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URBAN AGRICULTURE AS A CLIMATE CHANGE AND DISASTER RISK REDUCTION STRATEGY

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Urban agriculture in floodzones in Antananarivo, Madagascar - ©RUAF

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Urban and peri-urban agriculture is considered as a strategy that can bring multiple benefits and help to build resilient urban food systems at the city region level. Cities have an important role to play in climate change mitigation and adaptation, disaster risk management and in enhancing the climate resilience of their vulnerable residents. Major emitters of greenhouse gas (GHG), cities are not only contributing to climate change, but are also directly and indirectly impacted by it. Acute or chronic climate change is threatening access to basic urban services such as water, energy and food for growing populations. Key issues include rising temperatures, increasing rainfall, flooding and urban food insecurity. Rapid urban growth will only increase the number of highly vulnerable urban communities, with the urban poor being most at risk. Only with a coordinated approach and action at the global, regional, national and local levels can the climate change emergency be curbed, and its effects mitigated.

INTRODUCTION

Urbanisation and climate change are closely linked. More than 50% of the world's population lives in urban areas, and by 2050 this figure is projected to rise to nearly 70% (UNPF, 2018). Urban areas consume as much as 80% of the energy produced worldwide and account for over 70% of energy-related global greenhouse gases (GHGs) – and both these figures are expected to rise. It is estimated that almost 90% of the increase in CO₂ from energy use will be from developing countries, especially from fast-growing cities in Asia and Africa (IEA 2008). Moreover, poor waste management in many cities contributes to chlorofluorocarbons (CFCs) and methane emissions (UN Habitat, 2018).

Whereas growing cities already face considerable challenges, such as ensuring safe housing, infrastructure, economic opportunities and adequate, safe, nutritious, affordable and culturally appropriate food for their populations, they also have to cope with climate change and the looming risk of climate-related disasters, which are among the most serious environmental, societal and economic issues facing the world today.

However, cities also possess the capacity to take scalable action, as they harbour the bulk of economic activity, and cultural and social capital. Over the past decade, many local authorities have acknowledged their potential to influence both the causes and consequences of climate change and are contributing to national and international climate change strategies. In this context, urban and peri-urban agriculture and forestry offer solutions to these challenges and help build more resilient cities.

THE CONTEXT OF INCREASED VULNERABILITY OF URBAN AREAS

Climate change, together with a decrease in green cover, parks, trees and agricultural activities that absorb GHGs in cities, poses serious threats to urban infrastructure, access to basic services and quality of life, while negatively affecting the urban economy (World Bank, 2010). The recent report of the Intergovernmental Panel on Climate Change (IPCC) on global warming of 1.5°C (IPCC, 2007, 2018) highlights the heightened exposure of cities to extremes of temperature, sea-level rise and severe storms, and the subsequent effects on infrastructure systems, water, health and economic development. Cities are increasingly being affected by both acute shocks amplified by climate change (such as droughts, floods, windstorms, forest fires or landslides) and chronic stresses resulting from longer-term projected climate change or uncontrolled urban growth. The most vulnerable cities are those in arid and water-stressed countries, island states, and less developed countries, as well as coastal and low-lying cities. In areas where climate change results in reduced precipitation, human settlements may be affected by drought, reduced water tables and food scarcity. In the past decade alone, Mumbai, Colombo, Bangkok and Manila are among the Asian cities that have faced massive disruptions to food systems, asset losses, price rises and hampered business operations for as long as three months due to events like waterlogging and flooding. Climate change also aggravates the urban heat island effect – that is, the increase of mean-day temperatures in built-up areas due to human, industrial activities and reflection of heat by buildings and pavements – which can result in increased energy use through air conditioning, air pollution and smog, and health problems for residents.

An increase in climate change-related extreme weather events and natural disasters, as well as chronic shocks, impacts food production, processing and distribution along the entire food supply chain. Cities are highly vulnerable to the disruption in critical (food) supplies, and climate change exacerbates this vulnerability. Urban economies suffer as rural agricultural production is adversely affected by storms, floods, shifting seasonal patterns, droughts or water scarcity. At the same time, changing temperature and precipitation patterns affect what crops can be grown in a given locale (Lotsch, 2008, UNEP, 2009). Increasing food prices resulting from food supply disruptions directly impact consumers in urban areas because they are almost entirely dependent on purchasing (rather than growing) their food. The hardest hit are vulnerable populations who are already experiencing or at risk from food insecurity. Furthermore, the effects of climate change on (productivity in) certain rural areas can result in more migration into cities (for economic or environmental reasons), leading to the accelerated growth of slum areas.

ASSESSING THE FOOD SYSTEM'S VULNERABILITY TO CLIMATE CHANGE

The city of Toronto, one of the RUAF Partners, has been committed to building a sustainable food system for years as a priority in its resilience planning. Recent research from the Initiative for a Competitive Inner City (ICIC 2018) investigated the risks posed by climate change to food distribution and access within Toronto. The analysis identified six key vulnerabilities to extreme weather events for Toronto's food system: urban flooding; infrastructure; the Ontario Food Terminal (wholesale market); vulnerable neighbourhoods that are already lacking in grocery provisioning; food insecurity; and coordination. Multi-actor involvement in addressing these issues is key.

Moreover, climate change disproportionately affects the urban poor and vulnerable groups (such as the elderly and disabled), a large percentage of whom live in informal settlements in low-lying and flood-prone areas on steep slopes, with limited access to viable livelihoods and precarious food and nutrition security (including the "silent hunger" of micronutrient deficiencies). In the event of a disaster, these settlements can rapidly become uninhabitable and prone to disease epidemics, disrupting the dwellers' ability to access (or safe use) of any home-stored foods, home gardens and cooking facilities.

The urban poor are also particularly vulnerable to variations in food prices and income, since food makes up a large part of their household expenses (often over 60%). A nutrition study implemented by the RUAF Foundation (Prain, 2010) in low-income neighbourhoods of five large cities showed that many poor urban households reduced the number of meals during financial and food crises and turned to cheaper and less nutritious food, with negative effects on the nutritional status of family members (particularly women and young children).

THE NEED FOR RESILIENT FOOD SYSTEMS

Increasing international policy attention is paid to the role of cities in contributing to more sustainable and resilient food systems, which are able to withstand and recover from the effects of crises, whether they are natural disasters such as droughts, storms and floods or socioeconomic shocks.

A resilient food system is understood as: "A system that has the capacity over time to provide sufficient healthy, sustainable and fair food to all in the face of chronic stresses and acute shocks, including unforeseen

circumstances... A resilient food system is robust (it can withstand disturbances without losing food security), has redundancy (elements of the system are replaceable and can absorb the effects of stresses and shocks), is flexible, can quickly recover lost food security and can adapt to changing circumstances” (Carey et al, 2016).

A resilient food system is thus likely to have some of the following features:

- diversified food supply chains that draw on large-scale and small-scale systems of food production and distribution, using a variety of approaches to production and distribution, and that draw on both commercial and community-based sources, without being dependent on one source;
- the capacity to draw on waste streams (wastewater, food waste and organic waste) for food production;

- the capacity to create synergies and achieve multiple benefits across a range of policy objectives, e.g. increasing access to healthy food and creating jobs;
- is people-centred and inclusive – people are at the heart of the food system, benefiting from increased access to healthy, sustainable food and from employment, and they engage actively with the food system as citizen-consumers;
- the capacity to monitor and address threats and reduce disaster risks in food systems;
- contributes to reducing GHG emissions and is an important local strategy for climate change adaptation and mitigation;
- supports effective land management and soil restoration.

THE RISE OF INTERNATIONAL FRAMEWORKS PROMOTING URBAN RESILIENT FOOD SYSTEMS

The UN 2030 Agenda for Sustainable Development recognises the need to “Make cities and human settlements inclusive, safe, resilient and sustainable” (Sustainable Development Goal 11). It also includes goals for sustainable agriculture to help reduce poverty (SDG 1), improve nutrition and reduce hunger (SDG 2), ensure sustainable consumption and production patterns (SDG 12), and help to combat climate change and its impacts (SDG 13). The Paris COP21 agreement (2015) and the Sendai Framework for Disaster Risk Reduction 2015-2030 both recognise the fundamental priority of safeguarding food security and ending hunger and the vulnerabilities of food production systems to the impacts of climate change. They underline the need for increased ability to adapt to the adverse impacts of climate change (both chronic stresses and sudden shocks). UN-Habitat addresses urban and human settlement issues in National Adaptation Plans (NAPs), essential in articulating the adaptation needs and priorities of countries (UN Habitat 2019).

UN-Habitat coordinates the Cities and Climate Change Initiative (CCCI) that seeks to enhance the preparedness and mitigation activities of cities in developing countries. The ICLEI Seoul Declaration for Sustainable Cities, adopted in 2015, and the UN-Habitat New Urban Agenda, adopted in Quito in October 2016, emphasise the need to “strengthen food system planning” and recognise that dependence on distant sources of food and other resources can create sustainability vulnerabilities and supply disruptions. The agenda includes a commitment to “support urban agriculture

and farming, as well as responsible, local, and sustainable consumption and production, and social interactions, through enabling accessible networks of local markets and commerce as an option to contribute to sustainability and food security”.

C40, the network of the world’s leading cities, promotes actions to reduce GHG emissions and climate risks; in 2016 it launched its Food Systems Network, in partnership with EAT.

As of April 2019, over 190 cities around the world had signed the Milan Urban Food Policy Pact (MUFPP), committing themselves to build more sustainable and resilient urban food systems. The Pact includes among its recommended actions: “Develop a disaster risk reduction strategy to enhance the resilience of urban food systems, including those cities most affected by climate change, protracted crises and chronic food insecurity in urban and rural areas.”

These international frameworks acknowledge the importance of sub-national governments and other actors adopting direct, locally appropriate measures to reduce climate impacts on food systems, rather than relying on national-level solutions that may be inadequate or unsuitable to local conditions. They can serve as a call for national governments to support and enable efforts by local governments, through framing policies, funding and locally applicable programmes.

All in all, building resilience in a city requires an integrated and, ecosystems-based approach that considers mitigation (e.g., strategies to reduce greenhouse gas emissions), adaptation (e.g., reducing the vulnerability to climate change) and development (such as poverty alleviation, income generation and food security) (World Bank, 2010). Urban and peri-urban agriculture and forestry may be suitable strategies to address this triple challenge.

ENHANCING THE POTENTIAL OF URBAN AGRICULTURE THROUGH CITY REGION FOOD SYSTEMS APPROACH

Agriculture has always been practised in and around cities, but only recently has urban agriculture been formally recognised in international agendas. Urban and Peri-urban Agriculture and Forestry (UPAF) is defined as the growing of trees, food and other agricultural products (herbs, pot plants, fuel, fodder) and raising of livestock (including fisheries) within a built-up area (intra-urban agriculture) or on the fringe of cities (peri-urban agriculture). UPAF includes various production systems such as horticulture, livestock, (agro-) forestry and aquaculture as well as related input supply, processing and marketing activities.

The most striking feature of UPAF is not its urban location but rather the fact that it is an integral part of the urban socioeconomic and ecological system (Mougeot, 2000). UPAF uses urban resources (land, labour and urban organic wastes), grows produce for urban citizens, is strongly influenced by urban conditions (urban policies and regulations, high competition for land, urban markets, prices, etc.) and impacts the urban system (having effects on urban food security and poverty, as well as having impacts on ecology and health). Interest in UPAF is triggered by recognition of its (potential) multiple co-benefits and contributions. Beyond its potential impacts on food security, health, urban environmental management, social inclusion, community building and local economic development, UPAF has also been recognised for the important role it can play in resilience.

During the last 10 years, urban agriculture has rapidly moved from a “fringe interest” into the centre of attention of policymakers and urban planners, both in developing and developed countries. Feeding an urbanising world has become an imperative for cities (FAO, 2012, 2014). The (re-)introduction of productive landscapes into city design and development planning has now been widely accepted (Bohn, 2010). This aligns with urban development concepts like rural-urban linkages (FAO, 2013) and “mosaic landscape development” (Tuts, 2011), Urban Food Systems, and City Region Food Systems (FAO/RUAF, 2015, Blay-Palmer, et al. 2018). Developed by RUAF Partners and the FAO, the city region food system (CRFS) perspective provides a platform on which to build concrete policy and offer investment opportunities to address pertinent developmental issues with the objective of achieving better economic, social and environmental

conditions in both urban and surrounding rural areas. Building a sustainable and resilient CRFS requires political will – integrating available policy and planning instruments (e.g. infrastructure, logistics, public procurement, land use planning), involvement of various government departments and jurisdictions (local and provincial), and inclusive organisational structures at different scales (municipal, district, etc.). An effective CRFS offers a lens through which this integration and coherence can be addressed at a specific territorial level (FAO, RUAF, 2018)

IMPROVING FOOD SECURITY WITH A CRFS APPROACH

RUAF collaborated with the City of Antananarivo, Madagascar to improve food security and income of the urban poor, and on the integration of urban agriculture in urban land use planning in order to reduce the impacts of climate change, notably flooding (AULNA project). The collaboration is continuing for the development of a city region food policy. Urban farming is an adaptation mechanism that helps to secure people’s ability to provide themselves with fresh, locally produced food, while reducing transport related GHG emissions.

As part of a sustainable CRFS, UPAF can play a role in:

- reducing “food miles” by producing fresh food close to urban markets;
- reducing fertiliser use and energy consumption by productive reuse of urban organic wastes;
- enhancing rainwater infiltration;
- reducing the urban heat island effect by increasing the surface of green areas;
- enhancing carbon sequestration (urban forests);
- providing better diets, urban food security, jobs and income;
- reducing the vulnerability of the urban poor and enhancing their coping capacity;
- diversifying income opportunities: creation of “green jobs”; safety nets in times of economic crisis;
- enhancing community building, innovation and learning;
- keeping low-lying zones free from construction so that floods have less impact, stormwater runoff is reduced, and excess water is stored and infiltrates green open spaces;
- enabling productive reuse of organic wastes, thereby reducing methane emissions from landfill and reducing energy use in the production of fertilisers;
- reuse of urban wastewater to free fresh water for higher value uses and reduce emissions from wastewater treatment.

Governments and city administrations must recognise the opportunities offered by UPA to improve urban food security and livelihoods. By adopting policy responses that better integrate agriculture into urban development, developing countries can reap considerable benefits, especially enhancements in social, economic and environmental sustainability (FAO Statistical Yearbook 2012: 216).

CITY STRATEGIES USING URBAN AND PERI-URBAN AGRICULTURE AND FORESTRY

The following measures may be taken by city governments to strengthen climate change adaptation and risk reduction strategies through UPAF:

1. integrating urban food security and urban agriculture into climate change adaptation and disaster management strategies;
2. maintaining and managing agriculture projects as part of the urban and peri-urban green infrastructure;
3. identifying open urban spaces prone to floods and landslides, and protecting or developing these as permanent agricultural and multifunctional areas;
4. integrating urban agriculture and forestry into comprehensive city water(shed) management plans, and in social housing and slum upgrading programmes;
5. developing a municipal urban agriculture and food security policy and programme.

By adopting policy responses that better integrate agriculture into urban development, developing countries can reap considerable benefits, especially enhancements in social, economic and environmental sustainability

Toronto (Canada) includes UPAF in its city climate change action plan. Actions include financial support for doubling the existing tree canopy by 2020, community-based projects, e.g., community orchards and gardens, home gardens, etc., and the promotion of composting organic wastes and rainwater harvesting. It also includes the reduction of the city “food print” by requiring shipping distance on food labels, promotion of regional products, support of farmers’ markets, and preferential procurement of locally-produced food.

In 2017 the Metropolitan District of Quito (MDQ) (Ecuador) published its resilience strategy, a development in partnership with the Rockefeller Foundation’s 100 Resilient Cities initiative. The strategy includes the need to develop a solid food economy, alongside other measures to reduce vulnerability to natural hazards, and proposes the development of a plan to strengthen the city’s food system.

In Bobo-Dioulasso (Burkina Faso), land surface temperatures increased approximately 6% a year in the period 1991-2013 due to increased urbanisation. The city now promotes agroforestry activities in open urban lots (greenways), while protecting

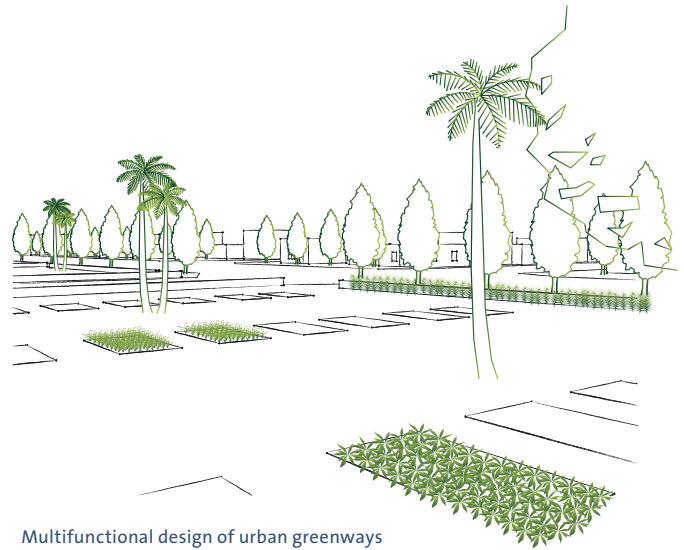
the peri-urban forests to help reduce urban temperatures. The greenways are planted with different fruit-bearing tree species and space is provided for recreation. Involved households have increased consumption of fresh vegetables and reduced their food expenditures. The new policy in Bobo Dioulasso includes acknowledging agroforestry and gardening as urban land use.



Rooftop gardens in Toronto - ©RUAF

In dense urban centres and settlements where space is limited, cities can promote rooftop gardens to increase thermal comfort in apartments located under the rooftop. Agricultural rooftops also provide food for the household and possible income for sales. A scenario developed for Vancouver (Canada) illustrates that if half of the city's usable rooftop space were used for urban agriculture, it could generate around 4% of the food requirements of 10,000 people. When combining this with hydroponic greenhouses, this figure could be increased to 60%. Kathmandu Metropolitan City-KMC (Nepal) has been promoting rooftop gardens in the city since 2012. By promoting household waste recycling, urban waste volumes that otherwise would end up in landfill are reduced. KMC trained over 500 households in rooftop farming, built demonstration rooftop gardens, and formulated a rooftop garden policy. In 2014, KMC signed an agreement with the Ministry of Federal Affairs and Local Development to ensure that by the end of 2016 at least 20% of all households in the city produce vegetables from their rooftop.

Other cities promote UPAF for reasons of food security, local economic development or environmental management. In the following cases, UPAF is not supported by climate change programmes, actors or funding, though they do have a bearing on climate change adaptation or mitigation. Freetown (Sierra Leone) has zoned all wetlands and low-lying valleys for urban agriculture in order to promote urban agriculture production for food supply and job creation, which at the same time increases water infiltration, reduces flooding, and keeps the flood-zones free from legal and illegal construction.



Multifunctional design of urban greenways in Bobo Dioulasso, Burkina Faso - ©F. Skarp

Growing built-up surfaces associated with urbanisation also reduce water infiltration and increase water runoff during rainstorms. With increasingly intense rainfall, flooding is common in cities that lack adequate drainage systems. Urban and peri-urban agriculture can reduce the impacts of higher rainfall by keeping low-lying zones free from construction so that floods have less impact, runoff is reduced, and excess water is stored and infiltrated. The cities of Kesbewa (Western Province, Sri Lanka) and Rosario (Argentina) promote the preservation and protection of green and productive areas on stream banks to reduce flood risks.



Promoting agricultural rooftop gardens in Kathmandu Metropolitan Municipality, Nepal - ©ENPHO/KMC and RUAF

Cities also promote sustainable urban and low-carbon development with potential connections to UPAF policy and implementation measures. As part of its Urban Master Plan (2005-2020), the city of Beijing (China) aims to preserve farmland and green spaces, designate permanent green areas in city fringes and corridors, promote wastewater recycling and rain and flood water harvesting, protect forest areas and parks, and certify and subsidise energy-saving production.

Besides integrating urban agriculture and forestry as part of climate change strategies and plans, better integration of food policies with land-use and zoning policies, waste management programmes, transportation projects and economic development policies is called for. In São Paulo (Brazil) and Lima (Peru) urban agriculture is integrated in social housing and slum upgrading programmes by including space for home gardens or community gardens, street trees for shade and fruits, and “productive parks”. In Rosario (Argentina), fiscal and tax incentives are provided to landowners who lease out vacant private land to groups of urban poor willing to produce on this land. Cities can also make municipal land available to groups of urban poor for gardening purposes, either through short- or medium-term lease arrangements, or by providing occupancy licenses to the urban poor producing informally on municipal land. As in La Paz (Bolivia), these contracts with farmers often include conditions regarding safe and sustainable land, crop and waste management practices. Municipal land that is provided might be earmarked for other uses but not yet in use as such, including land that is not fit for construction.

THE WAY FORWARD: BRIDGING THE DATA GAP

To support the promotion of UPAF as an effective component of climate-compatible development strategies and climate change financing, greater empirical evidence and quantification of its benefits are needed. Besides, climate change vulnerabilities for urban and city regional food systems can dramatically vary from place to place. Cities therefore need to choose the specific types of urban and peri-urban agriculture and forestry that best fit their CRFS, and their local socioeconomic, climatic, agronomic and spatial conditions. Yet there is a general lack of awareness and data on the possible role that they can play.

Even though statistics on the impact of disasters are collected and reported for all sectors, they do not capture the impact of climate change on the food system at the city region level. Moreover, many cities do not yet have a local climate change action plan or resilience strategy – and where they do, food system resilience tends to be included only to a limited extent.

There is a pressing need to better understand the impacts of climate change (both acute shocks and chronic stresses) on urban and city region food systems and their vulnerable populations, to serve as a basis for planning and monitoring. Cities and city regions that actively plan for resilient food

systems will help ensure that (a) the food supply chain is diversified and resilient to future climate impacts and that (b) food access returns to pre-disaster levels as quickly and as equitably as possible, so that all residents have adequate access to food in their neighbourhoods.

CREATING ADAPTABLE TOOLKITS

FAO and RUAF Global Partnership (led by Laurier University) are collaborating on a second phase of the City Region Food Systems initiative to strengthen attention to resilience and adaptation to climate risks. Local governments of three pilot cities (still tentative) in Vietnam (Danang), Rwanda (Kigali) and Madagascar (Antananarivo) will receive support in (i) assessing the resilience of the CRFS to both acute shocks (e.g. natural disasters affecting a city) and chronic stresses (e.g. projected longer-term climatic changes), and (ii) identifying adaptation strategies to strengthen the resilience to these shocks and stresses. The new methodology module on climate risk and vulnerability assessment will build on existing FAO tools and approaches; it will be flexible enough for application to very diverse CRFS contexts in both developing and developed countries.

If urban and peri-urban agricultures are to be further promoted as integral strategies for climate change adaptation, mitigation and disaster risk reduction, respective indicators and monitoring frameworks are needed to better understand its actual contributions. Both cities and international organisations are calling for more monitoring data in order to better design climate change strategies, plans and financing mechanisms that include urban agriculture.

Data could be effectively used to (1) develop GHG emission and air pollution reduction plans, considering UPAF as well as other interventions, (2) develop local food system strategies or urban afforestation/reforestation programmes (selecting species that can adapt to changing climates) and (3) integrate UPAF in urban planning as an appropriate use for vulnerable sites. In addition, data could (4) enhance awareness among citizens, the private sector and policymakers on UPAF and climate change, (5) obtain national and international support and funding for mitigation and adaptation measures involving UPAF and (6) mainstream UPAF in the international agenda by showing its social, economic and environmental benefits.

DATA MONITORING FRAMEWORKS (EXISTING AND UNDER DEVELOPMENT)

With support from UN-Habitat and the Climate and Development Knowledge Network (CDKN), RUAF designed a framework for indicators and tools to monitor the actual adaptation and risk-reduction impacts and development benefits of urban agriculture activities in different cities. FAO, MUFPP Secretariat, RUAF and partners have developed the MUFPP monitoring framework to help cities in formulating and monitoring urban food policies and in assessing progress made by cities in achieving more sustainable food systems. A methodological guide to help cities and partners in collecting and analysing the right data for the indicators is being drafted. The guide will also highlight the connections with the Sustainable Development Goals (SDGs). The framework is now being piloted in three signatory cities, Antananarivo, Nairobi and Quito, under the guidance and technical support of FAO and RUAF.

CONCLUSION

Policy participation of all actors in the food chain, from producers to consumers, needs to be enhanced to ensure relevant, accountable, equitable and sustainable action. Taking into account the needs and perspectives of vulnerable populations, whose homes, livelihoods, health and food access are most at risk from climate-related events, should be enabled by governance mechanisms.

Prompt action, e.g. enhancing energy efficiency, reducing pollution and promoting urban greening results in direct positive impacts on public health, improved quality of living, and cost savings on energy. This provides cities with opportunities to address deficiencies in housing, green spaces and services, and to create jobs and other local economic development opportunities. There is a pressing need to enhance awareness of local governments and other stakeholders involved in urban climate change programmes, about the potential of UPAF in climate change adaptation and mitigation, as well as its developmental benefits.

Finally, exchange of best practices and the development of monitoring tools are key to identify the types of production that are most appropriate to local contexts (e.g. farming in flood zones; agro-forestry on steep slopes; community gardening; promotion of aquaculture, etc.) as well as to design and implement projects where UPAF would yield the highest climate change impacts and co-benefits.

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 - Practitioner brief: Rooftop Agriculture – A climate change perspective
 - Final report: Integrating urban and peri-urban agriculture and forestry into city climate change strategies