



# Seasonal Production and Availability of Vegetables from Urban and Peri-Urban Market Gardening in the City of Korhogo (Northern of Cote D'Ivoire)

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Date of publication (dd/mm/yyyy): 27/09/2023

**Abstract** – A study was carried out on the production and seasonal availability of vegetables in the market gardening perimeters of the city of Korhogo, in the north of Cote d'Ivoire. It was based on a survey carried out in the urban and peri-urban market gardening areas of the city, in the rainy and dry seasons. Random sampling was carried out and the targeted producers were interviewed individually to avoid responses influenced by those around them. The data collected and processed revealed 18 species of vegetables which are divided into 14 genera and 10 families. Leafy vegetables are the most represented species of this flora dominated by the Solanaceae family (4 species). In the rainy season, 16 species are cultivated for their leaves (7 species) and their fruits (7 species) in general, while in the dry season, 16 species are cultivated with a dominance of leafy vegetables (8 species). The market gardening activity is dominated by Ivorian women, more than 95%, who are mostly illiterate and permanent producers. Crop areas are larger in the rainy season (57,476.4 m<sup>2</sup>), with a dominance of leafy vegetable plots (30,626 m<sup>2</sup>), on the other hand the areas are smaller in the dry season (41,293.07 m<sup>2</sup>), with a dominance of fruit-vegetable plots (26,179.07 m<sup>2</sup>). Farm irrigation sources are mainly wells, with greater use in the dry season. This urban agriculture, which provides income to local populations, deserves technical support to boost this sector of activity.

**Keywords** – Market Gardening Perimeters, Urban Agriculture, Vegetables, Korhogo, Cote D'Ivoire.

## I. INTRODUCTION

Food security remains a concern today in countries around the world currently facing climate disruption and economic crisis (Bognini, 2010). The FAO put forward the number of 923 million people suffering from hunger in 2007, an increase of more than 80 million people compared to the reference period 1990-1992 (FAO, 2008). Faced with this situation, the development of agriculture is one of the most powerful levers that can help put an end to extreme poverty, strengthen the sharing of prosperity and feed the 9.7 billion people who will make up the planet in 2050 (World Bank, 2008). In Africa, the development of urban and peri-urban market gardening remains a valuable solution to enable cities to ensure food security for their populations (Kanda et al., 2014). It employs a large proportion of city dwellers (Delamarche, 2007). Dongmo et al., (2005) argue that this form of agriculture offers the possibility of a supply of fresh produce.

Previously marginalized and relegated to the background because it was considered a degrading activity in the urban environment, urban agriculture now appears to be a safety valve for those excluded from the modern sector (Olahan, 2010). This activity plays a central role in supplying cities with growing populations since the UN (2014) estimates that more than two-thirds of the world's population will live there in 2025. According to FAO (2017), 40% of urban dwellers practice farms in the towns of sub-Saharan Africa for self-consumption,



and more secondarily, for sale on town markets, for example. Urban agriculture contributes to ensuring the food security of the farmers themselves, through their production directly, but also indirectly through sales on the local market, the income being able to be used to purchase foodstuffs (Diedhiou, 2010). In Cote d'Ivoire, the agricultural food sub-sector for local consumption also occupies an important place in the economy with a contribution of 10% of GDP in 2014 (MINADER, 2017). Like other countries in West Africa, market gardening production is growing in the country to meet the demand of large urban centers (Parrot et al., 2015). However, the supply of fruits and vegetables is not enough to meet the consumption demand estimated at 920,000 tons per year. National vegetable production therefore covers 80% of consumption needs. The overall annual consumption of fresh vegetables is estimated at 38 kg per capita per year (FIRCA/ CIRAD, 2019). It is in the search for a sustainable solution, meeting the expectations of consumers, and information on the production capacities and seasonal supply flows of the city of Korhogo in fresh vegetables that this study is part of. The objective of this study is to contribute to a better knowledge of market gardening in the city of Korhogo in order to promote its promotion and development.

## II. MATERIALS AND METHODS

### 2.1. Study Zone

The study is made in urban and peri-urban areas of the city of Korhogo, located in the north of Cote d'Ivoire between 8°32' and 10°20' north latitude and 5°16' and 6°16' longitude. West (Figure 1). The climate is of the Sudanian tropical type with two seasons and belongs to the sub-Sudanese phytogeographical zone according to the subdivisions of (Guillaumet and Adjanohoun, 1971), quoted by Gboze *et al.*, (2020). According to these authors, the climate vegetation is open forest. Rainfall is 1200 mm/year with very high inter annual variability. Average annual temperatures range between 24°C and 29°C. The soils are essentially ferruginous and ferralitic (Kone, 2004).

### 2.1. Material

#### 2.2.1. Biological Material

It is made up of vegetable producers (market gardeners) and all vegetable species grown in market garden plots.

#### 2.2.2. Technical Material

The technical equipment consists of survey sheets, a digital camera, a backpack, personal protective equipment (boots, muffler, waterproof suit), a Trade mark scale imperial standard a tape measure for measuring the area of cultivated plots and a motorcycle.

### 2.3. Methods

#### 2.3.1. Field Prospecting

A three-week field trip made it possible to prospect all the peri-urban and urban areas of market gardening. The purpose of this step was to make contact with the market gardeners, to have a mastery of the field while immersing oneself in these realities. This prospecting was also beneficial because it made it possible to forge links with market gardeners.

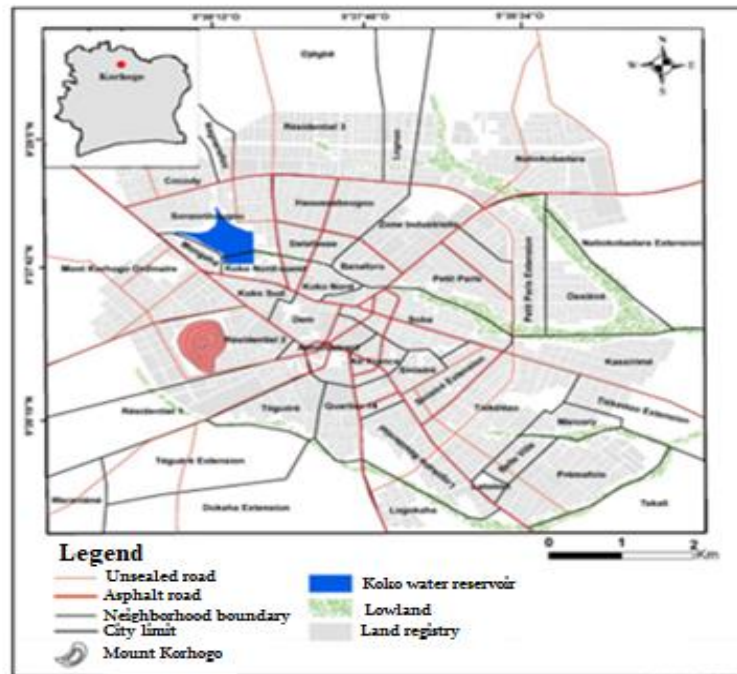


Fig. 1. Location of the study area.

### 2.3.2. Field Data Collection

A survey was carried out after the prospecting phase in the urban and peri-urban areas of the city of Korhogo, over a period of 6 months from July to December. It took place in two phases, that is to say a double-pass survey, the first was carried out from July to September and the second phase from October to January. The selection criterion used is random sampling. The producers were questioned during their time of activity on their plot and individually in order to avoid responses influenced by those around them. The languages used for the administration of the questionnaires are Senoufo, Malinke and French.

### 2.4. Data Analysis

The questionnaire completed with the producers was entered and processed with Word and Excel software. This made it possible to assess the impact of certain important variables in the production process of vegetable crops. It also made it possible to calculate simple arithmetic means and percentages.

## III. RESULTS

### 3.1. Diversity of Cultivated Species

The study identified 18 species of vegetables divided into 14 genera and grouped together by 10 botanical families grown by market gardeners in the town of Korhogo. The most represented families (Table 1) are Solanaceae (4 species), Brassicaceae, Apiaceae, Liliaceae, Malvaceae, and Cucurbitaceae (2 species). According to the organs consumed, the distribution shows that eight (8) species (44.44%) are cultivated for their leaves, seven (7) species (38.89%) for their fruits and three (3) species (16.67%) for their roots. In the rainy season, 16 species, divided into 13 genera and nine (9) families, were observed on the producers' plots. Fruit vegetables are the most cultivated with seven (7) species identified (43.75%), followed by root vegetables with two (2) species (12.5%). In the dry season, 16 species divided into 13 genera and 10 families are cultivated. Leafy vegetables



are the most cultivated plants, with eight (8) species (50%). Next come fruiting vegetables, with five (5) species (31.25%) and root vegetables, with three (3) species (18.75%).

Table 1. Diversity of cultivated species according to the rainy and dry seasons.

Types of Vegetables	Species	Family	Common Names	Rainy Season	Dry Season
Fruit Vegetables	<i>Abelmoschus esculentus</i>	Malvaceae	Okro	+	-
	<i>Cucurbita pepo</i>	Cucurbitaceae	Zucchini	+	+
	<i>Cucumis sativus</i>	Cucurbitaceae	Cucumber	+	+
	<i>Capsicum annum</i>	Solanaceae	Chilli, Pepper	+	+
	<i>Phaseolus vulgaris</i>	Fabaceae	Green bean	+	+
	<i>Solanum lycopersicum</i>	Solanaceae	Tomato	+	+
	<i>Solanum melongena</i>	Solanaceae	Eggplant	+	-
Leafy Vegetables	<i>Allium schoenoprasum</i>	Liliaceae	Chive	+	+
	<i>Amaranthus paniculatus</i>	Amaranthaceae	Amaranth	+	+
	<i>Brassica oleracea</i>	Brassicaceae	Cabbage	+	+
	<i>Hibiscus sabdariffa</i>	Malvaceae	Guinea sorrel	+	+
	<i>Ipomoea batatas</i>	Malvaceae	Potato leaf	-	+
	<i>Lactuca sativa</i>	Asteraceae	Lettuce	+	+
	<i>Petroselinum crispum</i>	Apiaceae	Parsley	+	+
	<i>Solanum laxum</i>	Solanaceae	White nightshade	+	+
Root Vegetables	<i>Allium cepa</i>	Liliaceae	Onion	-	+
	<i>Brassica rapa</i>	Brassicaceae	Turnip	+	+
	<i>Daucus carota</i>	Apiaceae	Carrot	+	+

### 3.2. Characteristics of Producers

In the urban and peri-urban area of the city of Korhogo, the producers interviewed during the rainy season and the dry season are all of ivoirian nationality (100%) and the languages spoken are Sénoufo and Malinke. Vegetable production is dominated by women in the rainy and dry seasons at respective proportions of 96.16% and 95.35% (Table 2). The average age of the producers surveyed is 41 years old in the rainy season, compared to 38 years old in the dry season. The majority of producers are between 40 and 60 years old in the rainy season, while in the dry season they are between 20 and 39 years old (Figure 2).

Table 2. Proportion of producers according to gender according to the rainy and dry seasons.

	Proportion Women (%)	Proportion Men (%)
Rainy season	96,16	3, 84
Dry season	95,35	4,65



In the rainy season, market gardening is practiced by 85.37% of illiterate people, of whom 82.3% are women, while in the dry season, 93.84% of people are involved in the activity with a proportion of 89.23% of women (Figure 3). Permanent producers are the most numerous with proportions of 89.45% and 67.13%, respectively in the dry season and in the rainy season. This group is followed by that of seasonal producers with a rate of 30.58% in the rainy season, against 10.55% in the dry season. Occasional producers are the least represented in the rainy season, with a proportion of 2.29% and absent in the dry season (Table 3).

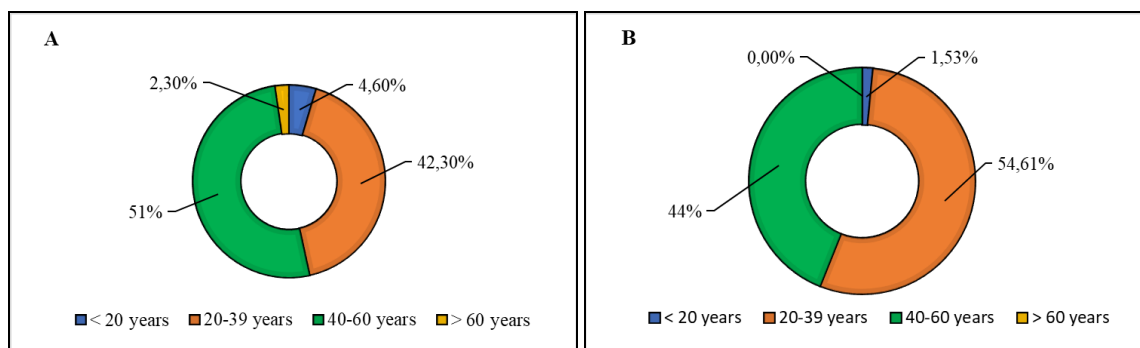


Fig. 2. Distribution of market gardeners by age group in the rainy (A) and dry (B) seasons in Korhogo city.

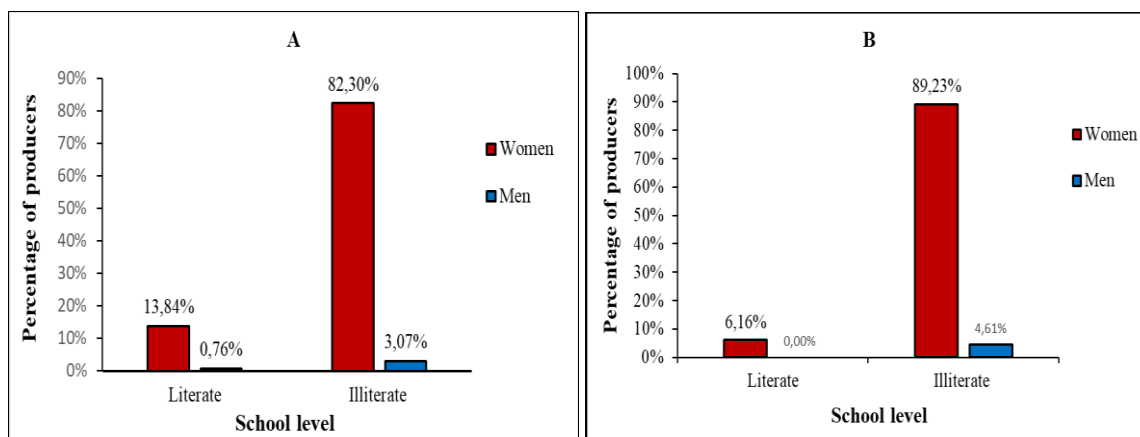


Fig. 3. Farmers' literacy levels in the wet season (A) and dry season (B) in Korhogo city.

Table 3. Proportion of producers according to their regularity according to the rainy and dry seasons.

	Permanent Producers (%)	Producteurs Saisonniers (%)	Producteurs Occasionnels (%)
Rainy Season	67,13	30,58	2,29
Dry Season	89,45	10,55	0

### 3.3. Production System

#### 3.3.1. Mode of Land Acquisition

The results of the survey showed that in the rainy season the exploitation of the plots is done by women, with a rate of 55.38%, against 3.07% of men. The leased plots are owned exclusively by women, with a rate of 13.38%. As for the plots lent, they are also held in majority by women, with a rate of 26.92%, against 0.76% of men (Figure 4A). In the dry season, the exploitation of the plots is also done by women, with a rate of 31.53%, against 4.61% for men. The leased plots are occupied exclusively by women with a proportion of 24.61%. As for the plots loaned, they are also wholly owned by women, with a proportion of 39.23% (Figure 4B).

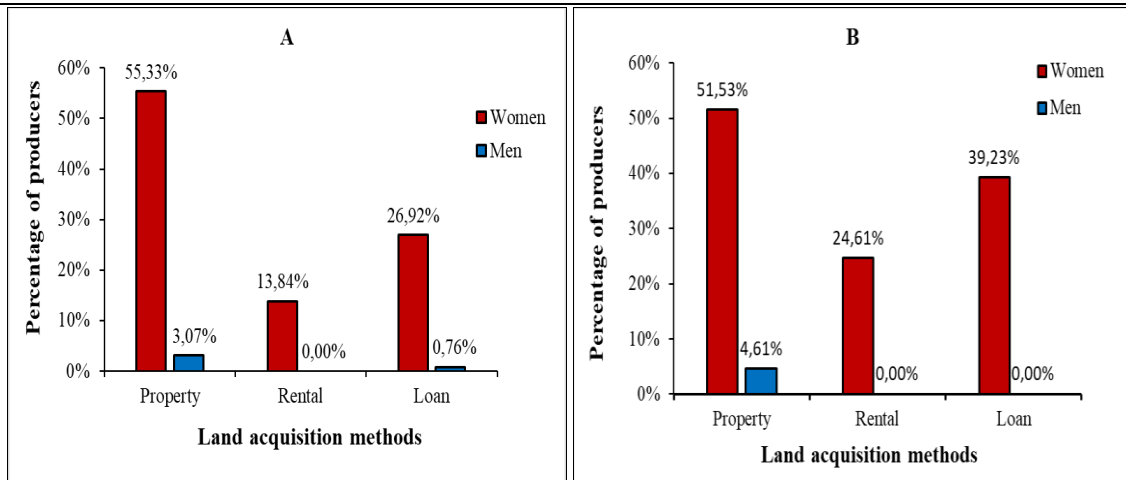


Fig. 4. Land acquisition of market gardening land by gender in the rainy season (A) and dry season (B) in Korhogo city.

### 3.3.2. Areas Cultivated by type of Vegetable

The results of the study showed that market gardening in the city of Korhogo is more intense in the rainy season, with areas estimated at 57476.4 m<sup>2</sup>, compared to 41293.07 m<sup>2</sup> of plots in the dry season.

In the rainy season, leafy vegetables are the market garden crops that occupy the largest area, which is 30626 m<sup>2</sup>. They are followed by fruiting vegetables with a total area of 26202 m<sup>2</sup> and root vegetables occupying the smallest area, which is 648 m<sup>2</sup> (Figure 5-7). At the level of leafy vegetables, cabbage cultivation occupies the largest area, which is 17,381 m<sup>2</sup>, followed by lettuce cultivation, with an area of 9928 m<sup>2</sup>. The cultivation of parsley occupies the smallest area (285 m<sup>2</sup>) of leafy vegetables (Figure 5). Regarding fruit vegetables, green beans accumulated the largest area which is 9678 m<sup>2</sup> followed by okra with an area of 5902 m<sup>2</sup> and eggplant, with an area of 5230 m<sup>2</sup>. Pepper cultivation occupies the smallest area (111.3 m<sup>2</sup>) of this crop group (Figure 6). For root vegetables, carrot cultivation occupies the largest area, which is 6829 m<sup>2</sup>, compared to 648 m<sup>2</sup> for turnip cultivation (Figure 7).

In the dry season, fruit vegetables are the major market garden crops, with an area of 2617907 m<sup>2</sup> followed by leafy vegetables, with an area of 10066 m<sup>2</sup>. Root vegetables occupy the smallest area, which is 5048 m<sup>2</sup> (Figure 8-10). In terms of fruit vegetables, green beans dominate crop areas, with an area of 4921 m<sup>2</sup>. It is followed by pepper and zucchini crops, with respective areas of 2835 m<sup>2</sup> and 1116 m<sup>2</sup>. Pepper is the least dominant crop at this time of year with an area of 180 m<sup>2</sup> (Figure 8). With regard to leafy vegetables, the cultivation of cabbage occupies the largest area of the plots, which is 9150 m<sup>2</sup>, followed by the cultivation of lettuce, with an area of 590790 m<sup>2</sup> and that of guinea sorrel, with an area of 5716 m<sup>2</sup>. Parsley is the least represented crop with an area of 44 m<sup>2</sup> (Figure 9). For root vegetables, carrot is the most represented crop, with an area of 3706 m<sup>2</sup>, while onion cultivation (Figure 10) is practiced on the smallest area (568 m<sup>2</sup>).

### 3.3.3. Vegetable Irrigation Sources

The sources of irrigation water for urban and peri-urban market gardening in the city of Korhogo consist of wells and surface water. The main source of irrigation water exploited by vegetable producers is the well, with proportions of 94.61% and 62.30% (Figure 11), respectively in the rainy season and in the dry season. Surface water with low proportions is used more in the dry season (37.70%) than in the rainy season (5.39%).

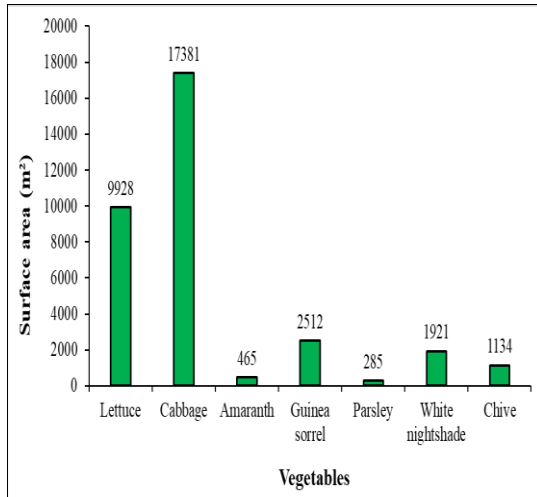


Fig. 5. Area cultivated with leafy vegetables by market gardeners in Korhogo during the rainy season.

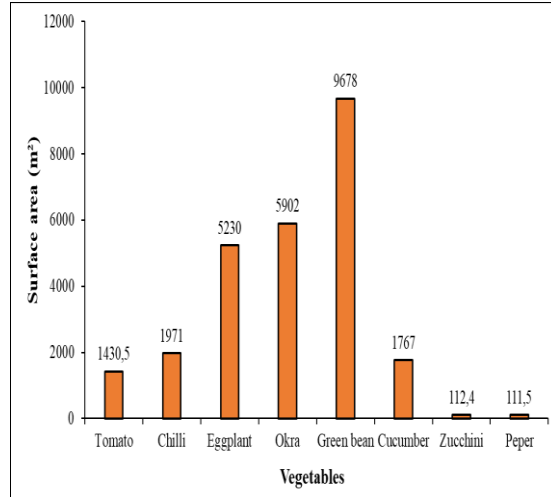


Fig. 6. Area cultivated with fruit vegetables by market gardeners in Korhogo during the rainy season.

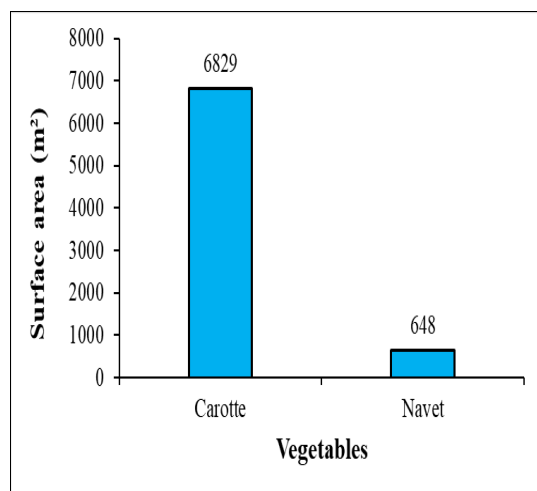


Fig. 7. Area cultivated with root vegetables by market gardeners in Korhogo during the rainy season.

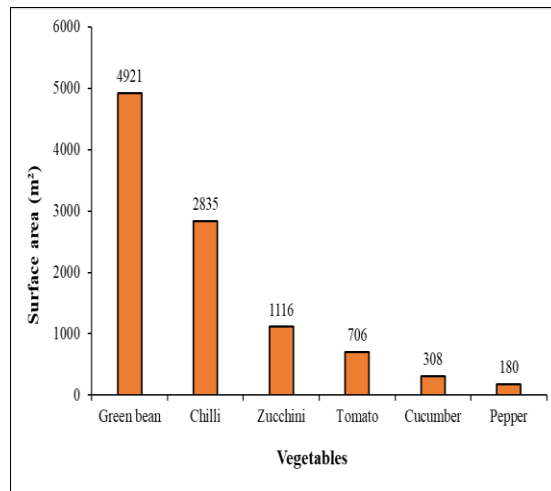


Fig. 8. Area cultivated with fruit vegetables by market gardeners in Korhogo during the dry season.

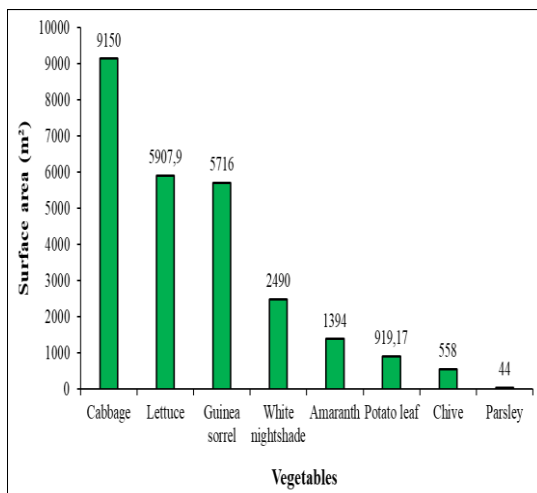


Fig. 9. Area cultivated with leafy vegetables by market gardeners in Korhogo during the dry season.

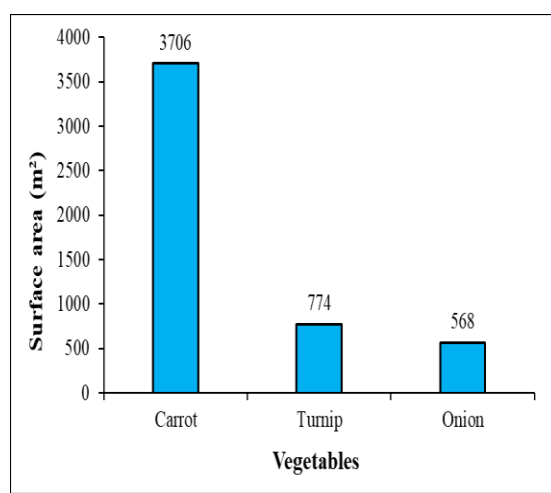


Fig. 10. Area cultivated with root vegetables by market gardeners in Korhogo during the dry season.

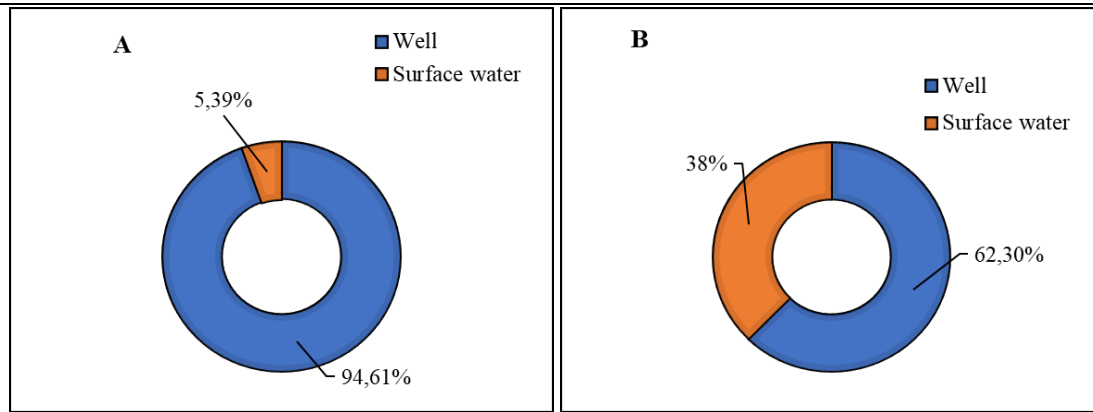


Fig. 11. Sources of irrigation water used by market gardeners in the town of Korhogo during the rainy season (A) and dry season (B).

#### IV. DISCUSSION

The study carried out in the city of Korhogo, in the North of Cote d'Ivoire showed that urban and peri-urban market gardening is rich in 18 species divided into 14 genera and 10 families. These results are similar to those of Afanou (2010) who identified 23 species divided into 17 genera and 13 families, in the Lacs prefecture in Togo. On the other hand, Kanda (2009) who worked in an urban area in Lome, identified 32 vegetable species which are divided into 23 genera and 14 families. These differences in results may be related to the size of the sample but also to the dietary habits of local populations. The diversity of cultivated species may be due to cultural mixing that leads urban populations to diversify their food consumption (Dongmo *et al.*, 2005). Indeed, the urban way of life is very often accompanied by an increase in vegetable consumption (Temple and Moustier, 2004).

Market gardening in the town of Korhogo is held exclusively by Ivorians. This high rate of Ivorians is due to the fact that they are the precursors of market gardening and the owners of arable land. This activity is now a source of income for many families.

Women are the main producers and seem to constitute the vulnerable social stratum affected by illiteracy, unemployment and poverty. Indeed, women practice market gardening to meet their needs and those of their children. This result obtained locally is different from that of Tano *et al.* (2011), which showed that vegetable producers are largely male (88%) in the city of Yamoussoukro. However, Ayrault (1999) asserted that in the large cities of sub-Saharan Africa, market gardening is practiced by women wishing to meet the consumption needs of the family and ensure a small income.

The majority of the producers met are illiterate. Yeo *et al.* (2022) made the same observation in the town of Bouake, where over 50% of farmers have no formal education. Indeed, agricultural activity does not necessarily require a high level of education, although the level of education does have an impact on the mastery of agricultural techniques and farm management (Gnacadjia *et al.* (2022). In terms of land acquisition, the study showed that 47.30% of market gardeners farm on sites that belong to them (owners). This observation is due to the fact that the majority of market gardeners in the town of Korhogo are nationals settled on their personal estates or those of their families. This result is close to that obtained by Nchoutnji (2009) who records that more than 40% of vegetable producers own land in Cameroon.

In terms of production, market gardening occupies a larger area during the rainy season. This would be justifi-



-ed by the presence of rain which facilitates the plowing of the land, watering and allows producers to practice the cultivation of vegetables that require little daily watering such as eggplant and okra. During the dry season, vegetables are produced on small areas. This is due to the fact that during this dry period, plowing the land is difficult, soil moisture is reduced, watering a large area is painful, and water sources dry up. The plots are generally located in wetlands (lowlands) or close to permanent water sources (dam lake, wells). These results corroborate those of Cissé *et al.*, (2002) who observed that certain market gardening sites disappear in the dry season to reappear in the rainy or cool season in the city of Ouagadougou, Burkina Faso. According to these same authors, the market gardening sites are mainly permanent around the water resources of the dams.

Generally, the practice of market gardening in the city of Korhogo is done all year round because the majority of women carry out this activity on a permanent basis. The most cultivated vegetables in terms of area in the study area are cabbage, lettuce, guinea sorrel (leafy vegetables), green beans, peppers, okra, eggplant (fruit vegetables) and carrot (fruit vegetable). These results are different from those obtained by Tano *et al.*, (2011) in the city of Yamoussoukro which show that lettuce, chives, carrots and cucumber are the crops of choice for producers. Kouakou *et al.*, (2019) observed a preference of market gardeners in the municipality of Port-Bouet (Abidjan) for lettuce and chive crops. New ways of life and cultural mixing lead urban populations to diversify their food consumption (Temple and Moustier, 2004). The low practice of onion cultivation in the city results from several combined factors such as the recent establishment of this culture and a reluctance of certain populations to practice it because of cultural reasons and political and security instability in the North of 2003 to 2011, which largely destroyed the efforts made during the 1990s to develop this sector (Rongead – Ngo Chigata, 2013).

## V. CONCLUSION

This study has highlighted some parameters that govern market gardening in the city of Korhogo. The diversity of vegetables identified is 18 species that include 14 genera and 10 families. The Solanaceae family is the most predominant of this flora of market garden crops, which consist mainly of leafy vegetables. However, the growing seasons seem to influence vegetable production in the study area. The practice of market gardening is the exclusive activity of Ivorians and is dominated by more than 95% by women, the majority of whom are illiterate, whatever the season. In the rainy season, the activity is carried out by older people (40-60 years old) than those observed in the dry season (20-39 years old). The crop plots are occupied by permanent producers whose proportions are 89.45% in the dry season and 67.13% in the rainy season. Market gardening activity is more intense in the rainy season, with an area of 57476.4 m<sup>2</sup>, compared to 41293.07 m<sup>2</sup> in the dry season. Green beans and cabbage are the crops most grown by producers during the rainy and dry seasons respectively. The irrigation sources of the farms are made up of wells and surface water from the city with a high use of well water whatever the season. The market gardening activity in the city of Korhogo is a source of diversification and income for the agricultural populations. Technical support for market gardeners on appropriate technical itineraries could help boost this sector of activity.

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