

Characteristics of Urban Market Gardening in Porto-Novo, Republic of Benin, West Africa

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Abstract: In Benin, gardening products include traditional vegetables (tomato, pepper, okra, onion), leafy vegetables (big nightshade, amaranth) and exotic vegetable (carrot, cabbage, lettuce, cucumber, leek, green beans ...) and market gardening is on the rise with massive investments from government. This study was carried out in Porto-Novo (capital of the Republic of Benin, West Africa) to find out the characteristics of the urban market gardening system. A questionnaire was used for the study. The investigation revealed that, in Porto-Novo, urban gardening was practiced in seventeen out eighty-eight neighbourhoods. Three hundred and forty-three people middle-aged (41.82 years) were urban gardeners, 38.19% of them were female and 76.09% of them can read and write. About 80.17% of producers are motivated by the profitability of market gardening, and eighteen vegetables are grown (sweet pepper, celery, carrot, bitter leaf, okra, hot pepper, onion, green bean, pot-herb, cabbage, tomato, basil, watermelon, lettuce, large nightshade, cucumber, celosia and amaranth). Around 95.92% of producers use organic and chemical fertilisers, 86.59% of them use plant protection products to fight pests, 54.81% of them have an activity complementary to urban gardening, 0.29% of urban gardeners only is on their own land. The urban gardening is an option to reduce the risk of urban food insecurity in Porto-Novo and an opportunity to increase the income of producers. Land tenure security, access to inputs, and access to finance are the constraints that can prevent the development of urban gardening in Porto-Novo.

Keywords: Urban gardening, vegetables, fertilisers, Porto-Novo

1. Introduction

Agricultural production has increased sharply in all parts of Africa (Jules et al., 2011). Today, peri-urban market gardening is developing in major African cities (Temple & Moustier, 2004) and leafy vegetables play an important role in the diets of all populations in the world, particularly in Africa, Asia and Oceania where they provide the essential part of nutritional and medicinal needs (Adebolu and Oladimeji, 2005; Batawila et al., 2005; Sinha, 2011; Dossou et al., 2012). Market garden is the name given to commercial horticulture and is defined as the science and art of cultivation, processing and marketing of fruits, vegetables, nuts and ornamental plants (Adebisi-Adelani et al., 2010), and it has to be sustainable. Indeed, Sustainable agricultural intensification is to

produce more output from the same area of land reducing the negative impact on the environment (Pretty, 2008; Royal Society, 2009; Conway and Waage, 2010; Godfray et al., 2010; Anthony et al., 2013).

Urban and peri-urban agriculture is a phenomenon in progress, and there are million active urban farmers in the world. In Benin, as in all other sub-Saharan African countries, market gardening plays an important role in socio-economic activities and contributes quantitatively and qualitatively to improving food and nutritional situation of rural and urban populations by bringing minerals elements and vitamins. It is a lucrative business for some households and it contributes significantly to a country's economy. It is practised in all regions of Benin, on the plateaus, in the alluvial plains, and in

the valleys. In Benin, urban gardening products consist of traditional garden produces (tomato, pepper, okra, onion, etc.), leafy vegetables (large nightshade, amaranth, etc.) and exotic plants (carrot, cabbage, lettuce, cucumber, green beans, etc.). But vegetable production is much larger in the south than in northern Benin (Tokannou and Quenum, 2007). According to Assogba-Komlan *et al* (2007), in South Benin, leafy vegetables rank second behind tomatoes and are consumed by 62.5% of Benin's population. Nutritional education campaigns recommend the consumption of gardening products because of their vitamins and minerals content. The nutritional and therapeutic importance of leafy vegetables has been the subject of much research in the world and especially in Africa (Kpeki, 2008). Vegetables provide the human body with important nutrients in addition to those provided by other foods and also help to cure certain diseases (Rubaihayo, 2002, Vodouhè *et al.*, 2012). Porto-Novo, the capital of Benin, doesn't make exception to the dynamics of urban gardening. This urban agriculture is a main source of market garden products for the population of the capital of the Republic of Benin.

2. Material and Methods

This study was conducted between March and April 2017 among all urban gardeners in Porto-Novo, Republic of Benin. Urban gardeners are people who grow their own vegetables for sale. This work allowed identifying market gardening

sites and information on urban agriculture in Porto-Novo. The material used is an individual survey form, a questionnaire in which answers are written or checked off on the form. The interviews comprised a series of open and closed questions which cover different aspects of the topic. The questions are related to gender, years of experience, family size, level of education, motivation, profitability, type of produce, inputs, and sources of water, complementary activities, land tenure security and difficulties. All the market gardeners met during the survey are taken in the study population. Agricultural extension officers were recruited for the survey. The data were treated manually.

The Republic of Benin is located in West Africa, and Porto-Novo its capital is located in the south-east of the country (Figure 1). The area of Porto-Novo is 110 km², about 1.08% of the national territory area. Porto-Novo has eighty-six (86) districts. The climate is subequatorial, and the average of temperature is 28 °C. The month of March is the warmest (32 °C), and the month of August is the least hot (24 °C). The rainfall pattern includes two rainy seasons and two dry seasons of unequal duration. Usually, it rains from March to July (big rainy season) and from September to November (small rainy season). The annual rainfall is estimated at 1200 mm/year. The rhythm of the seasons has been disturbed in the past twenty years. Adaptation to climate change is essential for the resilience of agricultural and food systems (Bellon and Van Etten, 2014, Folke, 2006).



Fig. 1 Geographical location of Porto-Novo (designed from google images, 2017)

3. Results and discussion

The study identified three hundred and forty-three (343) urban gardeners in seventeen (17) districts. 60.81% of market gardeners are male; and 38.19% are female. This female percentage is close to the 34% found in the city of Parakou in the North of the Republic of Benin (Abdoul-Ramane & Aboudou, 2015) and far from the 26.8% found in Chihota in the Republic of Zimbabwe in the market gardeners households headed by female (Bindu & Chigusiwa, 2013). Also, in Anambra State in Nigeria, Market gardening is essentially practised by men (70.80%) (Ofoka et al., 2013). In contrast, Market gardeners in Kapit (Malaysia) were typically the work of female (Sarah, 2005). According to some authors, there is a gap that varies across countries in agricultural productivity between plots managed by men and women (Aguilar et al. 2015; Backiny-Yitna & McGee, 2015; Oseni et al. 2015; World Bank & ONE, 2014). Women in agriculture will remain largely neglected by information and service providers unless their differing needs, access to, and control over resources are considered at policy and project design stage (Patricia K. et al., 2017).

In Porto-Novo, 12.83% of producers are in the 20 to 30 age group, 28.57% are in the 30 to 40 age brackets, 36.15% are in the 40 to 50 age group, 22.45 % are over 50s bracket. The average is 41.82 years. This average is close to year average of market gardeners in Niamey in the Republic of Niger, and in Anambra State in Nigeria (Ludovic & Philippe, 2011; Ofoka et al., 2013).

The size of the family of urban gardeners in Porto-Novo varies from one (01) person to ten (10) people. 30.50% of producers have a family size of 4 people, 17.89% of producers have a family size of 3 people, 15.25% of vegetable producers have a family size of 2 people, 12.32 % have a family size of 5 people. The average family size of urban gardeners is 3.83 people. These data on household size contrast with those found among market gardeners in Niamey in Republic of Niger, where average household size is 12 with the highest number of members in a household at 27 and the minimum at 5 members (Ludovic & Philippe, 2011).

In the capital of Benin; 95.04% of market gardeners are married, 3.79% are single and 1.17% is widowed. 76.09% of market gardeners are educated and can read and write. Most have the primary education level, some have the secondary school level, and some have a university level. In Chihota in Zimbabwe, just over 84% of the market

gardeners completed their primary level (Bindu & Chigusiwa, 2013), while in Anambra in Nigeria, all have some form of formal education (Ofoka et al., 2013). In contrast, market gardeners in Kapit in Malaysia are poorly educated (Sarah, 2005).

Table 1 Urban gardeners by district in Porto-Novo (Survey data, 2017)

District	Number	%
Anavie	1	0,29%
Avakpa	1	0,29%
Donoukin	2	0,58%
Ouando	2	0,58%
Ouelinda	4	1,17%
Kandevie	9	2,62%
Gbedji	10	2,92%
Houegbe	10	2,92%
Sedjeko	11	3,21%
Djegandaho	13	3,79%
Akonaboue	16	4,66%
Apkassa	17	4,96%
Agbokou	19	5,54%
Lokpodji	19	5,54%
Gbekon	21	6,12%
Akron	28	8,16%
Sokome	57	16,62%
Zounkpa	61	17,78%
Louho	71	20,70%
	343	100,00%

From the analysis of the table 1, it follows that 55.10% of urban gardeners are concentrated in the districts (Louho, Zounkpa and Sokomè) and that 84.54% of urban gardeners are in eight districts (Louho, Zounkpa , Sokomè, Akron, Gbèkon, Agbokou-Lokpodji, Apkassa and Akonaboè).

Concerning years of experience, 25.66% are less than 5 years old in market gardening, 17.78% are between 5 and 10 years of seniority in market gardening, 22.16% are between 10 and 15 years of seniority in market gardening, 15.45% are between 15 and 20 years old in market gardening; 18.95% have more than 20 years in market gardening. In the districts of Apkassa, Agbokou Lokpodji and Akron, there are market gardeners who have more than 40 years of experience. In Niamey in Niger, on average, the producers have been practising market gardening production for 16 years (Ludovic & Philippe, 2011).

The reasons motivating the urban gardening are profitability (80.17%), employment (8.16%) and continuity in the parents' inheritance (4.08%). This confirms the role of market gardening as a source income for individuals and households as observed by other authors (Becker, 2000; Swindell et al., 1999; Van den Berg, 2002; Wooten, 2003).

Table 2 Estimated area of market gardening per district (Survey data, 2017)

Districts	Area (square meter)	%
AVAKPA	13200	8,48%
DJEGANDAHO	5520	3,55%
DONOUKIN	2400	1,54%
OUELINDA	15387	9,89%
SEDJEKO	13474	8,66%
GBEKON	6000	3,86%
APKASSA	6000	3,86%
ANAVIE	400	0,26%
LOUHO	400	0,26%
KANDEVIE	400	0,26%
OUANDO	10200	6,55%
GBEDJI HOUEGBE	12000	7,71%
ZOUNKPA	2000	1,29%
AKRON	34060	21,88%
AKONABOUE	13701	8,80%
SOKOME	10820	6,95%
AGBOKOU	9671,2	6,21%
LOKPODJI	155633,2	100,00%

About labour in urban gardening, 44.61% of urban gardeners of Porto-Novo have occasional workers; 29.74% have parents for workforce; 22.45% have parents and neighbours as workforce and 3.21% have no workforce. Those who have no labour are those with small areas.



Fig. 2 Leafy vegetables at Porto-Novo

According to area rough estimate made on the basis of declarations (Table 2), 15.85142 hectares of land are cultivated for urban garden products in Porto-Novo. Nine (9) out of the seventeen (17) districts are home for more than 85% of the total area.



Fig. 3 Leafy vegetables at Porto-Novo

Table 3 Urban garden products grown in Porto-Novo (Survey data, 2017)

N°	Market garden products	Scientific name of the plant	Number of beds	Percentage
1	Sweet pepper	<i>Capsicum annuum</i>	10	0,06%
2	Celery	<i>Apium graveolens L.</i>	25	0,16%
3	Carrot	<i>Daucus carota subsp. sativus</i>	45	0,29%
4	Bitter leaf	<i>Vernonia amygdalinum</i>	48	0,31%
5	Okra	<i>Abelmoschus esculentus</i>	52	0,33%
6	Hot pepper	<i>Capsicum frutescens</i>	53	0,34%
7	Onion	<i>Allium cepa</i>	55	0,35%
8	Green bean	<i>Phaseolus vulgaris</i>	122	0,78%
9	Pot-herb	<i>Corchorus olitorius L.</i>	171	1,09%
10	Cabbage	<i>Brassica oleracea L.</i>	200	1,27%
11	Tomato	<i>Solanum lycopersicum L.</i>	431	2,74%
12	Basil	<i>Ocimum basilicum L.</i>	446	2,84%
13	Watermelon	<i>Citrullus lanatus</i>	539	3,43%
14	Lettuce	<i>Lactuca sativa</i>	1390	8,84%
15	Large nightshade	<i>Solanum macrocarpon</i>	1519	9,66%
16	Cucumbers	<i>Cucumis sativus</i>	1954	12,43%
17	Celosia	<i>Celosia argentea L.</i>	2970	18,89%
18	Amaranth	<i>Amaranthus cruentus</i>	5694	36,21%
			15724	100,00%

As shown in the Table 3, fifteen thousand seven hundred and twenty-four (15724) beds with an average size of 10 m² per bed were enumerated. Eighteen urban garden products have been identified, and five of them represent more than 85% of the total. These are amaranth (36.21%), celosia (18.89%), cucumber (12.43%), large nightshade (9.66%) and lettuce (8.84%). These results corroborate those of some authors who reported the importance of leafy vegetables (*Amaranthus cruentus*, *Celosia argentea L.*, and *Solanum macrocarpon*) in southern Benin (Assogba-Komlan et al. 2007). In Parakou, the big city in the North Benin, the important species are the fruit vegetables (okra), root vegetables (carrot) and the leafy vegetables (garden marjoram) (Abdoul-Ramane and Aboudou, 2015)

Three hundred and twenty-nine (329), that is to say 95.92% of urban gardeners use fertilizers (organic or chemical) in Porto-Novo. Out of the 329 fertilizer users, 83.28% use chicken manure, 48.94% use urea, 38.30% use compost, and 26.44% use NKP (Nitrogen-Potassium-Phosphorus), 18.84% use rabbit dung, 9.12% use pig excrement, 8.81% use “nééré” seeds (*Parkia biglobosa*) waste, 8.21% use potting soil. This use of fertilizer shows

the depleted state of the soil in Porto-Novo. In Chihota in Zimbabwe, 73% of the study population uses inorganic fertilizers and chemicals (Bindu & Chigusiwa, 2013). Several authors have reported the use of organic fertilizers in the non-polluting production of vegetables (Pannell 2006, Ajayi 2007; Li et al 2008; Assogba et al 2007). Once soils are contaminated by pests, they hardly have any ways to control them in organic farming (Collange et al., 2011), except moving crops away from the contaminated plots.

About 86.59% of urban gardeners in Porto-Novo use plant protection products listed in Table 3, which are of various types for the control of pests. All the users buy the plant protection products from the retail in the street or from the shop and they cannot distinguish between the genuine and the counterfeit plant protection products. These pesticides are not authorized by national authority. A joint study by the Food and Agriculture Organization of the United Nations together with World Health Organization showed that an estimated 30% of pesticides imported and marketed in developing nations fall short of internationally accepted quality standards (FAO and WHO, 2001).

Table 4 Phytopharmaceutical products used (Survey data, 2017)

Trade name	Active ingredients	Concentration	Chemical family	To fight against
TOPSIN M	Methylthiophanate	800 g/kg	BE	mites, caterpillars
DECIS	Deltamethrin	15 g/l	PY	mites, caterpillars, flies
ACARIUS 018 EC	Abamectin	18g/l	Avermectine PY	mites, caterpillars, flies
COTALM P 218 EC	Lambda-cyhalothrin	18 g/l		mites, caterpillars, nematodes, locusts, butterfly in nursery
	Profenofos	200 g/l	OP	
CYPERCAL 50 EC	Cypermethrin	50 g/l	PY	butterfly in nursery
EMACOT 019 EC	Ememectin benzoate	18 g/l	AV PY	mites
PACHA 25 EC	Lambda-cyhalothrin	15g/l	NE PY	mites, caterpillars, whiteflies, cochineals, flies, locusts
	+ acetamiprid	10g/l		
CYPERCIAL	cypermethrin	50 g/l		mites, caterpillars, nematodes
	profenofos	200 g/l	OP	
DIAFURAN	Carbofuran	25 g/l	CA	mites, caterpillars, nematodes
NEEM OIL	Essential oil of neem seeds		OF	mites, caterpillars, nematodes
AQUEOUS EXTRACT OF PAPAYA LEAVES	Essential oils of papaya leaves		OF	mites, caterpillars, nematodes
AQUEOUS EXTRACT OF LEAVES OF NEEM	Essential oil of neem leaves		OF	mites, caterpillars, nematodes

PY: pyrethroid; OP: organophosphorus; CY: cyclodiene; OC: organochlorine; Ne: neonicotinoid; CA: carbamate; BE: benzimidazole; CI: inorganic carbon; OF: Organic formula; AV: Avermectin.

For the use of plant protection products (Table 4), 77.55% claim to have simple means of protection such as trousers, gloves, shoes and 72.59% ensure to adopt prophylactic measures that boil down to washing their hands with detergents or sand, burial empty containers, washing tools and equipment, and burning cans products. These facts expose market gardeners to problems of intoxication (Cissé et al. 2006; Ahouangninou et al. 2011 ; Ngom et al. 2012 ; Gnankiné et al. 2013 ; Roditakis et al. 2015 ; Lehmann et al. 2016). Also, many vegetables growers do not respect the dose and frequency of recommended treatments of plant protection products. Some authors have highlighted bad use of pesticides in the Republic of Burkina Faso (IFDC, 2007; Naré et al., 2015). Each of these problems can be solved and none of them provide a reason to discourage, suppress or prohibit agricultural production in urban areas in general, especially in the light of the many positive functions of urban farming. The main challenge is to strengthen its synergy with the city and to remedy any risks or conflicts. Everybody has the right to safe food and should be able to trust that the food he or she buys has been checked for poisonous or pathogenic components. They should at least be sure that

simple measures like washing and cooking will make them safe to eat (Van den Berg, 2002).

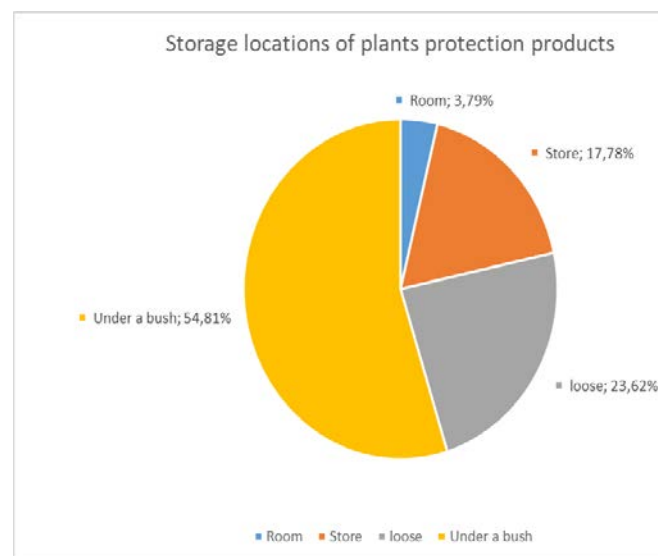


Fig. 4 Storage locations of plant protection products (Survey data, 2017)

Plant protection products (Figure 2) are stored under bush (58.81%), in a store (17.78%), in the room (3.79%), and are left loose (23.62%). These

results corroborate those of Zimba & Zimudzi (2016) who found near Harare in Zimbabwe that a quarter of the farmers stored pesticides in the field; just over a quarter kept pesticides in storerooms in the home and just over a fifth had chemical cabinets in the home. It is important to highlight the rules on proper storage of pesticides in order to maintain product efficacy and to prevent contamination of the surroundings (FAO, 2003).

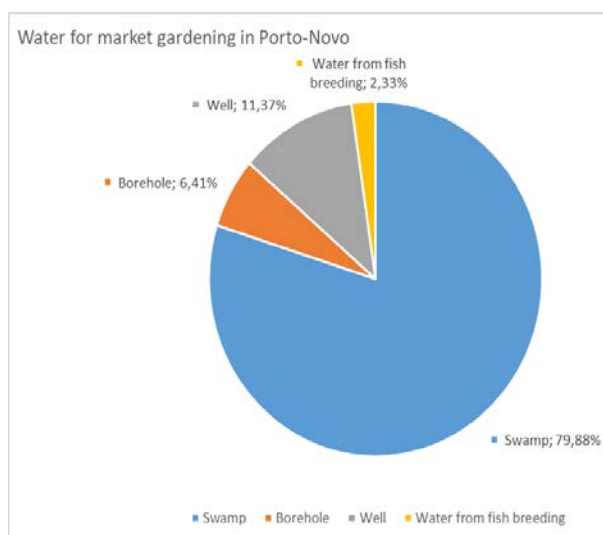


Fig. 5 Water for market gardening in Porto-Novo in non-rainy seasons (Survey data, 2017)

According to the figure 3, during non-rainy periods in Porto-Novo, 79.89% of producers use swamp water because they are close to these water sources. 11.37% of producers use water from ordinary wells, 6.41% of producers use borehole water and 2.33% of producers use water from fish breeding. The water sources used by most of the respondents depended on accessibility and cost. Usually, it is observed that most of the market gardeners are located near perennial streams (Ofoka et al., 2013; Nwangbo, 2014).

Among the producers, 34,11% have a division of tasks between women and men highlighting that the activities of weeding, the making of the beds are entrusted to the men while the activities of watering, transplanting are fulfilled by the women. Except for a urban gardening (GEA project) where the activities concern females only, 54.81% of producers do not have a complementary activity to market gardening; 25.07% of producers are also retail sellers, especially females and 11.66% in addition do poultry farm. Market gardening activities contribute to job creation. In a country where jobs are temporary, social security does not exist and government has difficulties to

manage population growth, self-help is the rule (Ludovic & Philippe, 2011; Ofoka et al., 2013). Market gardening, whether directed towards self-consumption or sale, is part of the livelihoods of many urban households (Van den Berg, 2002). While market gardening requires a large workforce, most market gardening systems are not very demanding in terms of starting capital, offering employment opportunities for very low-income families (Sarah, 2005).

In Porto-Novo, Benin, 82.80% of vegetable producers rented the land, 16.91% occupy the public domain and 0.29% uses their own land. This use of land belonging to other people or the state for urban gardening has been observed in Niamey in Niger (Ludovic & Philippe, 2011), in Anambra State in Nigeria (Ofoka et al., 2013), in Parakou in Benin (Abdoul & Aboudou, 2015).

Around 66.47% of urban gardeners do not know about organic products while 33.53% say they know about organic products. According to those who know organic products, they are products that resist during storage, products that are good for health, products without chemicals.

The difficulties faced by producers are related to lack of financial help (40%), irrigation difficulties (23.59%), sales difficulties (17.95%), difficulties in controlling pests (12.31%), the difficulties of acquisition inputs (6.15%). Access to land is a primary difficulty. About 75.80% of urban gardeners primarily hope that the authorities secure the land while 25.20% believe that the priority is to finance vegetables production.

4. Conclusion

The urban gardening in Porto-Novo is an opportunity for the producers to increase their income and to contribute to the reduction of the food insecurity and malnutrition. The characteristics of urban gardening can be improved by future development programs and policies in order to increase the gross margins and to reduce the constraints that prevent the development of the activities. Clear guidelines on how to address the constraints in the environment of agricultural systems in Benin are still lacking. More 'action research' is needed and better integrating research and practices can accelerate the development of urban gardening in Porto-Novo, while enabling the urban gardeners to become agents of their own progress.

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