

Urban agriculture in the city of Daloa, Central-West Côte d'Ivoire: Crop species, market practices and economic fallout

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Abstract

In Côte d'Ivoire, urban agriculture is expanding in several cities due to its proximity to consumers and its financial benefits. In the city of Daloa, several plant species are cultivated as food crops in market gardens. A survey based on semi-structured interviews was carried out among 19 people at 8 market gardening sites. This sector is controlled by functional illiterate persons who are more than 5 years' experience. Eleven species included in 9 genera and 8 families and grouped into 5 types of vegetables were recorded. Carrot, Cabbage, Courgette, Spinach, Green Bean, Parsley, Lettuce and Tomato were the most grown vegetable. The most represented families were Apiaceae, Asteraceae and Liliaceae. Leafy vegetables (lettuce, cabbage, parsley) were the most grown. Market gardening generates monthly incomes depending on actor, species, and seasons. Thus, this sector provides an important source of income for local populations and deserves support from authorities.

Keywords: Urban agriculture; Market gardening; Crop species; Financial income; Côte d'Ivoire

1. Introduction

In sub-Saharan Africa, the urban population will reach 300 million by 2020 with a yearly growth rate of 3.7% [1]. In 2013 for example, more than 53.26% of the Ivorian population lives in urban areas [2]. This population creates considerable food needs. That is a great challenge regarding the crucial issue of urban food security which is a major concern of African decision-makers [3, 4, 5]. Even more, due to the scarcity of land and the growing food need of populations, urban agriculture practices are increasing significantly in cities [6]. It plays an important role in developing countries mainly in Africa for its support to more than 70% of their populations [7, 8].

Gardening had been promoted by the colonial administration since 1955 because of its profitability [9] and developed over the years in both suburban and urban areas. Market gardening is made of annual or perennial plants, shrubs, or herbaceous plants maintained in a delimited agrarian space intensively exploited. They are harvested and sold fresh [10]. It is an important agricultural sector based on the intensive production of vegetable species mainly for fresh sale [11].

These urban vegetable crops offer households a diverse range of food products that contribute to fighting against food shortages [10, 12]. In the city of Daloa, market gardening production is exclusively towards the sale. Farming and Market gardening is less documented in Daloa. Besides, Gardeners' profile, the plants used in urban agriculture and its financial impact need to be known. The objective of this study is to contribute to the knowledge of the specific diversity of species

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grown in urban agriculture in Daloa city and to identify existing market garden practices and the economic benefits of this activity for its promotion in this city.

2. Material and methods

2.1. Study area

This study was carried out in the city of Daloa in Central West of Côte d'Ivoire. Daloa is located at 6°27'00" North Latitude and 5°56'00" West Longitude. It is bounded by the localities of Vavoua, Zuénoula and Bouaflé (North), Gonaté (East), Issia (South) and Guézou (West). Daloa belongs to the Guinean domain characterized by an equatorial-type climate regime with two rainy seasons and two dry seasons [13]. The monthly rainfall ranges from 1300 mm to 1800 mm. The average temperature is 25.60 C per year. This zone belongs to the mesophilic sector. Vegetation is made of dense semi-deciduous forests, degraded forests and mesophilic savannahs [14]. It is suitable for cash crops such as cocoa, coffee, rubber, cashew and food crops including rice, yam, cassava, eggplant and tomatoes. The city of Daloa is chosen for this study because of its enormous agricultural potential and cosmopolitan population including many ethnic groups traditionally involved in urban agriculture practices.

2.2. Material

The biological material included crop species grown in urban agriculture. The technical equipment consists of a geographic positioning device (GPS), a digital camera, a tape measure, survey plugs, pruning shears and twine.

2.3. Methods

2.3.1. Data collection

Selection of market gardening sites

A two-week prospecting visit was carried out in the agricultural perimeters of the entire city of Daloa to list the market garden areas. Then, eight market gardens were selected based on their availability and the stretch cultivated areas (Fig. 1). They are Baoulé (site 1), Commerce (site 2), Tazibouo 2 (site 3), Lobia 1 (site 4), Lobia 2 (site 5), Kenedy (site 6), Gbokora (site 7) and Orly (site 8). Each site was located using a Global Positioning System.

Market gardener surveys

The surveys were carried out during a semi-structured interview on each site with Market gardeners using a questionnaire pre-set for this purpose. The information collected was about the socio-demographic characteristics of the respondents (age, gender, education level, ethnicity, experience in the activity), cultivated species, the marketing methods and economic benefits of the activity. We are familiar with the locality, but a local interpreter's assistance was sometimes necessary to simplify communication with respondents who speak only the local language. Otherwise, to our knowledge, no typical market gardening survey has yet been carried out in this locality. In each gardening area, plants used in the field were inventoried and recorded in floristic inventory sheets.

2.3.2. Evaluation of expenditure and income

Two parameters were used to assess the expenditure and income of market marketers. They are gross margin and net margin. The gross margin (GM) of an activity is the difference between the production value (PV) and the total variable costs (TVC). It was used to assess the costs and benefits of market gardening activity. It is calculated according to the following formula [11]:

$$GM = PV - TVC$$

As for net margin (NM), it is the difference between gross margin (GM) and total fixed costs (TFC) its formula is:

$$NM = MB - CFT.$$

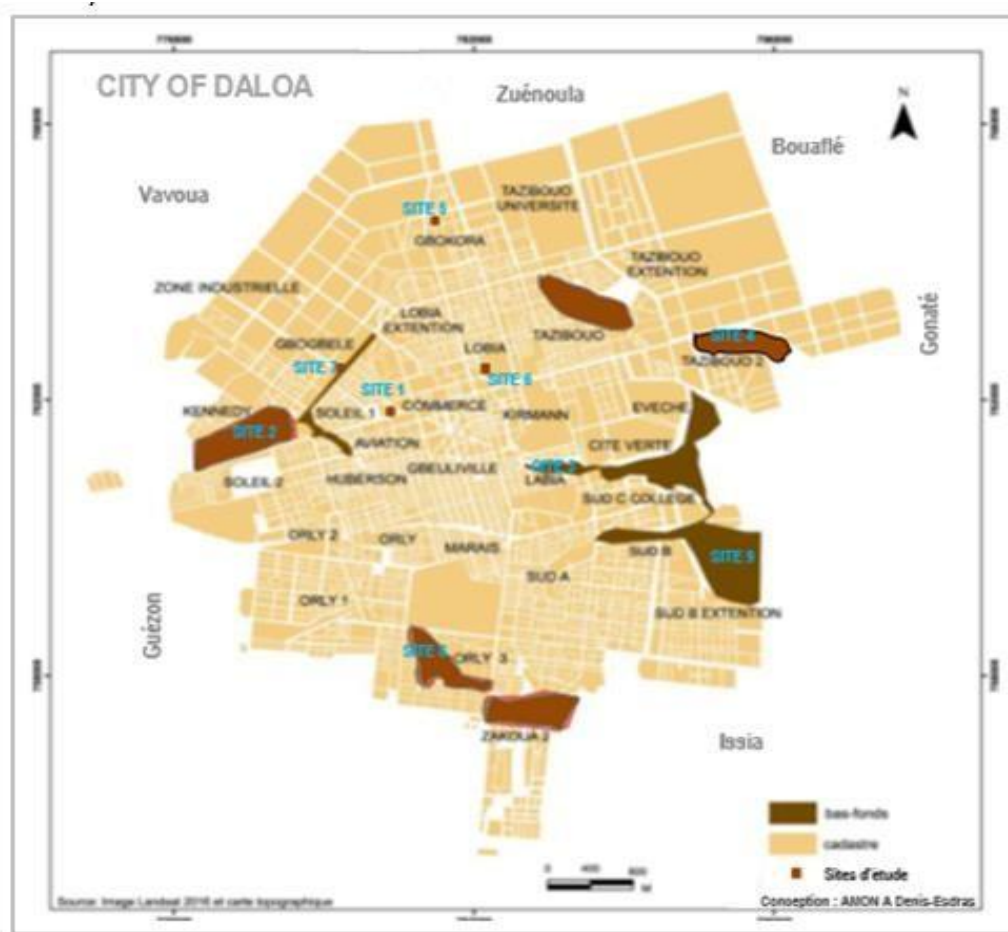


Figure 1 Location of market surveyed garden sites in Daloa

3. Results and discussion

3.1. Socio-demographic characteristics of market gardeners in Daloa

The survey was conducted among 19 market gardeners in 8 selected sites. These were 10 men (52.63% of respondents) and 9 women (47.37%) Table 1. The two genders were almost equally represented in this sector.

Their age range varied from 24 to 70. People aged 25 to 45 were the most dominant with 11 persons (57.89% of respondents). Young people under 25 were in the minority. Only 2 persons of this range or 10.53% were represented in gardening sites surveyed. Farmers over 65 were the largest minority. Only one person was recorded.

These interviewees have a majority of 5 years' experience in the market gardening sector with 15 people or 78.25% of respondents. For these actors, the cultivation and sale of market garden products is a permanent activity. Only 1 person with less than 1-year experience was recorded (Table 1).

The survey showed that gardening is strongly dominated by functional illiterate persons. This group was represented by 13 (68.42%) of the 19 interviewees. It is followed by those who have primary school level (5 or 26.32% of respondents). Only one respondent has a secondary level. None of the respondents had a university level.

On the other hand, Ivorians are well involved in this sector compared to foreign citizens. Interviewees were made of 11 (57.89%) Ivorians and 8 (42.11%) foreigners. These Ivorians actors included Malinke, Baoule and Senoufo allochthons. No local community members as Bete, Niaboua were encountered in the study sites (Table 1).

Table 1 Socio-demographic characteristics of market gardening actors in Daloa

Parameters		Interviewees	Frequencies (%)
Gender	Male	10	52.63
	Female	9	47.37
Age	≤ 25 years	2	10.53
	25 - 45	11	57.89
	46 - 65	5	26.32
	≥ 65	1	5.26
Experience year	≤ 1 year	1	5.26
	1 - 5 years	3	15.79
	> 5 years	15	78.95
School level	Illetrate	13	68.42
	Primary school	5	26.32
	High school	1	5.26
Ethnic group	Malinke	4	15.56
	Baoulé	9	47.37
	Mossi	3	15.79
	Senoufo	3	15.79
Citizenship	Burkina Faso	5	26.32
	Côte d'Ivoire	11	57.89
	Mali	3	15.79
Actors	Wholesalers	3	15.79
	Retailers	2	10.53
	Producers	14	73.68

The other citizens are from Burkina Faso and Mali representing 5 persons or 26.32% and 3 people or 15.79% respectively. The surveys also showed that three main actors are involved in the market garden sector in the city of Daloa. These are the Market Gardeners (Producers), Retailers and Wholesalers. Then, 14 market gardeners, or 73.68% were interviewed. This is the most dominant group. It is followed by Wholesalers with 3 persons or 15.79%. Retailers were the least represented with only 2 persons. Table 1 showed the socio-demographic characteristics of market gardening actors in the city of Daloa.

3.2. Plants grown in market gardens in Daloa

Inventories showed that 11 species including 9 genera and 8 families of food plants were grown in the Daloa market gardens (Table 2). The most cultivated families were Apiaceae, Asteraceae and Liliaceae with two species each. The most cultivated species were *Lactuca sativa* (Asteraceae) and *Petroselinum crispum* (Apiaceae). They are grown at all sites. They are followed by *Spinacia oleracea*. (Chenopodiaceae) and *Allium cepa* (Liliaceae). These plants are divided into 5 types of vegetables (Table 2).

Table 2 Species inventories in the market gardens in the city of Daloa

Plants grown		Scientific name	Family	Interest
Legume type	Usual name			
Leaf vegetables	Cabbage	<i>Brassica oleracea</i> var. <i>capitata</i> L.	<i>Brassicaceae</i>	**
	Round cabbage	<i>Lactuca sativa</i> L.	<i>Asteraceae</i>	***
	Butter Lettuce	<i>Lactuca sativa</i> var. <i>capitata</i> L.	<i>Asteraceae</i>	***
	Parsley	<i>Petroselinum crispum</i> (Mill.) Fuss	<i>Apiaceae</i>	***
	Spinach	<i>Spinacia oleracea</i> L.	<i>Chenopodiaceae</i>	**
Edible bulb vegetables	Onion	<i>Allium cepa</i> L.	<i>Liliaceae</i>	***
	Galic	<i>Allium sartvum</i> L.	<i>Liliaceae</i>	**
Fruit legumes s	Courgette	<i>Cucurbita pepo</i> Juss.	<i>Cucurbitaceae</i>	*
	Tomatoe	<i>Solanum lycopersicum</i> L.	<i>Solanaceae</i>	**
Root Legumes	Carot	<i>Daucus carota</i> L.	<i>Apiaceae</i>	*
Seed Legumes	Green bean	<i>Phaseolus vulagaris</i> L.	<i>Fabaceae</i>	**

*: Lowly cultivated species; **: Medium-cultivated species; ***: Highly cultivated species

These are leafy vegetables, edible bulb vegetables, fruit vegetables, root vegetables and seed vegetables. Leafy vegetables were the most diversified with 5 cultivated species. These are cabbage, *Brassica oleracea* var. *capitata* L. (*Brassicaceae*), Round cabbage, *Lactuca sativa* L. (*Asteraceae*), *Butter Lettuce*, *Lactuca sativa* var. *capitata* L. (*Asteraceae*), Parsley, *Petroselinum crispum* (Mill.) Fuss (*Apiaceae*) and the Spinach, *Spinacia oleracea* L. (*Chenopodiaceae*). Seeds and roots vegetables are represented only by one species each of which are carrots, *Daucus carota* L. (*Apiaceae*) and green beans *Phaseolus vulgaris* L. (*Fabaceae*) respectively. Fig. 2 presents some species inventoried in the market gardens in the city of Daloa.

**Figure 2** Some species inventoried in market garden sites in Daloa.

A: Cabbage (*Brassica oleracea* var. *capitata*), B: Round cabbage (*Lactuca sativa*), C: onion (*Allium cepa*), D: Green bean (*Phaseolus vulgaris*), E: Parsley (*Petroselinum crispum*), F: Tomatoe (*Solanum lycopersicum*), G: Carot: *Daucus carota*)

3.3. Benefits of the Market garden in the city of Daloa

The survey revealed that all the respondents (100%) considered market gardens as an economical and profitable sector. Benefits are generated monthly and yearly depending on the type of vegetable species and involved actors. Vegetables from market gardens in Daloa are directly sold on the sites to wholesalers and retailers. Markets in various neighborhoods of Daloa are the privileged place of sale. The price ranges from 25 to 200 XOF per unit depending on events period and seasons. Besides, the monthly income of market gardeners ranges from 5,150 to 16,100 XOF, for an average of 10,502 XOF per crop (Table 3).

Interviews also showed that the average of growers' annual income is 240,300 XOF. For wholesalers and retailers, monthly incomes after all expenses are 35,000 and 11,100 XOF, representing an average annual margin of 426,000 XOF and 181,200 XOF, respectively. Table 3 presents the economic effects of the market garden in all actors in the city of Daloa (Table 3).

The current was carried to describe market gardeners' Socio-demographic profile in the city of Daloa. The surveys showed that men (52.63% of respondents) and 9 women (47.37% of respondents) are almost equally represented in this sector. This result differs from that of Koffie-Bikpo and Adaye [11] who reported that men were well represented in market gardening sites in the city of Bouaké, Côte d'Ivoire.

The study also showed that the age range of actors varied from 24 to 70 and people aged 25 to 45 was the most dominant with 11 persons (57.89% of respondents). Young people (under 25 years old) were in the minority. Only two persons of this range or 10.53% were represented in surveyed gardening sites. Farmers over 65 were the largest minority (only one person recorded or 5.26%). These proportions are higher than Fondio [15] who recorded 31% of adults (25-45 years old) in the market gardening of the urban and peri-urban area of Bouaké in Côte d'Ivoire. However, they are lower than Koffie-Bikpo and Adaye [11]. These authors reported 69% of adults and 31% of young people in the market gardening areas in Abidjan. The differences could be due to the number of interviewees.

It is shown in this study that 68.42 % of Market garden actors are functionally illiterate persons. They cannot read, write, or even speak properly any official language.

Five and only one interviewee had the primary and secondary levels, respectively. There was no graduate and university level recorded. Fondio *et al.* [15] reported similar results (68% of illiterate) in the Market garden sector in Bouake. However, these actors feed the population of products from their activity.

This study noticed the good involvement of Ivorians native (57.89%) in this sector compared to foreign citizens (42.11%) from Burkina Faso and Mali. This result differs from Koffie-Bikpo and Adaye [11] who recorded only 18.40 % of Ivorians in this activity. Our results could be explained by the fact that urban agriculture in Côte d'Ivoire appears as an answer to deal with poverty [9]. Also, gardening could be a great alternative to the lack of employment already existing in many sectors in Côte d'Ivoire [15] and became crucial after the political-military crisis occurred in 2010. In this case, local community members as Bete and Niaboua may be encouraged to join this important agricultural sector.

This study was also aimed at identifying species grown in market gardens in Daloa. Eleven species included in 9 genera and 8 families were inventoried. This number is significantly lower than 43 vegetable species included in 30 genera and 17 families recorded by Kanda *et al.* [1] in the city of Abidjan, the capital city of Côte d'Ivoire. The differences could be due to the extent of the study sites. This study was carried out into only 8 small market garden sites while these authors surveyed all the market gardens of Port-Bouet in Abidjan. Besides, in Daloa Market gardens, the most cultivated families of vegetables were Apiaceae, Asteraceae and Liliaceae. This differs from de Kouakou *et al.* [16] who reported Compositae and Liliaceae as the most grown families in the municipality of Port-Bouet (Abidjan).

Leafy vegetables are the most common and most sold with a predominance of *Brassica oleracea* var. *capitata* L. and *Lactuca sativa* L. This result is in agreement with Kanda *et al.* [1] and Kouakou *et al.* [16]. The results also showed that three main actors are involved in the market garden sector in Daloa. They are Market gardeners (Growers), wholesalers and retailers. This confirms the earlier findings from Lepreideur and Moustier [17] in Congo Brazzaville and Wade [18] in Senegal.

Table 3 Margin obtained by market gardening actors in Daloa (Currencies are in XOF).

Parameters			Fertilizer NPK	Manure	Fungicides	Insecticides	Seeds	Transport	Total variable costs per Crop	Mean of Net margin per Month per crop		Mean of Annual Gross margin (GM) per Crop
Market gardeners (Growers)	Carrots	E	850	350	1500	-	3500	-	6200	-	30 880	370 560
		I	-	-	-	-	-	-	-	37080		
	cabbage	E	700	-	750	-	4500	-	5950	-	24 550	294 600
		I	-	-	-	-	-	-	-	30500		
	Courgette	E	650	-	680	-	3800	-	5130	-	14 370	172 440
		I	-	-	-	-	-	-	-	19500		
	Spinach	E	350	-	-	-	1750	-	2100	-	14 600	200 400
		I	-	-	-	-	-	-	-	16700		
	Green bean	E	1500	-	2300	750	2700	-	7250	-	14 250	171 000
		I	-	-	-	-	-	-	-	21500		
	Parsley	E	-	450	-	-	1200	-	1650	-	13 850	166 200
		I	-	-	-	-	-	-	-	15500		
	Round cabbage	E	800	600	-	-	-	-	1400	-	25 600	307 200
		I	-	-	-	-	-	-	-	27000		
	Tomato	E	2000	-	950	850	3800	-	7500		20 000	240 000
		I	-	-	-	-	-	-	-	27500		
Wholesellers		E	-	-	-	-	-	9500	-	-	35 500	426 000
		I	-	-	-	-	-	-	-	45 000		
Retailers		E	-	-	-	-	-	400	-		11 100	181 200
		I	-	-	-	-	-		-	15500		

E - Expenditure, I - Income

This study was also conducted to identify the benefits of urban agriculture regarding its income for actors. It revealed that all the actors recognized the marketing of market garden products and their economic benefits. The surveys showed the estimated average financial margins per month and per actor varies after deducing charges [1, 11].

A market gardener's monthly income varies from 13,850 to 30,880 XOF per crop. For wholesalers and retailers, it is 35,300 and 11,100 XOF, respectively. Market gardens can strongly reduce poverty. This activity needs support from local and national authorities.

4. Conclusion

This study was carried out to better understand the urban agriculture sector in the city of Daloa to enhance its development. The surveys were carried out on 8 market gardening sites. They showed that actors of the sector are mostly functional illiterate adults. Young people and the elderly are in the minority, while men and women have almost equal representation. These surveys also identified 11 market garden species included in 9 genera and 8 botanical families. The most represented families are Apiaceae, Asteraceae and Liliaceae. This sector includes three main actors are Market gardeners (producers), wholesalers and retailers. Their income is not insignificant and varies according to market garden produce and the actor. Ultimately, the practice of market gardening is an important sector that provides employment and deserves the attention of authorities. This data could be used to set up a development program for this sector in the city of Daloa.

Compliance with ethical standard

Acknowledgments

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Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

Author's contributions

This work was carried out in collaboration between all authors. Author AADE designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors KKE, KNKC, SK, SF and OPI managed the characterization analyses of the study, the literature searches and language. All authors read and approved the final manuscript.

Statement of informed consent

Each actor interviewed gave their consent deliberately and was willing to answer the different questions.

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