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Urban and peri-urban agriculture in Cameroon: Status and perspectives for development

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Abstract

Like elsewhere in the world, Cameroon is experiencing rapid and unplanned urbanisation. Simultaneously, there is a growing number of urban and peri-urban farmers. This paper analyses the status of urban and peri-urban agriculture (UPA) in Cameroon. We found that UPA is widely practised by urban dwellers of all social category and provides multiple benefits ranging from employment creation, revenues, food security and environmental services. However, due to an improper planning, its non-official recognition, insufficient access to productive resources especially land and water; in some cases, UPA can negatively impact human health and environment because of an uncontrolled intensification of production systems and the questionable quality of the food supplied by urban farmers. Therefore, to build sustainable urban production systems, we recommend an official recognition of UPA, its inclusion in urban master plans; the demarcation and development of agricultural zones in cities, the design and implementation of programmes and projects to support urban farmers; intensive farmers capacity building and the promotion of urban waste valorisation through composting. Furthermore, more empirical researches are needed to provide up to date quantifiable information on UPA contribution to urban livelihoods, food security and environmental protection, and the types of relationships existing among the various stakeholders involved in UPA.

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Introduction

The world population has significantly increased over the past decades and will continue to increase in the coming years. While 2 and 14% of the world population lived in cities in 1800 and in 1900 respectively (Orsini *et al.*, 2013); today, 54% of the world's population live in cities compared to 43% in 1990 and this figure will rise to about 66% by 2050 (UN-habitat, 2016a). In contrast, the world's rural population is expected to decrease by some 28 million between 2005 and 2030; thus, globally, future population growth will be in towns and cities and will mainly take place in developing countries which cities and towns are expected to host 80% of world urban population by 2030 (UN-habitat, 2007). Furthermore, Asia and Africa urban population are expected to double by 2030 compared to 2000 (UN-habitat, 2007; Orsini *et al.*, 2013) and nowadays, Asia is already 48% urbanised and home to 53% of the world's urban population (UN-habitat, 2016a). According to De bon *et al.* (2010), urbanisation in developing countries is exacerbated by poverty and causes problems of employment, rural-urban migration, transportation, food supply and environment protection. Besides, Orsini *et al.* (2013) suggest that being unforeseen, urbanisation has huge consequences in small cities urban planning. Indeed, as highlight by Baud (2000) quoted by Orsini *et al.* (2013), urbanisation comes with a series of challenges, including reduction of fertile lands, deforestation, air and water pollution, reduced drainage of the rainfall, and the creation of peri-urban areas where socio-economic constraints are exalted and poverty is condensed.

Over the last 20 years, despite a decrease of the proportion of slum dwellers in urban areas across all developing countries, the number of urban residents living in slums and informal settlements have been increasing; resulting in more challenges for urban services provision by municipalities (UN-habitat, 2016a). Though the current concentration of poverty, slum growth and social disruption in cities paint a negative picture, urbanisation can also be positive (UN-habitat, 2007). Indeed, with 54% of the world's population, cities account for over 80% of global GDP and no country in the industrial age has ever achieved significant economic growth without urbanization; the potential benefits of urbanization ("increased productivity, employment opportunities, improved quality of life, and large-scale investment in infrastructure and services") far outweighing its disadvantages (UN-habitat, 2016a).

Food security appears as one of the critical issue resulting from rapid urbanisation (De bon *et al.*, 2010; Prain, 2010; Orsini *et al.*, 2013; Magnusson *et al.,* 2014). Most of urban poor spend at least between 60 and 80% of their income just to feed themselves (Orsini *et al.,* 2013; Magnusson *et al.,* 2014); but their food consumption remains insufficient in quality and quantity (FAO, 2001; Orsini *et al.*, 2013). Urban and peri-urban agriculture (UPA) is "one mechanism that plays a role in enhancing access to and distribution of food in urban areas and, thus filling the hunger gap" (Lee-smith, 2010). Besides food provision, UPA constitutes one of urban dwellers livelihoods strategies and provides them with a series of socioeconomic and ecological benefits (FAO and World Bank, 2008; De bon *et al.* 2010; Prain, 2010; Ngome and Foeken, 2012; Asongwe *et al.*, 2014; Magnusson *et al.*, 2014; Noubissie *et al.*, 2016). Furthermore, worldwide, UPA involves some 800 million people and benefits not only urban and peri-urban farmers but also traders, input suppliers and other service providers involved in agricultural value chains (Lagerkvist, 2014).

Though UPA has been widely studied, there is no yet a universal definition of urban and peri-urban agriculture and several definitions exist (Magnusson *et al.*, 2014). For instance, UNDP (1996: 3) defines UPA as "an industry that produces, processes and markets food and fuel, largely in response to the daily demand of consumers within a town, city or metropolis, on land and water dispersed throughout the urban and peri-urban area, applying intensive production methods, using and reusing natural resources and urban wastes, to yield a diversity of crops and livestock". Also, UPA is defined as the cultivation of crops and the raising of animals for food and other uses within and around cities and

towns (De bon *et al.*, 2010); regardless of land size and the number of human resources involved (Rezai *et al.*, 2016). In addition to products from crop production and livestock; UPA includes "product from fisheries and forestry in the urban and peri-urban area [...] non-wood forest products, as well as ecological services provided by agriculture, fisheries, and forestry" (FAO, 2001), and other interrelated activities, such as the production and selling of agricultural inputs (Orsini *et al.* 2013). In this paper, we do not differentiate urban and peri-urban agriculture as they both contribute mainly to food production for urban populations consumption. Thus, the terms urban agriculture and UPA will be used interchangeably.

In Cameroon, urbanisation rate was estimated at 54% in 2014, with 65% of the urban population living in Slum and the number of slum dwellers increasing at an annual rate of 5.5% (UN-habitat, 2016b). This trend is similar across cities in all developing regions; where since 1990, the number of slum dwellers has gradually increased (UN-habitat, 2016a).

Furthermore, by 2030, about 65-75% of Cameroonian are expected to live in cities (De bon *et al.*, 2010; UN-habitat, 2016b). Moreover, if by 2030, 60% of the population still derive income from the primary sector, a significant portion of farmers, between 10 and 30% will live in towns (Parrot *et al.*, 2008; Parrot *et al.*, 2009a). Thus, in the future, UPA is called to play a key role in the country agricultural sector and food security. Thus, it is necessary to start thinking on how to organise it to make it sustainable and more profitable.

In Africa, urban agriculture traditionally constitutes a risk-sharing strategy for households (Parrot *et al.*, 2009a, 2009b; De bon *et al.*, 2010), but is also part of Africans culture and urban agriculture tradition (Page, 2002; Dongmo *et al.*, 2010; De bon *et al.*, 2010). Moreover, being close to local markets, UPA is expected to become increasingly important for food supply and nutrition in developing countries cities, particularly for perishable products (Lagerkvist, 2014). In Cameroon, the history of UPA is traced back to the colonial era when the first cities were created. For instance, in Yaoundé, the military stations were hiring workers who were also farmers to ensure that German settlements remain self-sufficient in food (Bopda *et al.*, 2010; Prain, 2010). However, UPA witnessed a significant development in the 1980s. When the economic crisis followed by structural adjustment policies slowed down rural agriculture, reduced public sector employment, and increased urban unemployment; UPA appeared as a means of survival and an additional source of income and food for the population (Musa, 1996; Page, 2002; Bopda and Awono, 2010). Today, agriculture remains an important aspect of urban Cameroonians lifestyle (Musa, 1996; Bopda *et al.*, 2010; Yemmafouo, 2014).

Moreover, urban agriculture is growing in popularity and becoming "an integral component of the push to improve food quantity and quality in neighbourhoods where healthy food is scarce or not readily available" (Asongwe *et al.*, 2014). This trend coupled with the rapid urbanisation, calls for actions to develop sustainable urban and peri-urban agriculture production systems in Cameroon given the key role it is called to play for food security and as a livelihoods strategy; and its potential impact on the environment. Recent researches on the topic are relatively rare in Cameroon, and those existing have approached UPA from different perspective. This paper aims at presenting with a global perspective the status of UPA in Cameroon and contributes to the provision of guidance to set up sustainable and profitable urban production systems.

It presents the mains characteristics of Cameroon UPA, its contribution to local livelihoods and environmental sustainability. It examines its constraints, challenges and potential negative impacts on the environment and human health. Finally, it discusses what can be done to improve the UPA sector.

Materials and methods

Databases uses

Using Web of Science, Google Scholar, ProQuest, and Ghent University online library; literature related to urban and peri-urban agricultural was retrieved and reviewed. Both literature in French and English were consulted.

An effort was made to ensure that only the most recent literature possible is used. A combination of Boolean connectors and keywords was used for data search. For instance, the following combinations were used: i) urban* agriculture AND Africa OR developing*countries OR Cameroon; ii) sustainable* urban agriculture OR urban* planning AND agriculture AND developing* countries OR Africa OR Cameroon; iii) urban AND peri-urban AND agriculture AND development AND improvement.

Literature selection criteria

The main criteria guiding the selection of papers included but were not limited to: the title, the abstract, the relevance of contents; and the main author affiliation. In addition, for scientific articles, a priority was given to peer-reviewed journals and whenever possible to those with an impact factor. Most of the papers found focus on Yaoundé which is the country capital, the second most populous city but also the city where the majority of research centre are located. The rest of papers deals with UPA in secondary cities like Bamenda, Buea, Dschang, Muea, Ngaoundéré, Bafoussam, and Mbouda.

Results and discussion

Characteristics of urban and peri-urban agriculture in Cameroon

Cameroon is a country with diverse agroecological zones suitable to distinct types of crops and livestock. Therefore, UPA dynamism is not the same everywhere. For instance, when a city like Douala with its sandy soils is not suitable for urban agriculture; cities like Yaoundé, Bafoussam and Bamenda benefits of excellent morpho-pedological and social conditions which make agriculture part of the daily activities of their residents (Yemmafouo, 2014).

Statistics on the number of urban and peri-urban farmers in the country are rare. Nevertheless, the number of urban farmers for the single town of Yaoundé is estimated to runs into thousands (Musa, 1996; Nguegang, 2008). Besides, existing data shows that most of the urban farmers are women (Gockowski *et al.*, 2003; Parrot *et al.*, 2008; Parrot *et al.,* 2009a; Bopda *et al.*, 2010; Dongmo *et al.*, 2010; Asongwe *et al.*, 2014).

Also, men and women have differents interest in UPA. For instance, there are two main production objectives, subsistence/consumption and commercialization (De bon *et al.*, 2010; Bopda *et al.*, 2010); and men tend to be more income oriented while women are more subsistence oriented (Ngome and Foeken, 2012). There are also differences in the type of activities undertaken. Studying livestock production in Yaoundé, Dongmo *et al.* (2010) found that more women (65%) were involved in keeping chickens and broilers while men (76%) were more involved in pigs' production. A similar result for pig production was found in Dschang by Defang *et al.* (2014) where 77% of stockbreeders were men. Furthermore, UPA is an activity undertaken by all the social components of the society regardless of their social status and income level (Musa, 1996; Nguegang, 2008; Parrot *et al.*, 2009a; Ngome and Foeken, 2012; Yemmafouo, 2014). Thus, UPA is performed both by civil servants including high officials, private sector employees, jobless people, youths, elderly, etc. In Yaoundé, these farmers are grouped in three groups by Nguegang (2008), full-time, temporary and part-time. However, he adds that this classification is not rigid; farmers shifting easily from one group to another. Most of these urban farmers cultivate their crop on rented land (Fonchingong, 1999; Gockowski *et al.*, 2003; Bopda *et al.* 2010; Ngome and Foeken, 2012; Asongwe *et al.,* 2014). Thus, farm location can also easily change with time; land insecurity not providing incentives for long-term investment, and freedom on the land uses.

UPA provides urban Cameroonians with a wide range of products with multiple uses including plants crops (vegetables, staple crops, fruits trees', ornamental trees' and flowers, medicinal plants, spices etc.) (De bon *et al.*, 2010; Bopda *et al.*, 2010; Sotamenou and Parrot, 2013; Yemmafouo, 2014) and animal products (Dongmo *et al.*, 2010; De bon *et al.*, 2010; Bopda *et al.*, 2010; Defang *et al.*, 2014; Yemmafouo, 2014). Piggery, poultry farms and broilers are the main components of livestock production (Dongmo *et al.*, 2010; Lee-Smith, 2010; Yemmafouo, 2014). Also, where livestock is present, manure is used by most of

the urban and peri-urban farmers to improve soils property of their cultivated land (Nguegang, 2008; Parrot *et al*., 2009a; Dongmo *et al.*; 2010; Asongwe *et al.*, 2014; Yemmafouo, 2014). Furthermore, in Yaoundé, Bopda *et al.* (2010) distinguish three main types of cropping: mixed crop systems dominated by improved varieties of maize in upland; mono-crop systems of improved maize grown in valley bottoms and intensive horticultural systems in valley bottoms. This is representative to what is found in most Cameroon cities. Nevertheless, horticulture in lowland and valley is the most dominant aspect of UPA in the country (Nguegang, 2008, Bopda *et al.*, 2010; Abang *et al.*, 2013; Asongwe *et al.*, 2014). Furthermore, Abang *et al.* (2013) claim that compared to rural production, the type of vegetables cultivate in cities is less diversify.

Benefits provided by urban and peri-urban agriculture to urban Cameroonians

A series of socioeconomic and ecological benefits are attributed to UPA. These include contribution to food security through increases in food diversity, availability, accessibility and stability; contribution to poverty alleviation through a reduction of expenditures and an increase of income; employment creation; and provision of ecological benefits such as creation of green zones within and around the cities, and contribution to municipal solid waste and water recycling (FAO, 2001). In Cameroon, these benefits have been recognised sometimes totally or partially by several scholars like Gockowski *et al.* (2003), Nguegang (2008); Parrot *et al.* (2008, 2009a, 2009b); De bon *et al.* (2010); Bopda *et al*., 2010; Ngome and Foeken (2012); Orsini *et al.* (2013); Asongwe (2014); Yemmafouo (2014) and Noubissie *et al.* (2016).

Contribution to food security

UPA contributes in supplying urban consumers with more or less safer foods produced locally, which they can easily control the quality (Debon *et al.*, 2010; Lagerkvist, 2014; Grebitus *et al.,* 2017). UPA role is key in providing cities with perishable products, especially vegetables (De bon *et al.*, 2010; Asongwe *et al.*, 2014), but also to other staples crops like maize, fruits and animal products. In some cases, more than 75% of urban supply comes from UPA. For instance, in Yaoundé, UPA supply 90%, 80%, 60% and 25% of maize, vegetables, plantain and tomato respectively (Orsini *et al.*, 2013). Furthermore, Bopda *et al.* (2010) indicate that urban subsistence farmers consume more than 80% of all their crops, selling or giving away the rest in equal proportions while commercial urban farmers consume about 25% of their traditional leafy vegetable production themselves and about 50% of their maize production.

Also, scholars mentioned by Yemmafouo (2014) note that UPA supply 50% of cereals and tubers consumed in urban households in the cities of Mbouda, Dschang and Bafoussam. Moreover, in Buea, Ngome and Foeken (2012) report that 66% of urban farmers consider their own food production as the most important source of calories and protein (Ngome and Foeken, 2012).

Because vegetables are highly perishable, have a short production cycle and are important in local consumers diet; they constitute an important component or urban and peri-urban production system and are the subject of most of the previous empirical research on UPA. In a study covering both urban and rural area at national level, Abang *et al.* (2013) found that 38% of total vegetable production was from urban agriculture.

This is a significant quantity given the production constraints they are faced with. Also, Bopda *et al.* (2010) estimated that about 27% of the leafy vegetables consumed by low-income households comes from their own home gardens. Gockowski *et al.* (2003) add that leafy vegetables contribute a significant share of essential nutrients for the urban households. Moreover, according to Bopda *et al.* (2010), three leafy vegetables (cassava leaves, Vernonia and Amaranthus) provide about 8% of the protein and 40% of the calcium intake of all urban consumers; their nutritional contribution being more significant for the urban poor than for wealthier families. In addition, the rearing of small livestock within and around the cities also constitutes an important source of animal protein for human nutrition (Dongmo *et al.*, 2010).

Contribution to poverty alleviation and employment creation

The number of urban farmers for the single town of Yaoundé is estimated to runs into thousands (Musa, 1996; Nguegang, 2008). Gockowski *et al.* (2003) found that in 1998–1999, over 32 000 households were involved in leafy vegetables production. With the rapid urbanisation of the past decades, this number has been increasing. Owing to their proximity with consumers to whom they sell their product directly, urban farmers have a comparative advantage compared to their rural peers (De bon *et al.*, 2010; Lagerkvist, 2014).

Also, in the case of vegetables growers, using alternatives sources of irrigation, farmers can produce during the dry season when prices are more than the double of the rainy season price. Thus, they can significantly improve their margin and generate sufficient profit to take care of their family and make UPA their main activity (Nguegang, 2008; Bopda *et al.*, 2010; Lee-Smith, 2010; Asongwe *et al.*, 2014).

Furthermore, according to Lee-Smith (2010), in a city like Yaoundé, there are only few employment alternatives as lucrative like UPA which incomes are estimated to be 50% above the minimum wage. Moreover, Nguegang (2008) reports some farmers unwilling to leave UPA to work as civil servants; these farmers generating monthly revenues of about 217.296 $US (126,354 XAF) far higher than the monthly salary of a category "B" civil servant (ones with at least two years of university education).

Also, a study by Parrot *et al.* (2008) in Muea indicate a significant increase with time of UPA contribution to urban households' incomes. For a selected group of households, Parrot *et al.* (2008) point that, between 1995 and 2004, the total annual incomes from horticulture which is mainly produced in urban and peri-urban area increased by 144% from 85 to 210 thousand euros whereas for the same period, incomes from cash crops increased by 63% from 115 to 190 thousand euros, and incomes derived from staple crops decreased by 81% from 1.5 to 0.3 million euros. Besides, except its contribution to income generation; through food consumption, UPA reduces households' consumption expenditures. For instance, researchers quoted by Yemmafouo (2014) report that UPA contributes to reduce by 50% the households' expenditure for cereals and tuber purchases in the cities of Mbouda, Dschang and Bafoussam. Therefore, the money saved can be reinvested in production or used to acquire other consumption goods and services.

Provision of ecological benefits

Through agroforestry, the planting of fruits trees, ornamental trees and shrubs and flowers; UPA contribute to urban greening (Nguegang, 2008; Debon *et al.*, 2010; Bopda *et al.*, 2010 Sotamenou and Parrot, 2013). These trees and flowers contribute in embellishing urban landscape (Nguegang, 2008), and the various fruits trees planted along cities main streets and next to houses are an important source of food (Bopda *et al.* 2010), provide shade and contribute in creating suitable microclimate during hot seasons. In some cases, using these trees and ornamental crops, municipalities directly generate some income like the Yaoundé city council with the Saint-Anastasie wood park of Yaoundé for which the entrance is not free. Nevertheless, in Cameroon, the challenges of such initiatives include insufficient monitoring, infrastructure maintenance and citizens incivility.

Furthermore, most Cameroonian urban farmers use compost and animal manure to complement chemical fertilisers (Nkamleu and Adesina, 2000; Nguegang, 2008; Parrot *et al.*, 2009a; Yemmafouo, 2014). By using compost made from households' garbage and manure from urban livestock production (Nguegang, 2008; Dongmo *et al.*, 2010; Lee-smith, 2010); UPA contributes to waste management by reducing the quantities of waste dump into the nature and thus to the reduction of air, soil and water pollution resulting from inappropriate disposal of waste. Moreover, compost production constitutes a lucrative business (Nguenang, 2008; Lee-smith, 2010; Yemmafouo, 2014). Still, Dongmo *et al.* (2010) and Parrot *et al.* (2009b) suggest that UPA contribution to waste management can be increased by improving the country composting system. Also, we can add that with shorter value chain and less processing and

transportation required; UPA generates fewer greenhouse gases and thus have a low carbon footprint compared to rural production.

Nevertheless, UPA also have implications which can have negative effects on urban health and the physical environment and its components (FAO, 2001; De bon *et al.*, 2010; Sotamenou and Parrot, 2013; Magnusson *et al.*, 2014). Some of these implications come from the constraints and problems faced by UPA.

Constraints to UPA development in Cameroon and impact on environment

Resource, institutional and practical constraints

The main constraints faced by UPA are like those encounter in other developing countries cities: land and water scarcity resulting from competition with alternatives uses (real estate, consumption, industry etc.), and restrictions of space dedicated to UPA (Nguegang, 2008; Parrot *et al.*, 2009a; Debon *et al.*, 2010; Ngome and Foeken, 2012).

In addition, in contrast to cities like Dakar (Senegal) and Cotonou (Benin) that officially recognised UPA with regulatory texts, and special portion of land affected to urban farmers (Nguegang, 2008); in most of Cameroon cities, there is no legal and regulatory framework to govern UPA which is officially prohibited by authorities. (Nguegang, 2008, Asongwe *et al.*, 2014; Yemmafouo, 2014). Indeed, as noted by Yemmafouo (2014), Cameroon public authorities often prohibit UPA and consider it as an occupation of public space; the government arguing that UPA results in poverty; urban landscape deterioration, diseases from biological and chemical contamination of foods; and insecurity with farms serving as hiding lodges for criminals. Nevertheless, depending on the goodwill of the municipal administration or the Divisional Officer (Yemmafouo, 2014); there are exceptions where urban agriculture is tolerated; the authorities most often doing so because they are unable to ensure urban household food security (Nguegang, 2008; Yemmafouo, 2014). Furthermore, this attitude is because most of the officials in charge of enforcing the laws are also involved directly or indirectly in UPA (Nguegang *et al.*, 2008; Bopda and Awono, 2010); relying on UPA to satisfy at least part of their daily food and nutritional requirements.

In addition to constraints related to UPA recognition, and land and water availability; there are constraints due to lack of funding to acquire equipment and inputs (De bon *et al.*, 2010; Dongmo *et al.*, 2010; Ngome and Foeken, 2012; Defang *et al.*, 2014); lack of education and training (Dongmo *et al.*, 2010; Ngome and Foeken, 2012; Abang *et al.*, 2013); marketing of product (Nguegang, 2008; Defang *et al.*, 2014), and product theft especially for high value product (Nguegang, 2008; Ngome and Foeken, 2012). These constraints have direct implications on the environmental impact of UPA and the quality of food produces by urban farmers.

Impact on food safety and human health; soils, water and air quality

UPA can be an environmental polluter and at the same time be affected by harmful materials derived from other sources (Bopda *et al.*, 2010). Indeed, because of land related constraints; UPA usually takes places in marginal and polluted areas where soil fertility level is often low (Nguegang, 2008; De bon *et al.*, 2010; Asongwe *et al.*, 2014). Thus, despite official prohibition, plants are grown in areas close to roads, households or factories including soap production and subject to pollution from emissions from vehicles, household discharges, and industries. (Asongwe *et al.*, 2014). Furthermore, to guarantee enough food production, farmers have no other choice than to intensify the production by using important quantities of fertilisers, pesticides, and waste water irrigation during dry seasons (Drechsel *et al.*, 1999; De bon *et al.*, 2010).

These practices have direct implications on food safety, soils and water pollution level. Indeed, there are substantial risk of food contamination from harmful microorganisms and heavy metals present in waste water used for irrigation and soils, and from pesticides and fertilisers residues (Nguegang, 2008; Bopda *et al.*, 2010; De bon *et al.*, 2010; Abang *et al.*, 2013; Asongwe *et al.*, 2014). For instance, in the city of Ngaoundéré, Noubissié *et al.* (2016) found that a

significant amount of heavy metals present in amended vegetable gardens soils was directly or indirectly coming from farmers practices, and some of these metals were present in the crops cultivated with concentrations exceeding the recommended limit values. This is alarming when considering that foods containing heavy metals when consumed can lead to several health damages ranging from infertility, coronary diseases, kidney failures, and respiratory problems (Asongwe *et al.*, 2014). Also, by using contaminated water, UPA practices' increases the prevalence of diseases like malaria, typhoid and dysentery (Nguegang, 2008; Bopda *et al.*, 2010).

Moreover, existing researches have shown that, because of pesticides uses, UPA has contributed to increasing mosquitoes' resistance to insecticides in cities like Yaoundé and Douala (Antonio-Nkondjio *et al.*, 2011, 2015). In Cameroon cities, UPA directly contributes to water and soils pollution mainly because of misuse of fertilizers and pesticides (Gockowski *et al.*, 2003; Nguegang, 2008; Bopda *et al.*, 2010; Asongwe *et al.*, 2014; Defang *et al.*, 2014; Defo *et al.*, 2015). For instance, Defo *et al.* (2015) identify pesticides and fertilisers used by urban and peri-urban agriculture as one of the main source of high concentrations (above threshold limits allowable) of Pb, Cd, Cr and Ni in soils and groundwater in the Ntem watershed; making groundwater which constitutes a major source of potable water supply for the population.

Dangerous for health. On the other hand, livestock production near residential areas in cities is a source of unpleasant smell and noises, and causes water pollution, through contamination of the water table by nitrates (Dongmo *et al.*, 2010).

Opportunities to develop sustainable urban and peri-urban agriculture production systems

In this section, we propose few measures that could be taken for the development of urban and peri urban agriculture; namely its official recognition and inclusion in urban master plan, and the design and implementation of adequate programme and project to support urban farmers.

Officials recognition and inclusion in urban master plan

Although planning is central to achieving sustainable urban development, today, many cities in the world still rely on outdated modes of planning (UN-habitat, 2016a). The situation is worst in Cameroon where less than 9% of cities have a master plan; most of which are outdated (UN-habitat; 2016b). Besides, urban planners and manager focus more on providing services like housing, transport, water, electricity; neglecting urban agriculture which is an integral component of the urban systems. Therefore, one of the must is an official recognition of UPA by authorities and its inclusion in the process of urban planning and agricultural development policies design. This will facilitate the regulation, the monitoring, coordination and food quality control. Also, this will ease the implementation of further interventions designed to benefit urban farmers. Indeed, official recognition and inclusion of UPA in development policies in cities like Dares Salaam and Kampala have proven to be effective (Lee-smith, 2010).

The current government strategy to solve the problem of non-constructible areas where people lives and simultaneously practices agriculture consist of land expropriation and people eviction. But, this only results on transferring the problem from one place to another (Parrot *et al.* (2009a). To solve this issue, urban planners should work to reduce the spatial extension of cities (+5% year) which is above Africa average (3,2%) (UN-habitat, 2016b). Indeed, cities expansion result in less dense cities which bring higher infrastructure costs, worsen mobility, and destroy agricultural land (UN-habitat, 2016a).

Therefore, by limiting cities expansion, more land will be available and zones could be assigned to urban agriculture. Also, part of the cost saved could be reinvested in areas dedicated to UPA. These investments could be on opening road access to farm land; the building of market infrastructures near the farms, of drainage canals in valley and effective irrigation systems. Also, if funds are available, these zones could be provided with extension services offices, composting units; food quality control

laboratory, etc. Once the zoning is done and the area developed, the land could then be rented to urban farmers with long-term lease contracts to provide them with incentives for long-term investments. When the issue of land is solved, the further step will be to provide urban farmers with the appropriate support for them to be productive and environmentally friendly.

Design adequate programme and project to support UPA

Providing technical, financial and material support to urban farmers will improve productivity and limit UPA negative impacts on food safety and environment (Nguenang, 2008; Ngome and Foeken, 2012). At first, building a sustainable urban production system requires urban farmers capacity building (Parrot *et al.*, 2008; 2009b; Ngome and Foeken, 2012; Abang *et al.* 2013) to reduce limit farmers practices like misuses of fertilisers and pesticides, and the use of waste water (Bopda *et al.*, 2010; Abang *et al.*, 2013; Noubissie, 2016). Further, sustainable and less hazardous practices need to be introduced to farmers (Ngome and Foeken, 2012; Abang *et al.* 2013; Sotamenou and Parrot, 2013), but also, they should be trained to adapt their practices to the existing constraints (Parrot *et al.*, 2008). For instance, by training urban farmers, and equipping them to practise techniques such as vertical agriculture, greenhouses farming and hydroponics; we can increase production and productivity, and ensure a continuous supply of food throughout the year. Moreover, by bringing close together urban farmers, their activity will be easily monitored, and that will facilitate food quality control. In addition, it is necessary to strengthen urban farmers capacity in agricultural products post-harvest handling and processing to increase their margins and reduce post-harvest losses.

Specific microcredit schemes should be defined for urban farmers to facilitate their access to productive inputs. As well, the State and civil society organisations should support initiatives that promote collective action among farmers and strengthen existing farmers organisations. Indeed; discussing urban informal financial associations; Parrot *et al.* (2008) indicate that, they have a positive effect on performances and increase ties between people, improve access to credit and information, and can be particularly relevant for inputs purchasing. Furthermore, with strong collaboration between urban households; it will be easier to promote and create community gardens which will contribute to urban food supply and social inclusion of vulnerable groups such as women and elderly.

At the municipal level, waste management practices need to be improved and composting promoted (Parrot *et al.*, 2009b; Sotamenou and Parrot, 2013). By building transfer stations where households garbage is collected, stored, sorted, and processed into compost; preferably near farms to reduce transportation costs (Parrot *et al.*, 2009a); municipalities will contribute to a sustainable urban waste management system and the increase of agricultural output. Indeed, recovered and recycled domestic waste are very rich in organic fraction for fresh and decomposed kitchen waste, and in nitrogen and potassium for recycled livestock waste (Parrot *et al.*, 2009a). With more compost available, the quantity used by farmers and initiatives for organic agriculture will also increase, and safer food will be delivered to consumers. Simultaneously, this will reduce the quantity of garbage dumped in open-air and responsible of air, water and soil pollution. Nevertheless, beforehand, adequate waste collection services at households' level needs to be designed (Sotamenou and Parrot, 2013).

This will require providing populations with garbage bins and train them on effective waste sorting and compost production. Thus, each urban household or at least the majority will be able to produce some compost for their personal use.

Also, it will be beneficial to motivate the private sector to get into the process. This could be done by providing them with a series of benefits like tax exemption, a free or cheap land for them to build their composting unit. This will increase the composting capacities, and compost supply which will eventually result in a lower price for farmers.

Conclusion

In this paper, we have discussed the status of UPA in Cameroon; especially its characteristics, socioeconomic and ecological benefits, constraints, and some perspectives to develop a sustainable urban production system. In summary, we have seen that UPA contributes significantly to food security and urban dwellers livelihoods, and provide several environmental services. However, due to insufficient planning and inadequate policies, the non-official recognition and inclusion of UPA in cities urban master plans and the limited access to productive inputs by urban farmers, this contribution is far below its real potential.

Furthermore, due to poor practices resulting from the predominance of an unskillful labour force; UPA constitutes in some cases a threat to the physical environment and to human health. To boost urban agriculture productivity, reduce its potential negative impact on the environment, and improve food safety and security; we recommend an official recognition of UPA and its consideration by urban planners, and the design of adequate programme and project to support urban farmers in terms of capacity building, facilitation of their access to credit, the promotion of collective actions, and the promotion of environmental friendly productive techniques. Nevertheless, as suggested by Lee-smith (2010), when undertake, these interventions should be the most gender sensitive possible to protect vulnerable groups, especially women.

The feasibility of these recommendations will require strong State political goodwill, and an extensive collaboration among stakeholders to obtain the technical, institutional and funding support necessary to boost UPA development. Besides, more empirical researches are needed to investigate rural-urban agriculture linkages and their mutual relations; to evaluate the perceptions of UPA by authorities, to quantify its real contribution to the local economy and to assess the types of partnership existing between urban farmers and other actors, and urban farmers readiness to get involves into collective action.

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