Resource-Efficient Land Use – Towards A Global Sustainable Land Use Standard
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Urban Food Systems and Global Sustainable Land Use

GLOBALANDS Issue Paper

- **DRAFT VERSION** -

prepared by

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Executive Summary

Global land use is dominated by agricultural production, especially permanent grasslands for animal grazing, and for cultivating feed and food crops. The global food system (value chain of production and consumption of food as well as transport, processing etc.) **changed radically** over the last centuries, from subsistence agriculture and food production within and close to villages and cities to more rural production and urban consumption patterns nowadays, with a growing role of international trade.

The future of the global food system is rather uncertainty due to climate change impacts, diet dynamics, and yield developments. With cities and urban areas being "hotspots" of sustainability challenges and opportunities, urban food systems (as subsets of the global food system) are of interest.

Cities occupy a share of 0.5% of the global land area, and approx. 4% of the global arable land. Thus, urban food production cannot have a major **direct** impact on global land use, even if many cities will grow substantially in the future. Yet, there are specific agricultural land uses which can possibly be replaced by so-called Urban Agriculture (UA), and activities favoring urban food systems may have important indirect effects.

UA ranges from subsistence production and processing at household level to fully commercialized agriculture, and typically **complements** rural agriculture. UA is **not** a new issue: especially in developing countries, it is practiced by 800 million people worldwide out of which 200 million sell products on the market. UA uses organic wastes and wastewater as fertilizers, and aims at **perishable products** such as vegetables and dairy products.

In industrialized countries, urban infrastructures are typically more evolved and due to limited (and costly) urban land, agri- and horticultural businesses aim for **integrating** into buildings (indoor farms, rooftop gardens and greenhouses). Many projects focus on hydro- or aquaponic systems which can effectively control in- and outputs. These systems often are capital-intense, but integration in existing buildings may lower the cost.

UA accounts for 5–15% of total agricultural production in most developing countries, which can be translated in a respective reduction of non-urban agricultural land use, though due to expected lower productivity, the net reduction effect may be lower than the production share.

There is not (yet) any quantification available for “modern” UA in industrialized countries, but due to its comparatively recent development, overall effects can be expected to be lower than 5% of overall food production.

In considering urban food production as a possibility to reduce the land demand of a city outside its boundaries, a longer-term (2050) potential of replacing up to 10% of the urban food demand through UA seems possible, which could result in approx. 5% reduction of rural agricultural (15% of arable) **land use**.

The results from various projects on UA demonstrated that there are many opportunities in developing countries for the urban poor, contributing to food security and nutrition, and providing additional employment, and income.

Yet, there are environmental and health risks of UA, mostly related to developing countries. On the **social** side, the key challenge is insecure land tenure in cities.

Besides security of tenure, land **price** risks are crucial for UA, as this has a large influence on production cost. Also, there is few evidence on employment aspects of “modern” UA in industrialized countries which must be seen as a constraint in mainstreaming UA activities, and may imply that its quantitative relevance in high-wage urban areas of industrialized countries will be restricted.

There is clear evidence, though, that the broader concept of urban food systems – i.e. going beyond UA and integrating the consumers – can have positive impacts on urban biodiversity, social cohesion and cultural integration.

The educational value of urban food production and its impact on urban diets may be an important opportunity to foster behavioral changes towards less meat consumption and reducing food waste, which would have significant net gains in terms of land demand.

Research is required on the capacity of urban production and economic and social co-benefits of local production and consumption.

Other options should be considered as well, e.g. so-called Metropolitan Food Clusters which are high-tech concepts inclusively linking rural farms to rural cities and larger urban centers, aiming at diversity and efficiency. These options need not be seen as alternatives to UA, but may well be complementary and could help transform the – dominating - industrial agricultural system.

Urban food systems are becoming a key issue in the process towards the UN HABITAT III conference, and should be seen less in a view of quantitative global land use relevance, but as important steps in a longer **transformation process** towards sustainability.

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Acknowledgement

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Acronyms

BMUB	German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit)
CBD	UN Convention for Biological Diversity
CSA	Community Supported Agriculture
EC	European Commission
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FPC	Food Policy Councils
GHG	greenhouse gas(es)
ICLEI	Local Governments for Sustainability
IFAD	International Fund for Agricultural Development
IINAS	International Institute for Sustainability Analysis and Strategy
IPCC	Intergovernmental Panel on Climate Change
MDGs	Millennium Development Goals
Mha	million hectares
OECD	Organisation for Economic Development and Cooperation
RUAF	Resource Centres on Urban Agriculture and Food security
SDGs	Sustainable Development Goals
UA	Urban Agriculture
UBA	German Federal Environment Agency (Umweltbundesamt)
UN	United Nations
UN-DESA	United Nations Department of Economic and Social Affairs
UNEP	United Nations Environment Programme
UN-HABITAT	United Nations Human Settlements Programme
UN-OWG	United Nations Open Working Group
WB	World Bank
WWF	World-Wide Fund for Nature

Introduction and Objectives

Within the GLOBALANDS project, the analysis of different global land use scenarios identified trends of urbanization, food consumption and diets, respectively, as key drivers for future land use (Fritsche, Eberle 2013).

Especially **food** has been the focus of more recent work which linked agriculture and food consumption to global threats such as biodiversity loss, climate change, soil degradation and water stress[1].

On the other hand, the second relevant "driver" of global land use changes and respective impacts is urbanization, i.e. the dynamics in the **urban** sphere:

"Cities are the new hot spots of global environmental change. They are the leading growth centres of population, consumption, resource use and waste" (WWF 2013).

"The next two decades present a window of opportunity for mitigation in urban areas, as a large portion of the world's urban areas will be developed during this period" (IPCC 2014b).

Food and cities can be combined in so-called **urban food systems** which are the focus of this Issues Paper[2].

In Section 1, a brief background of the global food system and its development is given.

Section 2 then compiles findings on urban food systems from the recent literature.

Building on another GLOBALANDS Issues Paper which addresses **urban-rural** linkages (Eppler, Fritsche, Laaks 2015), this paper aims to identify challenges and opportunities for global sustainable land use resulting from urban food demand developments and potential supply options ("urban agriculture"), and discusses the relevance of these opportunities in Section 3.

From that, the paper derives perspectives for further work (Section 4).

1 See e.g. HBS, IASS (2015); IPCC (2014a); WWF (2015).

2 Note that aquatic and especially marine food sources such as algae, fish, mussels etc. are beyond the scope of this paper, as GLOBALANDS is primarily concerned with terrestrial activities. Yet, it should be acknowledged that fishery products and related activities provide significant shares of the global diet, and are – together with aquaculture – projected to increase further (FAO 2014f). Also, aquaculture is increasingly reliant on land-based feedstocks (such as soy) so that an indirect link to global land use exists. Given that the focus of this Issues Paper is on urban food systems and their linkages to global land use, this aspect is not discussed further, though.

1 Background: The Global Food System

Of the 13.4 billion hectares of land available worldwide, 40% (approx. 5 billion ha) is agricultural land (FAOSTAT 2015) which makes **food and feed** the single largest global land use[3]. Agricultural land use is dominated by permanent grasslands mainly used for animal grazing (approx. 70%), and of the remaining 30% of arable land (1.5 billion ha), about 70% is used for cultivating feed crops (FAOSTAT 2015), i.e. less than 10% of the agricultural land (< 0.3 billion ha) is used directly for human food[4].

Today, more than 90 % of the world's farms are family farms, cultivating about 75% of global farmland and producing 80 % of the world's food (FAO 2014a; IFPRI 2015)[5]. Furthermore, the vast majority of small farmers is women (GRAIN 2014).

The value chain of production and consumption of food as well as transport, processing etc. is called "food system" (Tansey, Worsley 1995). The global food system changed radically over the last centuries, from subsistence agriculture and food production within and close to villages and cities to more rural production and urban consumption patterns nowadays, with a growing role of international trade (see Section 1.1)[6].

Due to increases in both agricultural land use and productivity, food production has risen faster than population, resulting in a **reduction of hunger**. The target of the Millennium Development Goals (MDGs) of halving the percentage of people suffering from hunger by 2015 is not yet achieved (UN 2014), but the proportion of undernourished people in developing regions has decreased from 24% in 1990–1992 to 14% in 2011–2013 (FAO 2014d).

The new post-2015 development agenda aims at Sustainable Development Goals (SDGs) which will be not only focusing developing countries (as the MDGs), but be universal, i.e. also relevant for industrialized countries and emerging economies. The current proposal of the SDGs states as Goal 2:

"End hunger, achieve food security and improved nutrition and promote sustainable agriculture" (UN-OWG 2014).

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3 Agriculture is further expanding, nowadays mainly replacing forests in the Tropics (Gibbs et al. 2010), thereby making agriculture the largest cause of deforestation: approx. 5-10 Mha are cleared annually for agriculture (IPCC 2014a). On the other hand, the Brazilian Soy Moratorium has been effective in reducing deforestation (Gibbs et al. 2015).

4 All FAOSTAT (2015) data are for 2011, the latest year currently available.

5 It should be noted that according to GRAIN (2014), small farms own only 25% of the **agricultural** land, i.e. including pasture (grassland). This figure was compiled by GRAIN in a bottom-up analysis of country data, but has not given a specific year.

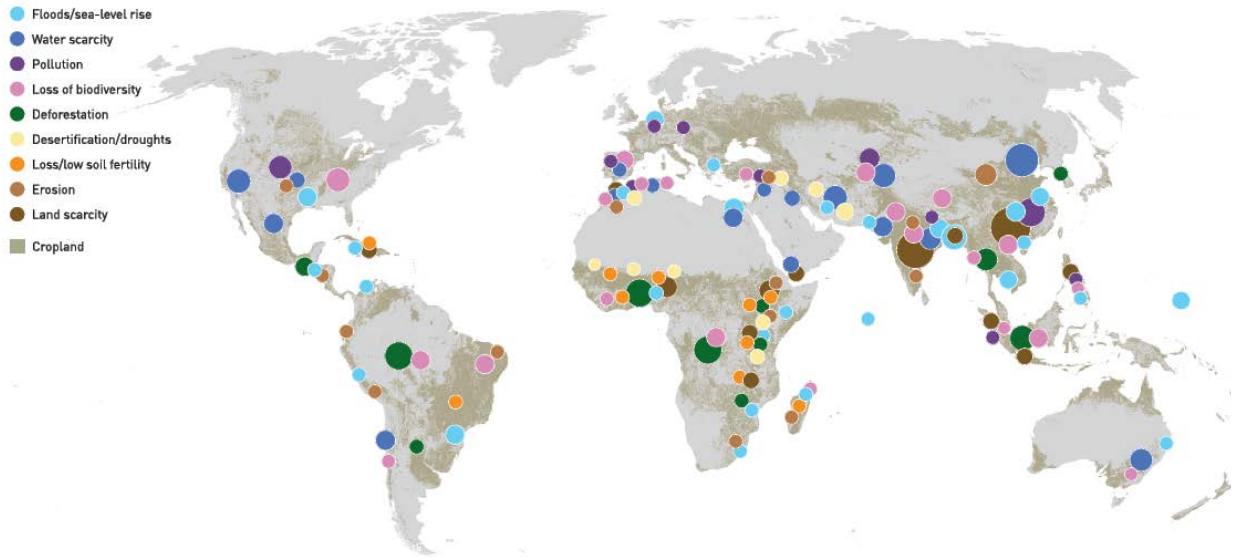
6 For a more detailed discussion of the historical development of the food system see Hummel et al. (2004).

SDG 2 has as targets to end hunger and all forms of malnutrition by 2030. With the expected growth of the global population and projected changes in diets, food production will have to increase substantially to meet these targets, although the main contribution to future growth in agricultural output is projected to come from **intensification on existing** agricultural land (FAO 2012d).

Given that climate feedback might negatively affect yields (Banse et al. 2014; IPCC 2014a; OECD 2014), that agricultural intensification is by no means a free ride on sustainability[7], and that risks for agricultural production arise from e.g. degrading soils, drought, erosion, pests, sea level rise and water scarcity (see Figure 1), it is also necessary to consider more resilient and diversified food systems – beyond the current industrialized approaches – and to reflect the key role of small-scale and family farming mentioned at the beginning of this section (IAASTD 2009; FAO 2014a).

Furthermore, food consumption patterns (see Section 2.2) play a critical role in the future development (UNEP 2012).

Figure 1 Overview of Risks associated with Agricultural Production



Source: FAO (2011)

The indicated uncertainty about the future of the global food system should be seen in context with the historical dynamics and trends which are briefly discussed below, before turning to the possible future of urban food systems (Sections 2 and 3).

7 See e.g. Buckwell et al. (2014); Gadanakis et al. (2015); Garnett et al. (2013) ; IIED (2015); Loos et al. (2014); Petersen, Snapp (2015);

1.1 Food: From a Local Resource to a Global Commodity

In all of human history, food plays a fundamental role for societal development – and contrary to current perceptions, food production has been intrinsically linked with **urban** development for many thousands of years, as cities were built on most fertile soils, transport infrastructure was non-existent, and preservation of food was rudimentary so that perishable products such as milk and vegetables had to be produced and consumed in close proximity (Hummel et al. 2004).

This radically changed with industrialization (and colonialism) during the 19th century: cities became hotspots of manufacturing, urban population growth[8] and economic development through non-agricultural labor allowed more and more to buy food (Stierand 2008). With improved transport infrastructures, rural areas became the "hinterland" supplying basic agricultural commodities to urban areas where trade and food processing took place – and not just within Europe[9].

In the 20th century, technological developments such as cooling (e.g. for dairy products) and canning of food (for fruit, meat and vegetables) allowed, together with the "green revolution" of larger, mechanized farming using agrochemical inputs, standardized varieties of grains, oil crops and cheap large-scale transport systems, that food supply chains became a complex global system. With that, the **spatial decoupling** of food production and consumption was accelerated.

International agricultural trade - and with it the trade of "virtual" land[10] - has increased 10-fold from the 1960s (UNCTAD 2013). This is a result of more open trade policies, market liberalization in many developing countries and advances in communications and transport systems (UNTAD 2014).

Although the overall dynamics of food trade in the last decade is still growth, there are differences among countries.

The most relevant ("top 20") countries for both ex- and imports are shown in Figure 2 which clearly indicates that – with the noteworthy exception of China as no. 1 – the importing champions are industrialized countries, while on the exporting side, many developing countries participate as relevant players in global food trade.

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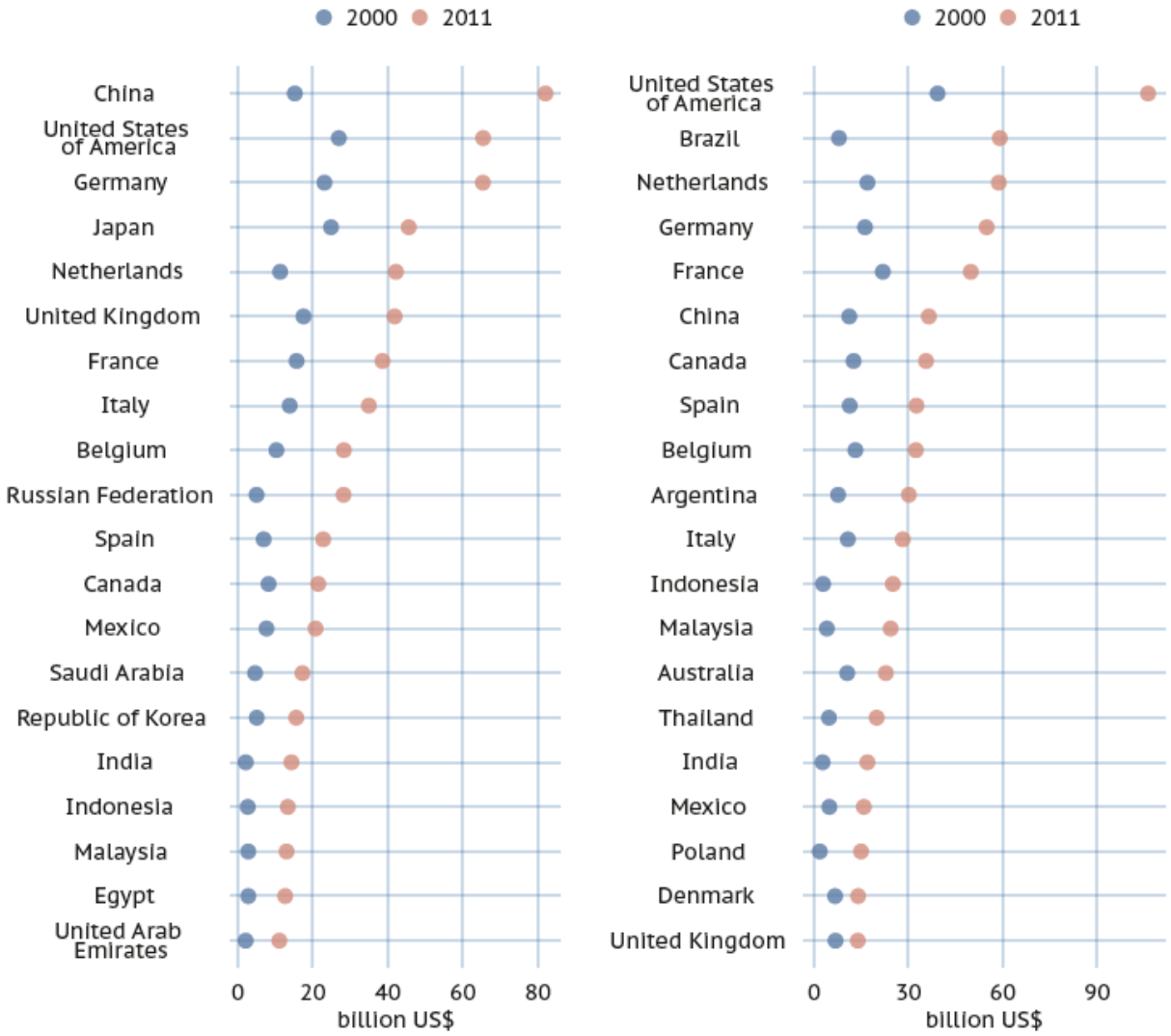
8 For key data and discussion of urbanization, see Eppler, Fritsche, Laaks (2015) and the literature and data sources referenced therein.

9 Even in this early stage of de-localizing the food system, colonialism allowed European countries to import grains and dried meat from overseas, making use of cheap slave labor (Stierand 2008). This massively increased international "trade" far beyond the earlier stage in which concerned mainly high-value non-perishable goods such as spices and dried fruit.

10 This concept was already introduced by Borgström (1965) who used the term "ghost acreage" to describe land use in other countries associated with imported feedstocks for animals. For more recent aspects of "virtual land" see UNEP-IRP (2014) and SERI (2011).

Figure 2 *Top Food Importing (left) and Exporting (right) Countries in 2000 and 2011*



Source: *FAO (2014d)*

The use of economic values **alone** to describe food trade patterns is misleading, though, as industrialized countries mainly import feed commodities such as soy, and export higher-value food products such as dairy, and meat (UNCTAD 2014).

Implicitly, increasing global agricultural trade is related to the growing number of land acquisitions for exports by foreign investors, often from industrialized countries – again with the noteworthy exception of China.

This “land grabbing” was initially (and often continues to be) seen in context with biofuel policies of the EU and the US (Cotula et al. 2009), but more recent

analysis using Land Matrix data[11] showed that food products are becoming more relevant (Anseeuw et al. 2012; GIGA 2014)[12].

Land grabbing is not only an issue of developing countries but has also been identified in Europe (TNI 2013). In consequence, policies to "safeguard" small farmers without secure land tenure against the globalized food system became an issue of the international community, resulting in several multilateral agreements[13].

1.2 Concentration in the Agribusiness

In parallel to increasing international trade, the globalized food system is also characterized by an unprecedented concentration of agribusinesses (EvB, FUE 2012; ETC 2013; UNCTAD 2013).

This also encompasses food distribution: retailers such as Wal-Mart organize globalized value chains, and supermarkets increasingly serve customers not only in a few cities, but in many countries (EvB, FUE 2012).

Vertical integration of agrochemical and seed producers and international logistics is ongoing (de Schutter 2010; Stierand 2014; UNCTAD 2014).

In consequence, smaller-scale local and regional retailers and farmer's markets lost their previous dominance, and many went out of business, being unable to compete with lower prices, increased standards for hygiene, and "shopping quality" (Stierand 2008+2014).

1.3 Changes in Food Products and Diets

Last but not least, the aspect of food products and diets needs consideration when describing the global food system. In the past, localized varieties of plants (cereals, fruit, vegetables etc.) and animals (cattle, fowl, goats, pigs etc.) built an agro-biodiverse base of food and feed production, and processing of farm produce was restricted to preservation.

With the rise of the globalized food system, **standardization** became necessary, implying a loss of local varieties an (Khoury et al. 2014), while food products became more **varied**: not only exotic products filled supermarkets and kitchen tables but myriads of preconditioned, artificially flavored and pre-cooked food items (Halwein 2002).

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11 See http://www.landmatrix.org and http://www.farmlandgrab.org/

12 It is not clear from available data to what extent land acquisitions are primarily contracting for food, feed or biofuels, as so called "flex crops" are cultivated on such lands which can be used for food or energy purposes (Börnecke, Beste 2013).

13 Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (CFS 2012), and the Principles for Responsible Investment in Agriculture and Food Systems (CFS 2014).

"Food design" using industrial processes to both mimic high-value natural products (e.g. cheese, meat) with low-grade products or even organic wastes, and to create completely new products ("functional" food) is gaining shares in diets (Stierand 2008).

The massive growth of dairy and meat consumption is another global phenomenon resulting from rising income in many countries (Allievi, Vinnari, Luukkanen 2015).

A final trend of the global food system is to increasingly replace the home kitchen by "eating out" (bistros, canteens, fast-food stalls…) and catering services which are supported by preprocessing and standardization of food products, and massive marketing (Stierand 2008).

2 Urban Food Systems

With cities and urban areas being "hotspots" of sustainability challenges and opportunities, urban food systems (as subsets of the global food system described before) are of interest.

It should be noted that there are urban-rural linkages as well, but in the following section, the focus is on cities[14].

2.1 Urban Food Production: A New "Urban Agriculture"?

"Food is coming back to the city" – more than a century after industrialization pushed food production out of modern cities (see Section 1.1), this slogan is used by many to describe a concept of re-integrating agricultural activities into urban areas to improve sustainable food systems, and food security (Ackerman et al. 2014; FAO 2009+2010; Hardman, Larkham 2014).

Urban Agriculture (UA) is generally defined as growing of plants and raising of animals for food and other uses within and around cities and towns, including related activities such as production and delivery of inputs, and processing and marketing of products.

UA ranges from subsistence production and processing at household level to fully commercialized agriculture (van Veenhuizen 2006), and typically **complements** rural agriculture (FAO 2007).

UA is **not** a new issue: especially in developing countries (RUAF 2010a+b; RUAF 2013), it is practiced by 800 million people worldwide out of which 200 million sell products on the market (FAO 2014b).

In many developing countries, UA uses organic solid wastes and wastewater as fertilizers, shows a low degree of farmer organization, and aims at **perishable products** such as vegetables, fresh milk and poultry products (FAO 2009; WB 2013; see also Table 2 and Figure 3).

Table 1 indicated that, depending on the country, between 10 and 70 % of urban populations in developing countries participated in UA.

[14] For a discussion of rural-urban links with some reflection on food see Eppler, Fritsche, Laaks (2015), and Section 4.

Table 1 Participation in Urban Agriculture in Developing Countries

	Total % participation in			
Country and Year	**crops (urban sample)**	**livestock (urban sample)**	**agric. (urban sample)**	**agric. (rural sample)**
Africa				
Ghana 1998	38	14	41	89
Madagascar 2001	30	13	33	85
Malawi 2004	45	14	46	97
Nigeria 2004	29	12	32	90
Asia				
Bangladesh 2000	26	14	30	90
Indonesia 2000	10	3	11	64
Nepal 2003	52	36	57	98
Pakistan 2001	4	13	14	74
Vietnam 1998	65	35	69	99
Eastern Europe				
Albania 2005	18	10	19	95
Bulgaria 2001	23	13	27	78
Latin America				
Ecuador 1995	17	28	35	93
Guatemala 2000	35	21	42	93
Nicaragua 2001	65	29	68	95
Panama 2003	31	12	34	87
Mean	*33*	*18*	*37*	*88*
Max	*65*	*36*	*69*	*99*
Min	*4*	*3*	*11*	*64*

Source: Zezza, Tasciotti (2010)

Urban food production can be quite important for the diets in developing countries, as Table 2 indicates.

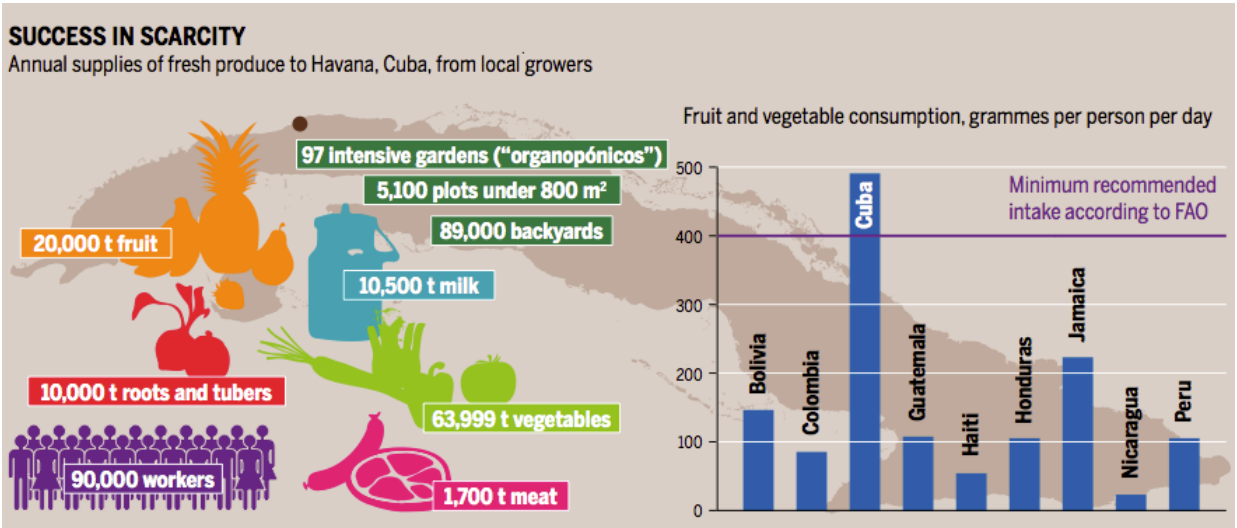
Table 2 Shares of Urban Food Consumption Provided by UA

City	Percentage of urban demand met by urban agriculture						
	Leafy vegetables	All vegetables	Eggs	Poultry	Milk	Pork	Fruit
Havana, Cuba (Gonzalez Novo and Murphy, 2000)		58					39
La Paz, Bolivia (Kreinecker, 2000)		30					
Dakar, Senegal (Mbaye and Moustier, 2000)		70–80		65–70	60		
Dar Es Salaam, Tanzania (Jacobi et al., 2000)	90				60		
Addis Ababa, Ethiopia (Tegegne et al., 2000)		30			79		
Accra, Ghana (Cofie et al., 2003)		90					
Ibadan, Nigeria (Olajide-Taiwo et al., 2009)	80						
Brazzaville, Congo (Moustier, 1999)	80						
Nouakchott, Mauretania (Laurent, 1999)	90						
Antananarivo, Madagascar (Moustier, 1999)	90						
Jakarta, Indonesia (Purnomohadi, 2000)		10					16
Shanghai, China (Yi-Zhang and Zhangen, 2000)		60	90	50	90–100	50	
Hong Kong, China (Smit et al., 1996)		45		68		15	
Singapore (Smit et al., 1996)		25					
Hanoi, Vietnam (GTZ, 2000; Phuong Anh et al., 2004)	80	0–75 seasonal variation	40	50		50	
Vientiane, Laos (Kethongsa et al., 2004)	100	20–100 seasonal variation					

Source: RUAF (2010a)

In Havana (Cuba), local food production is quite high, and urban fruit and vegetables cultivation provides high shares of minimum diets, as shown in the right part of Figure 3.

Figure 3 Local Production in Havana and Fruit and Vegetable Consumption of Selected South American and Caribbean Countries



Source : HBS, IASS (2015)

In industrialized countries, urban infrastructures are typically more evolved and due to limited (and costly) urban land, agri- and horticultural businesses aim for **integrating** into existing buildings (indoor farms, façade and rooftop gardens and greenhouses), e.g. in Basel[15], Lingköping[16], New York[17] and Singapore[18].

These new and often high-tech approaches should not be mistaken as "the" UA, though: given the long history, UA encompasses a wide range of activities differentiated by form, system, and spaces used (see Table 3).

Table 3 Overview on Urban Agriculture Forms, Systems and Spaces

Forms
Private gardens and allotments (Mok et al. 2013)
Community and public gardens (Barthel, Isendahl 2013; Colding, Barthel 2013)
(Semi-)Commercial horticulture and farms
Institutional gardens and farms, incl. school gardens, experimental fields
Systems
Crates, pots, sacks etc. filled with soil or substrates, rainfed or manually irrigated (WB 2013)
High-rise greenhouses and vertical gardens/farming (Despommier 2013), often combined with hydro- and aquaponics (Thomaier et al. 2015)
Spaces
Rooftops, facades and balconies (Specht et al. 2014)
Abandoned land, brownfields (FAO 2012a+b)
Public green spaces (Dietrich 2014)

Source: own compilation by IINAS

There are also several research projects in Europe to develop greenhouses on flat roofs, and to integrate farming into former office buildings[19].

15 "Vertical Greenhouse" (http://plantagon.com/about/business-concept-2/lead-project)

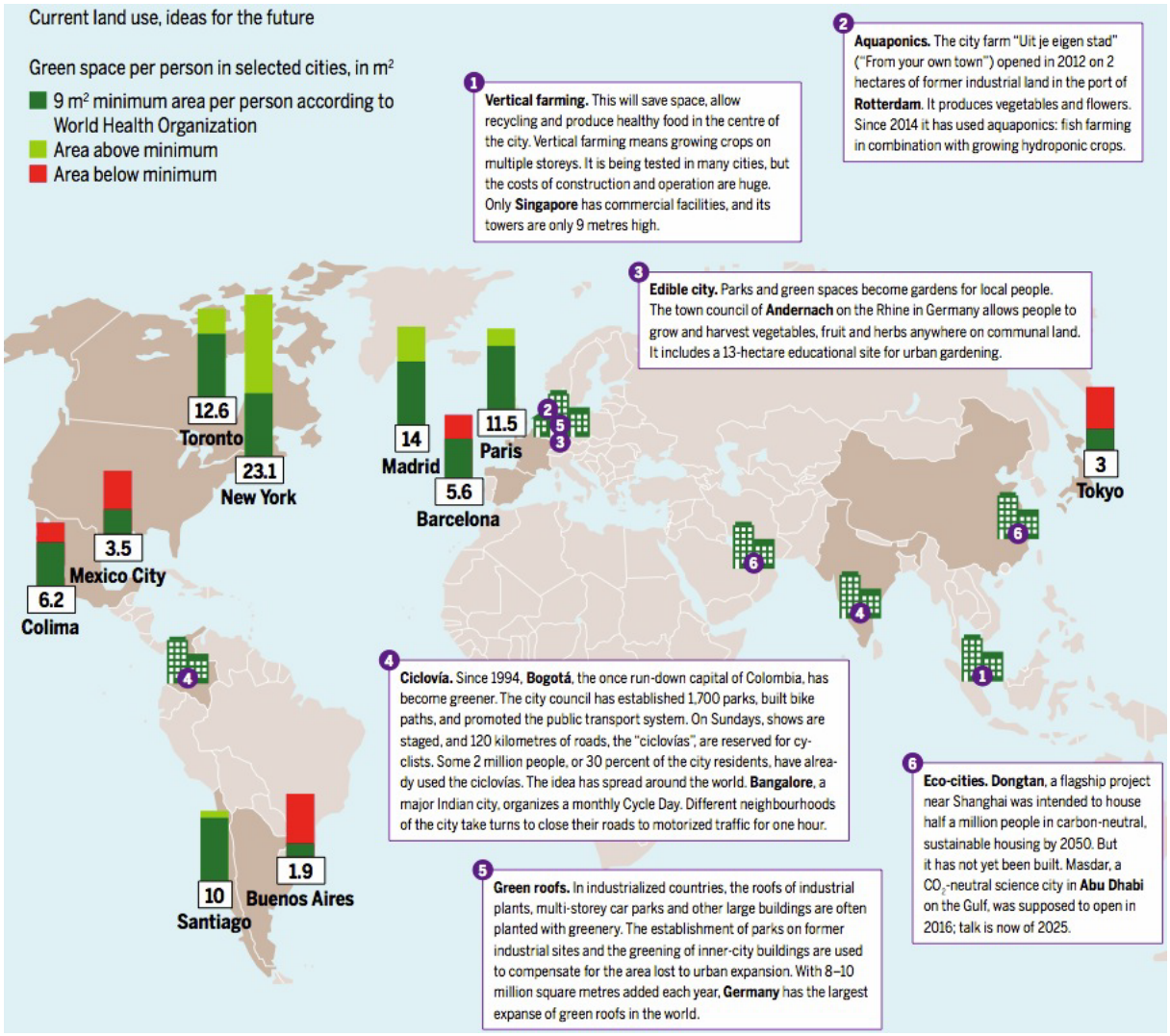
16 "Rooftop farm" in Basel (http://urbanfarmers.com/projects/basel)

17 See http://rooftopfarms.org and http://brooklyngrangefarm.com

18 See so-called "sky farm" in Singapore (http://www.skygreens.com).

19 See e.g., http://www.infarming.de and http://www.wageningenur.nl/en/Dossiers/file/Urban-agriculture-1.htm

Figure 4 Examples for UA-related Activities of Cities



Source: HBS, IASS (2015)

The project Zfarm (zero acreage farming) collected international activities and identified best practices (Thomaier et al. 2015)[20]. Many projects focus on hydro- or aquaponic[21] systems which can effectively control in- and outputs. These systems often are capital-intense (Love et al. 2015), but integration in existing buildings may lower the cost.

Thus, UA using modern technologies has to consider potential costs and risks (Thomaier et al. 2015), and both social and environmental impacts assessments are needed which are highly circumstantial.

On the other hand, more "traditional" forms of UA prevalent in developing countries must also be seen in context of their challenges (Section 3.2.1).

[20] See http://www.zfarm.de and http://www.user.tu-berlin.de/wolfgang.straub/zfarm/svg/index_svg.html

[21] See e.g., the EU project INAPRO (http://www.inapro-project.eu)

2.2 Urban Food Processing and Distribution

Compared to pre-World War II times, processing of food in the city declined – more and more, bakeries, butchers, creameries, mills etc. moved to larger, centralized plants in peri-urban and rural sites, connected to city customers through logistics and serving retailers which also became concentrated in super-markets, chains of standardized and specialized retail shops, and professional catering services (Stierand 2008).

Today, urban food supply in industrialized countries is characterized by over-supply and fierce competition between retailers. Gastronomy and canteens increasingly use pre-processed ("convenience") food and get served by larger-scale caterers offering comparatively low prices which small-scale producers cannot compete with[22].

The urban food supply in developing countries shifts towards similar patters: supermarket chains and more pre-processed food (Rischke et al. 2015), but street vendors remain serving significant part of urban dwellers, although rising hygiene standards and dietary changes may restrict their future role.

It has been argued that supermarkets may improve urban food security as they deliver better quality, safer food at lower prices than others, but supermarkets may serve as gateways to highly-processed, unhealthy foods (Battersby 2014).

2.3 Food Consumption, Diets and Waste

With cities becoming the livelihood of the majority of global population[23], the urban consumption behavior patterns and diets shape the global trends.

When moving to cities, people first shift from staple foods to more proteins-rich options and vegetables, and thereafter to more convenience food and to tailor-made functional foods, depending on income (FAO 2007)[24].

Given the plenty of options, city dwellers are more likely to eat out-of-home, not only in industrialized countries, but also in the developing world where urban food is often served by street vendors.

Urban food wasting seems higher, as prevalence for shopping in supermarkets and "eating-out", together with smaller household sizes, imply less effective food use rates in cities (Garrone, Melacini, Perego 2014; Gustavsson et al. 2011).

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22 At the same time there is the phenomenon of "food deserts", i.e. areas where people have limited access to a variety of healthy and affordable food, often being served only by fast food restaurants and convenience stores (USDA 2011).

23 Since 2008, the majority of people live in cities, and the global urbanization trend is expected to continue, see Eppler, Fritsche, Laaks (2015) for details.

24 Experience with urban gardening indicate a positive correlation with healthy eating patterns, see Figure 8 (Appendix).

2.4 Urban Food Policies

With food becoming (again) an urban issue, civil society organizations and urban policy makers started in the 1980s to consider local policies to improve food sustainability in the urban domain (Stierand 2008). In North America, Food Policy Councils (FPCs) were established in many cities[25], with similar developments in Europe[26]. These groups are typically roundtables bringing together urban and regional stakeholders from along the food value chain to discuss local food system issues, with healthy food and more sustainability as the main aims.

A more market-oriented approach is Community Supported Agriculture (CSA) which typically is trying to link farmers and customers through an economic arrangement more stable than e.g. local food markets. It was developed in the USA in the 1980s to create low-risk relations between farmers and consumers, and to make use of the "buying power" of consumers to help mostly small-scale, regional farmers (often oriented towards sustainable production) to find prime markets (Nost 2014). In return, farmers offer CSA consumers transparency, access to their farms and knowledge, and (voluntary or paid) farm working options (Bloemmen et al. 2015). CSA can and has been applied to UA as well, as the concept does not delineate between city borders and regional farmers.

Policies towards urban (and regional) food systems nowadays often are part of a broader movement called Transition Towns[27] which can be seen as a follow-up to "Local Agenda 21" initiatives which were founded in many countries after the 1992 Rio Conference and its respective "Agenda 21" declaration which in Chapter 28 calls for each community to formulate its own "Local Agenda 21" (UNCED 1992).

20 years later, the 2012 Rio+20 Conference called for a "Post-2015 Development Agenda" for which "Sustainable Development Goals" (SDGs) were proposed in Summer 2014 (UN-OWG 2014). Goal 11 of the SDGs aims to "make cities and human settlements inclusive, safe, resilient and sustainable". SDG 2 does not specifically name "food", but Goal 2 (end hunger, achieve food security and improved nutrition and promote sustainable agriculture) with its targets 2.1 (by 2030, end hunger and ensure access by all people) and 2.2 (by 2030, end all forms of malnutrition) will require cities to play a key role for implementation, and develop respective policies which also address (urban) food (HLPE 2014).

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25 For a brief overview of FPCs in North America see Halweil (2002), Spear (2013) and an interactive map at https://www.google.com/maps/d/viewer?mid=zEkpqOFl5shY.kId2ZOLkP--o. A popular example in Canada is Toronto (established in 1991), see http://tfpc.to

26 See e.g. Galli, Brunori (2013); Hardman, Larkham (2014); Moragues et al. (2013)

27 https://www.transitionnetwork.org/

3 Urban Food Systems and Sustainable Land Use

This section discusses potentials and challenges of urban food systems for sustainable land use[28]. Cities occupy a share of 0.5% of the global land area, and approx. 4% of the global arable land (D'Autilia, D'Ambrosi 2015). Thus, UA cannot have a major **direct** impact on global land use, even if many cities will grow substantially in the future. Yet, there are specific agricultural land uses which can possibly be replaced by UA, and activities favoring urban food systems may have important indirect effects.

3.1 Quantitative Agricultural Land Demand

The literature gives no clear evidence on how UA impacts on land use in rural areas. According to empirical data from surveys carried out by Zezza, Tasciotti (2010), urban agriculture accounts for 5–15% of total agricultural production in most developing countries, which can be translated in a respective reduction of non-urban agricultural land use, though due to expected lower productivity, the net reduction effect may be 20-30% lower.

There is not (yet) any quantification available for "modern" UA in industrialized countries, but due to its comparatively recent development, overall effects can be expected to be lower than 5% of overall food production.

In considering urban food production as a possibility to reduce the land demand of a city outside its boundaries, the potential depends on several factors[29]:

- City size: Smaller cities (< 500.000 cap) offer a higher potential, as they are often lower in density, i.e. offering more land within the city borders
- "Shrinking" cities: with de-industrialization and respective loss of workers, the need for housing is reduced, creating opportunities for suitable urban land for UA, and lower employment and income rates may imply higher interest for working in UA (e.g. the case of Detroit in the USA)
- UA systems used: In many cities in industrialized countries, waste heat can be used as an input for horticulture in building-integrated systems.

Martelozzo et al. (2014) investigated, based on the present situation, how much urban land would be needed to meet urban vegetable demands[30] in different countries (Figure 5).

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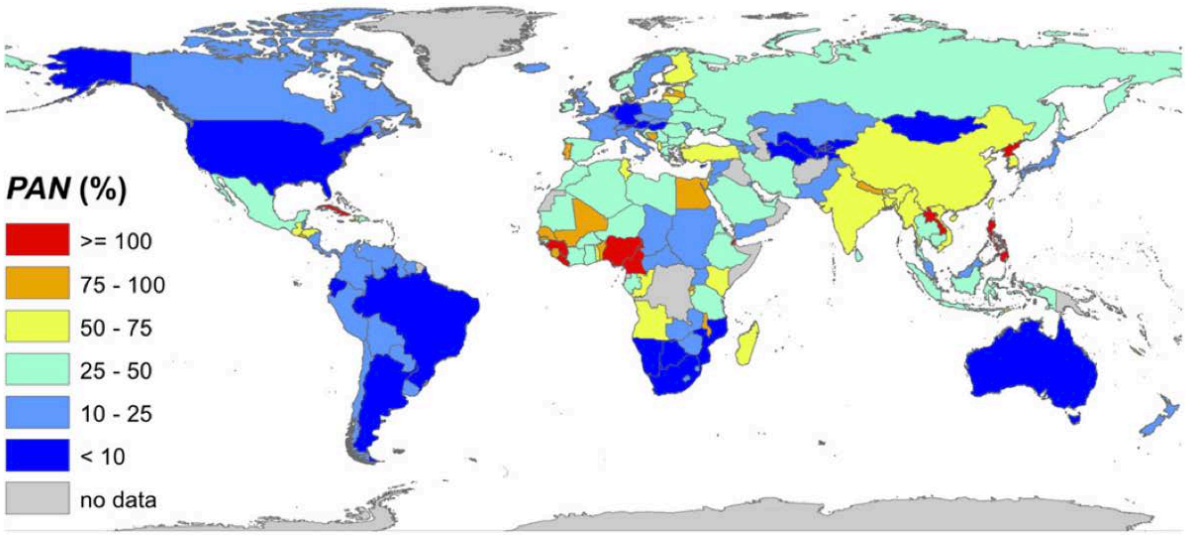
28 The GLOBALANDS project has defined this as follows: "A global sustainable land use serves the needs (for food, energy, housing, recreation etc.) of all human beings living today and in the future, respecting boundaries and resilience of ecological systems" (Kaphengst 2014).

29 For more details on "top-down" global analysis of UA see Thebo, Drechsel, Lambin (2014).

30 Vegetables are the most produced commodities in urban areas due to their relatively high economic value, and advantages over non-urban sources in terms of freshness.

Figure 5 Area needed to meet Urban Vegetables Demand through UA



Source: Martelozzo et al. (2014)

Globally, almost 40% of the urban vegetable demand could be met if 25% of the urban area would be used for UA. This would imply a relevant reduction of land use outside of cities[31].

Using the vertical space in cities (facades, rooftops) implies net positive effects on land use, as there is no additional land use on the ground[32].

A certain amount of livestock production could take place in urban areas but is not expected to reduce the arable land demand in a significant way as this depends on the crops cultivated for animal feed.

A further potential is to use existing public green spaces, as their maintenance together with food production can have lower cost[33].

In "shrinking" cities, former industrial areas (brownfields) could be used for UA (depending on soil contamination), as pressure from competing high-value land uses such as housing will be low.

31 Global vegetable production uses approx. 50 Mha out of a total of 260 Mha arable land directly used for food production (FAOSTAT 2015).

32 For the City of Cleveland, a scenario-based approach resulted in up to 18% food and beverage self-sufficiency through UA (Grewal, Grewal 2012)

33 The typical cost of urban gardening is discussed in CoDyre; Fraser, Landman (2015).

In combining different UA options, a longer-term (2050) potential of replacing up to 10% of the urban food demand through UA seems possible, which could result in approx. 5% reduction of rural agricultural (15% of arable[34]) **land use**.

This order-of-magnitude **estimate** is on the one hand conservative, as it assumes no major technological improvements, and includes yield differences between high-efficient industrialized agriculture and more low-input UA systems.

On the other hand, it can be seen as optimistic due to unknown willingness-to-pay for UA products outside of niche markets, and possible restrictions such as labor availability, and competing intra-urban land uses (see Section 3.3).

3.2 Qualitative Impacts of UA: Benefits and Opportunities

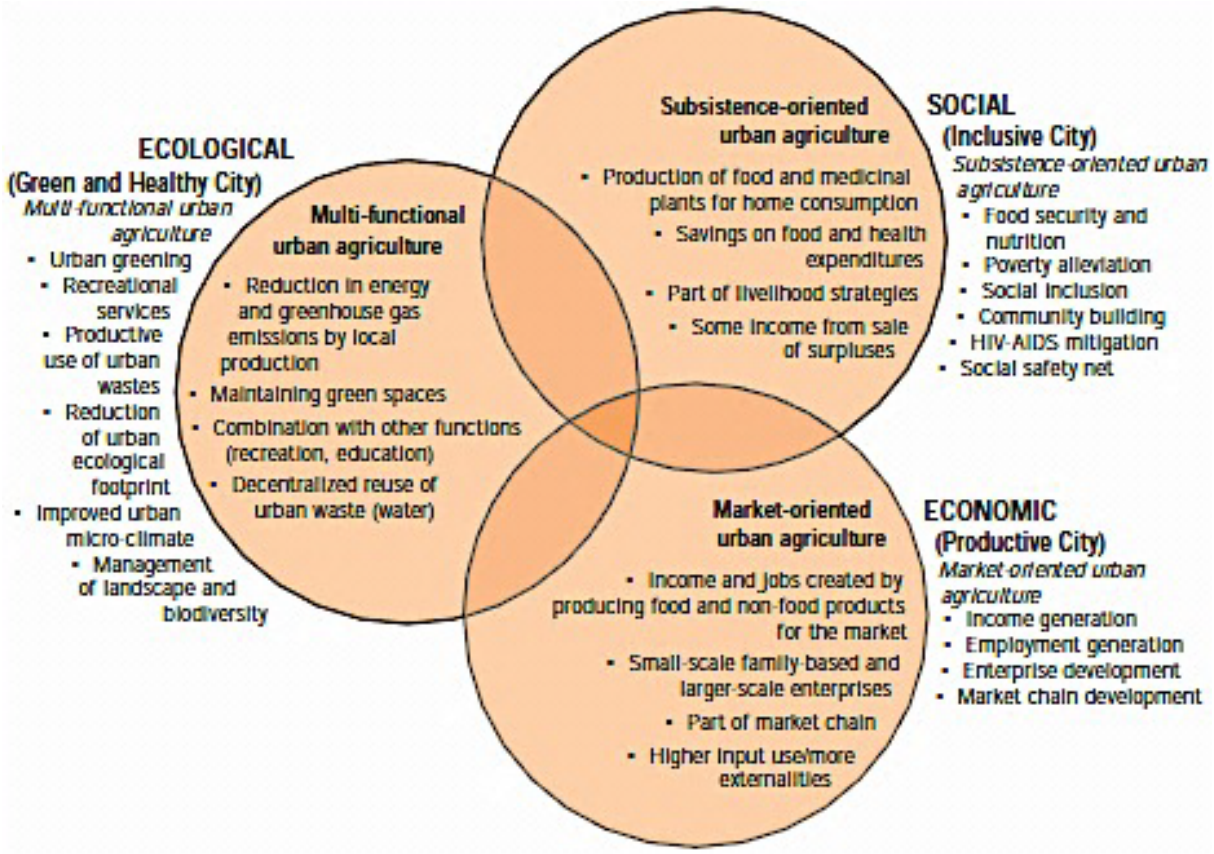
The results from various projects on UA demonstrated that there are many opportunities for cities in developing countries for the urban poor, contributing to their food security and nutrition (FAO 2007-2010; 2012a+b).

UA, especially urban horticulture, creates and stabilizes green belts (which protect biodiverse and fragile areas), may contain urban sprawl, build resilience to climate change, and can even lower city temperatures (FAO 2014b).

A collection of possible benefits identified in the literature and from UA projects in both developing and industrialized countries is given in Figure 6.

[34] This figure assumes that fresh produce (mainly vegetables) and some staple foods are the main UA products, while dairy and meat (due to restrictions of animal husbandry in cities) and fish (due to low direct land effect) will be of minor importance. The 15% reduction figure for arable land use takes grasslands (for animal grazing and feed production) out of the comparator.

Figure 6 Possible Benefits of Urban Agriculture



Source Dubbeling et al. (2010)

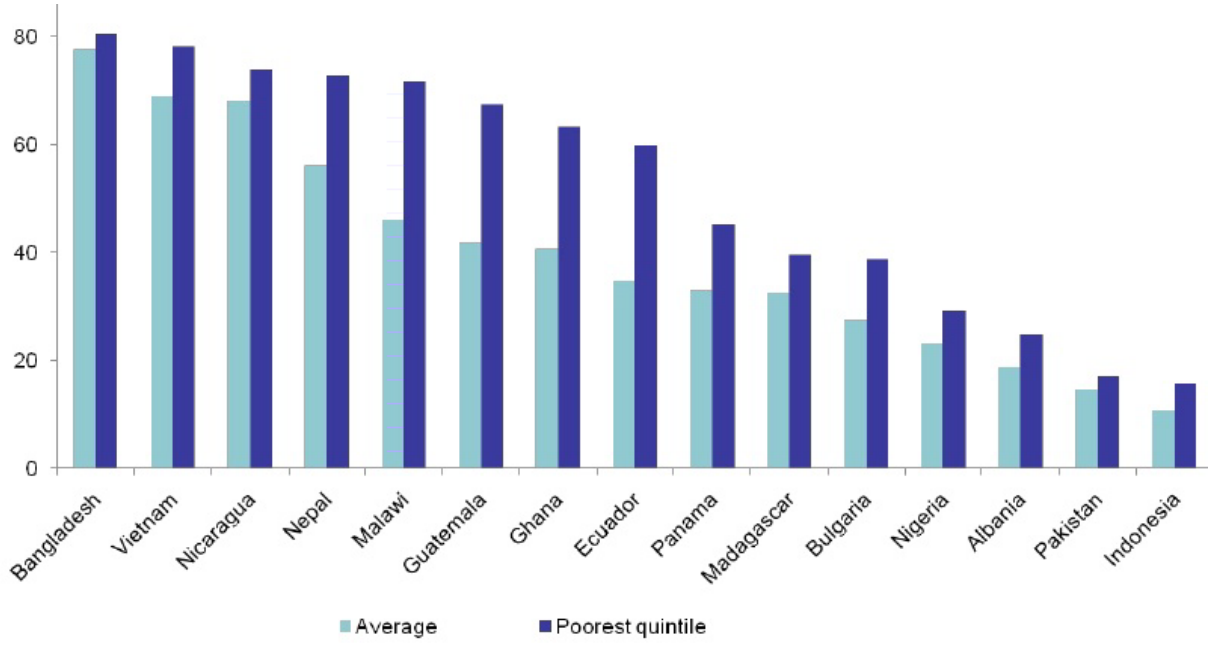
The reuse of nutrients in waste, resulting in less pollution and reduced energy demand for waste collection and disposal (Oudwater et al. 2013).

Greenhouses and aquaponics are water-efficient options, but require energy and other inputs (e.g. fish feed) which reduce positive impacts, and "green roofs" reduce air temperature due evapotranspiration especially in the summer (Dubbeling 2014). Such technologies contribute to "transforming" the urban metabolism to more sustainability (Walker et al. 2014).

UA on unsealed soil (i.e. not in greenhouses) improves ecosystem services (McGranahan et al. 2005) such as contribution to water absorption capacity, reducing impacts of floods by keeping flood plains free from construction, facilitating water filtration and storage, and reducing erosion, and can improve urban biodiversity (Dietrich 2014; Lin, Philpott, Jha 2015).

With regard to social and economic impacts, UA can be instrumental to provide additional employment, and income, as UA in many developing countries is an issue for the urban poor (see Figure 7).

Figure 7 Urban Households Participating in UA in Developing Countries



Source: FAO (2010); data given in %

Low-income urban families in developing countries spend up to 80% of their total income on food (Zezza, Tasciotti 2010) so that improved access to self-produced food is a clear benefit which also contributes to employment (FAO 2007).

Food security is a key issue in many developing countries. UA-derived produce such as fruit and vegetables provide some 10-20% of the nutritional needs of urban families in developing countries, thus making UA a major contribution to urban food security (FAO 2007).

More recent analysis found even higher figures:

„Self-production of food by poor urban households can represent 20 to 60 percent of their total food consumption, and is generally fresher, more nutritious, and diverse than food bought in shops, markets or street restaurants. This is particularly important for young children, elderly, or sick household members, particularly in poor households“ (WB 2013).

Similar findings are given in Zezza, Tasciotti (2010), and Tasciotti, Wagner (2015) who conclude:

“Promoting urban agriculture […] activities in urban areas can be considered a valid intervention aimed at preventing under-nutrition among household members and at improving children’s health status, and it should be encouraged in all those countries where under-nutrition still constitutes a widespread threat for the population”.

This is not just an issue in developing country cities, as examples in Italy (Orsini et al. 2014) and the US (Detroit, New York etc.) indicate:

"While urban agriculture cannot supply the entire city with all of its food needs, in certain neighborhoods it can significantly contribute to food security. There are a number of neighborhoods where a confluence of factors makes urban agriculture a particularly attractive and effective means of addressing multiple community challenges. These factors include low access to healthy food retail, high prevalence of obesity and diabetes, low median income, and comparatively high availability of vacant and other available land. These issues are all correlated, and it is in these areas where urban agriculture could have the greatest impact on food security" (Ackerman et al. 2012).

As urbanization brings more people to cities, at least some bring their (often traditional) knowledge about food production along, implying opportunities to cultivate this knowledge through UA activities. Sharing this with the young may be of even more importance, considering that by 2030, about 70% of urban residents will be under age 18 so that promoting lifestyles integrating healthy nutrition and biodiversity values is an important opportunity (CBD 2012).

While the links of changing diets to environmental degradation are evident[35], the **positive health** impacts of urban food diets are less explored, but recent studies indicate a significant influence[36].

3.3 Challenges and Risks of Urban Agriculture

The environmental and health risks of UA are mostly related to developing countries, and consist of

- contamination of crops with pathogenic organisms as a result of irrigation with water from polluted streams and insufficiently treated wastewater or unhygienic handling of products during transport, processing and marketing;
- spread of diseases by mosquitoes and scavenging animals; and
- contamination of soils and products with heavy metals due to traffic emissions and industrial effluents[37].

These risks must be addressed in UA activities, and respective monitoring[38].

On the **social** side, the key challenge is insecure land tenure in cities which undermines investment and may lead to mismanagement (UN-HABITAT 2011).

35 For respective recent work see e.g. Hallström, Carlsson-Kanyama, Börjesson (2015); Röös et al. (2015); WWF (2015).

36 See e.g. Hawkes et al. (2015); Libman et al. (2015); Tsui et al. (2015).

37 These bullets are derived from Hamilton et al. (2014) and FAO (2014b).

38 Angotti (2015) describes UA approaches in New York aiming at remediating contaminated soils, and using soil monitoring to assure adequate food quality.

The informal sector in urban and peri-urban slums grows due to rural migration in developing countries[39], and even if potential UA benefits are highest for the urban poor, successful establishment of UA practices requires tenure security (Tasciotti, Wagner 2015). In that regard it is worthwhile to note that the VGGT[40] can – and should - be applied in urban contexts as well (Wehrmann 2015) which would help fostering UA.

Besides security of tenure, land **price** risks are crucial for UA: In developing countries, land titling and even preparatory work to secure tenure and land rights can have significant impacts on land prices (Royston 2014), so that the economic prospects of UA in relation to higher-revenue options such as housing or commercial development can become unfavorable unless economic incentives are applied (La Rosa et al. 2014). In many industrialized countries, brownfields and derelict former industrial or commercial (e.g. logistics) areas are seen as prime targets for gentrification, with respective impacts on land prices. These dynamics can reduce availability and affordability of urban areas for UA.

Another socio-economic challenge for UA – as well as an opportunity (see Section 3.2) – is **employment**. The World Bank concluded from case study work: "There is some hard evidence to support the claim that urban agriculture is highly compatible with other kinds of employment, particularly informal business or even casual labor" (WB 2013).

Angotti (2015), referring to experiences in New York City, raises this as well:

"Who will do the work, how much will they be paid, and will they be paid at all? Farm laborers in the United States today, including those producing organic produce, are among the poorest paid, have to put up with miserable working conditions, and are largely invisible to the rest of the world. Who is to say that urban farms, whether public or private, won't follow the same pattern? Will the small bunch of enthusiastic volunteer farmers give way to a new generation of underpaid peons? Can unpaid labor be regenerative without being exploitative?"

There is - beyond anecdotal - little evidence on the employment aspects of UA in industrialized countries. This must be seen as a constraint in mainstreaming UA activities, and may imply that its quantitative relevance in high-wage urban areas of industrialized countries will be restricted[41].

39 More than 60% of people in towns and cities in sub-Saharan Africa live in informal settlements, which tend to be located in peri-urban environments and are characterized by insecurity of tenure and very poor infrastructure (Royston 2014). In Asia, the figures are somewhat lower, but indicate a similar trend in larger cities of e.g. India and the Philippines (FAO, IFAD, WFP 2014),

40 see footnote 13

41 This does **not** mean that UA necessarily remains a niche phenomenon which has little impact, as the **qualitative** impacts of UA activities may be far more important (see Section 4.2).

As noted before, the **economics** of UA is also an issue. While recent cost estimates for urban gardening indicate competitive options (CoDyre, Fraser, Landman 2015), Goddek et al. (2015) identify existing cost challenges of aquaponics, and Thomaier et al. (2015) and Love et al. (2015) point out that there is yet little evidence on the economic sustainability of commercial "modern" UA projects.

This does not imply that UA is uneconomic, but in addition to the land- and labor-related challenges, cost and revenues needs to be evaluated further especially for urban projects in industrialized countries, but should take into account the (also economic) benefits such as improved ecosystem services, and reduced health impacts.

4 Conclusions and Perspectives

This Issue Paper compiled key topics related to urban food systems and global sustainable land use.

Local and country case studies as well as recent literature give some evidence, but a systematic evaluation of the sustainable potential of urban food systems and their land use implications is **yet missing**.

UA has been identified to contribute sustainable land use, but the complexity of influencing factors makes it difficult to give reliable figures on the overall UA potential (Jennings et al. 2015).

In the following, some cautious conclusions are be drawn, though.

4.1 Urban Food Systems in Developing Countries

The analysis of the literature indicates that the key role for urban food systems in low-and middle-income countries is to **improve food security**, especially for those without secure land tenure (WB 2013; FAO, IFAD, WFP 2014; UN-HABITAT III 2015a+b).

On the other hand, Hamilton et al. (2014) argue that the overall efficiency of UA systems compared to industrialized agriculture needs to be proven, and point out that many developing countries regard UA as a retrograde step in development. These viewpoints may be to narrow, as UA cannot be judged just by its efficiency (see Section 3.2), and development views of political elites do not necessarily reflect the needs of their constituencies.

But the discussion on UA and its role on sustainable land use in developing countries is surely in an early stage so that - beyond the rather robust role in food security – further research is needed to broaden the evidence base for respective policies.

4.2 Urban Food Systems in Industrialized Countries

There is ample evidence that interest in “modern” urban food systems is growing in many cities in industrialized countries (Thomaier et al. 2015; ZALF 2013+2014).

Yet, a review by Mok et al. (2013) raises important open questions on biodiversity, efficiency, GHG emissions, and local governance, and the issue of labor demand (Section 3.3) needs consideration.

The “modern” approaches such as building-integrated or vertical farming are in early phases of development, with few cases of real-world implementation. Therefore, the potential and effects of urban food systems are yet uncertain.

There is clear evidence, though, that the broader concept of urban food systems – i.e. going beyond UA and integrating the consumers as "actors" – can have positive impacts on urban biodiversity, social cohesion and cultural integration (Dietrich 2014).

4.3 Urban Food Systems and Global Sustainable Land Use

The megatrend of concentration in all steps of the global food system is a major threat for sustainable land use[42].

In parallel, urbanization trends may improve opportunities for small-scale, inclusive urban food systems which could have the global potential to achieve a reduction of **rural arable land use in the order of 10% if** adequate support policies and governance could be achieved.

The educational value of urban food production and its impact on urban diets need further research[43], and may be an important opportunity to foster behavioral changes towards less meat consumption (Vranken et al. 2014) and reducing food waste, which would have significant net gains in terms of land demand.

Research is required on the capacity of urban production and economic and social co-benefits of local production and consumption, and decision makers should engage in inclusive actions to translate respective results into workable policies (ICLEI 2013+2014).

Other options should be considered as well, e.g. so-called Metropolitan Food Clusters (or "agroparks") which are high-tech concepts inclusively linking rural farms to rural cities and larger urban centers, aiming at diversity and efficiency (Smeets 2012; Kranendonk et al. 2014)[44].

These options need not be seen as alternatives to UA, but may well be complementary and could help transform the – dominating - industrial agricultural system.

4.4 Urban Food Systems as Transition Steps towards Sustainability

Urban food systems are becoming a key issue in the process towards the UN HABITAT III conference, as recent papers indicate (UN-HABITAT III 2015a+b).

42 See the brief discussion in Section 1, and the evidence given in Deng et al. (2015) for China.

43 Recent work on the role of information and communication technologies (ICT) in supporting sustainable urban food systems should be considered as well (Davies 2015; Choi, Graham 2014).

44 In that regard, approaches such as "industrial ecology" (Simboli, Taddeo, Morgante 2015) and "industrial symbiosis" projects as applied in China (Yu, Han, Cui 2015) might be further options.

Thus, it can be expected that more research results, evidence from UA practitioners, and related actors will become available in the near future. This should be followed-up closely.

In a vision for future sustainable cities, integrating urban food systems should be seen as a key issue, allowing to

- engage citizens in practical steps towards resource-efficient and resilient livelihoods,
- foster and disseminate innovative approaches towards urban food production,
- improve food security and healthy diets, and reduce food wastes.

The outcome of such activities should be seen less in a view of quantitative global land use relevance, but as important steps ("seeds for change") in a longer **transformation process** towards sustainability (UBA 2013; WBGU 2011).

References

Ackerman K et al. 2012: The Potential for Urban Agriculture in New York City; Urban Design Lab, Earth Institute, Columbia University; New York http://www.urbandesignlab.columbia.edu/sitefiles/file/urban_agriculture_nyc.pdf

Ackerman K et al. 2014: Sustainable Food Systems for Future Cities: The Potential of Urban Agriculture; in: The Economic and Social Review vol. 45 no. 2, pp. 189-206

Allievi F, Vinnari M, Luukkanen J 2015: Meat consumption and production – analysis of efficiency, sufficiency and consistency of global trends; in: Journal of Cleaner Production vol. 92, pp. 142-151

Angotti T 2015: Urban agriculture: long-term strategy or impossible dream? Lessons from Prospect Farm in Brooklyn, New York; in: Public Health (article in press) http://dx.doi.org/10.1016/j.puhe.2014.12.008

Aubry C et al. 2012: Urban agriculture and land use in cities: An approach with the multi-functionality and sustainability concepts in the case of Antananarivo (Madagascar); in: Land Use Policy vol. 29, pp. 429-439

Banse M et al. 2014: The Economics of European Agriculture under Conditions of Climate Change; in: GJAE vol. 63 no. 3, pp. 131-132

Barthel S, Isendahl C 2013: Urban gardens: agriculture and water management: Sources of resilience for long term food security in cities; in: Ecological Economics vol. 86, pp. 224–234

Battersby J 2014: The Need for a Diverse and Responsive Food System; in: URBAN AGRICULTURE MAGAZINE pp. 10–12 http://www.worldfuturecouncil.org/fileadmin/user_upload/Food_Security/UAM_27-Urban_agriculture_as_a_climate_change_and_disaster_risk_reduction_strategy.pdf

Bloemmen M et al. 2015: Microeconomic degrowth: The case of Community Supported Agriculture; in: Ecological Economics vol. 112, pp. 110-115

Borgström G 1965: The hungry planet: the modern world at the edge of famine; Macmillan

Börnecke S, Beste A 2013: Die Ernte der Heuschrecken - Das weltweite Landgrabbing und die Verantwortung Europas; Studie i.A. von Martin Häusling, MEP; Wiesbaden http://www.martin-haeusling.eu/images/attachments/BroschuereLandgrabbing_Download_.pdf

Buckwell A et al. 2014: The Sustainable Intensification of European Agriculture; sponsored by RISE Foundation; Brussels http://gallery.mailchimp.com/7e5f446a883c6b513832bd781/files/a6b31c96-e4f0-405d-bc1a-b1c557c4f7e9.pdf

CBD (Convention for Biological Diversity) 2012: Cities and Biodiversity Outlook; CBD Secretariat; Montreal http://www.cbd.int/authorities/doc/cbo-1/cbd-cbo1-summary-en-f-web.pdf

CFS (Committee on World Food Security) 2012: Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security; Rome

http://www.fao.org/fileadmin/user_upload/nr/land_tenure/pdf/VG_Final_May_2012.pdf

CFS (Committee on World Food Security) 2014: Principles for Responsible Investment in Agriculture and Food Systems; Rome http://www.fao.org/3/a-au866e.pdf

Choi J, Graham M 2014: Urban food futures: ICTs and opportunities; in: Futures vol. 62, pp. 151-154

CoDyre M; Fraser E, Landman K 2015: How does your garden grow? An empirical evaluation of the costs and potential of urban gardening; in: Urban Forestry & Urban Greening vol. 14, pp. 72-79

Colding J, Barthel S 2013: The potential of 'Urban Green Commons' in the resilience building of cities; in: Ecological Economics vol. 86, pp. 156-166

Cotula L et al. 2009: Land grab or development opportunity? Agricultural investment and international land deals in Africa; FAO, IIED, IFAD; London, Rome http://www.ifad.org/pub/land/land_grab.pdf

D'Autilia R, D'Ambrosi I 2015: Is there enough fertile soil to feed a planet of growing cities?; in: Physica A: Statistical Mechanics and its Applications vol. 419, pp. 668-674

Davies A 2015: Co-creating sustainable eating futures: Technology, ICT and citizen–consumer ambivalence; in: Futures vol. 62, pp. 181–193

Deng X et al. 2015: Impact of urbanization on cultivated land changes in China; in: Land Use Policy vol. 45, pp. 1–7

de Schutter O 2010: Addressing Concentration in Food Supply Chains; BRIEFING NOTE 03; Geneva http://www.ohchr.org/Documents/Issues/Food/BN3_SRRTF_Competition_ENGLISH.pdf

Despommier D 2013: Farming up the city: the rise of urban vertical farms; in: Trends in Biotechnology vol. 31 no. 7, pp. 388-389

Dietrich K 2014: Urbane Gärten für Mensch und Natur - Eine Übersicht und Bibliographie; BfN-Skripten 386; Bonn https://www.bfn.de/fileadmin/BfN/service/Dokumente/skripten/skript386.pdf

Dubbeling M 2014: Report on the (most relevant) potential impacts of Urban and Peri-urban Agriculture and Forestry (UPA/F) on climate change adaptation, mitigation and other co-developmental benefits; RUAF Foundation; Leusden http://www.ruaf.org/sites/default/files/Report%201.1%20Report%20on%20potential%20UPAF%20impacts%20on%20Climate%20Change%20%20%28Final%29_1.pdf

Eppler U, Fritsche U, Laaks S 2015: Urban-Rural Linkage affecting Global Land Use; GLOBALANDS Issue Paper prepared by IINAS; Berlin, Darmstadt

ETC (Action Group on Erosion, Technology and Concentration) 2013: Putting the Cartel before the Horse ...and Farm, Seeds, Soil, Peasants, etc. Who Will Control Agricultural Inputs, 2013; Communiqué number 111; Ottawa http://www.etcgroup.org/sites/www.etcgroup.org/files/CartelBeforeHorse11Sep2013.pdf

EvB (Erklärung von Bern), FUE (Forum Umwelt und Entwicklung) 2012: Agropoly – Wenige Konzerne beherrschen die weltweite Lebensmittelproduktion; Zürich, Berlin http://www.forumue.de/uploads/media/EvB_Agropoly_D_1-12_v02.pdf

FAO (Food and Agriculture Organization of the United Nations) 2007: Profitability and sustainability of urban and peri-urban agriculture; Rome ftp://ftp.fao.org/docrep/fao/010/a1471e/a1471e00.pdf

FAO (Food and Agriculture Organization of the United Nations) 2009: Introduction to FOOD for the CITIES; Rome http://www.fao.org/fcit/fcit-home/en/?lbw=1

FAO (Food and Agriculture Organization of the United Nations) 2010: Growing Greener Cities; Rome http://www.fao.org/ag/agp/greenercities/pdf/ggc-en.pdf

FAO (Food and Agriculture Organization of the United Nations) 2011: The State of the World's Land and Water Resources for Food and Agriculture (SOLAW) - Managing systems at risk; London http://www.fao.org/nr/solaw/

FAO (Food and Agriculture Organization of the United Nations) 2012a: Food for the cities; Rome ftp://ftp.fao.org/docrep/fao/012/ak824e/ak824e00.pdf

FAO (Food and Agriculture Organization of the United Nations) 2012b: Growing greener cities in Africa; Rome http://usir.salford.ac.uk/22993/

FAO (Food and Agriculture Organization of the United Nations) 2012c: Urban Agriculture Stakeholders Workshop proceedings, Addis Ababa, 21-22 February 2012; Rome http://www.fao.org/fileadmin/templates/FCIT/PDF/UAW_Proceedings_Addis2012.pdf

FAO (Food and Agriculture Organization of the United Nations) 2012d: World agriculture towards 2030/2050: the 2012 revision; Alexandratos N, Bruinsma J; ESA Working Paper No. 12-03; Rome http://www.fao.org/docrep/016/ap106e/ap106e.pdf

FAO (Food and Agriculture Organization of the United Nations) 2013: FAO Statistical Yearbook 2013 World food and agriculture; Rome http://www.fao.org/docrep/018/i3107e/i3107e.PDF

FAO (Food and Agriculture Organization of the United Nations) 2014a: The State of Food and Agriculture 2014 (SOFA); Rome http://www.fao.org/3/a-i4040e.pdf

FAO (Food and Agriculture Organization of the United Nations) 2014b: City region food systems - Sustainable Food Systems and Urbanization - An overview; Rome http://www.fao.org/fileadmin/templates/FCIT/documents/City_Region_Food_Systems_and_Sustainable_Urbanization_an_overview.pdf

FAO (Food and Agriculture Organization of the United Nations) 2014c: Growing greener cities in Latin America and the Caribbean - An FAO report on urban and peri-urban agriculture in the region; Rome http://www.fao.org/3/a-i3696e.pdf

FAO (Food and Agriculture Organization of the United Nations) 2014d: Food and Nutrition in Numbers 2014; Rome http://www.fao.org/3/a-i4175e.pdf

FAO (Food and Agriculture Organization of the United Nations) 2014e: International dimensions of the right to adequate food; Yeshanew S, Windfuhr M; Right to Food Thematic Study 7; Rome http://www.fao.org/3/a-i3896e.pdf

FAO (Food and Agriculture Organization of the United Nations) 2014f: Economic analysis of supply and demand for food up to 2030 – Special focus on fish and fishery products; Lem

A, Bjorndal T, Lappo A; FAO Fisheries and Aquaculture Circular No. 1089 FIPM//C1089 (En); Rome http://www.fao.org/3/a-i3822e.pdf

FAOSTAT 2015: Statistical Database of the FAO; Rome http://faostat.fao.org

FAO (Food and Agriculture Organization of the United Nations), IFAD (International Fund for Agricultural Development), WFP (World Food Programme) 2014: The State of Food Insecurity in the World 2014 - Strengthening the enabling environment for food security and nutrition; Rome http://www.fao.org/3/a-i4030e.pdf

Fritsche U, Eppler U 2013: Global Land Use Scenarios: Key findings from a review of international level studies and models; GLOBALANDS Working Paper 1.3; Darmstadt, Berlin http://www.iinas.org/tl_files/iinas/downloads/land/IINAS_2013_GLOBALANDS_AP-1_3.pdf

Gadanakis Y et al. 2015: Evaluating the Sustainable Intensification of arable farms; in: Journal of Environmental Management vol. 150, pp. 288–298

Galli F, Brunori G (eds.) 2013: Short Food Supply Chains as drivers of sustainable development - Evidence Document; FP7 project FOODLINKS; www.foodlinkscommunity.net

Garnett T et al. 2013: Sustainable Intensification in Agriculture: Premises and Policies; in: Science vol. 341 no. 6141 pp. 33-34 DOI: 10.1126/science.1234485

Garrone P, Melacini M, Perego A 2014: Opening the black box of food waste reduction; in: Food Policy vol. 46, pp. 129-139

Gibbs H et al. 2010: Tropical forests were the primary sources of new agricultural land in the 1980s and 1990s; in: PNAS vol. 107 no. 38, p. 16732-16737 http://www.pnas.org/content/107/38/16732.full.pdf

Gibbs H et al. 2015: Brazil's Soy Moratorium; in: Science vol. 347 no. 6220, pp. 377-378

GIGA (German Institute of Global and Area Studies) 2014: Food or Fuel – The Role of Agrofuels in the Rush for Land; Nolte K, Ostermeier M, Schultze K; Hamburg http://www.giga-hamburg.de/de/system/files/publications/gf_international_1405_0.pdf

Goddek S et al. 2015: Challenges of Sustainable and Commercial Aquaponics; in: Sustainability vol. 7 no. 4, pp. 4199-4224

GRAIN 2014: Hungry for Land - Small farmers feed the world with less than a quarter of all farmland; Barcelona http://www.grain.org/article/entries/4929-hungry-for-land-small-farmers-feed-the-world-with-less-than-a-quarter-of-all-farmland.pdf

Grewal S, Grewal P 2012: Can cities become self-reliant in food?; in: Cities vol. 29, pp. 1-11

Gustavsson J et al. 2011: Global food losses and food waste - extent, causes and prevention; FAO report; Rome www.fao.org/docrep/014/mb060e/mb060e.pdf

Halweil B 2002: Home Grown: The Case For Local Food In A Global Market; Worldwatch Paper 163; Washington DC http://www.worldwatch.org/system/files/EWP163.pdf

Hallström E, Carlsson-Kanyama A, Börjesson P 2015: Environmental impact of dietary change: a systematic review; in: Journal of Cleaner Production vol. 91, pp. 1-11

Hamilton A et al. 2014: Give peas a chance? Urban agriculture in developing countries. A review; in: Agronomy for Sustainable Development vol. 34 no.1 , pp. 45-73

Hardman M, Larkham P 2014: The rise of the 'food charter': A mechanism to increase urban agriculture; in: Land Use Policy vol. 39, pp. 400-402

Hawkes C et al. 2015: Smart food policies for obesity prevention; in: The Lancet pub. online Feb. 18, 2015 http://dx.doi.org/10.1016/S0140-6736(14)61745-1

HBS (Heinrich-Böll-Stiftung), IASS (Institute for Advanced Sustainability Studies) 2015: Bodenatlas: Daten und Fakten über Acker, Land und Erde; Berlin http://www.boell.de/sites/default/files/bodenatlas2015.pdf

HLPE (High Level Panel of Experts on Food Security and Nutrition) 2014: Critical and Emerging Issues for Food Security and Nutrition - Synthesis of the Inquiry; A note by the HLPE Secretariat, 27 April 2014; Rome http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/Critical_Emerging_Issues/Synthesis-of-Inquiry_HLPE-Secretariat-note_27-April-2014.pdf

Hummel D u.a. 2004: Versorgungssysteme als Gegenstand sozial-ökologischer Forschung: Ernährung und Wasser; demons working paper 2; ISOE; Frankfurt http://www.demons-project.de/material/demons_wp2.pdf

IAASTD (International Assessment of Agricultural Knowledge, Science and Technology for Development) 2009: Agriculture at a Crossroads - Global Report; Washington DC http://www.agassessment.org/reports/IAASTD/EN/Agriculture%20at%20a%20Crossroads_Global%20Report%20(English).pdf

ICLEI (Local Governments for Sustainability e.V.) 2013: Resilient Urban Food Systems: Opportunities, challenges, and solutions - Outcomes of the Resilient Urban Food Systems Forum Bonn, 1 June, 2013; Dowding-Smith E; Bonn http://resilient-cities.iclei.org/fileadmin/sites/resilient-cities/files/Resilient_Cities_2013/RUFS/RUFS_2013_Report.pdf

ICLEI (Local Governments for Sustainability e.V.) 2014: URBAN AGRICULTURE STRATEGY MEETING - Drivers for sustainable urban food production; 28 May 2014, Bonn http://resilient-cities.iclei.org/fileadmin/sites/resilient-cities/files/Resilient_Cities_2014/UA_Strategy_Meeting__Program_26052014.pdf

IIED (International Institute for Environment and Development) 2015: Sustainable intensification revisited; Cook S, Silici L, Adolph B; IIED Briefing; London http://pubs.iied.org/pdfs/17283IIED.pdf

IPCC (Intergovernmental Panel on Climate Change) 2014a: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the IPCC; Field C et al. (eds.); Cambridge, New York https://ipcc-wg2.gov/AR5/images/uploads/WGIIAR5-PartA_FINAL.pdf

IPCC (Intergovernmental Panel on Climate Change) 2014b: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the IPCC; Edenhofer O et al. (eds.); Cambridge, New York http://report.mitigation2014.org/report/ipcc_wg3_ar5_full.pdf

Jennings S et al. 2015: Food in an Urbanised World Report: The role of City Region Food Systems in Resilience and Sustainable Development; prepared for ISU; Oxford http://www.fao.org/fileadmin/templates/agphome/documents/horticulture/crfs/foodurbanized.pdf

Kranendonk R et al. 2014: CoP in Focus - Community of practice on metropolitan food clusters, resource use efficiency and climate adaptation; Alterra-rapport 2497; Alterra Wageningen UR http://edepot.wur.nl/307752

Khoury C et al. 2014: Increasing homogeneity in global food supplies and the implications for food security; in: PNAS vol. 111 no. 11, pp. 4000-4006

La Rosa D et al. 2014: Agriculture and the city: A method for sustainable planning of new forms of agriculture in urban contexts; in: Land Use Policy vol. 41, pp. 290-303

Libman K et al. 2015: The role of urban food policy in preventing diet-related non-communicable diseases in Cape Town and New York; in: Public Health vol. 129, pp. 327-335

Lin B, Philpott S, Jha S 2015: The future of urban agriculture and biodiversity-ecosystem services: Challenges and next steps; in: Basic and Applied Ecology vol. 16 no. 3, pp. 189-201

Loos J et al. 2014: Putting meaning back into "sustainable intensification"; in: Frontiers in Ecology and the Environment 2014 https://ideas4sustainability.files.wordpress.com/2014/06/2014_loos_sust_intensification.pdf

Love D et al. 2015: Commercial aquaponics production and profitability: Findings from an international survey; in: Aquaculture vol. 435, pp. 67-74

McGranahan G et al. 2005: Urban systems; in: Hassan R, Scholes R, Ash N (eds.) 2005: Ecosystems and Human Well-Being: Current State and Trends: Findings of the Condition and Trends; Millennium Ecosystem Assessment Series; Washington DC

Mok H-F et al. 2013: Strawberry fields forever? Urban agriculture in developed countries: a review; in: Agronomy for Sustainable Development vol. 34 no. 1, pp. 21-43

Moragues A et al. 2013: Urban Food Strategies: the rough guide to sustainable food systems; Document developed in the framework of the FP7 project FOODLINKS http://www.foodlinkscommunity.net/fileadmin/documents_organicresearch/foodlinks/publications/Urban_food_strategies.pdf

Nost E 2014: Scaling-up local foods: Commodity practice in community supported agriculture (CSA); in: Journal of Rural Studies vol. 34, pp. 152-160

OECD (Organisation for Economic Co-operation and Development) 2014: Climate Change, Water and Agriculture - Towards Resilient Systems; Paris

Orsini F et al. 2014: Exploring the production capacity of rooftop gardens (RTGs) in urban agriculture: the potential impact on food and nutrition security, biodiversity and other ecosystem services in the city of Bologna; in: Food Security vol. 6 no. 6, pp. 781-792

Oudwater N et al. 2013: Innovative experiences with short food supply chains in (peri-) urban agriculture in the global South; SUPURBFOOD WP3 Thematic paper 2 http://www.ruaf.org/sites/default/files/Innovative%20experiences%20with%20short%20food%20supply%20chains%20in%20the%20global%20South.pdf

Petersen B, Snapp S 2015: What is sustainable intensification? Views from experts; in: Land Use Policy vol. 46, pp. 1-10

Rischke R et al. 2015: Supermarkets and food consumption patterns: The case of small towns in Kenya; in: Food Policy vol. 52, pp. 9–21

Royston L 2014: Incrementally securing tenure: Promising practices in informal settlement upgrading in southern Africa; paper for the World Bank 2014 Land and Poverty Conference, Washington DC, March 24-27, 2014 https://www.conftool.com/landandpoverty2014/index.php/Royston-343_paper.pdf?page=downloadPaper&filename=Royston-343_paper.pdf&form_id=343&form_version=final

RUAF (Resource Centres on Urban Agriculture & Food security) 2010a: Cities, Poverty and Food - Multi-Stakeholder Policy and Planning in Urban Agriculture; Dubbeling M, de Zeeuw H, van Veenhuizen R; Rugby http://www.ruaf.org/publications/cities-poverty-and-food-multi-stakeholder-policy-and-planning-urban-agriculture

RUAF (Resource Centres on Urban Agriculture & Food security) 2010b: THE GROWTH OF CITIES IN EAST-AFRICA: CONSEQUENCES FOR URBAN FOOD SUPPLY; prepared for World Bank; Leusden http://www.ruaf.org/publications/growth-cities-east-africa-consequences-urban-food-supply

RUAF (Resource Centres on Urban Agriculture & Food security) 2013: WP3 Synthesis report: Innovative experiences with (peri-) urban agriculture and urban food provisioning – Lessons to be learned from the global South; Leusden http://www.ruaf.org/sites/default/files/Synthesis%20report%20Innovative%20experiences%20with%20(peri-)%20urban%20agriculture%20and%20urban%20food%20provisioning%3B%20lessons%20to%20be%20learned%20from%20the%20global%20South%20RUAF-SUPURBFOOD.pdf

SERI (Sustainable Europe Research Institute) 2011: Europe's global land demand - A study on the actual land embodied in European imports and exports of agricultural and forestry products; Vienna http://www.foeeurope.org/publications/2011/Europe_Global_Land_Demand_Oct11.pdf

Simboli A, Taddeo R, Morgante A 2015: The potential of Industrial Ecology in agri-food clusters (AFCs): A case study based on valorisation of auxiliary materials; in: Ecological Economics vol. 111, pp. 65-75

Smeets P 2012: Metropolitan Food clusters; in: Heinrich-Böll-Stiftung (Hrsg.): Urban Futures 2050. Szenarien und Lösungen für das Jahrhundert der Städte; Berlin, S. 56-57 http://www.boell.de/sites/default/files/Endf_Urban_Futures_2050.pdf

Spear G 2013: Democratizing the Food System - The Food Policy Council Movement; in: Kaleidoscope vol. 11 art. 93 http://uknowledge.uky.edu/kaleidoscope/vol11/iss1/93

Specht K et al. 2014: Urban agriculture of the future: an overview of sustainability aspects of food production in and on buildings; in: Agriculture and Human Values vol. 31 no. 1, pp 33-51

Stierand P 2006: Das Nahrungssystem der Stadt; in: Raumplanung vol. 126, pp. 265-269 https://www.ifr-ev.de/upload/pdf/rp129/08-stierand.pdf

Stierand P 2008: Stadt und Lebensmittel - Die Bedeutung des städtischen Ernährungssystems für die Stadtentwicklung; Dissertation TU Dortmund; Dortmund http://speiseraeume.de/downloads/SPR_Dissertation_Stierand.pdf

Stierand P 2014: Speiseräume - Die Ernährungswende beginnt in der Stadt; München

Tansey G, Worsley T 1995: The food system - a guide; London

Thebo A, Drechsel P, Lambin E 2014: Global assessment of urban and peri-urban agriculture: irrigated and rainfed croplands; in: Environ. Res. Lett. 9 (2014) 114002 http://iopscience.iop.org/1748-9326/9/11/114002/pdf/1748-9326_9_11_114002.pdf

Thomaier S et al. 2015: Farming in and on urban buildings: Present practice and specific novelties of Zero-Acreage Farming (ZFarming); in: Renewable Agriculture and Food Systems vol. 30, pp. 43-54

TNI (Transnational Institute) 2013: Land concentration, land grabbing and people's struggles in Europe; prepared for European Coordination Via Campesina; Amsterdam http://www.tni.org/sites/www.tni.org/files/download/land_in_europe-jun2013.pdf

Tsui E et al. 2015: Institutional food as a lever for improving health in cities: the case of New York City; in: Public Health vol. 129, pp. 303-309

UBA (Umweltbundeamt) 2013: Szenarien für eine integrierte Nachhaltigkeitspolitik – am Beispiel: Die nachhaltige Stadt 2030. Band 1: Überblick und Fazit; Dessau http://www.umweltbundesamt.de/sites/default/files/medien/461/publikationen/4413.pdf

UN (United Nations) 2014: The Millennium Development Goals Report 2014; New York http://www.un.org/millenniumgoals/2014%20MDG%20report/MDG%202014%20English%20web.pdf

UNCED (United Nations Conference on Environment and Development) 1992: Agenda 21; adopted at Rio de Janerio, Brazil, 3 to 14 June 1992 https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf

UNCTAD (United Nations Conference on Trade And Development) 2013: Trade and Environment Review 2013: Wake up before it is too late - Make agriculture truly sustainable now for food security in a changing climate; Geneva http://unctad.org/en/PublicationsLibrary/ditcted2012d3_en.pdf

UNCTAD (United Nations Conference on Trade And Development) 2014: Trade and Development Report 2014: Global Governance and Policy Space for Development; Geneva http://unctad.org/en/PublicationsLibrary/tdr2014_en.pdf

UNEP (United Nations Environment Programme) 2012: The Critical Role of Global Food Consumption Patterns in Achieving Sustainable Food Systems and Food for All. A UNEP Discussion Paper; Moomaw W et al.; Paris http://www.unep.org/resourceefficiency/Portals/24147/scp/agri-food/pdf/Role_of_Global_Food_Consumption_Patterns_A_UNEP_Discussion_Paper.pdf

UNEP-IRP (United Nations Environment Programme - International Resource Panel) 2014: Assessing Global Land Use: Balancing Consumption with Sustainable Supply; Bringezu S et al.; A report of the Working Group on Land and Soils of the International Resource

Panel; Paris http://www.unep.org/resourcepanel/Portals/24102/PDFs//Full_Report-Assessing_Global_Land_UseEnglish_(PDF).pdf

UN-HABITAT (United Nations Human Settlements Programme) 2011: Urban World: Cities and Land Rights; in: Urban World vol. 3 no. 1

UN-HABITAT III (United Nations Conference on Housing and Sustainable Urban Development – Habitat III) 2015a: City Region Food Systems (CRFS) in the Context of Sustainable Urbanization http://www.fao.org/fileadmin/templates/agphome/documents/horticulture/crfs/CRFSsusturbcontext.pdf

UN-HABITAT III (United Nations Conference on Housing and Sustainable Urban Development – Habitat III) 2015b: City region food systems are key to sustainable urbanization: Summary points for Habitat III Prepcom 2, 14-16 April http://www.fao.org/fileadmin/templates/agphome/documents/horticulture/crfs/CRFSsusturb.pdf

USDA (United States Department of Agriculture) 2012: Characteristics and Influential Factors of Food Deserts; Dutko P, Ver Ploeg M, Farrigan T; Economic Research Service ERR-140; Washington DC

van Veenhuizen R (ed.) 2006: Cities farming for the future - Urban Agriculture for Green and Productive Cities; published by RUAF Foundation, IDRC and IIRR; Leusden http://idl-bnc.idrc.ca/dspace/bitstream/10625/31770/239/IDL-31770.pdf

Vranken L et al. 2014: Curbing global meat consumption: Emerging evidence of a second nutrition transition; in: Environmental Science & Policy vol. 39, pp. 95-106

Walker V et al. 2014: The energy-water-food nexus: Strategic analysis of technologies for transforming the urban metabolism; in: Journal of Environmental Management vol. 141, pp. 104-115

WB (World Bank) 2013: Urban Agriculture. Findings from Four City Case Studies; Development Series Knowledge Papers no. 18; Washington DC http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2013/08/29/000356161_20130829112110/Rendered/PDF/807590NWP0UDS00Box0379817B00PUBLIC0.pdf

WBGU (German Advisory Council on Global Change) 2011: World in Transition – A Social Contract for Sustainability; Flagship Report; Berlin http://www.wbgu.de/fileadmin/templates/dateien/veroeffentlichungen/hauptgutachten/jg2011/wbgu_jg2011_en.pdf

Wehrmann B 2015: Applying the Voluntary Guidelines on the Responsible Governance of Tenure (VGGT) in Urban and Peri-urban Areas: An Exploratory Framework; paper for the World Bank 2015 Land and Poverty Conference, March 23-26, 2015, Washington DC https://www.conftool.com/landandpoverty2015/index.php/Wehrmann-170-170_paper.pdf?page=downloadPaper&filename=Wehrmann-170-170_paper.pdf&form_id=170

WWF (World Wide Fund for Nature) 2013: Urban solutions for a living planet - Learning cases; Stockholm http://awsassets.panda.org/downloads/urban_solutions_lc_summary_web.pdf

WWF (World Wide Fund for Nature) 2015: Das grosse Fressen - Wie unsere Ernährungsgewohnheiten den Planeten gefährden; Dräger de Teran T; Berlin http://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/WWF_Studie_Das_grosse_Fressen_Zusammenfassung.pdf

Yu F, Han F, Cui Z 2015: Evolution of industrial symbiosis in an eco-industrial park in China; in: Journal of Cleaner Production vol. 87, pp. 339-347

ZALF (Leibniz-Zentrum für Agrarlandschaftsforschung e. V.) 2013: Innovationsprozesse in der Urbanen Landwirtschaft - Best-Practice-Beispiele; Hartmann I, Berges R, Piorr A; Müncheberg http://project2.zalf.de/innsula/downloads/Hartmann%20et%20al_2013_Innovationsprozesse%20in%20der%20Urbanen%20Landwirtschaft_Best-Practice-Beispiele.pdf

ZALF (Leibniz-Zentrum für Agrarlandschaftsforschung e. V.) 2014: Urbane Landwirtschaft – Innovationsfelder für die nachhaltige Stadt?; Berges R u.a.; Müncheberg http://project2.zalf.de/innsula/downloads/Berges%20et%20al%202014%20Urbane%20Landwirtschaft%20–%20Innovationsfelder%20für%20die%20nachhaltige%20Stadt.pdf

Zezza A, Tasciotti L 2010: Urban agriculture, poverty, and food security: Empirical evidence from a sample of developing countries; in: Food Policy vol. 35, pp. 265–273