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(RESEARCH ARTICLE)



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Abstract

The aim of the study was to assess the effectiveness of market garden crops in the urban and peri-urban area of San Pedro, Côte d'Ivoire, and to determine their contribution to the empowerment of market gardeners and to food security in the region. The sample was carried out on 50 market gardeners spread over 5 production sites, with a cumulative cultivated area of 16.6 hectares. The results show that thirteen (13) crops are grown, of which four are specifically grown by women, six are specifically grown by men and three are grown jointly by women and men. Short cycles are predominantly managed by women, while long cycles are dominated by men. The best gross margins were observed for eggplant cultivation in periods of scarcity and abundance. The study also revealed constraints linked to market gardening practices, as well as to fertilizer types and use. These results could be useful for improving market gardening practices in the region and boosting food security. This should help public policy-makers to make the right decisions.

Keywords: Food Security; Market Gardening; Urban and Peri-Urban Areas; Constraints; San Pedro

1. Introduction

Market garden crops are foodstuffs regularly used by the population to make up dishes (Coulibaly et al. 2021). They are very rich in nutrients (iron, magnesium, potassium...), vitamins (A, B, C, K ...), fiber, antioxidants, etc. useful for good human health (Ouikoun et al. 2019; Bon et al., 2018). They are practised in marshes and can be conducted above ground (Coulibaly et al. 2021, Fondio et al. 2017). They contribute to the employability of young people and women and to the food security of nations (Bancal and Tano, 2019). However, Bon et al., 2018, showed in the FIRCA, DCARA and PRO2M expert report that yields of these crops are low in the different agro-climatic zones of Côte d'Ivoire due to climate change. Indeed, increasingly intense and violent rains cause flooding of production sites, leading to loss of soil fertility and destruction of crops (Epanda and Tchokomakwa 2021; Angenais, 2013). Similarly, increasingly harsh and long periods of drought lead to water shortages on undeveloped production sites (Amigues et al., 2006). Added to these constraints are the high cost of chemical fertilizers and phytosanitary products, as well as insufficient know-how regarding their use (Bon et al., 2018). Three factors then motivated this study. Firstly, the lack of precise scientific data concerning market garden crops in San Pedro, as demonstrated by Bon et al., 2018 and Dosso et al. 2023. Secondly, the work of Hien et al. 2023 has shown that food crops are sourced from towns a long way away for markets in the town itself. Thirdly, the policy of industrial crops such as coffee, cocoa, oil palm and rubber introduced by the State between 1969 and 1980 through the

In the San Pedro region, the "Autorité pour l'aménagement de la région du Sud-Ouest (ARSO)" was set up. This has not enabled the creation of hydro-agricultural infrastructures for all-season market garden production, like those in the central and northern regions of the country (Bon et al., 2018; Ogou and Bidi, 2019). With this in mind, we investigated

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the practice of market gardening in the urban and peri-urban areas of the city. To this end, we interviewed fifty market gardeners. The aim is to assess the efficiency of market gardening. Specifically, this will involve i) listing the crops, their surface areas and production cycles, ii) calculating the doses of fertilizers and phytosanitary products used and their costs, iii) evaluating the mass produced per crop and the gross margins in periods of shortage and abundance per crop.

2. Methodology

2.1. Presentation of the study area

The department of San-Pedro (Côte d'Ivoire) was created by law N°85 - 186 of October 16, 1985, and is part of the Bas-Sassandra district. The town of San-Pedro is the departmental capital. It is located in south-west Côte d'Ivoire at 9°32' north latitude and 6°29' west longitude (4° 51' N, 6° 42' W), 368 km from Abidjan by coastal road (Périsso et al., 2021). It is bounded by the towns of Gabéagui to the north, Sassandra to the east, Grand-Béréby to the west and the Atlantic Ocean to the south. It covered an area of 662.21 km² (Dirrassouba et al., 2022). The population in 2021 was 390,654, representing a density of 590 inhabitants/km² (RGPH-INS, 2021). The indigenous populations are mainly made up of three ethnic groups: the Bakwés, the Kroumens and the Winnins (Awal et al., 2021). The terrain is rugged, with plateaus, hills, plains and valleys. Altitudes can reach an average of 300 m (Awal et al., 2021). The soil is ferrallitic and highly desaturated. Hydromorphic soils are found in the valleys, commonly referred to as lowlands, whose surroundings are used for market gardening (Awal et al., 2021). The main hydrological network is the San-Pedro river, 150 km long (Awal et al., 2021). The climate is humid tropical, with average rainfall of 1,350 mm/year. The mean annual temperature is 25°C (Dirrassouba et al., 2022; Awal et al., 2021). Monthly insolation is relatively low, averaging 176 hours. There are four seasons: two rainy seasons from March to June and September to November, and two dry seasons from December to March and July to August (Dirrassouba et al., 2022; Awal et al., 2021).

2.2. Data collection

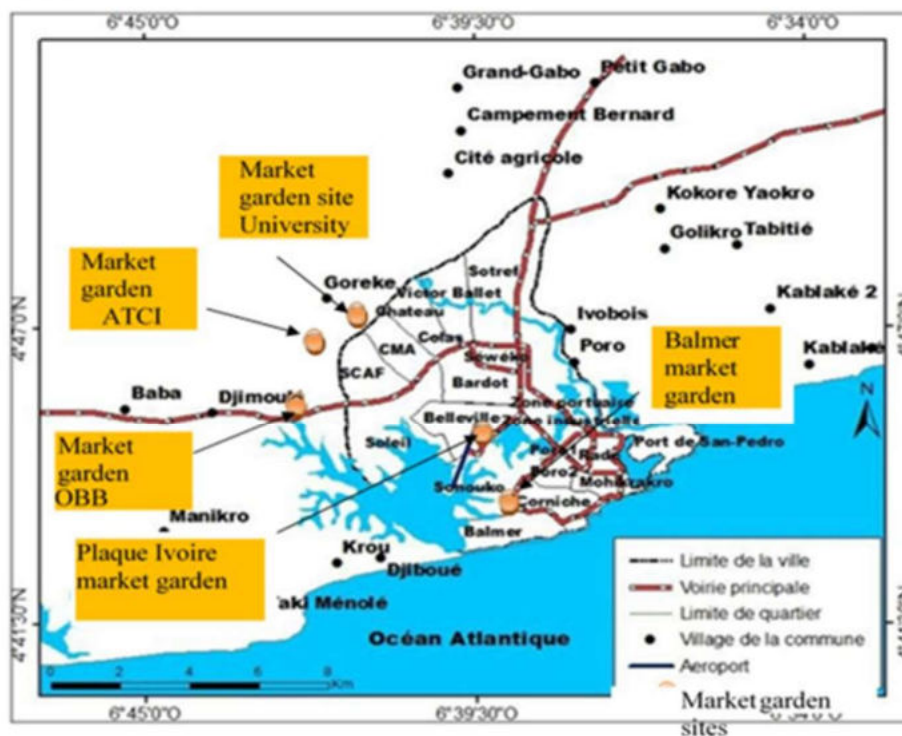


Figure 1 Map of the town of San Pedro (Awal et al., 2021)

Our surveys were carried out at the Balmer collège classique, plaque air ivoire, OBB, ATCI and University sites (Figure 1). Our approach is based on qualitative research. It was based on a semi-directive interview guide structured around the following themes: the main market garden crops grown, the corresponding surface areas, the types and doses of fertilizers and phytosanitary products used, the length of the crop production cycles, the masses produced, the

quantities sold, the selling prices, the sales outlets, the difficulties encountered and, finally, the needs. The 50 market gardeners interviewed were selected on the basis of internal diversification and saturation. The production sites were indicated by the Agence d'Appui au Développement Rural (ANADER) of San-Pedro. Documentary research completed the work. Conversions, such as hectare to square meter, gram to kilogram, ml to mg, were made.

3. Results

3.1. Diversity of crops, areas and production cycles

Our study involved 50 market gardeners, 27 of them women and 23 men. This represents 54% for women and 46% for men (Table 1). Our survey revealed that 13 crops are grown on the 5 sites (Table 1). They cover a total area of 16.6 hectares. The area cultivated specifically by women (9.8 ha) is greater than that cultivated solely by men (4.5 ha). The area cultivated specifically by women (8 ha) is greater than that cultivated solely by men (4.5 ha). Of the 13 crops, 34% of men grow 6 crops specifically for women, distributed as follows

tomatoes (14%), zucchinis (2%), watermelons (4%), chilies (4%), cabbage (4%) and green beans (6% men). Four crops are grown specifically by 40% of women. These are potato leaves (14%), chives (18%), cucumber (4%) and okra (6%). The crops grown by both men and women are spinach (6% women and 2% men), lettuce (6% men and 2% women) and eggplant (4% men and 4% women). Eggplant is grown equally by men and women. Lettuce and spinach are grown by both genders. However, lettuce is grown more by men and spinach by women. Short-cycle crops (30 days) are mostly grown by women.

Table 1 Areas and production cycles by genus

Culture	Scientific name	women's acreage (ha)	area men (ha)	Cycles (Days)		of women	% of men
Tomato	<i>Solanum lycopersicum</i> L.	0		1,59	90	0	14
Potato leaf	<i>Ipomoea batatas</i> leaves	3		0	30	14	0
Chives	<i>Allium schoenoprasum</i> L.	4		0	30	18	0
Lettuce	<i>Lactuca sativa</i> L.	0,5		2	45	2	6
Spinach	<i>Spinacia oleracea</i>	0,9		0,3	30	6	2
Eggplant	<i>Solanum melongena</i> L.	0,5		0,1	90	4	4
Chili pepper	<i>Capsicum annum</i>	0		0,9	180	0	4
Green bean	<i>Phaseolus vulgaris</i>	0		0,4	45	0	6
Cabbage	<i>Brassica oleracea</i>	0		0,2	90	0	4
Cucumber	<i>Cucumis sativus</i> L.	0,8		0	60	2	0
Okra	<i>Abelmoschus esculentus</i>	1,1		0	90	6	0
Zucchini	<i>Cucurbita pepo</i>	0		0,5	90	0	2
Watermelon	<i>Citrullus lanatus</i>	0		1	90	0	4
TOTAL		9,8		6,8			

3.2. Gross margin by crop and type

Pesticides and fertilizers were taken into account as the most important loads. The most widely used insecticide is K-Optimale 35 EC, with two active ingredients: Lambda- cyhalothrin 15 g/l and Acetamiprid 20 g/l. The price per liter is 6,000 f CFA. The most widely used fungicide is MANCOZAN 80% WP, with the active ingredient Mancozeb 800 g/kg. It is used exclusively on tomatoes, okra and cabbage. The price per kilogram is 4,000 f CFA. Tihan 175 O-TEQ with the active ingredient Flubendiamide 100 g/l is used specifically for cabbage. The price per liter is 16,000 f CFA.

The fertilizers used are NPK, urea, chicken droppings and cow dung. NPK and urea are used on all crops. Chicken droppings are not used on peppers or zucchinis. Cow dung was used more on potato leaves, chives, spinach, eggplant and cucumber.

The sales taken into account are those during periods of shortage and abundance. Table 2 shows that chives have the largest surface area (3.5 hectares). In second place are potato leaves and lettuce, with equivalent areas of 2.5 hectares. Tomatoes use more fertilizer and plant protection products. As a result, it has the highest production load. It is followed by chives. Eggplant has the highest gross margins in periods of shortage and abundance, at 22,103,640 and 9,303,640 f CFA respectively. It is followed in periods of shortage by okra, with a gross margin of 18,324,223 f CFA, and in periods of abundance by chives, with a gross margin of 7,065,720 f CFA. Women's specific crops have a gross margin of 37,909,183 f CFA in periods of scarcity and 14,829,183 f CFA in periods of abundance. Cumulative margins amount to 52,738,366 f CFA. For men, specific crops have a gross margin of 19,669,953 f CFA in periods of scarcity and 7,618,286 f CFA in periods of abundance. Cumulative margins are 27,288,239 f CFA.

Table 2 Cumulative gross margins by crop

Crops	Area (hectare)	Fertilizer cost (f CFA)	Cost pesticides (f CFA)	Fertilizer + pesticide charges	Gross margin Shortage	Gross margin Abundance	%of women	%of men
Tomato	1,6	2251200	228960	2480160	8259840	2889840	0	14
Potato leaf	2,5	195500	160000	355500	6784500	2024500	14	0
chives	3,5	876500	225280	1101780	9788220	7065720	18	0
Lettuce	2,5	335000	240000	575000	1845000	877000	2	6
Spinach	1,2	98000	73600	171600	1868400	848400	6	2
Eggplant	0,6	215000	81360	296360	22103640	9303640	4	4
Chili pepper	0,9	377600	129600	507200	4812800	1772800	0	4
Green bean	0,4	150000	46080	196080	928920	253920	0	6
Cabbage	0,2	624000	46080	670080	1663253	496587	0	4
Cucumber	0,8	78000	149760	227760	3012240	852240	2	0
Gombo Koto	1,1	281877	206400	488277	18324223	4886723	6	0
Zucchini	0,5	120000	88960	208960	2491040	691040	0	2
Watermelon	1,0	543900	192000	735900	1514100	1514100	0	4
		More important						
		Less important						

4. Discussion

4.1. Diversity of crops, areas and production cycles

Agricultural activity, once a source of family subsistence, is now a source of employment and income (Dosso et al., 2023). It plays a role in food security, the economy and the fight against hunger (PNIA 2017-2025, Bosc et al. 2014). In San Pedro, the diversity of crops meets the family needs of producers and those of populations from other sectors of activity, which are very cosmopolitan. As a tourist destination, the town has a large number of hotel establishments, which require substantial quantities of food products. Port and industrial activities also attract workers whose food requirements are constantly growing. Studies by Yéo et al., 2022; Périsol et al., 2021 and Kouakou et al., 2019 have also made these observations. The importance of this increasingly urbanized population can be seen in the general population and housing censuses, which show an increase over the years (RGPH-INS, 2021). According to statistics from the Institut National de la Statistique (INS), the population has risen from 31,606 in 1975 to 390,654 in 2021. These

figures suggest that the population's food requirements will continue to grow. This means that more efficient production mechanisms are needed to boost food security.

Côte d'Ivoire's agricultural policy, faced with a shortage of foodstuffs to meet the needs of the Ivorian population, is motivating agricultural production for self-sufficiency and food security (Bon et al., 2018; Yabillé, 2011). This has led to agricultural projects such as the *Projet d'appui au développement des filières Manioc et Maraîchères en Côte d'Ivoire (PRO2M)*, financed by the European Union to the tune of 11,151,269,000 FCFA (PNIA 2018 - 2025; JAAD, 2019).

The diversity of crop areas and production cycles is also linked to gender. Women are contributing more and more to household expenses, and are becoming increasingly involved in income-generating activities. With this in mind, they are particularly interested in market gardening as a source of income (Dosso et al., 2023). They mainly grow short-cycle crops, as they are very busy with household chores and managing their households. They have less time for field work than men. This statement corroborates that of OECD, 2022, which states that women have a workload of around 10 hours a day, compared with 8 hours a day for men. Specifically, women spend 5.1 hours a day on domestic tasks, compared with 1.3 hours for men.

4.2. Gross margin by crop and type

The market gardeners of the town of San Pedro, concerned about the food security of Côte d'Ivoire, contribute to this through the diversity of their crops. The pesticides they use depend on the surface area and parasitic pressures observed when growing the various crops. This observation was revealed by the work of N'GORAN et al., 2014. As for fertilizers, their use is based on plant needs for specific elements such as nitrogen for leafy vegetables and short-cycle crops.

The higher gross margins of eggplant corroborate the studies of Dosso et al. 2023, who showed that it is a vegetable whose production is important and much consumed in Côte d'Ivoire. We contribute to this assertion by including the good economic profitability of this vegetable. It has lower production costs than tomatoes in the San Pedro agro-ecological zone. It is produced by both women and men because of its financial profitability. Okra and chives, the second most profitable vegetables in periods of scarcity and abundance, are grown specifically by women, because they are easy to sell on the markets. Indeed, these two highly perishable commodities, like chilies and tomatoes as described by Hien et al. 2023, cannot be sourced from very distant regions for the San Pedro markets. However, they are easily sold on the town's markets. This guarantees regular income and consequently for the women's family expenses. Men's margins are lower than women's, due to competition with products from elsewhere. As a result, they have smaller acreages than the women.

5. Conclusion

The lack of precise scientific data on market gardening in San Pedro led us to carry out this study, which revealed that market gardeners grow a wide variety of crops to ensure food security for the population. They are divided according to gender, and crop management takes this into account. Women, because of household constraints, grow short-cycle crops with good financial returns, thus contributing to their empowerment. Men, on the other hand, grow long-cycle crops with good financial returns, but lower than those of women. These market gardeners are unable to fully express their production potential due to the lack of hydro-agricultural facilities and financing. These constraints make dry-season production difficult. As a result, the price of market garden produce soars at this time of year, which has a negative impact on household purchasing power. With this in mind, we suggest the hydro-agricultural development of certain low-lying areas for all-season vegetable production in the urban and peri-urban zone of San Pedro, to ensure food security in the aforementioned town and in Côte d'Ivoire. Our future work will focus on optimizing vegetable crop yields.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to disclosed.

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