

Edited by
Henk de Zeeuw and Pay Drechsel

Cities and Agriculture

Developing Resilient Urban Food Systems



CITIES AND AGRICULTURE

As people increasingly migrate to urban settings and more than half of the world's population now lives in cities, it is vital to plan and provide for sustainable and resilient food systems which reflect this challenge. This volume presents experience and evidence-based “state of the art” chapters on the key dimensions of urban food challenges and types of intra- and peri-urban agriculture.

The book provides urban planners, local policy makers and urban development practitioners with an overview of crucial aspects of urban food systems based on an up-to-date review of research results and practical experiences in both developed and developing countries. By doing so, the international team of authors provides a balanced textbook for students of the growing number of courses on sustainable agriculture and food and urban studies, as well as a solid basis for well-informed policy making, planning and implementation regarding the development of sustainable, resilient and just urban food systems.

Henk de Zeeuw is Senior Advisor at the RUAF Foundation, based in Leusden, the Netherlands. The RUAF Foundation (Resource Centres on Urban Agriculture and Food Security) is a global network and a leading centre of expertise in the fields of (intra- and peri-) Urban Agriculture and City Region Food Strategies.

Pay Drechsel is Principal Researcher at the International Water Management Institute, based in Colombo, Sri Lanka, and Leader of the Flagship on Recovering and Reusing Resources in Urbanized Ecosystems of the CGIAR Water, Land and Ecosystems Research Program.

Other books in the Earthscan Food and Agriculture Series

The Politics of Land and Food Scarcity

*Paolo De Castro, Felice Adinolfi, Fabian Capitanio, Salvatore Di Falco
and Angelo Di Mambro*

Principles of Sustainable Aquaculture

Promoting social, economic and environmental resilience
Stuart Bunting

Reclaiming Food Security

Michael S. Carolan

Food Policy in the United States

An introduction
Parke Wilde

Precision Agriculture for Sustainability and Environmental Protection

Edited by Margaret A. Oliver, Thomas F.A. Bishop and Ben P. Marchant

Agricultural Supply Chains and the Management of Price Risk

John Williams

The Neoliberal Regime in the Agri-Food Sector

Crisis, resilience and restructuring
Edited by Steven Wolf and Alessandro Bonanno

Sustainable Food Systems

Building a new paradigm
Edited by Terry Marsden and Adrian Morley

Seasonal Workers in Mediterranean Agriculture

The social costs of eating fresh
Edited by Jörg Gertel and Sarah Ruth Sippel

Food Security, Food Prices and Climate Variability

Molly E. Brown

Depolarizing Food and Agriculture

An economic approach
Andrew Barkley and Paul W. Barkley

For further details please visit the series page on the Routledge website:
<http://www.routledge.com/books/series/ECEFA/>

CITIES AND AGRICULTURE

Developing resilient urban
food systems

Edited by Henk de Zeeuw and Pay Drechsel

First published 2015
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

and by Routledge
711 Third Avenue, New York, NY 10017

Routledge is an imprint of the Taylor & Francis Group, an informa business

© 2015 RUAF Foundation and International Water Management Institute

All rights reserved. No part of this book may be reprinted or reproduced or utilised in any form or by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying and recording, or in any information storage or retrieval system, without permission in writing from the publishers.

Trademark notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data

Cities and agriculture : developing resilient urban food systems / edited
by Henk de Zeeuw and Pay Drechsel.

pages cm.—(Earthscan food and agriculture series)

Includes bibliographical references and index.

1. Urban agriculture. 2. Sustainable agriculture. 3. Food
supply. 4. Food security. I. Zeeuw, Henk de. II. Drechsel, Pay.

S494.5.U72C566 2015

338.1—dc23

2015007324

ISBN: 978-1-138-86058-2 (hbk)

ISBN: 978-1-138-86059-9 (pbk)

ISBN: 978-1-315-71631-2 (ebk)

Typeset in Bembo

by Apex CoVantage, LLC

CONTENTS

<i>Preface</i>	<i>vii</i>
<i>Foreword by HRH The Prince of Wales</i>	<i>xi</i>
<i>List of abbreviations and acronyms</i>	<i>xiv</i>
1 Urban food systems <i>Johannes S.C. Wiskerke</i>	1
2 Urban food policies and programmes: an overview <i>Lauren Baker and Henk de Zeeuw</i>	26
3 Process and tools for multi-stakeholder planning of the urban agro-food system <i>Henk de Zeeuw and Marielle Dubbeling</i>	56
4 Agriculture in urban design and spatial planning <i>André Viljoen, Johannes Schlesinger, Katrin Bohn and Axel Drescher</i>	88
5 Urban agriculture and short chain food marketing in developing countries <i>Paule Moustier and Henk Renting</i>	121
6 Urban agriculture's contributions to urban food security and nutrition <i>Maria Gerster-Bentaya</i>	139

7	Productive and safe use of urban organic wastes and wastewater in urban food production systems in low-income countries	162
	<i>Pay Drechsel, Bernard Keraïta, Olufunke O. Cofie and Josiane Nikiema</i>	
8	Urban agriculture and climate change	192
	<i>Shuaib Lwasa and Marielle Dubbeling</i>	
9	Urban horticulture	218
	<i>Hubert de Bon, Robert J. Holmer and Christine Aubry</i>	
10	Urban livestock keeping	255
	<i>Delia Grace, Johanna Lindahl, Maria Correa and Manish Kakkar</i>	
11	Urban forestry and agroforestry	285
	<i>Fabio Salbitano, Simone Borelli and Giovanni Sanesi</i>	
12	Urban aquaculture for resilient food systems	312
	<i>Stuart W. Bunting and David C. Little</i>	
13	Gendering urban food strategies across multiple scales	336
	<i>Liam Riley and Alice Hovorka</i>	
14	Financing urban agriculture: what do we know and what should we know	358
	<i>Yves Cabannes</i>	
15	Role of urban agriculture in disasters and emergencies	387
	<i>Andrew Adam-Bradford and René van Veenhuizen</i>	
	<i>List of contributors</i>	411
	<i>About the RUAF Foundation</i>	421
	<i>About the International Water Management Institute (IWMI)</i>	422
	<i>Index</i>	423

PREFACE

Urban agriculture – both inside the built-up city and in the peri-urban area – has various functions in the urban system. It plays, for example, an important role in feeding the increasing urban populations, often with highly nutritious food; a role that is specific and complimentary to food supply from rural areas. This context has often been underestimated, but the latest data point at a global farm area of more than 60 million ha within urban agglomerations,¹ which is a larger area than what we see, for example, under rice in South Asia, and if we include all farms up to 20 km from a city, the area is larger than the one of the European Union.

Next to the specific role in urban food supply, urban agriculture also plays other important functions in the urban system including the provision of eco-services, offering opportunities for recreation and enabling synergies (water, energy, CO₂, organic wastes) with other urban sectors.

Given the increasing recognition of urban food demand and other opportunities and challenges for agriculture in the urban context, the RUAF Foundation decided that it is timely to produce an up-to-date overview of the “state of the art” on agriculture in the urban context.

The developments in this innovative field of work in the last decade have been manifold, including amongst others:

- A growing interest of local governments and citizens in the Global North and Global South in food and agriculture and urban-rural linkages.
- The emergence of new drivers steering attention to urban agriculture and urban food systems.

For decades, many local governments have supported urban farming as a strategy for poverty alleviation, social inclusion and enhancing food security and nutrition

of the urban poor. Also, the role of (intra- and peri-) urban agriculture and forestry in urban greening and providing recreational opportunities for the urban citizens has been recognized for quite some time. However, more recently:

- Local governments started to support urban agriculture for the eco-services it provides (e.g., urban heat reduction, storm water management, biodiversity management) and its role in disaster risk management and city adaptation to climate change.
- Other cities have set out to shorten the food supply chains and promote the consumption of food produced in the city region in order to enhance the resilience of the urban food system and stimulate the local economy.
- There is also an increasing consciousness for a stronger water-energy-food nexus and closed-loop processes (circular economy, ecosanitation) through resource recovery and reuse, turning, for example, organic wastes and wastewater and excess energy, heat or CO₂ from industry, into valuable resources for urban food production.
- A broadening of the research and planning focus from urban agriculture to urban (or city-region) food systems, including (intra- and peri-) urban food production as well as the processing of the local produce, its marketing/distribution, food waste management (including resource recovery and reuse), and related inputs supply and support services.
- And as a consequence, a quickly growing body of evidence and experience-based knowledge.

With this publication we attempt not only to update earlier benchmark publications by the RUAF Foundation (*Growing Cities, Growing Food* with DSE, 2000; *Cities Farming for the Future* with IIRR, 2006; and *Cities, Poverty and Food* with Practical Action, 2011), but also to bridge between urban food and agriculture research and planning in the South and North. We hope that this publication will contribute to the intensified sharing of research results and policy and planning experiences between different regions and countries and to facilitate innovation and more effective urban food system research, policy planning and implementation. However, urban food systems, and the socio-economic, cultural and political factors shaping these systems, may differ substantially from region to region and even country to country, and lessons learned in one country or region might not fit another.

We expect that this publication will be of use for policy advisors, researchers, urban planners, specialists, practitioners and others involved in urban food system assessments and the design of urban food strategies and/or specific policies on urban agriculture or other components of the urban food system and that it will find its way to educational institutes that provide training in this field.

We want to thank all the authors that contributed to the various chapters: We are very grateful.

We also like to thank our chapter reviewers, Kingsley Kurukulasuryia for the language editing, Desiree Dirkzwager (RUAF Foundation) for the text editing and layout, and Ashley Wright (Earthscan) for coordinating the production and distribution of this book.

The editors,
 Ir. Henk de Zeeuw (*RUAF Foundation, Leusden, the Netherlands*)
 Dr. Pay Drechsel (*IMWI, Colombo, Sri Lanka*)

Note

- 1 Thebo, A. L.; Drechsel, P.; Lambin, E. F. 2014. Global assessment of urban and peri-urban agriculture: irrigated and rainfed croplands. *Environmental Research Letters* 9: 114002.

This page intentionally left blank



CLARENCE HOUSE

With so many challenges and pressures evident on the road to sustainability, it is easy to feel overwhelmed by the magnitude and diversity of barriers that must be passed in reaching the kinds of outcomes that the scientific community tell us are evermore urgently required. Anyone seeking solutions to the loss of biological diversity, depletion of critical resources, such as soils and water, or who is dealing with the causes and consequences of climate change will know what I mean.

One thing that I have learned during the four decades or so that I have paid close attention to these questions is that our lack of progress is not so much due to our inability to address individual parts of the sustainability challenge, but more to do with our inability to come up with truly integrated, systemic approaches that can tackle multiple facets of what are ultimately different expressions of common, underlying problems. Perhaps nowhere is this more evident than in relation to the rather important matter of how we feed ourselves.

This has been a key challenge for people down the ages, revolving around the conundrum of how to secure enough food to supply rising demand while at the same time keeping prices affordable. When one looks at the various indices of nutrition and how we have more or less managed to keep pace with recent explosive population growth, a record of apparent success is revealed. Despite a four-fold increase in human numbers during the 20th century, the supply of more and more food has meant that forecasts of epic famines affecting hundreds of millions of people have been largely avoided. There is, however, good reason to pause before declaring an unqualified triumph.

Our ever more globalized and high-input food systems have delivered massive increases in the supply of calories, but it is now becoming clear that not only has this performance not been enjoyed by all, it has also been bought largely at the expense of the overall health of the food system. Indeed, what we have seen is a kind of mining of the food system's key assets; ranging from the loss of farmers, soils and biodiversity to massive greenhouse gas emissions that are affecting the stability of our climate, and to changes in diets that are not only harmful to the health of our environment, but to people's health as well. This parlous situation is more and more widely recognized and a growing chorus of voices is now asking if there might be ways of doing things better, not only to ensure affordable nutrition, but also to sustain the healthy ecosystems that are an essential prerequisite for healthy people and to foster the healthy social systems that might enable societies to adapt better to the inevitable shocks that will come with changing conditions, not least shifts in climate.

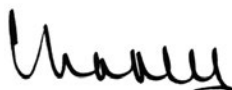
The big question, of course, is how? One encouraging trend is the way that people in different contexts around the world are taking the opportunity to improve their food systems. This is being done through actions at the city level, and strengthening the linkages between urban areas and their rural hinterlands in ways that help reduce some of the negative consequences arising from the current conventional approach. Such actions can help to increase the resilience of farming in the face of the pressures that during the coming years we can only expect to grow. The potential benefits are manifold. They include improved security in nutrition, increased availability of healthier food, opportunities to secure the livelihoods of small producers and their businesses, increased local participation in decision-making and engagement with food culture, improved scope for the more sustainable management of landscapes and the natural assets they sustain, and increased opportunity for synergy in meeting other key priorities, for example in relation to energy, waste and water security. All this, and more, can be achieved from a more integrated and socially inclusive approach at the city level. Experience from different parts of the world is beginning to reveal the scale of the positive opportunities at hand, if only we can adopt the strategies to seize them.

One important way to render these benefits more transparent is to undertake what might be called true cost accounting. The negative impacts that come in the wake of our ever-more industrialized food system are often justified in the name of 'cheap' food. Stepping back, however, and taking a more comprehensive view reveals that our food is actually very far from cheap; it is just that the costs are cropping up elsewhere. The effects of soil damage are, for example, reflected in increased water bills as technology has to be installed to remove pesticides, chemicals and nitrates. Soil degradation also creates costs in protecting people and property from flooding, which can increase due to the silting up of watercourses. There are mammoth hidden costs in "dead zones" in the oceans caused by the run-off of agri-industrial pollutants. There are costs reflected in public health trends too, for example arising from diets dominated by cheap processed food and so called 'empty calories' with too few fresh fruits and vegetables. Then there are the costly social impacts arising from rural unemployment. Crucially, these and other costs often resonate more loudly at the city level than at the national level which is often more focussed on short term macroeconomic concerns. The true costs of cheap food can also often be more effectively minimized at a city-region level than they can globally, thus offering prospects not only for more resilient outcomes but, in the end, more cost-effective ones too.

Fortunately, and in large part due to the leadership of organizations such as R.U.A.F., there is now real interest and engagement with the question of how to re-embed the historic relationship that existed for thousands of years between cities and the countryside surrounding them. For example, a range of international processes have recently considered the different steps that might be taken. These include an agreement reached at the World Urban Forum in 2014, amongst key U.N. and other international organizations, to share knowledge and to improve the coordination of their actions under the City Region Food Systems Collaborative. Cities themselves have also begun to act together, generating and exchanging knowledge in order to develop frameworks for action such as the Global Urban Food Policy Pact that has been catalysed by the city of Milan in 2015.

This is why I am so pleased to see the publication of *Cities and Agriculture – towards resilient urban food systems*. This timely and thorough overview about the opportunities for enabling city regions to drive a transformation towards much more sustainable, resilient and healthy food systems will, I hope, raise awareness as to the potential for a different direction of travel to the one we are presently embarked upon. Such a transformation would be based on using our increased knowledge to empower partnerships and develop the kind of integrated approaches to policy and planning that take us beyond the simple trade-offs which place faith in 'cheap food' and toward seeing the wider picture.

I can only congratulate the many scientists and practitioners for their valuable contributions to this important publication and very much hope it will find its way to national and local policy-makers, urban planners, academia, non-governmental groups, producers and consumers organizations, private sector companies and others that can make a contribution to building more resilient food systems through concerted and far-sighted action at the level of the city region.



HRH The Prince of Wales

ABBREVIATIONS AND ACRONYMS

AAA	Atelier d'Architecture Autogérée
AB Bank	AB Bank Limited (Bangladesh)
ADB	Asian Development Bank
AESOP	Association of European Schools of Planning
AFSUN	African Food Security Urban Network
AMAP	Associations pour le Maintien de l'Agriculture Paysanne (Associations for the Maintenance of Peasant Agriculture)
APA	American Planning Association
AR5	Fifth Assessment Report of the IPCC
As	arsenic
ASF	animal source food
AVRDC	the World Vegetable Center (formerly: "Asian Vegetable Research Centre")
BMI	body mass index
BSE	bovine spongiform encephalopathy, commonly known as mad cow disease
CAP	Common Agricultural Policy of the European Union
CBA	cost benefit analysis
CBD	Convention on Biological Diversity (UN)
Cd	cadmium
CDKN	Climate Change and Development Knowledge Network (UK)
CFF	Cities Farming for the Future (a RUAF programme)
CFS	Committee on World Food Security
CGIAR	Consortium of 15 international agricultural research organisations (originally founded as the "Consultative Group on International Agricultural Research")
CIRAD	Centre de coopération Internationale en Recherche Agronomique pour le Développement

CLT	community land trusts
C/N	carbon/nitrogen ratio
CO ₂	carbon dioxide
CPULs	continuous productive urban landscapes
Cr	chromium
CSA	Community Supported Agriculture
Cu	copper
CWP	Center for Watershed Protection (USA)
DEP	Department of Environmental Protection (New York City)
DPSIR	Driving forces, Pressures, State, Impacts, Responses (an assessment framework)
DPU	Bartlett Development Planning Unit, University College London
DRR	disaster risk reduction
ECHO	European Commission's Humanitarian Aid and Civil Protection Department
EKW	East Kolkata Wetlands
EKWMA	East Kolkata Wetlands Management Authority
EMPs	environmental management plans
ENPHO	Environment and Public Health Organization (NGO, Nepal) Top of Form
EPA	Environmental Protection Organization (USA)
FAO	Food and Agriculture Organisation of the United Nations
FEU	family economical unit
FSiT	From Seed to Table (a RUAF programme)
GAP	good agricultural practices
GBH	gravel bed hydroponic system
GHG	greenhouse gas (emissions)
GIS	geographical information systems
HACCP	hazard analysis and critical control points
HighARCS	Highland Aquatic Resources Conservation and Sustainable development project (EU)
HIV	human immunodeficiency virus
HOPSCOM	Horticulture Cooperative Horticulture Marketing Society (India)
IAP	integrated action plan
ICLEI	ICLEI-Local Governments for Sustainability (founded as the International Council for Local Environmental Initiatives; an international association of local governments)
ICM	impervious cover model
ICRC	the International Committee of the Red Cross (Switzerland)
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDPs	internally displaced persons
IDRC	International Development Research Centre (Canada)
IFA	International Federation of Landscape Architects
IICA	Inter-American Institute for Cooperation on Agriculture

xvi Abbreviations And Acronyms

IIED	International Institute for Environment and Development (UK)
ILRI	International Livestock Research Institute
INRA	L'Institut National de la Recherche Agronomique (French National Institute for Agricultural Research)
IPCC	Intergovernmental Panel on Climate Change
IPES	IPES–Promotion for Sustainable Development (NGO, Peru)
IPGRI	International Plant Genetic Resources Institute (now Bioversity International)
IPM	Integrated Pest and Disease Management
IRC	International Water and Sanitation Centre (the Netherlands)
IRRIGASC	an NGO based in Senegal working on sustainable development in the Sahel region, especially small-scale irrigation
ISA	International Society for Arboriculture
ISDR	International Strategy for Disaster Reduction (United Nations)
IUFRO	International Union of Forest Research Organizations
IWMI	International Water Management Institute
JEV	Japanese Encephalitis Virus
LAC	Latin America and the Caribbean
LEGS	livestock emergency guidelines and standards
LMR	limit maximal residues
LPI	lived poverty index
LRRD	linking relief, rehabilitation and development
LST	land surface temperatures
MAMC	Maulana Azad Medical College (India)
MDG	Millennium Development Goal
MENA	Middle East and North Africa
MFI	micro-finance institution
MOISA	The Markets, Organisations, Institutions and Actors' Strategies Unit of CIRAD
MPAP	multi-stakeholder policy formulation and action planning
MPSACCO	Mahila Prayas Savings and Credit Co-operative Ltd. (Nepal)
MSc	Master of Science
MSW	municipal solid waste
N	nitrogen
NBO Bank	National Bank of Oman
NFIs	national forest inventories
NGO	non-governmental organization
Ni	nickel
NO ₂	nitrogen dioxide
NUFU	National Urban Forestry Unit (UK)
NYC	New York City
O ₃	ozone
O&M	operation and maintenance
OECD	Organisation for Economic Co-operation and Development

OPV	open-pollinated varieties
P	phosphorus
PAPUSSA	Production in Aquatic Peri-Urban Systems in Southeast Asia project (Stirling University)
Pb	lead
PB	participatory budgeting
PhD	Doctor of Philosophy
PROVE	Programa de Verticalização da Produção (Verticalisation of Production Programme, Brazil)
PTE	potentially toxic element
PYMV	potato yellow mosaic virus
RCZI	Roadmap to Zoonosis Initiative
RGB image	digital aerial maps that are made by a special processing of perpendicular camera axis aerial images
RS	remote sensing
RUAF	RUAF Foundation (International network of Resource centres on Urban Agriculture and Food security)
SAD-APT	The joint interdisciplinary research team formed by INRA-SAD and AgroParisTech (France)
SDGs	Sustainable Development Goals (UN)
SFSC	short food supply chain
SISEF	Italian Society of Silviculture and Forest Ecology
SO ₂	sulfur dioxide
SSHRC	Social Sciences and Humanities Research Council (Canada)
STEPS	Social, Technical, Environmental, Political, Sustainability (a planning framework)
SWOT	Strengths, Weaknesses, Opportunities, Threats (an assessment method)
T4P	training for performance
TFPC	Toronto Food Policy Council
TIPA	techno-agricultural innovations for poverty alleviation
TLVs	traditional leafy vegetables
ToF	trees out of forests
TYLCV	tomato yellow leaf curl virus
UAV	unmanned aerial vehicles
UCLG	United Cities and Local Governments
UHI	urban heat island
UK	United Kingdom
UMP	Urban Management Programme (UN-Habitat/UNDP)
UN	United Nations
UNEP	United Nations Environmental Programme
UNHCR	United Nations High Commission for Refugees
UNU	United Nations University
USA	United States of America
USDA	United States Department of Agriculture

xviii Abbreviations And Acronyms

VSLA	village savings and loans associations
WASH	water, sanitation and hygiene
WISDOM	Wood Fuel Integrated Supply and Demand Review Mapping
WHO	World Health Organization
WRAP	Wetland Resources Action Planning (a toolkit)
WTP	willingness to pay
WWF	World Wildlife Fund
Zn	Zinc

1

URBAN FOOD SYSTEMS

Johannes S. C. Wiskerke

RURAL SOCIOLOGY GROUP, WAGENINGEN UNIVERSITY, THE NETHERLANDS

Introduction

An important milestone occurred in mid-2009, when the world's population, at that time about 6.8 billion, became more urban than rural. By 2050, when the world population is expected to have increased to 9.5 billion, approximately 66% of the world's population will be living in urban areas (UN 2014). Levels of urbanization differ when one looks at different continents. As Cohen (2006: 70) states: "There are enormous differences in patterns of urbanization between regions and even greater variation in the level and speed with which individual countries or indeed individual cities within regions are growing". Currently, Asia and Africa still have a predominantly rural population, while Europe, North America and Oceania were already urbanized regions before 1950. By 2050, however, all major areas will be urbanized (see Table 1.1).

TABLE 1.1 Urbanization trends by major regions (1950–2050)

Major region	Percentage urban				
	1950	1970	2014	2030	2050
Africa	14.4	23.5	40.0	47.7	56.0
Asia	17.5	23.7	47.5	55.5	64.4
Europe	51.3	62.8	73.4	77.4	82.2
Latin America and the Caribbean	41.4	57.1	79.5	83.4	86.0
Northern America	63.9	73.8	81.5	85.8	87.3
Oceania	62.4	71.2	70.8	71.4	74.0

Source: UN 2014.

Urbanization is and will partially be taking place through the growth of mega cities, cities with a population of more than 10 million (Sorensen and Okata 2010). However, the vast majority of urban population growth will occur in smaller cities and towns (i.e., urban settlements with a population of less than 1 million residents), followed by medium-sized cities (1–5 million residents). According to Cohen (2006), about 10% of the world's urban population will be living in mega cities, while just over half of the total urban population will reside in the smaller cities and towns.

Both mega cities and smaller cities face several development, governance and sustainability challenges, albeit that in some cases the kind of challenges differ substantially between the two. According to Sorensen and Okata (2010: 7–8), the increasing speed of urbanization has major consequences for mega cities: “building infrastructure takes time as well as money, and rapid growth often means that there is not enough of either to keep up with needs. Perhaps more fundamentally, political processes and governance institutions take time to evolve and generate effective frameworks to manage complex systems that make giant cities more liveable”. The governance capacity is also mentioned as a challenge for the smaller cities and towns: “many small cities lack the necessary institutional capacity to be able to manage their rapidly growing populations” (Cohen 2006: 74). The increasing governance complexity is not only due to the rapid urban population growth, but is also a result of the decentralization of regulatory responsibilities and policy implementation: “In the areas of health, education, and poverty alleviation, many national governments have begun to allow hitherto untested local governments to operate the levers of policy and programs” (ibid.: 74–75).

In addition to shifting governance responsibilities and growing governance complexities for cities, urbanization also poses a number of other challenges. One of these challenges is resource use (Madlener and Sunak 2011). Cities consume 75% of the world's resources, while covering only 2% of the world's surface (Pacione 2009), which means that the vast majority of resources used by a city are taken from, and produced in, places outside cities' borders. This is often referred to as the urban ecological footprint: “the total area of productive land and water required continuously to produce all the resources consumed and to assimilate all the wastes produced, by a defined population, wherever on Earth that land is located” (Rees and Wackernagel 1996: 228–229). Hence, the ecological footprint is “a land-based surrogate measure of the population's demands on natural capital” (ibid.: 229). In the process of urbanization, the urban ecological footprint, expressed in the annual demand for land and water per capita, has increased, particularly due to the growing energy demand for mobility, for cooling and heating of houses and offices, for all sorts of equipment for domestic use, and for long-distance transport, processing, packaging, cooling and storage of food (Lang 2010, Madlener and Sunak 2011). The growing ecological footprint of cities has also resulted in a characterization of cities as “parasites”, exploiting the resources of its rural hinterland while simultaneously polluting land, water and air (Broto et al. 2012). A shortcoming of the urban ecological footprint approach is that it is based on the average annual resource use per capita, thereby obscuring differences between urban dwellers within cities.

This brings us to another urbanization challenge: growing inequalities in wealth, health, access to resources and availability and affordability of services (Cohen 2006, Broto et al. 2012). Historically, cities developed in places that had a natural advantage in resource supply or transport and that hence offered opportunities for social and economic development: “cities have always been focal points for economic growth, innovation and employment” (Cohen 2006: 64). In most major regions of the world urbanization has gone hand in hand with economic development. This does not hold true for Africa, where current urbanization seems to occur despite economic development: “cities in Africa are not serving as engines of growth and structural transformation” (World Bank 2000 cited in Cohen 2006). Rather, these cities serve as a magnet for those seeking a better quality of life. However, the structural investments to provide this are largely lacking or at least insufficient. Urban growth generally means that cities become culturally and socioeconomically more diverse. Typical for many cities in developing countries, regardless of whether these cities are small, medium-sized or very large, is the significant difference between the upper- and middle-class and the low-income class with regard to access to clean drinking water and electricity and presence of adequate sewerage and solid waste disposal facilities (Cohen 2006, Broto et al. 2012). The reproduction, or perhaps even acceleration, of urban inequalities is often attributed to poor urban governance – i.e., municipal authorities unable to keep up with the speed of urban growth and/or with the increasing complexity of urban governance as a result of decentralization of policies – and neo-liberal reforms of urban services, which tend to exclude the urban poor from access to these services (Broto et al. 2012).

A fourth challenge of urbanization often mentioned in the domain of urban studies is environmental pollution, like water pollution across the developing world and air pollution, in particular when it comes to mega cities (Mage et al. 1996, Cohen et al. 2005). The images of cities full of smog and pedestrians wearing face masks to protect themselves from air pollution are telling examples of the problem of urban air pollution. Traffic congestion is considered to be a major source of air pollution in developing countries: “Over 90% of air pollution in cities in these countries is attributed to vehicle emissions brought about by high number of older vehicles coupled with poor vehicle maintenance, inadequate infrastructure and low fuel quality” (www.unep.org/urban_environment/issues/urban_air.asp). The greatest environmental health concerns caused by air pollution are exposure to fine matter particles and lead. This contributes to learning disability in young children, increase in premature deaths and an overall decrease in quality of life (Cohen et al. 2005, Cohen 2006). As “vegetation can be an important component of pollution control strategies in dense urban areas” (Pugh et al. 2012: 7693), the prevalence of air pollution in cities worsens due to the disappearance of the urban green (Pataki et al. 2011). The lack of urban green also contributes to urban heat islands, an urban environmental health challenge that is aggravated by climate change (Susca et al. 2011). Heat islands “intensify the energy problem of cities,

deteriorate comfort conditions, put in danger the vulnerable population and amplify the pollution problems” (Santamouris 2014: 682). Recent research indicates that green roofs can play an important role in mitigating urban heat islands and hence in reducing the urban environmental health problems resulting from climate change (Susca et al. 2011, Santamouris 2014).

An urban challenge that is gaining attention, but which was ignored for a long time in urban studies as well as in urban policies and planning, is food provisioning. Neglecting the dynamics and sustainability of food provisioning in scientific research on sustainable urban development is a serious omission, because, as Steel (2008) argues, “feeding cities arguably has a greater social and physical impact on us and our planet than anything else we do”. Like Steel in her much acclaimed book *Hungry City: How Food Shapes Our Lives*, the founders of food planning in the USA, Pothukuchi and Kaufman (1999: 216) state that in urban policy “food issues are hardly given a second thought” because urban policies are usually associated with issues such as “the loss of manufacturing jobs, rising crime rates, downtown revitalization, maintaining the viability of ageing neighbourhoods, and coping with rising city government expenditures”. This is also reflected in the names of municipal departments and the domains for which municipalities usually bear political responsibility (although this may differ between countries): planning and spatial development, finances, waste management, health, public transport, education, parks and recreation, and community development.

One reason why food has never been a prominent issue on the urban agenda is rooted in the persistent dichotomy between urban and rural policy. Food is often seen as part of the realm of agriculture and hence as belonging to rural policy. According to Sonnino (2009), this urban–rural policy divide is responsible for three shortcomings in urban food research, policy and planning:

- a) The study of food provisioning is confined to rural and regional development, missing the fact that the city is the space, place and scale where demand is greatest for food products.
- b) Urban food security failure is seen as a production failure instead of a distribution, access and affordability failure, constraining interventions in the realm of urban food security.
- c) It has promoted the view of food policy as a non-urban strategy, delaying research on the role of cities as food system innovators.

Linked to the urban–rural policy dichotomy is ignorance among many urban dwellers and policy officials about the significance of food for sustainable urban development and quality of urban life (Pothukuchi and Kaufman 1999), although this is more likely to be the case in cities where the availability of food has never been a real issue of concern for the “average” urban dweller. According to Pothukuchi and Kaufman (1999: 217), food should be understood as an important urban issue as it is “affecting the local economy, the environment, public health, and quality of neighbourhoods”.

In this chapter, I want to elaborate on this by presenting and discussing the conditions that are shaping urban food systems. An urban food system encompasses the different modes of urban food provisioning, in other words, the different ways in which locations where food eaten in cities is produced, processed, distributed and sold. This may range from green leafy vegetables produced on urban farms, to rice produced in the countryside surrounding the city, up to breakfast cereals produced, industrially processed and packaged thousands of kilometres away from the place of consumption. The food provisioning system of any city, whether small or large, in Europe, sub-Saharan Africa or Latin America, is always a hybrid food system, i.e., combining different modes of food provisioning. Some cities are mainly, though not exclusively, fed by intra-urban, peri-urban and nearby rural farms and food processors, while other cities are largely dependent, though not entirely, on food produced and processed in other countries or continents. Hence an urban food system is not only shaped by the dynamics characteristic for that particular city-region (i.e., the city and its urban fringe and rural hinterland), but also, and sometimes even predominantly, by dynamics at a distance. This is why the elaboration of the conditions shaping urban food systems is somewhat of a global and generic nature, introducing and explaining the main trends influencing urban food system dynamics. I will introduce some examples to highlight more concretely how and to what extent a city's food system is influenced by these conditions. However, the primary aim of this chapter is to introduce the different topics and themes related to urban food systems, and more in particular to (intra- and peri-) urban agriculture, elaborated upon in the following chapters in the book.

Building on these conditions, I want to conclude this chapter by proposing and discussing several guiding principles for designing and planning future urban food systems. Also this will touch upon issues that are further developed, discussed and illustrated in the following chapters.

The conditions shaping urban food systems

Living and eating in cities have increasingly become inextricably linked to globalized chains of food provisioning (Murdoch et al. 2000, Steel 2008). This is particularly true for industrialized economies, but also in many developing economies, processed foods, long-distance food transport and supermarkets as important food outlets for domestic consumption are on the rise (Reardon and Timmer 2007, Popkin et al. 2012). This globalized food system has brought many benefits to the urban population: food is usually constantly available at relatively low prices and many food products have a year-round supply. However, these benefits have also come at a series of costs (Wiskerke 2009, Lang 2010, De Schutter 2014), which are undermining a continuation of business as usual. Together with several current trends and dynamics that are impacting upon food provisioning activities, these costs inherent in the globalized industrial food system shape the conditions for current and future urban food systems. I will present and discuss below these trends, dynamics and costs.

Population growth, urbanization and changing diets

The first condition shaping current and future urban food systems is the combined process of population growth, urbanization and changing diets. As mentioned in the introduction to this chapter, the world population is expected to grow from 7 billion at present to 9.5 billion in 2050, of which 6.2 billion will be living in urban areas. Concomitant with population growth and urbanization, a change in diet is occurring, regularly referred to as the nutrition transition (Popkin 1999). The nutrition transition consists of two aspects: 1) an increase in energy intake and 2) a change in the composition of diets. The energy intake per capita per day has been increasing in the past decades and is expected to increase in the forthcoming decades (see Table 1.2).

TABLE 1.2 Global and regional food consumption patterns (in kcal per capita per day)

<i>Region</i>	<i>1964–1966</i>	<i>1974–1976</i>	<i>1984–1986</i>	<i>1995–1997</i>	<i>2006–2008</i>	<i>2030</i>
World	2,358	2,435	2,655	2,680	2,790	3,050
Developing countries	2,054	2,152	2,450	2,540	2,570	2,980
Near East and North Africa	2,290	2,591	2,953	3,100	3,150	3,170
Sub-Saharan Africa	2,058	2,079	2,057	2,150	2,270	2,540
Latin America and the Caribbean	2,393	2,546	2,689	2,740	2,920	3,140
East Asia	1,957	2,105	2,559	2,830	2,980	3,190
South Asia	2,017	1,986	2,205	2,300	2,360	2,900
Industrialized countries	2,947	3,065	3,206	3,250	3,430	3,500

Sources: Joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases 2003 (1995–1997 data) and www.fao.org/fileadmin/templates/ess/documents/food_security_statistics/FoodConsumptionNutrients_en.xls (2006–2008 data).

Diet composition is also changing with the transition from a rural to an urban diet as, for instance, illustrated by trends in the consumption of animal proteins (see Table 1.3). Popkin (1999) states:

Urban residents obtain a much higher proportion of energy from fats and sweeteners than do rural residents, even in the poorest areas of very low-income countries. Most urban dwellers also eat greater amounts of animal products than their rural counterparts. Urbanites consume a more diversified diet and more micronutrients and animal proteins than rural residents but with considerably higher intakes of refined carbohydrates, processed foods, and saturated and total fat and lower intakes of fiber.

TABLE 1.3 Per capita consumption of livestock products

Region	Meat (kg per year)			Milk (kg per year)		
	1964–1966	1997–1999	2030	1964–1966	1997–1999	2030
World	24.2	36.4	45.3	73.9	78.1	89.5
Developing countries	10.2	25.5	36.7	28.0	44.6	65.8
Near East and North Africa	11.9	21.2	35.0	68.6	72.3	89.9
Sub-Saharan Africa	9.9	9.4	13.4	28.5	29.1	33.8
Latin America and the Caribbean	31.7	53.8	76.6	80.1	110.2	139.8
East Asia	8.7	37.7	58.5	3.6	10.0	17.8
South Asia	3.9	5.3	11.7	37.0	67.5	106.9
Industrialized countries	61.5	88.2	100.1	185.5	212.2	221.0

Sources: Joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases 2003.

Hence the combined process of population growth, urbanization and nutrition transition implies that one of the grand societal challenges for the decades to come is how to feed the growing and urbanizing world population. An often heard slogan is that we “need to double food production to feed 9 billion” (Godfray et al. 2010, Foley 2011, Herrero 2013). This need to double food production is, however, criticized by different scholars (e.g., Holt-Giménez et al. 2012, Tomlinson 2013) for several reasons.

The first critique regards the production bias in the food security discussion. By focusing on food production as the means to address global food and nutrition insecurity, the real cause of food and nutrition insecurity is neglected. Food insecurity is first and foremost a problem of availability, accessibility, affordability and adequacy (De Schutter 2014). At the global level there are significant inequalities between countries and within countries in the availability of food; in some parts of the world there is an abundance of food available for consumption while in other parts there is insufficient food available, in terms of energy needs and/or nutritional needs. But even in places where there is sufficient food available, not everyone has equal access to nutritious food. The notion of “food deserts” (Wrigley 2002, Wrigley et al. 2002, Cummins and Macintyre 2006), i.e., impoverished urban neighbourhoods that lack supermarkets and grocery stores, but boast dozens of fast food and snack shops – has been introduced to highlight the problem of unequal access to food in cities in industrialized economies. With supermarkets and grocery stores moving to the outskirts of cities for logistical reasons, ownership of a car becomes more or less a prerequisite to have access to fresh food for

home preparation and consumption (Pothukuchi and Kaufman 1999). If public transport facilities to these outskirts are underdeveloped or simply lacking, then disadvantaged people are deprived of access, or at least easy access, to nutritious foodstuffs.

A third aspect of food security is affordability, referring to the price of food and the amount of money a person or a household has to purchase food. This implies that poverty is an important, if not the major, cause of food and nutrition insecurity (De Schutter 2014, Wegerif 2014). There is no reason to assume that doubling world food production will change anything in the affordability of food. A final aspect of food and nutrition security that is quite often neglected in international debates is the adequacy of food (De Schutter 2014). Adequacy refers not only to safety and nutritional value, but also to cultural appropriateness. What is considered to be a normal food item or even a delicacy for one person may be too sweet, too heavy or a taboo for another one. This means that food and nutrition security cannot be reduced to having access to sufficient calories and micronutrients. Also the kinds of food products that are available, accessible, safe, nutritious and affordable define food security.

An illustrative example of the availability, accessibility and affordability side of the food security equation is Wegerif's study of patterns of food provisioning in Dar es Salaam, Tanzania's largest city and among the top ten fastest-growing cities in sub-Saharan Africa. In Dar es Salaam only 10% of the households have motorized transport, 16% of the households live under the basic needs poverty line, 41% of the households have only one room in a house they share with other households, 74% of the households have three or more members and 23% of the city's population has a refrigerator (Wegerif 2014). This implies that for the vast majority of the population food outlets at walking distance are crucial due to limited or no possibilities to travel far to purchase food. Furthermore, the statistics indicate that a large percentage of the population has little to no space to store food and no possibility for cool storage of food. Using eggs as a case study, Wegerif shows the importance of the egg-provisioning network consisting of (intra- and peri-) urban farmers and *dukas* (street shops). The farmers often not only produce the eggs but also transport them by bicycle to the *dukas*. According to Wegerif (2014) this network has four main strengths for the urban poor compared to the supermarket system:

- 1 The price of eggs in a *duka* is lower than in supermarkets.
- 2 *Dukas* are found in any street in the city, while there are only a few supermarket stores in Dar es Salaam. Hence, a *duka* is always within walking distance.
- 3 *Dukas* offer the flexibility of being able to buy fewer eggs from one upwards compared to the 6, 10 or 30 egg trays available in the supermarket.
- 4 *Duka* owners offer access to short-term interest-free credit, something that the supermarkets are unable to do.

Lower prices, proximity, flexibility and the possibility of interest-free credit are "crucial for people surviving on limited and sporadic incomes. In addition, these

factors do away with the need for storage space, something not to be taken for granted by people who live in cramped spaces, often sharing, with uncertain tenure and with limited or no assets such as fridges or other furniture” (ibid.: 3768).

A second argument for criticizing the production-bias in the food security debate is that the perceived need to double food production is based on the assumption that food consumption trends in the past decade can be extrapolated to the future (see Tables 1.2 and 1.3). Recent figures show, however, that, in Europe and North America, consumption levels of red meat, in particular beef, are declining (Kearney 2010). Poultry consumption levels are increasing, which seems to indicate that red meat is replaced by white meat. Feed conversion efficiencies for poultry are much higher than for beef, implying that poultry consumption is less resource demanding than beef consumption (Cronje 2011, Mekonnen and Hoekstra 2012). Although the overall meat consumption levels in Europe and North America are not yet declining, the increase in recent years has been much more modest than in the second half of the 20th century (Kearney 2010).

The third argument to question the need to double food production is that, at the global level, enough food is currently produced to feed 10 billion, yet approximately 40% of the food produced is not consumed due to harvest losses on the farm and post-harvest losses further up the food chain, including post-consumer waste. According to Smil (2000) and Lundqvist et al. (2008), current agricultural production levels are equal to about 4,600 kcal per capita per day, of which 1,400 kcal per capita per day are lost in different stages of the food chain. Reducing harvest and post-harvest losses could therefore be as important as increasing yields (Herren 2011). Obviously, this does not mean that reducing food waste in Europe and North America will help to reduce the problem of food insecurity in sub-Saharan Africa and South Asia. In industrialized economies food losses primarily occur in the latter stages of the food chain: in supermarkets and restaurants and at home. Food is removed from supermarket shelves or is not bought or consumed because it is close to or past expiry date, because people buy too much or because the portions served are too large to consume (Steel 2008).

According to Lang (2010), approximately 33% of all food purchased in the United Kingdom is thrown away. Reducing food waste in the last stages of the food chain, in particular the still good and safe food that supermarkets dispose of, only contributes to reducing food security insofar as this food goes to nearby food banks and charities. For many developing countries, food waste primarily occurs in the first stages of the food chain, i.e., during harvest, storage and transport (Aulekh and Ragmi 2013). Especially for perishable products such as fruits and vegetables, harvest and post-harvest losses are high. In an emerging economy like India, which is the world’s second-largest producer of fruits and vegetables, up to 30% of all food produced is lost during harvest, post-harvest storage and distribution. Poor transport infrastructure between city and countryside, together with a lack of cool storage, are the main causes of these food losses. Hence, improving rural–urban distribution connections and creating and preserving space for intra- and peri-urban production of fruits and vegetables are key means to

enhance urban food security (Renting and Dubbeling 2013), as studies about urban agriculture in different cities in the Global South show that up to 40% of the urban demand for fruits and up to 90% of the urban demand for leafy vegetables are met by intra-urban and peri-urban agriculture (De Zeeuw and Dubbeling 2009). The contributions of (intra- and peri-) urban agriculture to safeguarding and enhancing urban food security and nutrition are further explored in Chapter 6.

Scarcity and depletion of resources

Food provision activities – referring to the whole range of activities from agricultural production to eating – depend on the availability and quality of a variety of natural and human resources, such as energy, nutrients, seeds, water, land and labour. The ways in which resources are used and the amounts of resources needed to produce food differ according to the system of urban food provisioning, but generally speaking, many of the crucial resources for food provisioning are depleting at a rate in which they are likely to become scarce. Changes in the use of resources – both in the way they are used and in the amounts needed – are therefore inevitable to safeguard urban food provisioning in the long term. The most important resource constraints for urban food provisioning are:

- a) *Fossil fuel.* Food production, processing, distribution, storing and sales have become heavily dependent on fossil fuels and as a result the globalized food system contributes significantly to greenhouse gas (GHG) emissions and hence to climate change (Carlsson-Kanyama et al. 2003, Carlsson-Kanyama and Gonzalez 2009, Lang 2010). Life cycle analyses of Western diets indicate that it takes an average of seven calories of fossil fuel energy to produce one calorie of food energy (Heller and Keoleain 2000). Although different elements of the global food supply chain contribute to this energy inefficiency, the “heavy fossil fuel users” are pesticides and chemical fertilizer, food processing and packaging, food transport (depending on the means of transport) and cooling (during transport, storage and sales) (Pimentel et al. 2008). Regarding the type of food product, animal protein supply chains require more fossil fuels than do crop supply chains. This implies that the expected dietary changes occurring as a result of urbanization (more processed food and more animal protein) will lead to an increased demand for fossil fuel if nothing changes in the energy input-output ratio of food provisioning. The second implication is that the price of food will be strongly influenced by the price of oil – as actually happened during the food price hikes in 2008 – and this may worsen the food security situation for the urban poor in developing economies, who spend up to 80% of their income on food (De Schutter 2014).
- b) *Water.* Most of the world’s surface water and groundwater is used for the production of food. In the UK, the average use of tap water is 150 litres per person per day. If the amount of water embedded in the products that are used

is included, the daily water consumption amounts to 3,400 litres per day. Of this, 65% is embedded in the food that is consumed: “A tomato has about 13 litres of water embedded in it; an apple has about 70 litres; a pint of beer about 170 litres; a glass of milk about 200 litres; and a hamburger about 2,400 litres” (www.waterwise.org.uk/pages/embedded-water.html).

Mekonnen and Hoekstra (2011: 1578) make a distinction between blue, green and grey water to calculate the water footprint of food products: “The blue water footprint refers to the volume of surface and ground-water consumed (evaporated) as a result of the production of a good; the green water footprint refers to the rainwater consumed. The grey water footprint of a product refers to the volume of freshwater that is required to assimilate the load of pollutants based on existing ambient water quality standards”.

Mekonnen and Hoekstra (2011) conclude that 78% of the water used for crop production is green water and 12% is blue water, but that the fraction of blue water increases for crops produced in arid and semiarid regions. For the production of animal protein (meat, dairy and eggs) the water footprint is (much) higher. Beef cattle have the highest contribution to the global water footprint, followed by dairy cattle, pigs and chickens. Industrial forms of live-stock husbandry have a higher water footprint than grazing systems. Also the share of blue water in the overall water footprint is higher for industrialized forms of animal husbandry. Mekonnen and Hoekstra (2012) conclude that “from a freshwater resource perspective, it is more efficient to obtain calories, protein and fat through crop products than animal products”. A similar conclusion was already drawn for the use of fossil fuels. It has been estimated that if the entire world population were to adopt a Western-style diet, 75% more water would be necessary for agriculture and this could imply that the world runs out of freshwater (Lang 2010).

- c) *Land*. At a global scale land is becoming a scarce resource (Lambin and Mayfroidt 2011), which implies that the competition over land use is becoming increasingly fierce (Lang 2010). Agricultural land is needed for the expansion of cities (or construction of new cities), for industrial development and for infrastructure. As many cities, though not all, have developed in areas that were (and often still are) very suitable for agricultural production, the expansion of cities usually goes at the expense of land for agricultural production, triggering deforestation to maintain sufficient amounts of land for agricultural production. In many countries we also witness a growing demand for other forms of land use in rural areas, such as land for recreation, nature and rural dwelling (Van Dam et al. 2006). Another competing claim regarding agricultural land use is the competition between food production and the production of biofuels (Matondi et al. 2011). With an increase in the price of oil, the production of biofuels becomes an economically interesting alternative for food production. Finally, there is also competition over land use for food production, especially in Africa and South East Asia, with foreign governments and transnational

corporations buying large areas of land (“land grabbing”) that can serve as sites for fuel and food production in the event of future price spikes (Borras et al. 2011).

These three resource constraints – energy, water and land – have for example been identified by New York’s City Council as potential threats to New York City’s food supply. To improve the resilience of New York City’s food system its City Council has developed a food strategy that promotes agricultural production methods that are less energy demanding, supports regional food production to reduce food transport, encourages the development of urban agriculture and preserves farmland in the city’s rural hinterland. New York City’s food strategy entitled “FoodWorks: a vision to improve NYC’s food system” is a perfect example of a City Council’s understanding of the relations between these general and global trends like resource depletion and the future resilience of its urban food system:

Although many of these problems are national and global in nature, there are immediate steps that can be taken within New York City to strengthen our food system. The city can facilitate urban-rural linkages, support a market for regional products, and use its institutional purchasing power to support small and local producers. Moreover, by helping green the city’s landscape, assisting companies with adopting new technologies, and exploring better distribution networks, we can begin to address the high energy usage and greenhouse gas emissions characteristic of our food system.

(Quinn 2012: 8)

Climate change

Climate change is another condition that will impact on the dynamics and resilience of urban food systems in a twofold way. First of all, climate change already has and will have a tremendous impact on the productive capacity of agriculture across the globe (Garnett 2008). Some regions are expected to benefit from global warming, as this will create a more productive environment (longer growing season, sufficient rainfall), while many other regions are likely to suffer from global warming due to severe droughts and floods and will hence be confronted with food shortages. In particular, some of the currently most food-insecure regions in the world (sub-Saharan Africa, the Middle East and South Asia), which are also the regions with the highest population growth and urbanization rates, are expected to face significant declines in agricultural production. This is partly due to the long-term average temperature increase; but particularly for the most food-insecure regions in the world the frequency and severity of extreme climate events will have the highest negative consequences for food production and food insecurity (Easterling et al. 2007), affecting food availability, food accessibility, food utilization

and food systems stability (FAO 2008). The relation between agricultural production and climate change is a dualistic one. On the one hand, agricultural production is largely negatively affected by climate change but, on the other hand, it also contributes to climate change by emitting GHG. This implies that agriculture can also “contribute to climate change mitigation through reducing greenhouse gas emissions by changing agricultural practices” (FAO 2008).

This brings us to the second relation between climate change and urban food systems. As mentioned in the introduction to this chapter, urban heat islands are the result of the combined effect of global warming and the decline in the urban green. Urban agriculture is increasingly recognized for its role in climate change adaptation and mitigation (Dubbeling 2014, see also Chapter 8 in this volume) by creating and maintaining green open spaces and increasing vegetation cover in the city. This can help to reduce urban heat islands by providing shade and increasing evapotranspiration. Preliminary analyses of the impact of (intra- and peri-) urban agriculture on climate change mitigation and adaptation in the municipality of Rosaria in Argentina show that average temperatures in the urban gardens are 2.4 °C lower than in the centrally built environment (Piacentini et al. 2014). Furthermore, green productive urban spaces can help to store excess rainfall and thus reduce flood risks in cities. Urban agriculture can also help to reduce food transport and cool storage of perishable products, which are food-provisioning activities that contribute to GHG emissions. Finally, urban agriculture can play a role in the productive reuse of urban organic waste and wastewater, which may help to reduce energy use in fertilizer production and in organic waste collection and disposal (Dubbeling 2014, Piacentini et al. 2014) and in lowering emissions from wastewater treatment (see also Chapter 7 in this volume).

Public health

Of the 7 billion people on the planet more than 2 billion suffer from diet-related ill-health: obesity, malnutrition and hunger (Lang 2010, De Schutter 2014). According to the *European Strategy for Child and Adolescent Health and Development* of the World Health Organization, “the growing obesity epidemic is one of the most worrying emerging health concerns in many European countries” (WHO 2005: 5). Obesity rates in Europe range from 10 to 38% of the population. In particular, the rapidly rising prevalence of overweight children is alarming (Lobstein et al. 2005). Obesity costs society tens to hundreds of Euros per person per year (Van Baal et al. 2006) and is responsible for approximately 25% of the annual increase in medical spending (Thorpe et al. 2004). Simultaneously, malnutrition is also a growing health concern which, like obesity, is more prevalent among the socially and economically disadvantaged sections of the urban population. Surveys in the United States in the 1990s revealed that up to 80% of elderly people in homes were suffering from malnutrition (Pothukuchi and Kaufman 1999). Research carried out by the charity Age Concern in the UK shows that 40% of people aged over 65 admitted to a National Health Service hospital are malnourished, while

an additional 20% may develop malnutrition during their hospital stay (Age Concern 2006).

Child malnutrition is a major concern in many developing countries. Although the overall percentage of child malnutrition is decreasing worldwide, the prevalence of stunting among young children remains high in Africa (in particular western and eastern Africa) and South-Central Asia (De Onis et al. 2012). Particularly in Africa the slow decline in the percentage of malnourished children combined with the rapid population growth leads to an increase in the numbers of stunted children: from 44.9 million stunted pre-school children in 1990 to an expected 64.1 million stunted pre-school children in 2020 (ibid.: 4). Hunger in its most extreme form has decreased globally from over 1 billion people in 1990–1992 (18.9% of the world's population) to 842 million in 2011–2013 (12% of the world's population). According to De Schutter (2014: 4), these figures are an underestimation of the global hunger problem as “these figures do not capture short-term undernourishment, because of their focus on year-long averages; they neglect inequalities in intra-household distribution of food; and the calculations are based on a low threshold of daily energy requirements that assume a sedentary lifestyle, whereas many of the poor perform physically demanding activities”.

In many cities, diet-related ill-health is increasingly becoming a driver of change in urban food systems. The origin of the Toronto Food Policy Council (TFPC) can be traced back to the city's Department of Health incorporating food and nutrition in its health policy in the 1980s (Blay-Palmer 2009). The TFPC, established in 1990, has been an advisory body for the Toronto Department of Health for a long time. Similarly, the London Food Strategy developed by Mayor Ken Livingstone was largely inspired by his public health agenda (Reynolds 2009). An example of public health concerns driving urban food system reforms in the Global South is Belo Horizonte's policy to increase the access to healthy food for all urban dwellers along three action lines (Rocha and Lessa 2009):

- 1 Preventing and reducing malnutrition by assisting poor families and individuals at risk to supplement their food consumption needs, and promoting healthy eating habits throughout the metropolitan region.
- 2 Bringing food to areas of the city previously neglected by commercial outlets, through partnerships with private food vendors, and regulating prices and controlling quality of basic staples, fruits and vegetables.
- 3 Increasing food production and supply by providing support to small producers, creating direct links between rural producers and urban consumers, and promoting different forms of urban agriculture.

Belo Horizonte has received national and international recognition for its successful approach in reducing hunger and malnutrition and has been the prime source of inspiration for Brazil's national Zero Hunger (*Fome Zero*) campaign initiated by the Lula administration.

Guiding principles for resilient urban food systems

The variety and complexity of the conditions shaping current and future urban food systems, combined with the interdependency of these conditions, indicate that it is an enormous challenge to create resilient urban food systems. To quote Lang (2010), these conditions “cannot be addressed singly, but must be addressed comprehensively and collectively” as “there is the danger of unintended consequences in single solutions”. I will therefore not present solutions but limit myself to a set of guiding principles for designing and developing resilient urban food systems which provide stepping stones for addressing the aforementioned conditions in a comprehensive way.

Adopt a city region perspective

The 2007/2008 food crisis has made municipal authorities more aware of the need to strengthen the resilience of the urban food system. As a result, intra- and peri-urban agriculture have been taken up in municipal and sometimes also in national policies (Blay-Palmer 2009, Rocha and Lessa 2009, De Zeeuw et al. 2011, Moragues-Faus et al. 2013) in many developing countries, initially with a strong focus on enhancing food security and reducing poverty. With climate change becoming a more prominent urban challenge in recent years, strategies to reduce the urban ecological footprint and urban heat islands and to mitigate climate change have been incorporated as additional goals for intra-urban and peri-urban food production programmes in cities in developing countries. In Europe and North America public health concerns (obesity and malnutrition) together with concerns about the ecological footprint of urban food systems, have been the main reasons for municipal and regional authorities to place food on the urban agenda (Moragues-Faus et al. 2013). According to De Zeeuw et al. (2011), these trends in both developing and developed countries “fit with concepts in urban development that stress the regionality of city space”, which indicates “a spatial and economic urban development model that focuses on a regional urban system in which various nodes interact with each other and with the open spaces included in such a functional urban region”.

Hence, the first guiding principle is to adopt a city region perspective on urban food systems, implying that the city region is the most appropriate level of scale to develop and implement an integrated and comprehensive solution for a future-proof urban food system. Due to the diversity in the characteristics, problems and challenges of urban food provisioning systems, it is impossible to develop an integrated comprehensive set of solutions that can work in all city regions. Each city region has its specific characteristics, challenges and solutions and hence it is vital that city regions “assess their food dependencies, identify weaknesses and potential pressure points and, where possible, develop a variety of channels through which they can procure their food” (De Schutter 2014: 15). The Zero Hunger policy of the Brazilian city of Belo Horizonte (Rocha and Lessa 2009) and New

York City's food vision FoodWorks (Quinn 2012) are both based on a thorough analysis of the strengths and weaknesses of the city's food system, including the city's relation with its rural hinterland through its different food provisioning channels. As weaknesses and opportunities are context specific, the programmes developed by Belo Horizonte and New York City differ greatly: in Belo Horizonte the focus has been on reducing hunger and malnutrition among the urban poor and on creating direct access to food markets for peri-urban family farmers (Rocha and Lessa 2009), while in New York City the emphasis has been on fighting obesity, preserving farmland and supporting urban agriculture to create a green infrastructure to mitigate climate change (Cohen and Wijsman 2014).

Furthermore, the city region is increasingly becoming the appropriate level of action as a result of the aforementioned decentralization of policy responsibilities (Cohen 2006). Many of the conditions shaping urban food systems refer to policy domains for which many local governments bear responsibility (e.g., waste management, transport, spatial planning, environmental health) or are expected to develop programmes and strategies (e.g., biodiversity, climate change, public health).

Connect flows

A second guiding principle is to connect different urban flows, allowing resources in waste to be recovered for flows creating value. Due to the sanitary-environmental approach to urban waste management (Geels 2006), different urban flows that were once interdependent (e.g., pigs in cities fed on organic waste) have become disconnected from one another. In most cities in developed countries and in (parts of) some cities in developing countries, domestic wastewater and urban rainwater disappear from the urban scenery through sewage systems. In many cities in developing countries the lack of sewage systems and floods resulting from heavy rainfall pose an enormous challenge. Solid waste (organic and non-organic) is put into a landfill or is being incinerated. The collection and disposal of urban waste generally take up a large percentage of municipal budgets and contribute to GHG emissions. However, urban waste can be used for other purposes as well, that may have a higher rather than lower value (up-cycling rather than down-cycling).

When it comes to food waste there is a systematic approach developed in the Netherlands, called Moerman's ladder, which starts with preventing food waste, followed by a range of possibilities for optimizing residual food waste streams (Van der Schans et al. 2014):

- Use for human food (e.g., food banks).
- Conversion to human food (processing).
- Use as animal feed.
- Raw material for the industry (bio-based economy).
- Transforming into fertilizer through cofermentation (+ energy generation).
- Transforming into fertilizer through composting.

- Input for sustainable energy (goal is provision of energy).
- Incineration (goal is destruction, with potential benefit of providing energy).

Using food waste as animal feed not only reduces the amount of food gone to waste but also reduces the amount of water needed for the production of animal protein: “Animal farming puts the lowest pressure on freshwater systems when dominantly based on crop residues, waste and roughages” (Mekonnen and Hoekstra 2012: 413). In Europe it is, however, not allowed to feed kitchen waste to pigs, as this has been restricted after the Bovine Spongiforme Encefalopathie (BSE, also known as mad cow disease) crisis.

Another waste flow that could be converted into a valuable resource is that of human excrements (Cofie and Jackson 2013), which are rich in nutrients, in particular phosphate, which is one of the resources that may become scarce in the future. From a sanitary hygiene perspective there are quite a few legal and cultural barriers to use human excrements as a resource for food production (Geels 2006, Jewitt 2011). Pilot studies about collecting and co-composting faecal sludge and solid organic waste are, however, promising (Cofie and Jackson 2013) and may create both sanitary and economic solutions for cities in developing countries where sewage systems are lacking in large parts of the city. The potential of intra- and peri-urban agriculture in the productive reuse of urban organic waste and wastewater is further explained in Chapter 7.

Using the waste generated by one flow as the input for another flow implies that the approach to waste management should shift from reducing something harmful to adding something useful. This is, for instance, central to the Cradle-to-Cradle approach of McDonough and Braungart (2002) in which waste equals food. Circular metabolism is a similar concept increasingly featuring in the academic debates about creating more sustainable cities: “the long-term viability and sustainability of cities is reliant on them shifting from a linear model to a circular model of metabolism in which outputs are recycled back into the system to become inputs” (Broto et al. 2012: 853).

There are many different ways in which flows can be (re-)connected, ranging from decentralized low-tech systems to more centralized high-tech systems. Within agro-ecological production systems the production of compost from household waste and the use of human urine as liquid fertilizer in agriculture or urban wastewater-fed aquaculture are examples of decentralized low-tech systems of connecting flows (Cofie and Jackson 2013). Within agro-industrial production systems, metropolitan food clusters and agroparks based on the concept of industrial ecology are examples of spatially clustered and connected chains of food production, in which the waste or by-product of one chain can serve as a resource for another chain (Smeets 2011). Which kind of system or combination of systems works best will depend on the specific characteristics of a city region. Agroparks may be the best solution for mega cities with a small or poor productive rural hinterland and/or with a small percentage of the population working in agriculture, while other systems may perform better in cities that lack sewage systems, in

which a large part of the population earns a living from intra- or and peri-urban agriculture.

Create synergies

A third guiding principle in the design of resilient urban food systems is to create synergies. The aforementioned guiding principle of connecting flows can also be seen as an example of creating synergies by constructing urban food systems in which waste can be used as, or converted into, a valuable resource. In this section the emphasis will be more on spatial synergies by achieving multiple benefits from the same place and on creating synergies by using food as a medium to link different urban policy objectives. Developing multifunctional urban and peri-urban agriculture and agroforestry spaces in city-regions may serve different purposes simultaneously. For instance, the cultivation of rice in the floodplains in Antananarivo (Madagascar) provides a staple crop for a large part of the urban population, mitigates floods during the rainy season, contributes to income generation and job creation for farmers and reuses urban wastewater that flows onto (intra- and peri-) urban agricultural land (Renting et al. 2013).

Another example is rooftop farming, which can contribute to greening of cities, reduce energy consumption for heating and cooling buildings, help to combat urban heat islands, be used for storm water containment and generate biodiversity in cities (Mandel 2013, Ackerman et al. 2014). Other examples of creating spatial synergies through intra- and peri-urban agriculture are, for instance, the synergies between food supply, leisure and education in agro-recreational parks in different Chinese cities, the synergies between food production, climate change adaptation and water management in Amman (Jordan), and the synergies between food provisioning, green urban infrastructure and biodiversity conservation in Cape Town (South Africa) (Renting et al. 2013).

By rethinking and redesigning systems of urban food provisioning, several urban policy domains can be addressed simultaneously, for instance enhancing environmental quality, alleviating poverty, reducing nutrition insecurity and generating jobs. In the Introduction, the problem of air pollution caused by vehicle emissions was mentioned. As a significant percentage of vehicle movements in cities is related to food delivery and food purchase (Pothukuchi and Kaufman 1999), measures to reduce food transport and to use modes of transport that emit less GHG, fewer fine particles and less lead may help to improve air quality. The aforementioned case of egg supply in Dar es Salaam by bicycle from intra- and peri-urban farms to street shops and wet markets is an interesting example in this respect. This system of food provisioning is not only one without GHG emissions during transport and little to no waste as egg trays are being reused, it also outperforms the more corporate system of industrialized agriculture and supermarkets with regard to the accessibility and affordability of eggs (Wegerif 2014).

Protecting land for urban farming, developing people's markets within walking distance of as many people as possible and better designed cycle paths to increase

safety and extend the effective range of bicycles would be important measures to reduce air pollution caused by food transport, enhance food and nutrition security for the urban poor and safeguard jobs and income generation in the urban food economy (ibid.: 3775). Other urban policy domains that can be addressed by redesigning the urban food systems are, for instance, public health, community building and education (Pothukuchi and Kaufman 1999, Brown and Jameton 2000, Mikkelsen 2011). Creating synergies between urban sustainable development goals through rethinking and redesigning the way food is produced, transported, sold and eaten requires the support from governments by including food as a topic in urban policy and planning (Pothukuchi and Kaufman 1999, Viljoen and Wiskerke 2012).

Plan for resilient urban food systems

This brings us to the fourth and final guiding principle, i.e., to plan for resilient urban food systems. As discussed in the introduction to this chapter, food has been absent on the urban policy and planning agenda for many decades. Urbanization, combined with decentralization of policies and a growing understanding that many urban challenges are either directly related to, or influenced by, the system of food provisioning, makes food a suitable vehicle to integrate the economic, social and environmental dimensions of sustainability, as well as addressing justice and health issues.

In recent years, a rapidly growing number of cities in Europe and North America are developing food policies or strategies (Moragues-Faus et al. 2013, Morgan 2013) in which food provisioning challenges are addressed simultaneously with concerns and problems related to public health, quality of neighbourhoods, climate change, biodiversity, energy and transport. But cities in developing countries and emerging economies are also developing or have already well-developed programmes and policies in support of resilient urban food systems. Examples are Rosario (Argentina), Lima (Peru), Belo Horizonte (Brazil), Kesbewa (Sri Lanka), Antananarivo (Madagascar), Casablanca (Morocco) and Bogota (Colombia) (De Zeeuw et al. 2011, Renting and Dubbeling 2013). Urban food strategies, described as “a process consisting of how a city envisions change in its food system, and how it strives toward this change” (Moragues Faus et al. 2013: 6), differ tremendously between cities as they are shaped by the particular characteristics and circumstances of a city, like historical and cultural factors, strength and basis of the local economy, geographical setting, access to food sources and infrastructure, the political and democratic system, and strength of the state and of civil society (ibid.: 5). Developing comprehensive urban food strategies capable of, or at least enabling, the aforementioned connection of flows and creation of synergies are difficult, but not impossible, as the cases of Belo Horizonte (Rocha and Lessa 2009) and Toronto (Blay-Palmer 2009) show.

As the food policies and strategies of many cities are relatively new, it is difficult to assess if, and to what extent, these integrated comprehensive approaches

are capable of successfully addressing the challenges that urban food systems are facing. However, the few city regions that began developing and implementing a food strategy about two decades ago, such as Belo Horizonte and Toronto, show that significant progress can be made in different domains simultaneously (Rocha and Lessa 2009, Blay-Palmer 2009). The importance of developing such integrated and comprehensive strategies at city-region level is increasingly understood by local authorities in all regions of the world, as for instance symbolized by the 2013 Bonn Declaration of Mayors at the 4th Global Forum on Urban Resilience and Adaptation: “We invite local governments to develop and implement a holistic ecosystems-based approach for developing city-region food systems that ensure food security, contribute to urban poverty eradication, protect and enhance local biodiversity and that are integrated in development plans that strengthen urban resilience and adaptation” (http://resilient-cities.iclei.org/fileadmin/sites/resilient-cities/files/Resilient_Cities_2013/MAF_2013_Bonn_Declaration_of_Mayors.pdf).

As integrated urban food strategies cross different policy domains, one of the key challenges is to organize the administrative and political responsibility for an urban food strategy. Pothukuchi and Kaufman (1999) propose three different options: a municipal department of food, food as the responsibility of the planning department or a food policy council. A department of food might offer a new focal point for urban food issues but which has the danger of becoming a department in itself, and thereby losing the possibility of using food as a vehicle to link different urban policy domains and goals. In that respect it would be better to have an interdepartmental body linked to, and governed by, the different municipal departments that are responsible for food-related issues. The success of Belo Horizonte’s food strategy is largely attributed to the Secretariat for Food Policy and Supply (Secretaria Municipal Adjunta de Abastecimento – SMAAB), an example of such an interdepartmental body (Rocha and Lessa 2009). Food as the responsibility of the planning department can bring a more holistic understanding of the food system by putting food in the centre of urban and regional planning.

A food policy council, which can also be complementary to a food department, the planning department, or any other relevant municipal department or even the city council or the mayor’s office, is a steering group or network of actors from public, civil society and private sectors involved in the formulation and implementation of a food strategy (Moragues Faus et al. 2013). Having stakeholders from the public, private and the civic sphere involved in a food policy council or another kind of partnership has proven to be extremely important for the development of a long-term food strategy and to be less vulnerable to political change (Wiskerke 2009). To what extent this could work in cities and city-regions where the institutional capacity is still weak remains to be seen. The many inspiring cases of urban food policy and planning around the globe are promising and encouraging examples of cities having the energy and capacity to design and construct more resilient urban food systems, capable of addressing the urban

challenges of food security, resource depletion, environmental pollution, climate change and public health.

References

- Ackerman, K.; Conard, M.; Culligan, P.; Plunz, R.; Sutto, M.P.; Whittinghill, L. 2014. Sustainable food systems for future cities: The potential of urban agriculture. *The Economic and Social Review* 45(2): 189–206.
- Age Concern 2006. Hungry to be heard: The scandal of malnourished older people in hospital. London: Age Concern.
- Aulakh, J.; Regmi, A. 2013. Post-harvest food losses estimation: Development of consistent methodology. Available from: www.fao.org/fileadmin/templates/ess/documents/meetings_and_workshops/GS_SAC_2013/Improving_methods_for_estimating_post_harvest_losses/Final_PHLs_Estimation_6-13-13.pdf.
- Baal, P.H.M. van; Heijink, R.; Hoogenveen, R.T.; Polder, J. J. van. 2006. Zorgkosten van ongezond gedrag, Zorg voor Euro's 3. Bilthoven: Rijksinstituut voor Volksgezondheid en Milieuhygiëne.
- Blay-Palmer, A. 2009. The Canadian pioneer: The genesis of urban food policy in Toronto. *International Planning Studies* 14(4): 401–416.
- Borras Jr., S.M.; Hall, R.; Scoones, I.; White, B.; Wolford, W. 2011. Towards a better understanding of global land grabbing: An editorial introduction. *The Journal of Peasant Studies* 38(2): 209–216.
- Broto, V.C.; Allen, A.; Rapoport, E. 2012. Interdisciplinary perspectives on urban metabolism. *Journal of Industrial Ecology* 16(6): 851–861.
- Brown, K.H.; Jameton, A.L. 2000. Public health implications of urban agriculture. *Journal of Public Health Policy* 21(1): 20–39.
- Carlsson-Kanyama, A.; Ekström, M.P.; Shanahan, H. 2003. Food and life cycle energy inputs: Consequences of diet and ways to increase efficiency. *Ecological Economics* 44: 293–307.
- Carlsson-Kanyama, A.; González, A.D. 2009. Potential contributions of food consumption patterns to climate change. *American Journal of Clinical Nutrition* 89: 1704S–1709S.
- Cofie, A.; Jackson, L. 2013. Innovative experiences with the reuse of organic wastes and wastewater in (peri-) urban agriculture in the global South. SUPURBFOOD deliverable 3.1. Leusden: RUAF Foundation.
- Cohen, A.J.H.; Anderson, R.; Ostro, B.; Pandey, K.D.; Krzyzanowski, M.; Künzli, N.; Gutschmidt, K.; Pope, A.; Romieu, I.; Samet, J.M.; Smith, K. 2005. The global burden of disease due to outdoor air pollution. *Journal of Toxicology and Environmental Health, Part A: Current Issues* 68(13–14): 1301–1307.
- Cohen, B. 2006. Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability. *Technology in Society* 28: 63–80.
- Cohen, N.; Wijsman, K. 2014. Urban agriculture as green infrastructure: The case of New York City. *Urban Agriculture Magazine* 27: 16–19.
- Cronje, P.B. (ed.) 2011. Recent advances in animal nutrition – Australia 18. Armidale, NSW: University of New England.
- Cummins, S.; Macintyre, S. 2006. Food environments and obesity: Neighbourhood or nation? *International Journal of Epidemiology* 35: 100–104.
- Dam, F. van; de Groot, C.; Verwest, F. 2006. Krimp en Ruimte: Bevolkingsafname, ruimtelijke gevolgen en beleid. Rotterdam: NAI Publishers.
- Dubbeling, M. 2014. Urban agriculture as a climate change and disaster risk reduction strategy. *Urban Agriculture Magazine* 27: 3–7.

- Easterling, W.E.; Aggarwal, P.K.; Batima, P.; Brander, K.M.; Erda, L.; Howden, S.M.; Kirilenko, A.; Morton, J.; Soussana, J. F.; Schmidhuber, J.; Tubiello, F.N. 2007. Food, fibre and forest products. In: *Climate change 2007: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. (Eds.) Parry, M.K.; Canziani, O.F.; Palutikof, J.P.; Linden, P.J. van der; Hanson, C.E. Cambridge and New York: Cambridge University Press, pp. 273–314.
- FAO 2008. Climate change and food security: A framework document. Rome: Food and Agriculture Organization of the United Nations (FAO).
- Foley, J.A. 2011. Can we feed the world & sustain the planet? *Scientific American* 305(5): 60–65.
- Garnett, T. 2008. Cooking up a storm: Food, greenhouse gas emissions and our changing climate. Guildford: Food Climate Research Network, Centre for Environmental Strategy, University of Surrey.
- Geels, F.W. 2006. The hygienic transition from cesspools to sewer systems (1840–1930): The dynamics of regime transformation. *Research Policy* 35(7): 1069–1082.
- Godfray, H.C.J.; Beddington, J.R.; Crute, I.R.; Haddad, L.; Lawrence, D.; Muir, J.F.; Pretty, J.; Robinson, S.; Thomas, S.M.; Toulmin, C. 2010. Food security: The challenge of feeding 9 billion people. *Science* 327(5967): 812–818.
- Heller, M. C.; Keoleian, G. A. 2000. Life cycle-based sustainability indicators for assessment of the U.S. food system. Ann Arbor: Center for Sustainable Systems, University of Michigan.
- Herren, H. 2011. 'Agriculture at a Crossroads' Lecture for the All Party Parliamentary Group on Agroecology. Tuesday, March 15th, 2011. London, United Kingdom: House of Commons.
- Herrero, M. 2013. Feeding the planet: Key challenges. In: *Energy and protein metabolism and nutrition in sustainable animal production*. (Eds.) Oltjen, J.W.; Kebreab, E.; Lapierre, H. Wageningen: Wageningen Academic Publishers, pp. 27–34.
- Holt-Giménez, E.; Shattuck, A.; Altieri, M.; Herren, H.; Gliessman, S. 2012. We already grow enough food for 10 billion people . . . and still can't end hunger. *Journal of Sustainable Agriculture* 36(6): 595–598.
- Jewitt, S. 2011. Geographies of shit: Spatial and temporal variations in attitudes towards human waste. *Progress in Human Geography* 35(5): 608–626.
- Joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases 2003. *Diet, nutrition and the prevention of chronic diseases: Report of a joint WHO/FAO expert consultation, Geneva, 28 January–1 February 2002*. WHO Technical Report Series 916. Geneva: World Health Organization.
- Kearney, J. 2010. Food consumption trends and drivers. *Philosophical Transactions of the Royal Society B: Biological Sciences* 365(1554): 2793–2807.
- Lambin, E.F.; Meyfroidt, P. 2011. Global land use change, economic globalization, and the looming land scarcity. *Proceedings of the National Academy of Sciences of the USA* 108: 3465–3472.
- Lang, T. 2010. Crisis? What crisis? The normality of the current food crisis. *Journal of Agrarian Change* 10(1): 87–97.
- Lobstein, T.; Rigby, N.; Leach, R. 2005. Obesity in Europe: Briefing paper for the EU Platform on Diet, Physical Activity and Health. London: International Obesity Task Force.
- Lundqvist, J.; de Fraiture, C.; Molden, D. 2008. Saving water: From field to fork. Curbing losses and wastage in the food chain. SIWI Policy Brief. Stockholm: Stockholm International Water Institute (SIWI).

- Madlener, R.; Sunak, Y. 2011. Impacts of urbanization on urban structures and energy demand: What can we learn for urban energy planning and urbanization management? *Sustainable Cities and Society* 1(1): 45–53.
- Mage, D.; Ozolins, G.; Peterson, P.; Webster, A.; Orthofer, R.; Vandeweerd, V.; Gwynne, M. 1996. Urban air pollution in megacities of the world. *Atmospheric Environment* 30(5): 681–686.
- Mandel, L. 2013. Eat up: The inside scoop on rooftop agriculture. Gabriola Island: New Society Publishers.
- Matondi, P.B.; Havnevik, K.; Beyene, A. 2011. Biofuels, land grabbing and food security in Africa. London: Zed Books.
- McDonough, W.; Braungart, M. 2002. Cradle to cradle: Remaking the way we make things. New York: North Point Press.
- Mekonnen, M.M.; Hoekstra, A.Y. 2011. The green, blue and grey water footprint of crops and derived crop products. *Hydrology and Earth System Sciences* 15: 1577–1600.
- Mekonnen, M.M.; Hoekstra, A.Y. 2012. A global assessment of the water footprint of farm animal products. *Ecosystems* 15(3): 401–415.
- Mikkelsen, B.E. 2011. Images of foodscapes: Introduction to foodscape studies and their application in the study of healthy eating out-of-home environments. *Perspectives in Public Health* 131(5): 209–216.
- Moragues-Faus, A.; Morgan, K.; Moschitz, H.; Neimane, I.; Nilsson, H.; Pinto, M.; Rohrer, H.; Ruiz, R.; Thuswald, M.; Tisenkopfs, T.; Halliday, J. 2013. Urban food strategies: The rough guide to sustainable food systems. FOODLINKS report. Available from: www.foodlinkscommunity.net/fileadmin/documents_organicresearch/foodlinks/publications/Urban_food_strategies.pdf.
- Morgan, K. 2013. The rise of urban food planning. *International Planning Studies* 18(1): 1–4.
- Murdoch, J.; Marsden, T.K.; Banks, J. 2000. Quality, nature and embeddedness: Some theoretical considerations in the context of the food sector. *Economic Geography* 76: 107–125.
- Onis, M. de; Blössner, M.; Borghi, E. 2012. Prevalence and trends of stunting among pre-school children, 1990–2020. *Public Health Nutrition* 15(1): 142–148.
- Pacione, M. 2009. Urban geography: A global perspective. New York: Routledge.
- Pataki, D.E.; Carreiro, M.M.; Cherrier, J.; Grulke, N.E.; Jennings, V.; Pincetl, S.; Pouyat, R.V.; Whitlow, T.H.; Zipperer, W.C. 2011. Coupling biogeochemical cycles in urban environments: Ecosystem services, green solutions, and misconceptions. *Frontiers in Ecology and the Environment* 9(1): 27–36.
- Piacentini, R.D.; Bracalenti, L.; Salum, G.; Zimmerman, E.; Lattuca, A.; Terrile, R.; Bartolomé, S.; Vega, M.; Tosello, L.; Di Leo, N.; Feldman, S.; Coronel, A. 2014. Monitoring the climate change impacts of urban agriculture in Rosario, Argentina. *Urban Agriculture Magazine* 27: 50–53.
- Pimentel, D.; Williamson, S.; Alexander, C.E.; Gonzalez-Pagan, O.; Kontak, C.; Mulkey, S.E. 2008. Reducing energy inputs in the US food system. *Human Ecology* 36: 459–471.
- Popkin, B.M. 1999. Urbanization, lifestyle changes and the nutrition transition. *World Development* 27(11): 1905–1916.
- Popkin, B.M.; Adair, L.S.; Ng, S.W. 2012. Global nutrition transition and the pandemic of obesity in developing countries. *Nutrition Reviews* 70(1): 3–21.
- Pothukuchi, K.; Kaufman, J.L. 1999. Placing the food system on the urban agenda: The role of municipal institutions in food systems planning. *Agriculture and Human Values* 16: 213–224.

- Pugh, T. A.; MacKenzie, A. R.; Whyatt, J. D.; Hewitt, C. N. 2012. Effectiveness of green infrastructure for improvement of air quality in urban street canyons. *Environmental Science & Technology* 46(14): 7692–7699.
- Quinn, C. C. 2012. FoodWorks: A vision to improve NYC's food system. New York: The New York City Council. Available from: http://council.nyc.gov/downloads/pdf/foodworks_fullreport_11_22_10.pdf.
- Reardon, T.; Timmer, C. P. 2007. Transformation of markets for agricultural output in developing countries since 1950: How has thinking changed? *Handbook of Agricultural Economics* 3: 2807–2855.
- Rees, W.; Wackernagel, M. 1996. Urban ecological footprints: Why cities cannot be sustainable – And why they are a key to sustainability. *Environmental Impact Assessment Review* 16(4): 223–248.
- Renting, H.; Dubbeling, M. 2013. Innovative experiences with (peri-) urban agriculture and urban food provisioning: Lessons to be learned from the global South. SUPURB-FOOD deliverable 3.5. Leusden: RUAF Foundation.
- Renting, H.; Naneix, C.; Dubbeling, M.; Cai, J. 2013. Innovative experiences with multifunctional (peri-) urban agriculture in city regions in the global South. SUPURBFOOD deliverable 3.4. Leusden: RUAF Foundation.
- Reynolds, B. 2009. Feeding a world city: The London food strategy. *International Planning Studies* 14(4): 417–424.
- Rocha, C.; Lessa, I. 2009. Urban governance for food security: The alternative food system in Belo Horizonte, Brazil. *International Planning Studies* 14(4): 389–400.
- Santamouris, M. 2014. Cooling the cities: A review of reflective and green roof mitigation technologies to fight heat island and improve comfort in urban environments. *Solar Energy* 103: 682–703.
- Schans, J. W. van der; Ge, L.; Schmid, O.; Dominguez Garcia, M. D.; Simón Fernández, X.; Swagemakers, P. 2014. Closing of nutrient, water and urban waste cycles in urban and peri-urban agriculture: Results of the exploration stage. Wageningen: Wageningen University and Research Centre.
- Schutter, O. de. 2014. The transformative potential of the right to food. New York: UN Human Rights Council.
- Smets, P. J. 2011. Expedition Agroparks: Research by design into sustainable development and agriculture in the network industry. Wageningen: Wageningen Academic Publishers.
- Smil, V. 2000. Feeding the world: A challenge for the 21st century. Cambridge, MA: MIT Press.
- Sonnino, R. 2009. Feeding the city: Towards a new research and planning agenda. *International Planning Studies* 14: 425–435.
- Sorensen, A.; Okata, J. 2010. Introduction: Megacities, urban form, and sustainability. In: *Megacities: Urban form, governance and sustainability*. (Eds.) Sorensen, A.; Okata, J. Tokyo and New York: Springer, pp. 1–11.
- Steel, C. 2008. Hungry city: How food shapes our lives. London: Random House.
- Susca, T.; Gaffin, S. R.; Dell'Osso, G. R. 2011. Positive effects of vegetation: Urban heat island and green roofs. *Environmental Pollution* 159(8–9): 2119–2126.
- Thorpe, K. E.; Florence, C. S.; Howard, D. H.; Joshi, P. 2004. The impact of obesity on rising medical spending. *Health Affairs* W4: 480–486.
- Tomlinson, I. 2013. Doubling food production to feed the 9 billion: A critical perspective on a key discourse of food security in the UK. *Journal of Rural Studies* 29: 81–90.

- UN 2014. World urbanization prospects: The 2014 revision. Washington, DC: United Nations, Department of Economic and Social Affairs, Population Division. Available from: <http://esa.un.org/unpd/wup/Highlights/WUP2014-Highlights.pdf>
- Viljoen, A.; Wiskerke, J.S.C. 2012. Sustainable food planning: Evolving theory and practice. Wageningen: Wageningen Academic Publishers.
- Wegerif, M.C.A. 2014. Exploring sustainable urban food provisioning: The case of eggs in Dar es Salaam. *Sustainability* 6(6): 3747–3779.
- WHO 2005. European strategy for child and adolescent health and development. Copenhagen: World Health Organization (WHO) – Regional Office for Europe.
- Wiskerke, J.S.C. 2009. On places lost and places regained: Reflections on the alternative food geography and sustainable regional development. *International Planning Studies* 14: 369–387.
- World Bank 2000. World development report 1999/2000: Entering the 21st century. New York: Oxford University Press.
- Wrigley, N. 2002. Food deserts in British cities: Policy context and research priorities. *Urban Studies* 39: 2029–2040.
- Wrigley, N.; Warm, D.; Margetts, B.; Whelan, A. 2002. Assessing the impact of improved retail access on diet in a ‘Food Desert’: A preliminary report. *Urban Studies* 39: 2061–2082.
- Zeeuw, H. de; Dubbeling, M. 2009. Cities, food and agriculture: Challenges and the way forward. *RUAF Working Paper 3*. Leusden: RUAF Foundation.
- Zeeuw, H. de; Veenhuizen, R. van; Dubbeling, M. 2011. The role of urban agriculture in building resilient cities in developing countries. *The Journal of Agricultural Science* 149(S1): 153–163.

2

URBAN FOOD POLICIES AND PROGRAMMES

An overview

Lauren Baker¹ and Henk de Zeeuw²

1 CITY OF TORONTO/PUBLIC HEALTH, TORONTO FOOD POLICY COUNCIL, CANADA

2 RUAF FOUNDATION, THE NETHERLANDS

Introduction

Historically, the development of cities was intimately intertwined with the development of food and agriculture in the city region. Over the past 65 years this connection has been increasingly lost due to the industrialization and globalization of food systems. Urban policy development and planning increasingly got separated from policy development regarding food and agriculture – and the planning and management of the ecosystem and natural resources – in the hinterland of the cities.

As a consequence, with the exception of land use planning, municipal authorities usually have little influence on defining agricultural and food policies and mainly play roles related to the delivery of national or provincial programmes (Steel 2008; Friedmann 2011; Crush and Frayne 2011).

Many local governments, not only in the Global North but also increasingly in developing countries, have started to acknowledge and reclaim jurisdictional responsibility for food systems activities that directly impact the health and well-being of their residents. Cities and citizens increasingly recognize that local authorities and governments have a role to play to address problems related to urban food insecurity, hunger, the increase of diet-related chronic diseases, the growing dependency on global food markets and large-scale supermarket chains, and the growing vulnerability of the urban food system (distortions in globalized food supply chains, impacts of climate change). For example, over the last 30 years across Toronto a vibrant food movement has sprung up to confront this situation, developing alternatives to the corporate food retail format such as farmers markets, food box programmes, coops, etc. Toronto's food movement is linked directly to the municipal government through the Toronto Food Policy Council, a