



# Building Urban Resilience

Assessing Urban and Peri-urban Agriculture in Dakar, Senegal



UNEP



global change SysTem for Analysis, Research & Training

Published by the United Nations Environment Programme (UNEP), November 2014

© 2014 United Nations Environment Programme (UNEP)

ISBN: 978-92-807-3374-7  
DEW/1786/NA

This publication may be reproduced in whole or in part and in any form for educational or non-profit services without special permission from the copyright holder, provided acknowledgement of the source is made. UNEP would appreciate receiving a copy of any publication that uses this publication as a source.

No use of this publication may be made for resale or any other commercial purpose whatsoever without prior permission in writing from the United Nations Environment Programme. Applications for such permission, with a statement of the purpose and extent of the reproduction, should be addressed to the Director, DCPI, UNEP, P.O. Box 30552, Nairobi 00100, Kenya.

#### **Disclaimers**

Mention of a commercial company or product in this document does not imply endorsement by UNEP or the authors. The use of information from this document for publicity or advertising is not permitted. Trademark names and symbols are used in an editorial fashion with no intention on infringement of trademark or copyright laws.

We regret any errors or omissions that may have been unwittingly made.

© Images and illustrations as specified.

#### **Citation**

Sy, M., M. Khouma, M.O. Diagne, M.L. Dial, O. Diop, I. Niang, N.Y. Badiane, Y. Niang and M.S.G. Ndong (2014). Building Urban Resilience: Assessing Urban and Peri-urban Agriculture in Dakar, Senegal. [Padgham, J. and J. Jabbour (eds.)]. United Nations Environment Programme (UNEP), Nairobi, Kenya.

A digital copy of this report along with supporting appendices are available at [http://www.start.org/upa/dakar\\_en.pdf](http://www.start.org/upa/dakar_en.pdf)

Managing Editor: Jon Padgham

Associate Editor/Production Coordinator: Jason Jabbour


Assistant Editor: Katie Dietrich

Copy Editors: Bart Ullstein and Kristie Bates

Layout and Design: Jennifer Odallo and Audrey Ringler

Printing: UNON Publishing Services Section, Nairobi-ISO 14001-certified/D1 No. 14-00110/250

Cover Photo: © Peeter Viisimaa



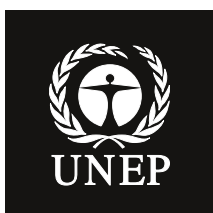
UNEP promotes environmentally sound practices globally and in its own activities. This report is printed on paper from sustainable forests including recycled fibre. The paper is chlorine free, and the inks vegetable-based. Our distribution policy aims to reduce UNEP's carbon footprint.

# Building Urban Resilience

---

## Assessing Urban and Peri-urban Agriculture in Dakar, Senegal

Moussa Sy, Mamadou Kouma, Mohamed Oumar Diagne,  
Mouhamadou Lamine Dial, Ousseynou Diop, Idy Niang,  
Ndèye Yacine Badiane, Youga Niang and Marie Sophie Gueth Ndong



## Preface

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

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

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

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



Jon Padgham  
Deputy Direct  
International START Secretariat



Jacqueline McGlade  
Chief Scientist  
United Nations Environment Programme

## Acknowledgements

We would like to thank the different individuals and institutions who in one way or another contributed to the execution of the larger European Commission-led project. In particular, the successful implementation and completion of the project, and the subsequent knowledge assessments were made possible due to the close cooperation and commitment of the International START Secretariat; the United Nations Environment Programme (UNEP) represented by the Division of Early Warning and Assessments and the Office of the Chief Scientist; the World Meteorological Organization (WMO), the University of Ghana, the University of Dar es Salaam, and the Bangladesh Centre for Advanced Studies (BCAS). Several colleagues across these organizations rendered valuable insight, expert advice, guidance and encouragement during this 4-year endeavor. We would especially like to recognize the efforts and support of Ghassem Asrar, Hassan Virji, Katie Dietrich, Clark Seipt, Chris Gordon, Pius Yanda, Atiq Rahman, Chipso Plaxedes Mubaya, Adelina Mensah, Elaine Tweneboah, Abu Syed, Salif Diop, Audrey Ringler, Jennifer Odallo, Peter Gilruth and Joseph Alcamo as well as Jon Padgham and Jason Jabbour, the project managers and editors of this series.

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

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

# Acronyms and abbreviations

ANSD	Agence Nationale de Statistique et de la Démographie (National Agency of Statistics and Demography)
ATADEN	d'assistance technique au développement économique des <i>Niayes</i> (Technical Assistance for <i>Niayes</i> planning and Economic Development)
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement (French Agricultural Research Centre for International Development)
CMIP5	Coupled Model Intercomparison Project Phase 5
CRDI	Centre de recherches pour le développement international
DDT	Dichlorodiphényltrichloroéthane
EDNA – RUF	Environnement développement action—Relais pour le Développement Urbain Populaire
FAO	Food and Agriculture Organization of the United Nations
GCCP	Global Climate Change Partnership of the United Nations
GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	Greenhouse gas
GIE	Groupement d'Intérêt Economique
GRET	Group of Research and Technological Exchanges
IAGU	Institut Africain de Gestion Urbaine (African Institute for Urban Management)
ICMSF	International Commission on Microbiological Specifications for Foods
IDRC	Institute of Research and Development (of Canada)
IFAN	l'Institut Fondamental d'Afrique Noire
IPCC	Intergovernmental Panel on Climate Change
IRD	L'Institut de recherche pour le développement
ISRA	Institut sénégalais de recherche agricole
NGOs	Non-governmental organizations
NRC	National Research Council
ONAS	Office National de l'Assainissement du Sénégal (National Office of Urban Sanitation in Senegal)
PASDUNE	Programme d'Action pour la Sauvegarde et le Développement Urbain des <i>Niayes</i> et zones vertes de Dakar
PDU	Plan Directeur d'Urbanisme (Urban Master Plan)
PNAT	Plan national d'aménagement du territoire
POP	Persistent organic pollutants
PPMP	Planning and preservation master plan
RCP	Representative Concentration Pathway
RegCM3	Regional climate model, version 3
RUAF	Resource Centres on Urban Agriculture and Food Security
START	Global change SysTem for Analysis, Research, and Training
UCAD	Universite Cheikh Anta Diop
UNEP	United Nations Environment Programme
UPA	Urban and peri-urban agriculture
WHO	World Health Organization
WWTL	Waste Water Treatment Laboratory

# Contents

••••• Executive summary . . . . .	vi
Introduction . . . . .	1
Objectives and methods . . . . .	3
Climate trends and projections . . . . .	5
Temperature trends and projections . . . . .	5
Rainfall trends and projections . . . . .	8
Heavy rainfall events, trends and projections . . . . .	10
Characteristics of UPA in Dakar . . . . .	13
Physical characteristics . . . . .	13
Economic characteristics of UPA in Dakar . . . . .	15
Characteristics of producers . . . . .	17
The policy environment . . . . .	21
Environmental and health policies affecting UPA . . . . .	21
Legal and jurisdictional frameworks . . . . .	21
Financing opportunities for UPA . . . . .	22
The land resource base and UPA . . . . .	23
Urban growth and land-use change . . . . .	23
Land-use change and flood risks . . . . .	23
The water resource base and UPA . . . . .	29
Health risks associated with the use of wastewater . . . . .	29
Threats to water and land resources in Dakar from sea-level rise . . . . .	31
Integrated water and wastewater management . . . . .	32
Agrochemical use in the <i>Niayes</i> . . . . .	35
Recommendations . . . . .	37
References . . . . .	43

