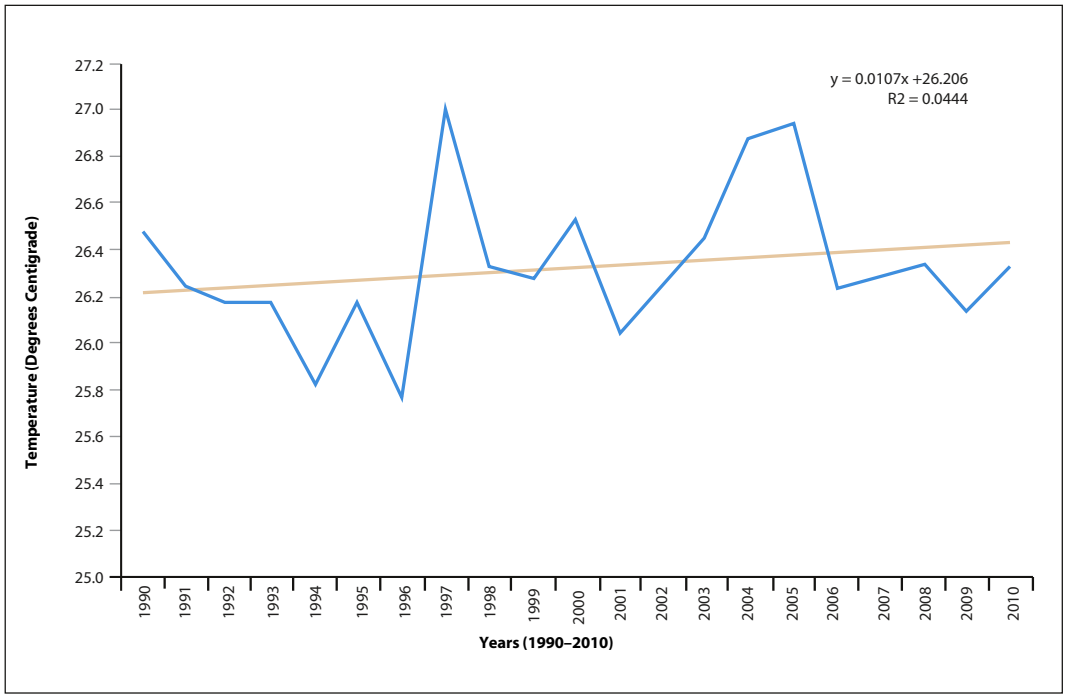


FIGURE 6.5
Mean annual maximum temperature for Entebbe, 1990-2010
Source: Entebbe Weather Station

FIGURE 6.6
Mean annual minimum temperature for Kampala, 1993-2010"
Source: Makerere Weather Station

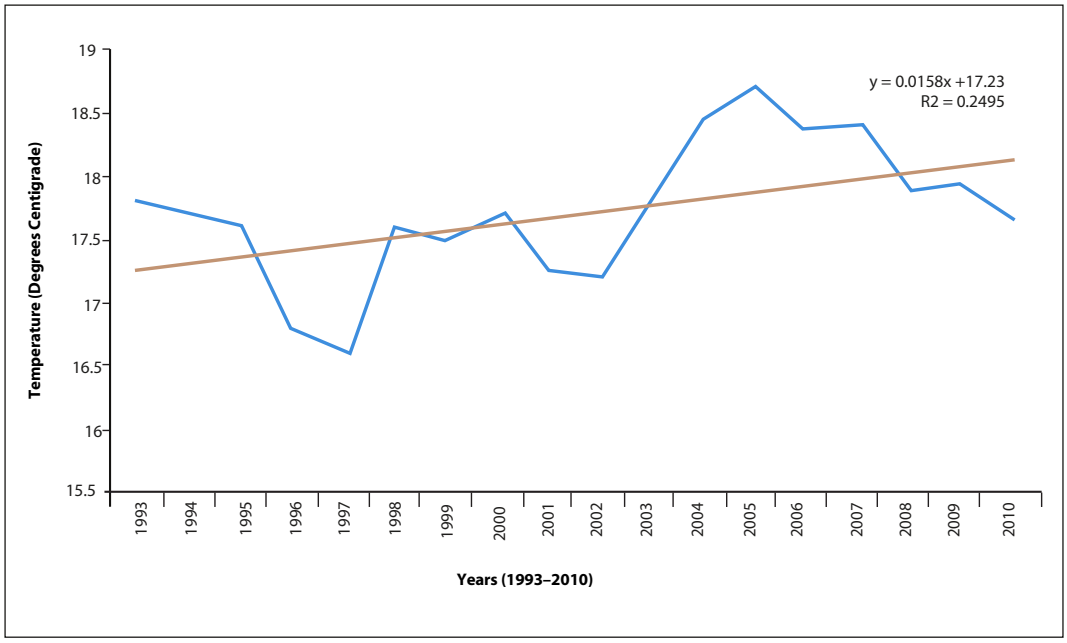
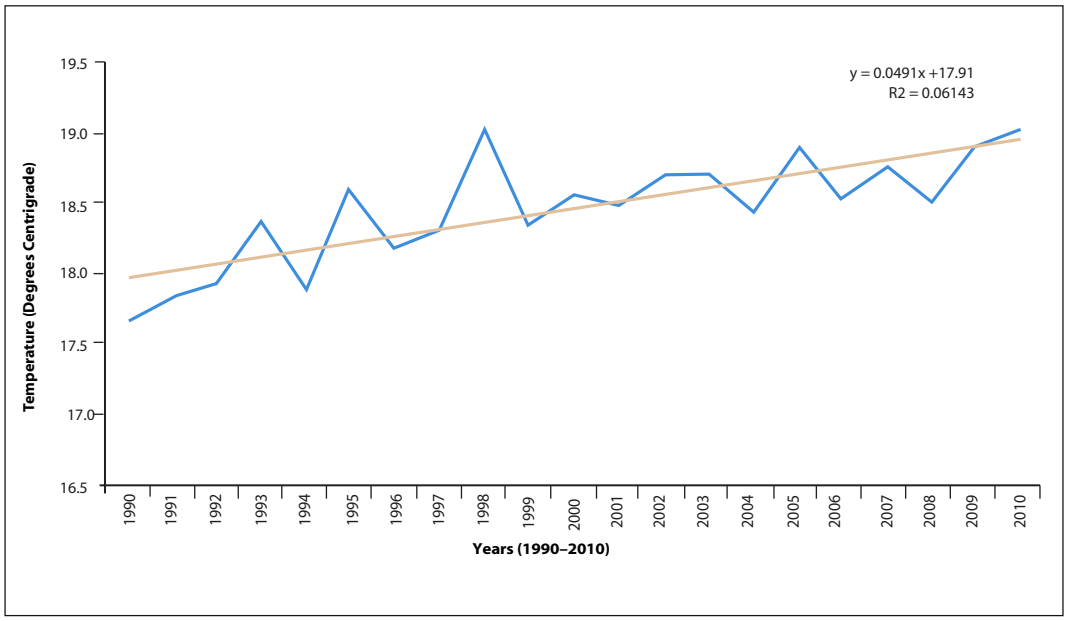


FIGURE 6.7
Mean annual minimum temperature, 1993–2010
Source: Entebbe Weather Station



While the length of the data set, 17 years, is not sufficient to detect an established trend, it does indicate potential areas of concern in that a decline in rainfall amount and number of rain days during the long rainy season (MAM) could have serious implications for rain-fed agriculture. No studies have been done to date in the Kampala region to quantify the current and potential impacts of shifts in the rainy season. Similarly, unpredictable episodes of rainfall events during an assumed dry period (DJF) do not help farmers since in most cases they are unprepared for the rain, do not trust weather forecasts and are therefore not able to take advantage of the rain. Section 7 explores farmers' perceptions of changing rainfall patterns.

Temperature

Temperature analyses of the Makerere University and Entebbe weather station data show an increase in mean annual temperatures between 1993 and 2010. The increase in mean annual temperatures appears to be due mostly to increases in minimum temperatures (Figures 6.6 and 6.7) and not to changes in maximum temperatures (Figures 6.4 and 6.5). While the length of the data set (17 years) is not sufficient to detect a change in climate, it does indicate potential trends of rising minimum temperatures consistent with that observed worldwide.

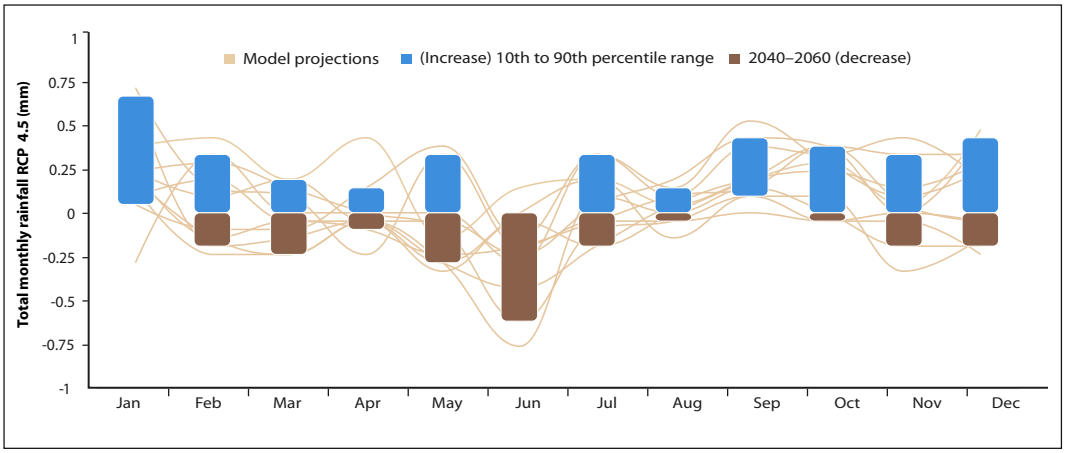
Rainfall projections

Rainfall and temperature projections for Kampala were derived from a suite of regionally downscaled model projections from the Coupled Model Intercomparison Project, Phase 5 (CMIP5) set of climate models, under a future scenario of low (Representative Concentration Pathway 4.5) and high (Representative Concentration Pathway 8.5) greenhouse gas emissions. Climate model projections presented in this report (Figures 6.8-6.11) were obtained from the Climate Information Portal (CIP) administered by the University of Cape Town's Climate Systems Analysis Group.

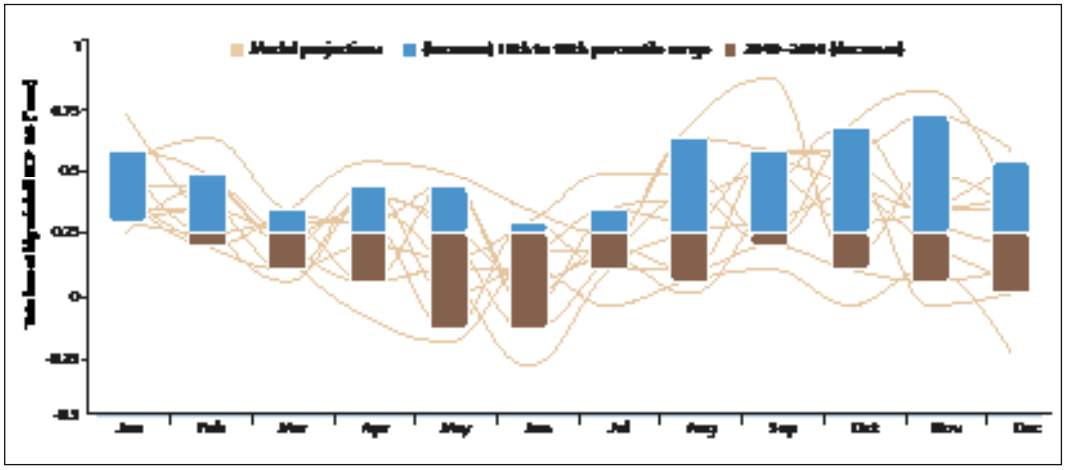
The bars in the figures below indicate the spread of the climate model results and thus the relative degree of uncertainty in the envelope analysis. The shorter the bar, the greater the level of agreement between the models (the less spread of the model results). The distribution of the bars is also important. Bars that are distributed predominately in one direction relative to the zero line indicate agreement between the models regarding the direction of future rainfall (increased rainfall—bar is mostly above the zero line— or decreased rainfall, bar is mostly below the zero line). Bars that evenly straddle above and below the line show poor agreement and thus a relatively high degree of uncertainty.

Future projections of rainfall (Figures 6.8 and 6.9) indicate that Kampala could experience changes in rainfall distribution with an overall increase in annual rainfall by mid-century (2040–2060). Projections for rainfall during Kampala's long rains (March–May) and short rains (September–November) indicate an increase in March, an uncertain direction of change in April (model projections are distributed above and below the zero line), a decrease in May, and increases in September through November. Rainfall is also projected to increase during the normally dry months of July, August, December and January.

FIGURES 6.8
Change in mean monthly rainfall, RCP 4.5



FIGURES 6.9
Change in mean monthly rainfall, RCP 8.5



Temperature projections

Mean monthly maximum temperatures are projected to increase by approximately 0.6 to 1.8° C in the 2040 to 2060 time period (above 2003 to 2012 mean monthly maximum temperatures) for the 2003 to 2012 period under a low (RCP 4.5) scenario (Figure 6.10a) and by approximately 1.1 to 2.5° C under a high scenario (RCP 8.5) (Figure 6.10b). Projections of mean monthly minimum temperatures exhibit a similar pattern with temperatures increasing by 0.8 to 2.1° C under the low scenario (Figure 6.11a) and 1.5 to 2.7° C under a high scenario (Figure 6.11b). As explained above, a height of the bars indicates the closeness of model agreement.

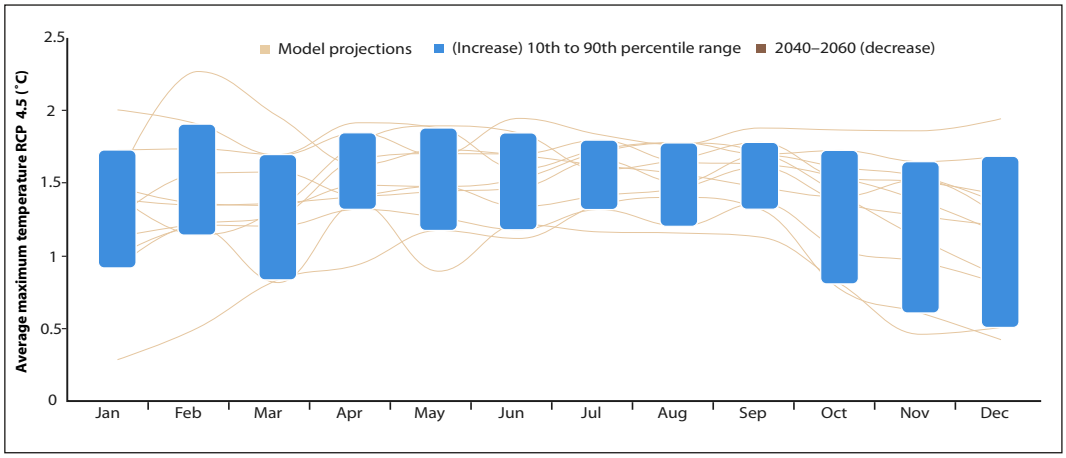
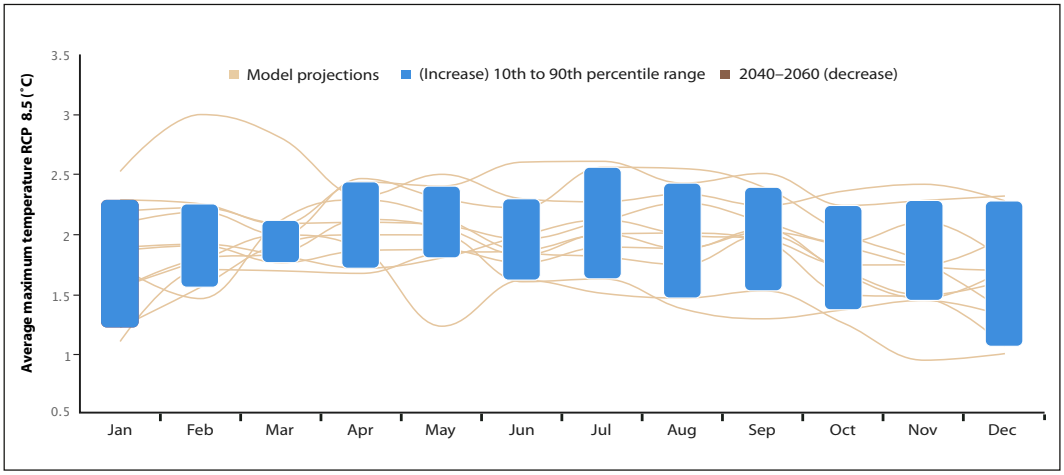


FIGURE 6.10a,b.
Projection of mean maximum temperature change under RCP 4.5 (top figure) and RCP 8.5 (bottom figure) emissions scenarios. Projections are for the 2040-2060 period compared with a 2003-2012 baseline



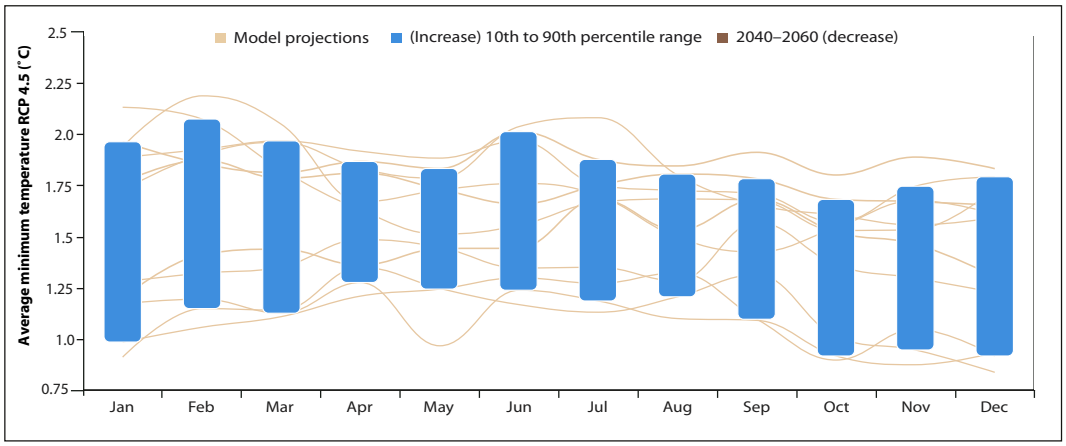
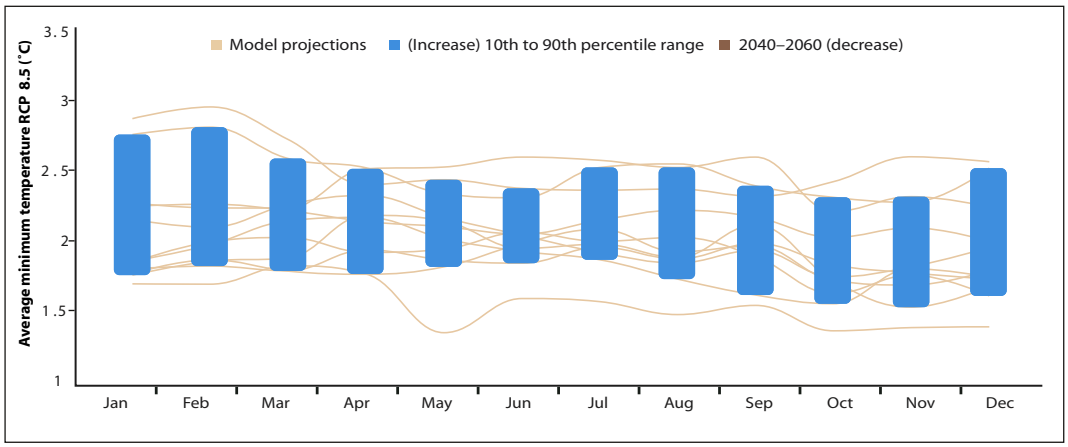


FIGURE 6.11a,b
Projection of mean minimum temperature change under RCP 4.5 (top figure) and RCP 8.5 (bottom figure) emissions scenarios. Projections are for the 2040-2060 period compared with a 2003-2012 baseline


Model projections
(Increase) 10th to 90th percentile range
2040–2060 (decrease)
Average minimum temperature RCP 8.5 (°C)
3.5
3
2.5
2
1.5
1
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

7 Challenges facing UPA

Climate risks and UPA

Flooding is a critical risk in Kampala. Much of the city is located in the valleys between steeply sloped hills. The topography combined with a tendency for rainfall in brief but heavy downpours, drainage of swamps and other land-surface conversions, and blocked storm drainage systems create ideal conditions for flooding (Matagi, 2002). While the frequency of annual flooding has not increased over the past 20 years (Tenywa *et al*., 2008; in Lwasa, 2010), the severity of flooding has. This is most likely due to increased urban growth, haphazard planning and overtaxed urban services and infrastructure. Analysis of rainfall is needed to understand whether rainfall intensity has increased.

Though the Ministry of Local Government and KCCA initiated the preparation of a Kampala Drainage Master Plan (KDMP) to ensure the rehabilitation and sustainable upgrading for overall storm water planning (MLG and KCC, 2002), flooding remains a serious risk. However, one important outcome of the KDMP effort is that Kampala has begun to initiate more deliberate planning after years of haphazard planning of settlements.

Floodwaters force their way into Kampala suburbs following heavy downpours in April 2014 © KMF News

Flooding and UPA

While the extent of UPA losses due to flooding has not been estimated, vegetable plots that are located close to informal settlements in wetland areas are regularly washed away after downpours. Of course, flooding presents compound risks that extend well beyond the loss of vegetable crops to include damage to housing in informal settlements, more waterborne disease outbreaks, and loss of other livelihood resources that further erodes household food security.

Farmers who participated in the FGDs provided their perspectives on flood risks in Kampala. They cited lack of maintenance of drainage systems and the high rate of construction of concreted compounds that do not allow sufficient infiltration as important causes of flooding. These sentiments are in general agreement with what Tenywa *et al.* (2008) reported about farmers' perceptions of the major causes of floods in Kampala: blockage of drainage channels and unplanned construction (28.6 per cent); settlement in wetlands (14.1 per cent); small and blocked drainage channels (16.2 per cent); excessive rainfall (13.1 per cent); poor drainage maintenance (12.4 per cent); and the construction of the northern bypass (8.9 per cent). The FGD participants also cited topography as one of the factors that predisposes some areas in Kampala to flooding. For example, the low-lying area of Kasubi-Kawaala is consistently flooded during the rainy seasons, whereas Komamboga Parish, which is at a higher elevation, hardly experiences storm floods.

Participants of the FGDs expressed knowledge of climate change through their observations of climate risks and how the magnitude of these has changed over time. The following climate risks were identified by FGD participants:

- changes in the timing and distribution of precipitation during the rainy seasons;
- changes in rainfall intensity and volume towards heavier rains;
- changes in rain coverage, which has now become more variable; and
- warmer temperatures, especially at night.

An FGD participant in Komamboga stated: "*… the month of October was known to be dry yet today, and (in) 2011 in particular, it has been a wet month with unpredictable heavy rains.*" The participants were of the view that during the 1970s through early 1980s, the rainy seasons were more regular and predictable (Table 7.1). The participants also noted a change in cloudiness—expressed as an imbalance between rain and sunshine —"*as soon as the rains stop, intensive sunshine follows.*"

The farmers also listed other climate risks that commonly affect them, these included: storm water floods, hail storms, high temperatures, dry spells, soil erosion, and heavy winds (hilly places not much affected). These climate risks impact negatively on urban agricultural enterprises as narrated by farmers:

- When we receive heavy rains, our crops such as beans, leafy vegetables, maize etc. get washed away by running water.
- Our livestock especially pigs, cattle and goats usually get fever during heavy rains.
- Grazing pasture becomes scarce due to heavy rains.
- We also get high soil erosion in the sloppy areas because of poor drainage.
- The soils also dry up soon after rains because the temperatures also rise immediately.
- Our crops (maize, sweet potatoes, vegetables, cassava) and livestock also get destroyed by hail storms. (Noticeable by the Komamboga community were the El Niño rains of 1997 that were reported to have been so destructive).
- We also experience dry spells with very high temperatures/sunshine that dries up our crops.

TABLE 7.1
Climate change perceptions*, 1970s–2010s

1970–1980	Season	Farmers' description of weather
Seasonal weather was more regular and predictable	Rainy: Late February–April In March, farmers prepare to plant because rains continue to April	More certainty and predictability of onset of rains; rains were heavy and regular
	August–September	Rains would be abundant with some hail storms
	November–December	Rains would be heavy with some hail storms
Dry seasons were known and predictable	Dry: May –July	Season was very hot and dry
	October	Less hot
	January–February	Very hot and dry
1980–1990	**Season**	**Farmers' description of weather**
Changes in climate started being noticeable from the early 1990s, with irregular unpredictable rains	Rainy: Less rain, changes in weather started being noticed	Not so much rain as before and surprising weather conditions, such as untimely and irregular rains
1990–2011	**Season**	**Farmers' description of weather**
Was noted by farmers as the period with outstanding changes in climate: increase in temperatures, unpredictable heavy rains	Rainy: • More rain is falling in October than used to be the case • High evaporation/soils dry up more quickly than in the past • Less infiltration of rain into soils • Windier than before • Spot rains in certain months	In the city now there is too much rain, which affects crops. There is a lot of change. • Dry season is less regular • It is hotter than before; more heat is affecting livestock • Rainfall events are more irregular with hail storms • There is now more wind accompanying rain; when sun shines, it is more intense than it was in the 1970s

*as reported by farmers in Komamboga and Kasubi-Kawaala parishes

- Heavy winds bring down our shelters for livestock and poultry. Trees and banana plantations are also brought down.
- Because of changes in climate, one can no longer predict the rainy seasons.

What the farmers perceive as climate change may actually be increased climate variability and not a statistical change in climatic conditions, as is also indicated by the met station data presented in Section 6. However, the degree of vulnerability to climatic and other risks, which urban farmers are experiencing, may be increasing as a result of changes in other factors such as urban encroachment, environmental degradation, soil degradation, etc., that lower the threshold of loss to heavy rainfall events, storm runoff and other effects associated with micro-scale weather events and larger-scale extreme events.

FIGURE 7.1
Land use in Kampala, 2010
Source: KCCA (2005); UBOS (2010)

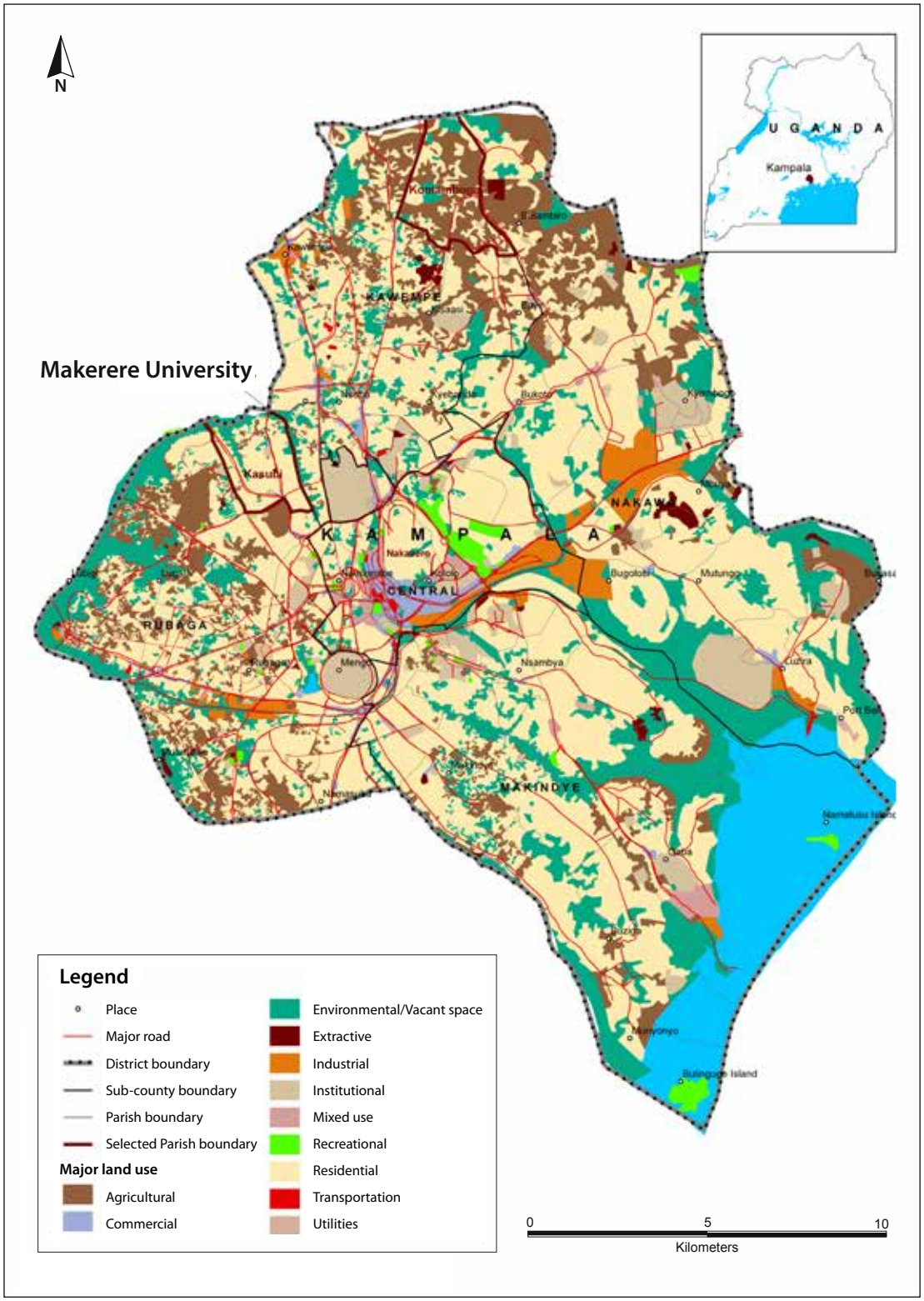


TABLE 7.2
Land use and land cover in Kampala in 1980 compared with 2002

Land use/Land cover	1980		2002	
	Area (Ha)	% of total	Area (Ha)	% of total
Bare ground	0.0	0.0	362.2	0.9
Built-up residential	6 192.0	16.0	12 269.6	31.7
Forest	458.6	1.2	1 032.3	2.7
Grassland	1 092.2	2.8	2 155.4	5.6
Industrial	669.4	1.7	1 827.0	4.7
Open water	2 193.6	5.7	2 147.6	5.6
Swamp	1 092.1	2.8	1 112.6	2.9
Subsistence agriculture	24 045.4	62.2	17 622.6	45.6
Swamp forest	2 921.5	7.6	135.4	0.4
Total	38 664.7		38 664.7	

Source: Landsat images (1980–2002) and Nyakaana et al. (2007)

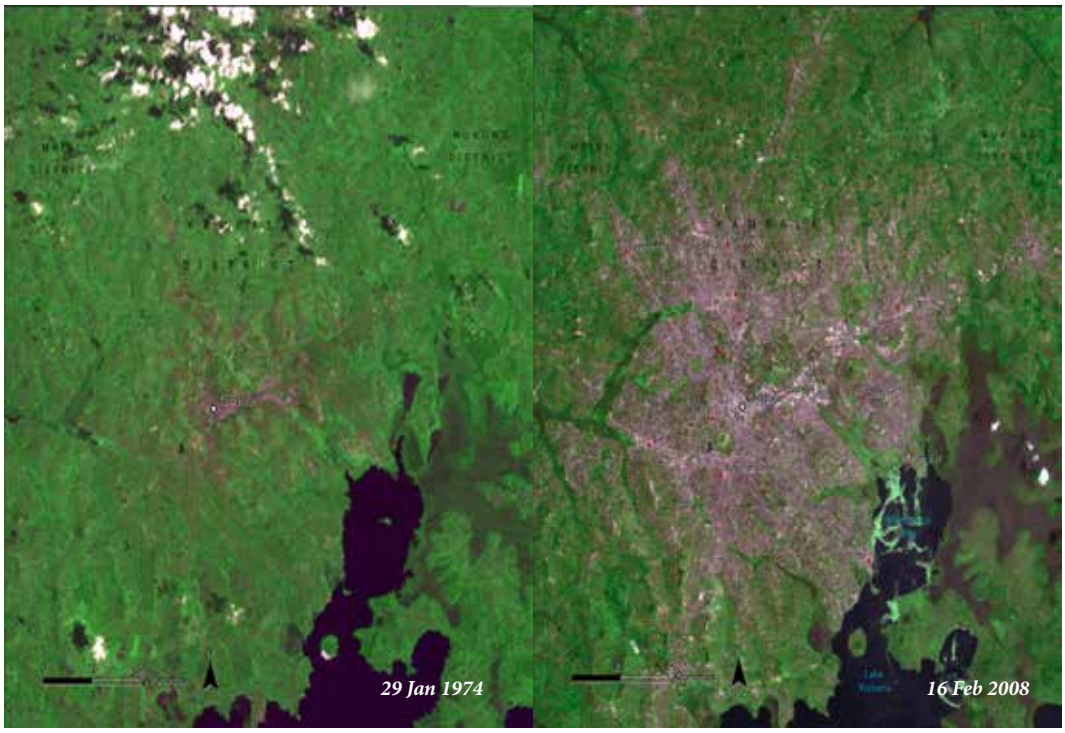
Implications of urbanization trends on land use and flood risks

Steady economic growth and political stability over the past two decades have spurred the expansion of urban centres, especially Kampala, and have led to the creation of hundreds of small trading centres in the countryside. The current and projected population growth in the Kampala metropolitan area (see Section 3) has led to increased demand for employment, land for housing, social services and infrastructure (Nyakaana *et al*., 2007). The cost of land has escalated in recent years, significantly affecting housing affordability for the majority of the population. People working in Kampala increasingly opt to live in the suburbs and peri-urban areas where land and housing prices are lower, prompting expansion of the urban boundary.

The challenges of urbanization in Kampala are exacerbated by the lack of proper planning. This is evident in several respects including in the lack of progress towards developing an urbanization policy, weak government policies and laws, lack of qualified urban planners and managers, and weak institutions and structures, resulting in a continued pattern of spontaneous and uncoordinated development. The recent emergence of an informal land market in the face of an inefficient formal one has resulted in the exclusion of some social groups, particularly the poor, and has increased competition for land between agricultural and non-agricultural users. This situation has further pushed the poor to settle on increasingly marginal lands, such as in wetland areas, which increases their exposure to flooding, with attendant socio-economic and health consequences (Lwasa, 2000 and 2004).

Residential development is by far the dominant land-use type in the Kampala metropolitan area (Figure 7.1). The increase in the urban population, industrialization and the associated demand for housing have ushered in a fast-paced process of land-use changes at the expense of agricultural land, with urban land nearly doubling between 1980 and 2002 (Table 7.2). Similar results are evident in the explosive growth of Kampala between 1974 and 2008 (Figure 7.2).

FIGURE 7.2
Aerial view of Kampala in 1974 (left) and 2008 (right)
Source: UNEP 2009



Current patterns of urban growth and expansion in Kampala are not sustainable given projections of rapid population growth over the next few decades. The total built-up area is expected to increase from 386 km^2 in 2010 to nearly 1 000 km^2 by 2030 (Vermeiren *et al.*, 2012). An urban growth scenario analysis conducted by Vermeiren et al. (2012) found that business-as-usual growth would triple the number of people living in hazard-prone areas—steep slopes and flood-prone wetlands in low-lying areas—by 2030, while a restrictive scenario in which people are not settled in these areas would push them into more remote areas. Wetland areas located between the city and Lake Victoria are important for farming and the areas also provides important environmental services in terms of regulating flooding and filtering sediment from the city. The lack of government oversight of these areas makes them attractive for new settlers who engage in agriculture and also brick-making, using clay soil dredged from wetland areas.

The need for urban landscapes to dampen flooding risks will become increasingly critical as flood-prone cities like Kampala attempt to adapt to climate change (UN-Habitat, 2011); maintaining permeable surfaces, through agriculture, wetlands and forest remnants would clearly contribute to such an effort. Currently, there are critical knowledge gaps concerning spatial planning for floodwater management and in understanding how the threshold for flooding could shift as both climate and land surfaces change in the future. Climate model projections point to an increase in heavy storm events with a warming atmosphere (Seneviratne *et al.*, 2012), and evidence is already emerging of an increase in the proportion of seasonal rainfall occurring as heavy events (Goswami *et al.*, 2006; Lyon and Dewitt, 2012; Shongwe *et al.*, 2011). Agriculture remains an important land use in Kampala's urban and peri-urban areas; maintaining its presence in a future-focused land-use planning framework is important not only for storm water management but also for its contribution to the urban food system.

Water and UPA

Two primary water sources are used in the urban and peri-urban areas of Kampala: piped and spring water. Based upon tax reports, it is estimated that 70 per cent of the population access piped water while the remainder depend on spring or rain water (Twikirize, 2001). Other surveys in informal settlements confirm the emphasis on piped water, always showing more than 50 per cent of households using it (Howard *et al*., 2003; Kulabako *et al*., 2010). The water table and sources of spring water have been affected by the drainage of swamps for agriculture and settlements. These springs now dry up in the dry season and limit water access for household use (Matagi, 2002).

While most agriculture in Kampala is rain-fed, farmers are increasingly using irrigation from a variety of sources, as noted in a survey of Bugolobi Farmers' Group (Table 7.3; Muwembe, 2008). However, there are risks; some studies estimate that 80 per cent of springs in Kampala are contaminated with faecal pathogens (Kulabako *et al*., 2010) and in wetlands throughout Kampala used for agriculture and irrigation, faecal pathogens have been detected in the water, soil, and on the outside and inside of vegetables (Nasinyama *et al*., 2010). This is particularly worrisome in the rainy season when latrines overflow.

Some farmers in Kampala are beginning to opt for rooftop rainwater harvesting, which appears to be a promising coping strategy for supplying water in the face of scarcity. Secondly, rainwater harvesting helps to arrest surface water runoff, thereby reducing soil erosion and flooding. In many cities, such as in India, urban agriculture plays a significant role in wastewater recycling through irrigation. However, the opportunity for this has not been fully exploited in Kampala. Wastewater treatment in

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TABLE 7.3
Use of irrigation water by source by Bugolobi Farmer's Groups

Source of irrigation water	Usage (%)	Crops
Open stream—untreated domestic and industrial waste	38	Vegetables, floriculture, tree nurseries, yams, maize, and beans
Treated/dilute wastewater	20	Vegetables, floriculture, tree nurseries
Mixed waste and piped water	27	Vegetables, floriculture, tree nurseries, yams, maize, and beans
Water tankers/trucks	4	Grassed compounds and flowers
Other, for example pool, deep well, and main sewerage	11	Flowers, vegetables, and tree nurseries

Source: Muwembe (2008)

the city occurs at low rates and there are no mechanisms for providing access by urban farmers to treated wastewater. In addition, the use of treated wastewater for agricultural production is not part of national policies.

8 Recommendations

Create a more enabling policy environment for UPA. UPA contributes in important ways to Kampala's food basket, and to household food provisioning across income groups. However, urban farmers lack a strong presence in the agricultural development priorities of the country. Incorporating urban agriculture into the National Agriculture Policy would lead to UPA being accorded greater official recognition and support by all government programmes.

Ensuring better policy outcomes for UPA could also be achieved through increasing farmer (and broader public) awareness of recently enacted urban agriculture ordinances on livestock and companion animals, meat, milk and fish, which are aimed at more effectively regulating urban agriculture in Kampala. Broader awareness would make it easier for the urban authorities to consistently and transparently implement the ordinances. Awareness of the ordinances is currently quite low, and whenever KCCA officials try to enforce the regulations, farmers complain of harassment.

Another important policy need is the integration of UPA in the Kampala City Slum Development Plans. Urban and peri-urban agriculture is a significant contributor to the food supply that serves urban slum dwellers, but it faces many obstacles and challenges. Integrating UPA into the City Slum Development Plans could lead to more sustainable urban food production, which in turn could help enhance food security for the urban poor. Realizing UPA's potential in urban slums requires comprehensive assessments of key practitioner and beneficiary groups of UPA in slum settlements to important socio-economic and environmental factors and stressors impacting their livelihoods, and the scope for optimizing UPA within this context.

Policy support is also needed for food production in space-constrained conditions. Shortage of land in Kampala is a perennial challenge for UPA. Adaptation to the constraints of space would help to ensure sustainable urban food production. For instance, minimum land-holding size should not be among the requirements for the issue of a license to carry out commercial urban agriculture.

Lastly, urban farmers would benefit from organizing themselves into strong associations that would provide them a better chance of benefitting from extension/advisory services provided through the government's NAADS programme, which requires beneficiaries to be registered in a farmers' group. Organization into producer groups could also help in advancing agro-processing within the UPA sector, if, for example, NAADS, relevant city officials, the private sector and farmer groups could converge on developing appropriate agro-processing technologies and marketing. Such efforts would help to increase the marketability and profitability, and shelf life, of UPA products, and it may also provide a potential entry point for the city's UPA sector into the expanding array of supermarkets in Kampala.

Optimize UPA's ability to recycle and reuse urban waste. UPA is playing an increasingly positive role in decreasing the city's waste stream through productive recycling and reuse of urban wastes as livestock feed and for soil amendment. A full assessment of this "waste-into-wealth" potential is needed in order to understand the extent to which UPA can positively impact the city's waste disposal challenges, what the key enabling factors are for optimizing the waste reclamation system while reducing health hazards associated with using waste, and the productivity implications for feeding waste to livestock. Such an assessment could inform efforts to develop appropriate policies and measures to make waste recycling effective, profitable (for waste sellers) and safe. A related issue concerns how to better manage animal feed shortages of silage and hay used by dairy cattle farmers in Kampala.

Recognize and solidify the role of informal food markets. Informal food markets are central to accessible and affordable food, particularly for the urban poor, but are poorly recognized or seen as a threat by city authorities. An assessment of the value of informal markets to the city's food security would inform city authorities of the need to integrate such markets into city planning. An assessment also reveals possibilities for programmes to support hygienic and quality control of food products on the informal market. In addition, informal food-outlet actors need to organize and cooperate across the value chain to establish their collective voice in solidifying informal markets as part of the city's economy. Such cooperatives can encourage authorities to recognize the need of such markets for employment opportunities and food security of the urban poor.

Better document the contribution that UPA plays in urban food security and environmental sustainability. While it has been reported that UPA increases food and nutritional security in Kampala, there is limited quantitative evidence to back this up, and those studies that do exist are outdated. Convincing city politicians and planners to allocate scarce urban land to UPA and provide other financial and policy incentives to the sector requires a strong evidence base for how UPA positively impacts the urban food system and food security of low-income groups. In-depth analyses are therefore needed to determine the full economic and alimentary benefits of UPA across income groups and production types (i.e., crops, livestock, fisheries). Such knowledge would help to better understand the nexus between UPA, household food security and poverty alleviation.

Additionally, studies are needed to better understand the multifunctional benefits of UPA to environmental sustainability and a "greener" Kampala. Specific areas for research and technological development include farming in confined spaces, storage and processing, access to markets, efficient and better utilization of locally available livestock feed resources, rearing animals close to homesteads, efficient and effective rainfall water use, land-productivity enhancement and reducing the health risks in farming practices, such as those associated with use of wastewater for irrigation.

Strengthen the knowledge base for comprehensive and future-focused urban land-use planning. The need for urban landscapes to dampen flooding risks will become increasingly critical as flood-prone cities like Kampala attempt to adapt to climate change. There is a critical need to generate knowledge of spatial planning that considers floodwater management and to understand how the threshold for flooding could shift as both climate and land surfaces change in the future. Spatial planning that encompasses agriculture within a flood mitigation strategy will be important for both its environmental service as well as its contribution to the urban food system. Including UPA in the urban land-use plans would also provide it with a firmer legal basis. Environmentally sensitive and hazard-prone areas, such as wetlands, should be a focus area for vulnerability reduction because low-income settlement in this area is increasing and urban agriculture is an important livelihood resource.

UPA, as with agriculture more broadly, faces a multitude of potential impacts directly and indirectly associated with climate change. Research on climate change and urban food production systems lags considerably behind research on staple crops and extensive livestock systems in rural areas. Among the issues for which virtually no research has been conducted are:

- heat and water stress on horticultural crops and urban livestock keeping under climate change scenarios;
- how expected increases in temperature and humidity and changes in rainfall patterns due to climate change could influence existing or emerging pests and diseases of urban crops and livestock; and
- impacts of flooding on key components of the urban food system infrastructure—transport, processing facilities, markets, and storage—and how disruptions to the food system infrastructure affects food-insecure groups—UPA producers and non-producers alike.

Transdisciplinary efforts that involve researchers, farmers, government officials, the private sector etc., can help to identify action-research themes for UPA related to new technologies, practices and approaches to address adaptation needs.

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