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## Nutrition-sensitive urban agriculture

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**Abstract** Urban and peri-urban agriculture make up a significant proportion of the food supply of many cities and its importance is increasing. Today, around 15 % of the world's food is grown in urban areas. City and suburban agriculture take many forms (backyard, roof-top, balcony, community gardening in vacant lots and parks, urban fringe agriculture and livestock grazing in open spaces). Food and nutrition security, both of which are necessary for a healthy and balanced diet, require focus on the urban production of food. Such food should include micro nutrients and complement lacking or difficult to obtain foodstuffs. Due consideration should also be given to quality aspects in production and marketing. Only in a few places is the role and importance of urban production, specifically for the poorer parts of urban society, is recognized and acted upon through sound policies, planning procedures and programs. This paper presents the arguments for urban agriculture—in the North as well as in the South—and shows that it has the potential to contribute to diversified diets of urban citizens. More attention should be given to linking it better to the local food system. Recommendations for the support of nutrition sensitive urban agriculture relate to sensitizing and training of all actors, particularly urban planners, in identifying and addressing the specific challenges and potentials as well as giving institutional support to groups working in the area. New, adapted technologies and production systems that fit better into the local food system should be enhanced with due consideration being given to the prevailing legal, social and economic conditions.

**Keywords** Food and nutrition security · Food safety · Urban agriculture · Nutrition sensitive · Poverty reduction · Health

### The challenge of urban food and nutrition security in a globalized world

Half of mankind lives in urban centres. In addition to the provision of basic services (e.g. adequate housing, water and sanitation systems, the provision of health infrastructure and schools), rapid urbanization has brought about severe challenges to food and nutrition security: where and how to obtain the necessary quantity and quality of safe, culturally accepted food to live a healthy and happy life?—as stated in a definition on Food and Nutrition Security (CFS 2012). Changes in food systems around the world and, increasingly, more global markets have resulted in the potential for greater availability of food as well as greater diversity of food choices. On the other hand, the acceleration of urbanization with an influx of people, well beyond the capacity of cities to absorb them, brings the challenge of a global change in household food security and the nutritional status of individuals in urban areas, in particular for low income households.

Especially in developing countries, new players enter the food market, such as large multi-national fast food and supermarket chains that compete for market share of food purchases. These changes have a considerable impact on the food and nutritional security of both producers and consumers in the country. This impact is being felt in the availability and access to food through changes to food production, procurement and distribution systems, the food trade environment and overall food culture (FAO 2010; FAO 2012; van Veenhuizen 2012). Through improved domestic production and international trade, increasingly diverse food items are available in urban markets. However, access to them depends on cash, and many households lack a fixed income for the purchase of food. In consequence, people with less money eat less (less quantity of food, fewer meals), eat less nutritious food (more carbohydrates, less fresh food containing minerals and vitamins) or eat inferior quality food (giblets, crusts, 'recycled' food etc.) and thus endanger their health.

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Many authors report on changes in dietary habits and traditional meal patterns when persons move from rural to urban environments (i.e. Regmi 2001; Ghosh 2010; Newton 2011; Moomaw et al. 2012; Dev 2012). The busy urban lifestyle causes people stay away from home throughout the day. Cities offer access to a variety of food outside the home from such sources such as street food, restaurants and kiosks (and the revenue from employment in the informal street food sector can be a significant source of income for many families). Although a wide variety of food is available in urban areas, the food consumed is not necessarily of good nutritional quality and food safety is a growing concern in many urban environments.

Compared to a rural environment, the possibilities of producing own food in cities is extremely limited, thus, access to food via income is key for the urban population.

The rise of food prices and consequent hunger problems in 2007/2008 which particularly affected African cities (see e.g. Ahmed et al. 2007; Cohen and Garrett 2009; FAO 2010, IFAD 2011), revealed the problem of urban food and nutrition security and gave an additional impetus to urban agriculture (UA)—in the North as well as in the South. How to encourage urban agriculture in general and how to enhance productivity specifically? What are the particular challenges of UA regarding nutrition? What is the role of the city administration in urban food security and how can it be translated into policies and programs? These are the questions this paper will explore. Nutrition sensitive aspects will be dealt with after having discussed current concepts, merits and challenges of UA worldwide and its possible role in the urban food system.

#### Definition and Importance of nutrition sensitive urban/peri-urban agriculture

It is expected that most cities in the South will not be able to cope with the rapid urbanisation and its accompanying negative effects predicted to occur: employment opportunities will not be sufficient for all and air pollution and waste (solid and fluid) will negatively impact citizens' lives. In particular, poorer groups of society will not be able to cope, and this will impact on their food and nutrition security. As space to grow food in urban areas is highly restricted, the possibility of growing food there is quite limited and consequently dependency on distribution systems and markets is increased. Access to food for poor households in many developing countries is more limited than in the countryside as typical coping strategies (e.g. collecting wild food from nature, Khatri-Chhetri 2006; Regassa 2011) in cities is usually not feasible. An increase in food prices leads to an increase in the proportion of household income spent on food, and other expenses (such as for health and education) will be reduced.

In addition, greater awareness of health and environment issues e.g. pollution, pesticides, food safety and healthy nutrition and an increased demand for information about the means of production and origin of food brings UA and peri-urban (PUA) back onto the agenda. Both urban and peri-urban agriculture are often referred to together under the acronym UPA.

#### Definition

Understanding of UPA has become progressively more comprehensive over the past years owing to increased recognition of its importance resulting in parallel increases in literature and research results. Based on Mougeot's definition from (2000), RUAF (Resource Centres on Urban Agriculture and Food Security), and the FAO define this is still their definition UPA as follows: UPA is any informal or formal agricultural production practice within and around cities or urban regions which compete for resources (land, water, energy, labour) that could also serve other purposes to satisfy the requirements of the urban population. Important sectors of UPA include horticulture (usually the major component of UPA and comprising vegetables, fruit crops, roots and tubers, ornamentals, mushrooms and condiments), fodder and short cycle livestock and poultry, milk and dairy production, aquaculture and (agro)forestry (FAO 2011b). Orsini et al. (2013) present but I am not quite sure; a more detailed typology of UA, depending on the location within the city, people involved, main aim of activities, size of farm and the technology applied. Gieseke and Adidi (2011) underline the multi-functionality aspect of UA, which includes, in addition to the production of food, the following:

- providing recreational and leisure opportunities,
- contributing to resource efficiency and urban recycling management,
- providing ecosystem services,
- integrating residential space functions,
- and should be beautiful.

This multi-functionality of urban agriculture offers new possibilities for urban planning and can constitute the exit to a deadlock in which many cities are today: it is now less a question of "either—or" (to plan for urban agriculture *or* settlements *or* industry), but rather: how can productive spaces be combined with other functions within the city and what synergies can be derived from a combination of various land uses.

Following FAO's understanding, nutrition sensitive means giving more attention to food-based interventions that promote dietary diversity and the consumption of nutritionally rich foods, thus improving the quality of diet and overcoming and preventing malnutrition and nutritional deficiencies. The approach recognises the nutritional value of food and underlines the multiple benefits derived from enjoying a variety of

foods. Moreover, it stresses the importance and social significance of the food and agricultural sector for supporting rural livelihoods. This nutrition-sensitive view encourages and equips people to consider their total diet in relation to their preferences, individual lifestyles, physiological requirements and physical activity levels (Thompson and Amoroso 2011).

#### Importance and merits of urban agriculture—the main arguments

The production of food is only one aspect around which many other benefits can develop and which indirectly contributes to dietary diversity and food and nutrition security. UA is considered to be a mitigating factor with various facets influencing the livelihoods and wellbeing of citizens. In this section, the arguments that are commonly found for promoting UA in general are presented in a condensed way and the more detailed health and nutrition-related reasons will be presented in section 3.

*Urban agriculture can contribute to diverse food supplies for local population centres* Closeness of production and consumption has several advantages: (i) it minimises transport costs, traffic congestion and the pollution this entails, (ii) reduces reliance on more distant (even global) supply chains, (iii) helps to meet safety requirements for perishable products and (iv) may promote technologies that can be managed by individual families (FAO 2011a, b).

*Easier access to nutritious and healthy food* Good quality food, especially perishable vegetables are expensive and need to be bought often to be fresh; lower income households tend to buy fewer such foods (Beaulac et al. 2009 cited in Gordon et al. 2011; Larson et al. 2009 cited in Hartline-Grafton 2011). Through own production or local marketing of urban agricultural products, food is closer to the consumer and more affordable and thus can contribute to healthier diets.

*Urban agriculture reduces the expense of food purchases at the household level* What people produce for their own consumption, they do not need to buy and thus they save money. In addition, own or local production in cities by low-income families minimizes the higher costs involved in transport and time they would have to pay to access more distant markets.

*Urban agriculture makes farmer-consumers less vulnerable to price fluctuations* Own and local production can minimize the negative effects of price volatility on farming households.

*Urban agriculture benefits from the city as a high potential provider of special resources* Cities are not only consumers but also producers providing resources useful for agriculture such as recycled water, which can be used for irrigation and

organic matter, which can be collected, composted and used as organic fertilizer<sup>1</sup>. Such resources may be more readily available than in the country.

*Better availability of inputs, services and networks in urban centres* Tools, seeds, chemicals, synthetic fertilizers and other agricultural inputs are often traded in urban centres and are therefore, theoretically, more readily available. Credit institutions are also located in cities. Information and extension services are more easily accessed in the city than the countryside, partly because of better infrastructure (e.g. internet access) and also because of the ease of networking.

*Urban agriculture as a strategy for climate adaptation* Dubbeling and de Zeeuw (2011) observed a growing recognition of UPA as an important strategy for adaptation and resilience of cities to climate change. A research project in Casablanca showed that an increase in the amount and variation of urban vegetation can reduce heat loads in buildings and streets. Moreover, the installation of efficient irrigation systems for urban vegetation can sustain its biotic activity and consequent ecosystem services, which may help to regulate the urban climate (Scherer et al. 2013).

*Urban productive open space as a planning element* From the point of view of urban designers, UA is considered as a means to manage open spaces within the city and to achieve a livable city with green spaces and recreation areas close by. Discussions on multi-functionality open new possibilities for urban food production to be integrated as an additional planning option for managing open spaces within cities.

*Urban agriculture creates a “beautiful green and varied landscape”* Any kind of production changes its appearance over time, particularly vegetable production. This changes the landscape and maintains its attractiveness. UA can be integrated into leisure concepts and combined with other functions (such as education, recreation and minimization of heat stress).

*Urban agriculture—the window to food production for citizens* Often, citizens don't know how agricultural production takes place and what are the raw products from which their food comes. Urban farming as part of the urban landscape is visible to citizens when they pass by the fields. Pedagogic support in the form of information signs, farms and events creating awareness can sensitize urban populations—particularly children—to production cycles, organic

<sup>1</sup> See Cofic et al. (2010) Recycling of Urban Organic Waste for Urban Agriculture

production, processing and use of produce and may influence their consumption habits.

Urban agriculture can constitute an important economic activity for urban households. However this aspect is little researched. Zezza and Tasciotti (2010) compiled from various reports worldwide, published between 1998 and 2005, the contribution of UA to income. The greatest was in African countries (18–24 %) and Asia (3–13 %) while, in other

regions, the contribution was below 5 %. It would be of interest to see figures from more recent years.

Any kind of commonly conducted food production such as community gardens, school gardens and intercultural gardens as well as direct marketing activities provide opportunities for community involvement and social interaction among ethnically and age-diverse communities. In particular, they offer possibilities for nutritional, health and environmental education. Direct marketing strategies can strengthen connections

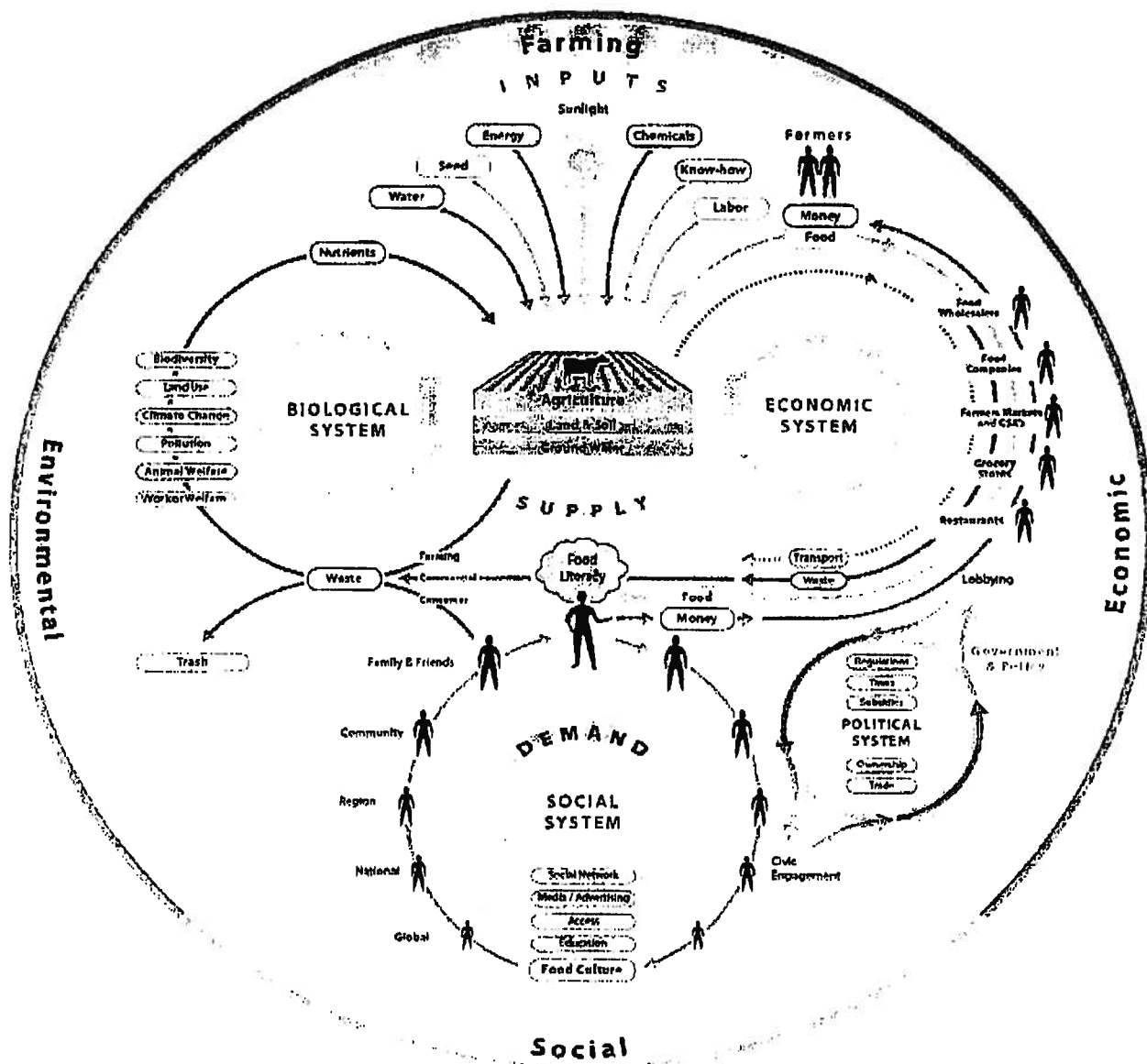


Fig. 1 The food system map. Source: Nourish Food System Map, © 2012 WorldLink. All rights reserved. [www.nourishlife.org](http://www.nourishlife.org)

between farmers and consumers and can contribute to economic security of the community (Lyson 2004). The Casa-blanca research project has shown that urban agriculture can foster community building, mutual trust, sharing, feelings of safety and comfort, and friendships that translate into a collective investment in the common good of a neighbourhood. It can also be seen as a facilitator or catalyst of communication, exchange and change (Gerster-Bentaya 2013).

Initiatives that address youth, particularly youth at risk, report urban agriculture as a strategy for decreasing or preventing crime (e.g. Hargesheimer 1998; Mogk et al. 2012). It is also seen as an alternative strategy to reuse vacant property and to prevent trash accumulation, illegal dumping, littering and fires. Mogk et al. (2012) state that farms and gardens can increase safety because the land will be occupied and monitored by those who farm and use it for agriculture related activities. Thereby urban producers eliminate the need for the city to police and to maintain the vacant property.

#### Urban/peri-urban agriculture as part of the urban food system

##### The urban food system

The term “food system” is used frequently in discussions about nutrition, food, health, community and social economic development and agriculture. The linkages between these various components and their interdependencies are illustrated in Fig. 1.

A food system is made up of all of the subsystems and paths travelled by food. These include everything from production and processing to distribution, consumption and disposal. Also included are the inputs and products of each subsystem, including natural and human resources. Structures and processes are necessary to keep the system working. The food system operates within and is influenced by social, political, economic and natural environments. Each step in each subsystem is also dependent on human resources that provide labour, research and education.

The boundaries of an urban food system depend on the locations where all the various food items that are consumed by the citizens come from; it usually goes far beyond the administratively defined boundaries of the city and varies from city to city, depending on the food policy developed by the municipality.

##### The rural–urban continuum

The potential of urban production is influenced by the availability and access to land, the quality of the soils, the production systems that are set up, the capacities the producers have

and the support and services they can access. Last but not least political will, rules and regulations that exist (or not) may facilitate or hamper UPA. A city rarely, if ever, will be able to fully feed itself, and thus will always depend on rural areas.

Agriculture and growth of cities are inseparably linked. Due to the development of cities it is difficult to divide rural from urban space. Urban development can take different forms. Poly-centric urban areas with loose structures between the various centres are linked to each other via “corridors” (main transport lines, such as main streets, highways and railways). Between the centres, there is space for agricultural production which takes place within various time-scales, ranging from the intermediate use of potential construction land to sustainable long-term rural islands in the urban region. These have high potential for establishing sustainable multifunctional urban and recreational structures taking into consideration ecological, economical and cultural functions.

#### Urban and peri-urban agriculture and food and nutrition security

##### Who is engaged in and concerned by urban agriculture

The stakeholder landscape in UPA is quite diverse. The various types of producers are quite visible but there are important and influential actors who are not visible, e.g. holders of real estate and some others (see below).

##### The urban producers

In urban centres, settlements may encroach on already existing farms, making the former rural farmers peri-urban or urban farmers. In some cases, their production system hardly changed despite new opportunities offered by the city close by (see e.g. Crozet et al. 2013). Others took advantage and changed their production and marketing to high value products such as mushrooms, snails and certain types of fruits.

Another category of urban producers are the land speculators who buy land mainly in the periphery of a city for a relatively low price. While waiting for the price of the land to rise and construction of settlements to start, this land is used for agriculture. Such “models” are often favoured by tax regulations as if land is used for agriculture, less or no tax has to be paid. The question is to what extent are the land speculators interested in agriculture and would put effort and money into enhancing productivity of the land.

A third category of people who can become involved in UA are the migrated rural population who moved to the urban centre due to lack of basic services in the countryside, such as education, health and water. They used to be farmers in the countryside and know how to produce. Farming alongside the

**Table 1** Proportion of urban populations participating in agriculture activities compared to rural populations

| Country and year      | Participation in crop activities in % | Participation in livestock activities (%) | Participation in general agricultural activities (%) | Participation in general agricultural activities (%) |
|-----------------------|---------------------------------------|---|--|--|
|                       | Urban sample                          |   |  | rural sample   |
| <i>Africa</i>         |                                       |   |  |  |
| Ghana 1998            | 38                                    | 14  | 41   | 89   |
| Madagascar 2001       | 30                                    | 13  | 33   | 85   |
| Malawi 2004           | 45                                    | 14  | 46   | 97   |
| Nigeria 2004          | 29                                    | 12  | 32   | 90   |
| <i>Asia</i>           |                                       |   |  |  |
| 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   |
| <i>Eastern Europe</i> |                                       |   |  |  |
| Albania 2005          | 18                                    | 10  | 19   | 95   |
| Bulgaria 2001         | 23                                    | 13  | 27   | 78   |
| <i>Latin America</i>  |                                       |   |  |  |
| 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   |

adapted from Zezza and Tasciotti 2010,268

roads, on obviously fallow land around their settlement is a coping strategy for accessing food at the household level. Money that is saved through own production can be used for other purposes such as transport, education and health. However, as soon as they have other opportunities to earn money they are likely to quit agriculture immediately. This is due to their experiences with poor farming outcomes in the country and was the reason for their migration to the city in the first place. Also, in some societies, farming has a negative connotation which people want to leave behind.

Zezza and Tasciotti (2010) state that, particularly in cities of the South, UA is regarded as a sign of poverty. Although UA is even discouraged by some municipal authorities, many urban households farm for direct household consumption or as a means of supplementary income. However, there is high involvement of urban populations in UA in some cities in the South (Table 1).

Conflicts in certain areas of a country may force people to move to the cities where they seek protection. FAO (2011a, 14) reported UPA food production in Freetown, in post conflict Sierra Leone mainly as an opportunity for internally displaced people (IDP). UPA provided employment for the IDPs and improved food supply for the city.

UA is not limited to citizens in countries in the South. International migration and the relocation of industries to other places, mainly abroad due to cheaper labour, result in new impoverishment of urban populations and demand changing roles for UA. In many of these cities, after decades of industrialisation and globalisation, a counter trend of localising part of agricultural and food production is appearing (van Veenhuizen (2006). People who are unemployed become involved in urban agriculture – often with little or no knowledge of farming.

Moreover, many UPA initiatives during the past 15–20 years, mainly in cities in the North, have occurred for environmental, social and health-related reasons. In addition to economic ones. These new urban producers are farmers who have taken an informed decision to farm in the urban area. They lease, 'grab' or buy the land. Contrary to the other groups of urban producers, they often don't have the knowledge and skills necessary for farming and need to acquire them. Frequently, they join groups in order to organize training, marketing and other awareness creating activities dealing with gardening, environment, food and nutrition. The social aspect is often as important or even more important than the economic benefit derived from the farming activities.

### Other stakeholders influencing urban agriculture

Other than the urban producers themselves, UA specifically gathers a series of stakeholders that are directly or indirectly involved in deciding the kind, the location, the quality and the intensity of urban/urbanized production, particularly its future role in relation to urban development and the urban food system. The private sector involved in the distribution system, such as transport, retailers, supermarkets, hotels and restaurants, and the producers themselves, depend on their marketing strategies. Investors in real estate and particularly land speculators, who buy peri-urban agricultural land and wait for the price to rise are other actors that influence UA.

Urban, regional and national agencies, particularly municipalities with their various departments e.g. city planning departments can influence UA positively or negatively depending on their understanding of its merits and issues. It is to be noted that the way agriculture is presented in the city administration is an indicator of the importance a city ascribes to it. Often, even if an agricultural department within a municipality exists it has an extremely weak position relative to other departments dealing with economic and social affairs. These challenges are important when thinking about possible institutional settings to promote multifunctional urban agriculture.

Lastly, the consumers and their awareness about food and their daily food choices impact on the (local) food system and thus decisions on the future of urban agriculture. In some countries, civil society food movements (e.g. in Brazil) have considerable influence.

### What is produced?

RUAF's analysis of 40 urban agriculture projects all over the world shows that vegetables are most commonly produced

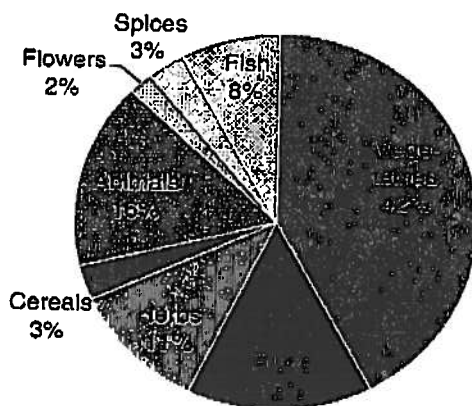


Fig. 2 Urban agriculture production proportions. Source: adapted from RUAF

(Fig. 2). Yet, the types of products depend on the traditional production system in a given area e.g. in Casablanca, in 2010/11, still more than 68 % of the arable land in the peri-urban area was used for cereal production and only 9.7 % for vegetables (Crozet et al. 2013).

A great weakness in urban agricultural research is the lack of updated data on the contribution of urban production to urban food needs. This might be due to the high degree of informality in production, transformation and marketing of urban products, the complex food flows, and the huge diversity of food which make comprehensive studies almost impossible. The figures that are reported tend to be anecdotal, and the most recent compilation made by RUAF includes those mainly from the years between 1996 and 2003. Individuals report on the successes of their initiatives and give figures or present them only orally e.g. Tawak 2013 reported figures from the Middle East and North Africa (MENA) region: in Lebanon, more than 70 % of fresh vegetables, bananas and citrus fruits consumed all year round are produced on the urban coastal strip of the country and greater Amman produces 45 % of its vegetables. Table 2 gives at least an idea about the contribution to the urban food needs of various cities in the South but, most probably, the situation has changed in the meantime in the cities mentioned in either direction. Leafy vegetables are predominant and to a lesser extent animal products—foods that contain minerals, vitamins and micro-nutrients, which are essential for a healthy diet.

### The benefits of urban agriculture for food and nutrition security

According to FAO (2010) benefits from UA derive from better access to additional and more nutritious food: urban households that engage in farming activities tend to consume greater quantities of food (sometimes up to 30 % more) and have a more diversified diet, as indicated by an increase in the number of food groups consumed. Vegetable, fruit and meat products are consumed in greater quantities, which translates into an overall higher intake of energy as well as higher calorie availability.

According to Smit et al. (2001; Table 3), and many other authors, urban agriculture can contribute significantly to improve health, combating urban hunger and malnutrition in several ways:

Production for self-consumption and small trade increases the food security of the poor by making it possible to obtain food they could not otherwise afford or find, even during bad financial times. Poor families gain control over the quantity, quality, and stability of their diet because daily food intake does not depend on their unstable daily income but on what they produce.

Through self-production, producers have control over the nutritional balance of the family diet. More expensive food items such as fruit, vegetables and meat can be supplied through home production. This improved nutritional balance

**Table 2** Percentage of food demand met by urban and peri-urban agriculture

| City, country (author, year)                                 | Leafy vegetables | All vegetables            | Fruit           | Eggs | Milk   | Poultry | Pork |
|--|------------------|---------------------------|-----------------|------|--------|---------|------|
| Havana, Cuba<br>(Novo and Murphy, 2000)                      |                  | 58                        | 39 <sup>a</sup> |      |        |         |      |
| La Paz, Bolivia<br>(Krcineckor, 2000)                        |                  | 30                        |                 |      |        |         |      |
| Dakar, Senegal<br>(Mbaye and Moustier, 2000)                 |                  | 70–80                     |                 |      | 60     | 65–70   |      |
| Dar Es Salaam, Tanzania<br>(Jacob et al., 2000)              | 90               |                           |                 |      | 60     |         |      |
| Addis Ababa, Ethiopia<br>(Tegegne et al., 2003)              |                  | 30                        |                 |      | 79     |         |      |
| Accra, Ghana<br>(Cofie et al., 2003)                         |                  | 90                        |                 |      |        |         |      |
| Ibadan, Nigeria<br>(Olaide-Taiwo, et al., 2009)              | 80               |                           |                 |      |        |         |      |
| Brazzaville, Congo<br>(Moustier, 1999)                       | 80               |                           |                 |      |        |         |      |
| Nouakchott, Mauritania<br>(Laurent, 1999)                    | 90               |                           |                 |      |        |         |      |
| Antananarivo, Madagascar<br>(Moustier, 1999)                 | 90               |                           |                 |      |        |         |      |
| Jakarta, Indonesia<br>(Purnomoahadi, 2000)                   |                  | 10                        |                 |      |        |         |      |
| Shanghai, China<br>(Yi-Zhung and Zhangen, 2000)              |                  | 60                        |                 | 90   | 90–100 | 50      | 50   |
| Hong Kong, China<br>(Smit, Naar and Ratta, 1996)             |                  | 45                        |                 |      |        | 68      | 15   |
| Singapore<br>(Smit, Naar and Ratta, 1996)                    |                  | 25                        |                 |      |        |         |      |
| Hanoi, Vietnam<br>(GITZ, 2000; Phuong Anh et al., 2004)      | 80               | 0–75 seasonal variation   |                 | 40   |        | 50      | 50   |
| Vientiane, Laos<br>(Kethongsai, Khamtanh and Moustier, 2004) | 100              | 20–100 seasonal variation |                 |      |        |         |      |

<sup>a</sup> non citrus

Source: adapted from de Zeeuw and Duijbeling 2009

reduces protein and energy malnutrition as well as deficiencies of essential micronutrients and vitamins.

Especially perishable food from outside the city, such as fruit, vegetables and fish, lose part of their nutritional value during transit and storage. Urban food is produced close to the consumer and therefore avoids lengthy transport and consequent deterioration of quality.

Locally produced, stored and directly sold food improves physical access and decreases or eliminates involvement of middlemen, making foods more affordable. As a result, more money is available for other expenditures, such as healthcare or education.

In combination with education, adequate crop selection and awareness of nutritional qualities, household gardens can be expected to have a beneficial impact on the nutritional balance and micronutrient intake of farming households. The pilot home gardens projects in Bangladesh implemented by the Helen Keller Foundation and an evaluation of program participants found the nutritional status of women and children was improved (HKI 2012).

UA provides opportunities for public health programmes aimed at improving knowledge of nutrition and influencing attitudes and dietary intake (Bellows et al. 2004). Local food production, i.e. production close to the consumers allows them to see how food is produced or grown and creates enhanced understanding of food systems and thus an awareness and willingness to pay for healthy food.

How can the various benefits be assessed?

The fact that urban agriculture often fulfils several functions at the same time makes it difficult to assess the entire benefit. The Five Borough Farm team has suggested a matrix which they call a Metrics Framework. It is a methodology and a set of user-friendly tools that can be used by farmers and gardeners everywhere to track and evaluate UA's innumerable impacts (<http://www.fiveboroughfarm.org/impact/metrics-getting-started/>).

Briefly, One of UA's benefit is in the relatively high production of fresh, perishable vegetables but its greatest merit is



**Table 3** Impact of urban agriculture on health, nutrition and well-being

| Country              | Impact  |
|----------------------|---|
| <b>Africa</b>        |   |
| Kenya                | Twenty-five percent of the country's urban population depends on self-produced food for nutritional survival.   |
| Uganda               | In Kampala, children of low-income farming families were found to be as healthy as children of wealthy families and healthier than children of non-farming low-income families. Save the Children Fund recommended that supplementary feeding programs in low-income areas of Kampala were not needed, and that urban food production was a factor.   |
| Zambia               | A severe economic crisis led to increased food production in Lusaka. By 1977, 43 % of a low-income community was farming home gardens and 57 % in other city farms – saving 10–15 % on food costs.  |
| <b>Asia</b>          |   |
| China                | In Shanghai, vegetables grown in the metropolitan area are very fresh, and reach markets 10–15 h after harvest.   |
| Indonesia            | In Java, home gardens supply about 18 % of caloric consumption and 14 % of proteins.  |
| Nepal                | In Kathmandu, 41 % of the average daily total food intake was derived from household production and 37 % of households, polled in a survey, reported that they met their plant food needs through household production. Households reported consuming an average of 72 % of home plant production and an average of 86 % of home animal production.   |
| Philippines          | On the island of Negros, malnutrition among urban and rural children was reduced from 40 to 25 % 2 years after the start of biointensive gardens.<br>In Cebu City, horticulture combined with public health interventions increased vitamin A levels significantly among children and provided other nutritional benefits that supplementation and fortification interventions alone did not. |
| <b>Latin America</b> |   |
| Argentina            | In Buenos Aires, 20 % of nutrition needs of the city is produced by part-time farmers.  |

Data compiled by The Urban Agriculture Network from various sources  
Source: Smit, Nasr and Rattan 2001, Chapter 7, p.2

the combination of benefits that derive from production in the urban setting, including and combining social, economic, landscape/leisure benefits. These contribute to a system of healthy food production and a livable environment. (Fig. 3).

### Urban agriculture for healthy nutrition?—The challenges

Despite the merits of UA, there are a number of aspects that need to be addressed for the selection of sites, the choice of production systems and their monitoring during production.

#### Food safety, safe production and health and environmental risks

The greatest concern for agricultural production is not only to have land available, but also to have enough safe water, non-contaminated soils and air for nutritious and healthy food production. These factors influence not only the quality of the food and thus the consumer, but also affect the health of the producers. The main unsolved issues and risks for and from urban production are as follows:

#### Polluted sites used for Urban Agriculture

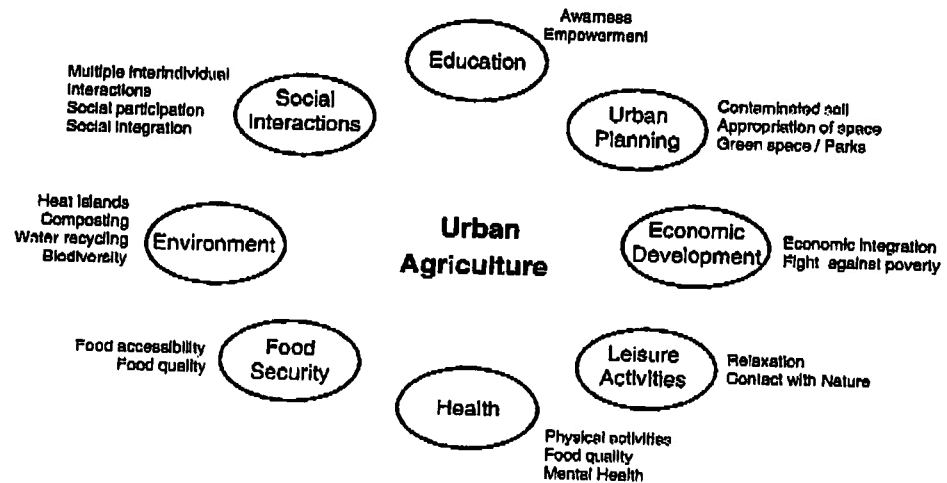
The concern is to grow healthy food. This requires 'healthy' soils and a healthy natural environment—factors that are particularly critical for cities. Production spaces for urban agriculture are often vacant plots of former industrial zones (cleared brownfields), plots alongside roads or railways, vacant construction land or communal land. The spaces are usually littered with refuse and the quality of the soil unknown but in many cases might be contaminated with heavy metals and other toxic residues, depending on its former use (Heinegg et al. 2002; Bretzel and Calderisi 2006; Egwu and Aghenin 2013—to mention a few studies). Also, farming on previous industrial land is sometimes encouraged and allowed without prior checking for pollution. However, the issue has started to be addressed and guidelines are being developed (e.g. EPA 2011). For heavy metals alongside the road, Säumel et al. (2012) identified significant differences in trace metal concentrations depending on local traffic, crop species, planting style and building structures.

Littered and contaminated soil is also a problem for animals. In particular, the improper disposal of plastic bags is a health risk for animals but also other items such as ropes, hair, paper and leather can be found in the rumen of sheep and goats (Tiruneh and Yesuwork 2010). Okai et al. (2011) reported that in the surroundings of Kumasi, Ghana more than two thirds of the sheep and almost one third of cattle contained plastic in their rumens.

#### Air pollution

Air pollution and its negative impact on food production in cities is also a concern. Agrawal et al. (2003) attributed reduction in yield in peri-urban agriculture due to air pollution with SO<sub>2</sub>, NO<sub>2</sub> and O<sub>3</sub>. Also alongside roads and airports emissions from combustion engines may contaminate food unless certain protection measures are followed such as

**Fig. 3** Different areas of urban agriculture activities. Source: adapted from Duchemin et al. 2008,44



planting at a specified distance from the road or airport or planting protective vegetation (Shayler et al. 2009)

#### *Contamination of crops*

Water is a precious resource and extremely important for any kind of production. Irrigation with used and untreated water is common in urban agriculture. Its availability in urban areas is a benefit but it is rarely treated and may be heavily contaminated with chemicals. Owing to overuse of agrochemicals, which occurs mainly in areas after many years of intensive horticulture and also air, soil and water pollution, noxious chemicals may accumulate in UA products and also in the human body, leading in some cases to cancer. Export crops are generally carefully regulated and checked for food safety, but items for domestic consumption are less well examined, "...and while exposure to agricultural chemicals is known to lead to varied health effects, including birth defects, blindness, cancer, and even death, their levels are weakly monitored in most developing countries. Additionally, poorly monitored food processing and preparation increasingly introduce additives and adulterants that present yet non-quantified direct or indirect effects on human health" (Trench et al. 2013, 95).

Crops that are likely to be eaten uncooked, such as lettuce, may be contaminated with pathogens or chemicals if irrigated with untreated wastewater. This may put various categories of people at risk e.g. agricultural workers and their families, crop handlers, consumers of crops, meat and milk and those living near the areas irrigated with wastewater (Pescod 1992, Lock and de Zeeuw 2001; Shayler et al. 2009).

*Diseases transferred to humans by rodents and flies attracted by agriculture (tick born diseases) or domestic animals*

Agriculture production and its residues, particularly animal production with its waste, is seen as a public health issue as it

attracts flies, rats and other unwanted organisms. When poultry, small ruminants or even pigs that are roaming around are kept in combination with a lack of sanitation, hygiene and health problems may well arise (van Veenhuizen 2012).

#### *Unhygienic handling of food*

Food safety doesn't end with production. Storing and processing fresh produce, especially dairy products and meat, need certain equipment, such as refrigerators, hygienic containers, processing facilities, clean water and protective gloves as well as good standards of hygiene. These are even more important if the processed goods are to be sold. Poor households often lack knowledge about the hygienic aspects of processing and the capital to invest in the necessary facilities. Lack of facilities, awareness and knowledge of food safety issues (particularly around milk, fast food, street kitchens) as well as lack of control of standards are risks to human health (Gerster-Bentaya 2012).

#### *Recognition, legal framework and regulations*

Small scale subsistence farming is often viewed negatively by farmers themselves and society. In cities of the South—with the exception of Asia—farming is considered as a temporary activity of poor people with no other choice. Such urban farmers rather seek off-farm employments than maintain or further develop their food production. So far, awareness and recognition of the benefits of UA has reached only a small proportion of citizens.

UA is a 'poor cousin' in urban planning. Even in cases where municipalities realize the benefits of urban agriculture, it is either not recognized or addressed as part of land use plans or town planning schemes—or not respected—a governance issue. Particularly in peri-urban areas, there is often lack of

clear regulations and administrative authority over land use. Planners and decision makers lack the knowledge required to deal with the complex challenges of balancing land tenure, production, ecology, recreation and economic aspects.

Food production in peri-urban areas often takes place on land that is about to be or is already sold for construction and leased out to farmers on short term contracts. If land for production is temporary, investments are less likely to take place. The establishment of sustainable production systems and training of human resources need security about time frames and will not take place if this security is lacking. The situation is additionally aggravated by the lack of clarity on ownership and access rights and by absentee or non-accessibility of landholders.

UA is often an informal activity. As long as householders grow food in the garden around their house, or have rented a plot in a community garden or similar for self-consumption there is no problem. However, it becomes critical when food and particularly processed food is sold. Food safety regulations are often lacking or are either not known or not observed by the actors involved.

#### Institutional set-up and services

Agriculture as the dwarf among giants within municipal departments has a soft voice or none. Urban food production aspects, including upstream and downstream conditions and activities, are rarely sufficiently considered at the planning level, particularly when viewed from a multifunctional perspective; no cooperation takes place in negotiations concerning the various kinds of functions a given space can have.

The missing voice for food production is reflected in the poor services provided for urban producers, although they are theoretically more readily available in cities. Extension services exist for rural producers, but are very rare for urban production. Credit facilities are even more difficult to obtain as production is often limited in time and plots are extremely small and are not accepted as collateral. Training in urban agricultural practices is not part of the normal curriculum of agricultural sciences and there is a lack of trainers, training approaches and curricula adapted to UPA..

#### Nutritious food from urban agriculture—What needs to be done?

Obviously, the situation differs from country to country and even from city to city. The following suggestions are far from complete and do not refer exclusively either to the North or to the South. Rather, there is need to look into each situation and based on the challenges and options, a strategy needs to be designed for promoting UA that contributes to greater nutrition

security for vulnerable groups and other interested parties in the urban population.

#### Recognizing urban and peri urban agriculture: champions, policies and promotional programs

There is a need for an overall policy for a holistic urban food system, which would serve as a guide to integrate all the necessary elements including the multifunctional/multidisciplinary, multi-institutional effort that has to be made to work. So far, there is a lack of knowledge and understanding at the different levels, due to "silo thinking". The first requirement is a clear understanding by policy makers of the possibilities of using space in the cities in a multifunctional way and then to prioritize them.

*Need for champions, alliances and partnerships* The examples of Brazil (specifically President Lula and the mayor of Belo Horizonte, Patrus Ananias) and the US (First Lady Michele Obama and the mayor of New York, Michael Bloomberg) show that if people in key positions take up the issues of urban food systems and UA, this creates a favourable environment and provides additional impetus for already existing initiatives and for the start of new ones.

#### Planning for urban agriculture

*Land tenure—securing land for production* Productive land needs to be protected by temporary tenure agreements, zoning and demarcation as well as regulations. NGOs may play a vital negotiating role in such processes. Temporary arrangements need to be well documented (FAO, <http://www.fao.org/scit/policy-planning-institutions/land-tenure/en/>).

*Organic waste chains* The concept of "urban mining" needs to be taken serious. Waste so far is not sufficiently addressed though there is recognition about the value of organic waste and treated waste water in many countries. More effort needs to be made by municipalities to value organic resources and to set up (decentralized) systems of collection, transformation and re-distribution of organic waste for urban agriculture. These resources not only can be made available for urban food production but production of the resources can be seen as an economic activity as well. Moreover, this would create a healthy environment for the people themselves and for food production.

*Addressing air pollution and polluted soils* Healthy air and a proper environment is not only a concern for the production of nutritious food but for the citizens in general. All measures that improve the air quality and cleanliness of a city will positively influence urban agriculture as well. Green walls

(vertical greenery i.e. introducing plants onto building facades) not only can mitigate heat stress but can also improve the air quality and reduce the surface temperature of the built environment (Sheweka and Magdi 2011. Soil testing (Turner 2009) prior to planting should be part of the training and extension modules for urban producers.

**Access to food markets** For low income families, the distance to places where food can be bought is often of concern. The expansion of supermarkets in developing countries has had considerable impact (Wiggerthale 2007). If they are far away from poor people's homes, they additionally have to afford transport for purchasing food (Battersby 2011). Local markets, shops within walking distance or at least sales points that are accessible via public transport would lower these additional expenses. Dubbeling and de Zeeuw (2011) suggest the following points should be observed:

- Integrating urban food security/urban and peri-urban agriculture into climate change adaptation and disaster management strategies
- Maintaining and managing agriculture projects as part of the urban and peri-urban green infrastructure
- Identifying open urban spaces prone to floods and landslides and protecting or developing these as permanent urban and peri-urban agriculture/multi-functional areas
- Integrating urban and peri-urban agriculture into comprehensive city water(shed) management plans
- Including urban and peri-urban agriculture in social housing and slum upgrading programmes
- Developing a municipal urban agriculture and food security policy and programme.

#### Awareness creation, training and services

**Rehabilitating the image of farming and acknowledging the benefits of urban agriculture** In many countries, being a farmer has a very negative connotation. People migrating from rural areas want to leave this "chapter of life" behind them as quickly as possible as it is linked to bad experiences of a livelihood situation. Not only farmers themselves, but also food decision makers need to revise their concepts and images of farming and the people who are producing food. Farming as a profession has to be valued and the reputation of farmers needs to be rehabilitated in the spirit and minds of the urban population, particularly in those of young people.

From all parts of society there is a need to acknowledge the value of UA with its various dimensions: as an economic sector in itself, as an element of landscape design, for its recreational function as well as for ecosystem services and as an opportunity to produce nutritious food for the enrichment of the daily diet.

**Decision makers need to be sensitized to the multifunctional dimensions of UA** They should receive information and training in the application of tools that help different interest groups.

**Extension services for urban farmers and gardeners need to be strengthened** Particular potentials and challenges of specific sites should be considered. Advice should be provided for the type of crops that can be produced with regard to their nutritional value (vitamins and mineral content) and their proper handling during harvesting storage and packaging, in addition to technical production skills. (Community) Garden associations can be important institutions in delivering services (advice as well as common input supply). Also these multipliers need proper training prior to starting work.

**Training** This is needed for agricultural promoters and multipliers, such as school teachers and extension workers. First, they need to understand that agriculture can fulfil several functions at a time in a certain space. Then the technical aspects need to be addressed, such as safe food production, as well as techniques for communication and raising awareness.

**Nutrition education** This is required to promote dietary diversity and the consumption of nutritionally rich foods, in combination with training in urban agriculture/gardening. Consumers should know which crops they can grow in their home gardens or community gardens for an improved diet.

#### Networking among stakeholders and institution building

Close cooperation is needed between the departments that tackle issues of health, economic and social development, and agriculture to address and agree on solutions with regard to food safety issues for polluted sites, air pollution, and unhygienic/unsafe production, processing and marketing practices.

Support for associations, farmer groups and cooperatives is needed. Especially the creation and development of food movements and interest groups should be promoted that could promote awareness of the public at large of food issues.

#### New technologies and alternative production systems

UA can be limited by competition for space with other forms of urban development, a lack of formalized land use rights (FAO) and health hazards related to food contamination. The use of green roof technology in urban agriculture has the potential to alleviate some of these problems, without adversely affecting the benefits provided by UA (Whittinghill et al. 2011). It would not only enable the use of land for development and agriculture, but could also facilitate the formation of formal space and water use agreements and enable redistribution of ground-level resources among urban farmers. This

could decrease the use of contaminated land and water at ground level and alleviate health concerns. Before green roof technology can be incorporated into urban agriculture on a larger scale, installation costs must be reduced, roof weight limitations should be assessed, and appropriate management practices should be developed which will ensure that the benefits of green roofs, such as energy savings and storm water management, are still provided to urban communities (Wittinghill and Rowe 2011).

**Soil-independent production** Simple hydroponics as suggested by Bradley and Marulanda (2001), container gardens (Vegetables 2011), the use of plastic bags (<http://www.gardenguide.com/91870-plant-vegetables-plastic-bag-containers.html>) when urban agriculture is conducted on brownfields with unknown soil quality could be solutions to pollution. This can be seen at the same time as a recycling measure for packaging such as plastic bags and tetra packs.

**Value chain innovations** All technologies and investments that improve market coordination and quality assurance among processors or technologies that help reducing postharvest losses and shorten supply chains for perishable foods are important components for improving nutrition. Product packaging and product information (e.g. nutrition information and recipes), as well as labelling of the nutritional value of products, can provide the necessary information for behavioural change and can complement other forms of mass communicated nutritional information (Ecker et al. 2012,6).

## Conclusions

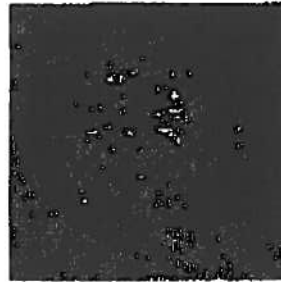
The challenges of increasing urbanization makes decision makers more open to questions of food security and local food systems. UA has the potential for diversifying the diet of urban populations as various examples have shown. Many of the statements and recommendations may not seem immediately nutrition specific. However, the combination of what to produce, where to produce, how to harvest, store, market and cook makes the difference between UA and nutrition-sensitive UA. The relevant stakeholders in the food system and the municipalities need to work together to analyse the challenges and potentials of UA, and exploit it for the improvement of nutrition, health and livelihoods of their respective localities.

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