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Use of chemical inputs and social implications among market gardeners in Tchèlèkro, Bouaké

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Abstract
With the crisis of the 1980s and the structural adjustment programs, vulnerable populations live in poverty. Making "penny-wise and pound-foolish savings", they are unable to meet their needs. One of the options available to women for their empowerment is to invest in so-called informal activities. The case of market gardening is an illustration. The objective of this research is to analyze the consequences of the use of chemical inputs by women in market gardening, an activity that allows them to meet their needs. To achieve this, the work is carried out in *Tchèlèkro* in the commune of Bouaké, the field of investigation. The research, both qualitative and quantitative, is based on a methodological approach that consists of a field survey of 95 women (market gardeners) in the village. It mobilized tools (interview guide, questionnaire) to collect information. The work presents the results of the fieldwork. The research first explains the importance of market gardening among women. Then, it analyzes the way inputs are used in the work. Finally, the research explains the consequences of the use of chemicals among women. The existence of health problems leads to a critical reflection on market gardening in the city of Bouaké.

Keywords: market gardening, chemical input, women's empowerment, health risk, critical thinking, Bouake

Introduction

Market gardening, a so-called informal activity that is essential for vulnerable populations, is increasingly affected by the climate, which in turn affects production. In addition to climatic hazards, the action of pests and agricultural parasites constitutes a real threat to the development of this agriculture. According to the FAO (2008), these pests are responsible for the destruction of more than one third (1/3) of the world's crops. To limit the irregularities of production linked to the great disasters of the agricultural pests and to protect the food reserves, the use of phytosanitary products constitutes one of the most effective methods and strongly recommended (E. Fournier, 1988).

However, the conditions of production of vegetable crops and the use of chemical inputs are associated with health and environmental risks. Indeed, the presence of unregistered products for these crops and the failure to respect pre-harvest application deadlines, coupled with the excessive toxicity of some products (class II products), exposes producers to risks of exceeding maximum residue limits (MRLs) and consumer poisoning, especially since the main crops grown by producers are lettuce and green beans, sensitive early crops often consumed fresh (B. Kouablé, 2002) [12]. According to A. Wognin (2013) [20], the lack of protective equipment, the high level of illiteracy and the absence of training programs on good urban farming practices could justify the behavior of producers who minimize the risks of contamination due to market gardening practices. Unsafe pesticide management also poses health risks to both users and consumers. In rural areas, especially in cotton and vegetable growing areas, agricultural chemicals cause human (nausea, vomiting, dizziness, death) and animal poisoning, water and air pollution, destruction of wildlife and dangerous changes in ecosystem functioning (F. Faye, 2010) [5]. According to PAN AFRICA (2003) [15], nearly 750,000 people contract a chronic disease such as cancer each year as a result of exposure to pesticides. At the environmental level, the CNRA (2010), reveals that the excessive washing of pesticide slurries in runoff water constitutes a threat to the water table.

In Côte d'Ivoire, peri-urban agriculture is booming in several cities of the country. The advantages of this activity are the rapid supply of fresh produce (lettuce, cucumber, tomato, green bean etc.) to urban populations (N.R. Koffi, 2011) [10]. However, the use of inputs is part of agricultural practices. The village of *Tchèlèkro* is not exempt, as the women of the locality also use chemical products in market gardening. This information allowed us to formulate some observations:

Finding 1: Market gardening, an essential activity. The work allows the women of the community to become autonomous. If the activity provides income, it also allows the market gardeners to meet their social needs, which is confirmed by this respondent: *"Market gardening is a source of income for us, who practice this activity. It allows us to satisfy our social needs, such as eating, clothing, housing, health care, education, etc.* (B.O, 38 years old, market gardener)";

Finding 2: The use of chemical inputs in market gardening. In order to increase production, and thus improve income, chemical products are used by the women of *Tchèlèkro*, which is supported by this respondent: *"Since I use the plot every year, which has finally become impoverished, my friends have recommended the use of phytosanitary products to increase production. This is what I do, on my plot every year (K.F, 29 years old, market gardener; K.D, 40 years old, market gardener)*";
Finding 3: Exposure of the population to health risks. The use of chemical inputs, the lack of protective equipment and the poor mastery of input dosage techniques constitute a major risk, which endangers the health of producers (V. Sawadogo, 2016) [19]. As far as the study is concerned, direct observations also support that gloves, protective masks are not used among women, during the treatment of phytosanitary products; which exposes them to health risks. From these observations, the following main question arises: "How does the use of chemical inputs in market gardening, an essential activity, affect the women of *Tchèlèkro*? This question is followed by secondary questions: "Why do women engage in market gardening? "How do they use chemical inputs? "What are the consequences of the use of chemical products in market gardening in *Tchèlèkro*? The objective of this research is to analyze the consequences of the use of chemical inputs by the women of *Tchèlèkro* in market gardening, an activity that allows them to meet their needs. Specifically, the research will first explain the importance of market gardening for women; secondly, analyze the way in which chemical inputs are used; and thirdly, explain the consequences of the use of chemical products by women. The thesis is as follows: "The use of chemical inputs in this essential activity, without any particular provisions, has an impact on the market gardeners of *Tchèlèkro*". This thesis is supported by secondary hypotheses, the first of which states that: "Women are involved in market gardening because of its economic and socio-cultural value. The second hypothesis states that: "The absence or occasional use of protective equipment in market gardening explains the way women use chemical inputs. The third hypothesis indicates that: "The use of chemicals in market gardening has caused socio-sanitary problems among the women of *Tchèlèkro*. This research is supported by a methodology.

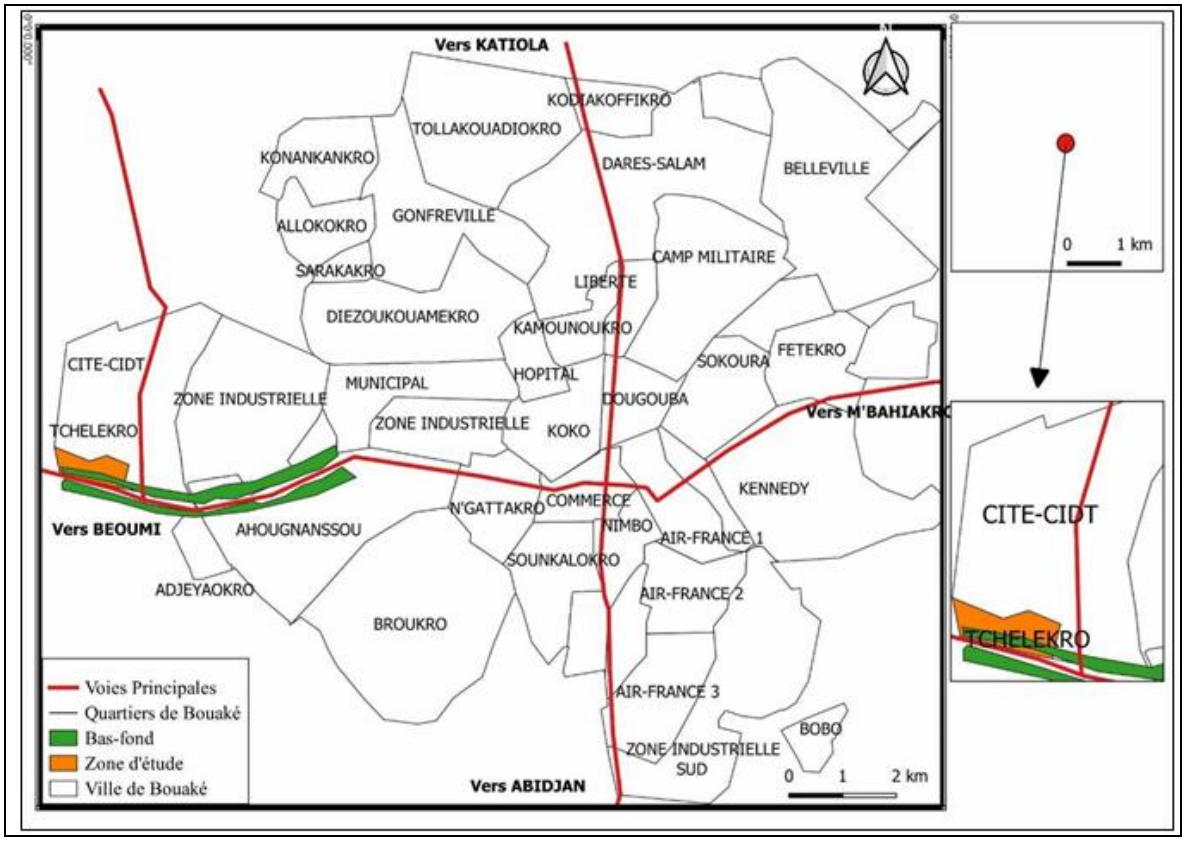
Methodology

Study site

Located in the north-central part of Côte d'Ivoire, the city of Bouaké is built on a granite dome. Covering an area of approximately 72,000 Km², the city is populated by 1,542,000 inhabitants (INS, 2014). The region of Bouaké belongs to a climatic transition zone, which makes 2 or 4 seasons appear from one year to the next. However, the rains are generally spread over 10 months, from February to November. The average annual rainfall varies between 1000 and 1200 mm. The temperature varies little during the year, with averages of 28 to 32° C. The annual relative humidity is between 75 and 90%. This variation in the climate of the city of Bouaké is favorable to the development of market gardening activities. In addition, the urban area is crisscrossed by numerous small rivers spaced 500 to 800 meters apart. This situation means that all of the city's neighborhoods, with the exception of the commercial center, are crossed or limited by strips of wetland (Diarrassouba, 1998).
The study site is the village of *Tchèlèkro*, located in the western corridor of Bouaké, on the road to Béoumi (Map 1). Once a village belonging to the commune of Bouaké, today *Tchèlèkro* has become a peripheral district of the city, due to urbanization and market gardening activities, which are developing there (MCLAU, 2014). This lowland is fed by the Loka watershed, and also serves as a source of water supply to other lowlands in the city, such as the Quartier Municipal, Koko, Dar-Es-Salam and Commerce lowlands. The following map shows the study site:

Data collection and analysis

The study site is Bouaké, a city with a population of 1542,000. It covers approximately 71788 km². For the present study, *Tchèlèkro* attracted our attention. The choice of this village is related to the presence of market gardeners, particularly women who use chemical products in their work. The respondents were selected according to their agricultural activities. Thus, only market gardeners are included in the study; women who produce cassava and yams are not of interest to the research. In addition, the criterion of "availability" of actors was used: only those willing to answer the questions were selected. In order to understand the use of chemical inputs in market gardening, health agents or professionals, administrative authorities, and chemical product vendors were also selected. We made a reasoned choice to target resource persons likely to provide further information. In total, 95 women out of 285 market gardeners identified (sampling frame), about one third (1/3), are concerned by the study. In order to collect data on chemical inputs in market gardening and their social implications, we used a semi-structured interview and a questionnaire. Using MAXQDA software, the data were qualitatively processed. SPSS software was used to process the information quantitatively.
Further analysis of the data required the functionalist theory of B. Malinowski (1922), to explain the importance of market gardening. Also, the dialectical analysis of F.N. Pierre (2012) [16], helped to understand the contradictions in connection with activity. The research is based on three parts. The first explains the socio-professional characteristics of the respondents and the socio-economic value of work. The second part analyzes the use of chemicals by women. The third part shows the socio-sanitary implications of market gardening in *Tchèlèkro*. Based on the methodology, we collected information in the field.



Source: MCLAU, 2014

Fig 1: Representation of stocking tapes-funds

Results

Market gardening issues in *Tchèlèkro*

Who does this activity in the community? The following are some of the responses to this question:
"There are men, mostly women. There are also youth, adults, natives, non-natives. Illiterate people and women who have attended western schools are part of the workforce [extract from interviews conducted on 15 /03/ 2020 in *Tchèlèkro* with a market gardener].

Socio-professional characteristics of market gardeners.

The following table presents the characteristics of the people involved in the work.

Table 1: Age distribution

Workforce / Age range	Number of market gardeners	Frequency
[18-39[	12	13
[40-60[	83	87
Total	95	100

Source: Our survey, January 2020

This table shows that the majority of women farmers in the swampy zone who work in market gardening in Chèlèkro are adults. With a total of 83 people, their age is between 45 and 60 years, or 87% of the population surveyed. Most of these people have lost their jobs as a result of the socio-political crisis in Côte d'Ivoire from 2002 to 2011, or are victims of the effects of the adjustments that the country has experienced. They are particularly involved in market gardening, spreading inputs and harvesting products. Twelve (12) market gardeners, approximately 13%, are between 40 and 60 years old. This age group is made up exclusively of young people. These market gardeners are often involved in mixing chemical inputs, drawing water and transporting agricultural products.

Table 2: Distribution by nationality

Workforce / Nationality	Number of market gardeners	Frequency (%)
Aboriginal people	75	79
Aboriginal people	15	16

Foreigners	5	5
total	95	100

Source: Our survey, January 2020

The data in the table indicate three (3) categories of women farmers in market gardening in *Chèlèkro*. These are the indigenous Baoulé, who represent 79%. They constitute the majority of market gardeners, followed by non-natives (Senoufo, Gouro, Koyaka, Bété, Malinké), about 16% of the population surveyed. Five (5) respondents are of foreign nationalities. They are Malian, Burkinabe and Nigerian, i.e., 5% who work in market gardening. The last two categories (non-natives, foreigners) request plots of land from the indigenous Baule for the said farming.

Table 3: Distribution by education level

Workforce / Level of education	Number of market gardeners	Frequencies
Illiterate	80	84
Primary and secondary levels	15	16
Total	95	100

Source: Our survey, January 2020

The data in the table indicate two categories of women in market gardening, with different levels of education. These are illiterate women, who cannot read or write. They represent the majority of those engaged in the activity, approximately 84%. Fifteen (15) women, with primary and secondary education, or 16%, also take part in the work. These women have dropped out of school very early. The market garden products cultivated on our study site are divided into broad categories. Some types of crops are observed in market gardening. These include chili, okra, eggplant, and tomato, which are used in traditional dishes. There are also modern crops, including cabbage, lettuce, zucchini, cucumber, green beans, etc. So why are these people more involved in this activity in *Tchèlèkro*?

Importance of market gardening for the women of Tchèlèkro

On the question concerning the involvement of this segment of the population in the said activity, here are some of the comments made by respondents:

"I learned the activity of market gardening from some of the people I worked with. That makes me six years in the exploitation of the lowland, to the benefit of the food crops, such as tomato, cabbage, pepper, eggplant, etc. I manage to provide for my family. I plan to open a store with the income from the sale of the products. [extract from an interview conducted on 02/01/2020 in Tchèlèkro with a market gardener].

"With the market gardening, I pay the school fees. The income allows me to celebrate *paquinou* without difficulties. I participate in the life of the village community. During religious ceremonies: Easter, Christmas, Tabaski, new clothes are bought or made for all the members of the family, gifts are distributed to the most needy, because it is important to honor God. "[Extract from an interview conducted on 03/01/2020 in Tchèlèkro with a market gardener].

From this information, the factors associated with the market gardening operation are derived. The economic value of the work, i.e., the income generated by the activity. Depending on the area farmed and the production, the monthly income of women varies between 55,000 and 75,000 FCFA. The frantic search for income is linked to their economic situation. As mentioned above, these people are "economic cancer patients", victims of the effects of the economic crisis of the 1980s, or of the socio-political crisis of 2002 to 2011. Clearly, it is poverty that has forced them to market gardening. By becoming more involved, they bypass this uncomfortable situation for their empowerment. The second cause is related to socio-cultural value. Indeed, the income from this activity is used to meet social needs (food, housing, health, education, and other expenses such as electricity and water), which are physiological. This income is invested in the economic field (motorcycles, stores), socio-cultural (participation in the associative life, in the needs of the village community, in religious festivals and celebrations). To increase production, women use inputs.

Use of inputs

The women buy the chemicals on the recommendation of close relatives or friends. Mixing is done by mixing insecticides or fungicides together. This allows them to maintain the plants. Also, the phytosanitary products, such as NPK and Urea intervene in the mixture. This respondent maintains to this effect:

> "To make the mixture, reverse the insecticides decis, califert, almanerbe and polythrin in a four liter can. Add one liter of water. This will produce a colorless liquid. After mixing, simply follow the dosage, taking between three and four times the closure of the product, and put the liquid in the sprayer. And it is done. The plants produce without problems. Besides, I don't have the means or the time to use the equipment. Anyway, I wash my hands after work. In any case, I wash my hands after work", [extract from interviews conducted on 16 /03/ 2020 in *Tchèlèkro* with a market gardener].

These comments indicate that the use of chemical inputs is a reality in the survey site. The doses and volume of pesticides used by the women contradict the written prescriptions, since they vary from one farmer to another. The women farmers contacted use a variety of non-recommended dosages, such as tomato cans, spoons and the naked eye. The quantity is often a function of the resistance of the pests. This respondent's position:

> "The doses and the writing are not in accordance with the reality in the fields. For example, when it says one liter per hectare, do they take into account the size of the weeds? In other words, when the weeds are high, it is important to buy several boxes of herbicides to control the weeds and insects in my opinion. So the dose will depend on the nature of the weeds and insects. "[extract from an interview conducted on 03/01/2020 in Tchèlèkro with a market gardener].

Strategies for the use of chemical inputs by farmers depend on the social representations of the actors. The doses of chemical products used in the workplace rhyme with the frantic search for maximum effectiveness of pesticides. The use of inputs is done without precaution or special provisions, due to the low level of education. As a result, women farmers are at risk of contracting diseases that will keep them away from the workplace.

Health risks

These are health problems related to the market gardening activity. In order to identify them, the women were asked: "What are the health risks to which you are exposed? They expressed themselves in these terms:

> "I use chemical inputs, since the plot is not large, and it is overused. This allows me to increase the vegetable production. The inputs are bought in the stores. The sellers tell us how to use them. In the field, chemical products are used. But this is not without risks, since I have eye problems, skin problems, coughing. In addition, there are injuries caused by sharp objects. The consequences also include poisoning of animals and people. "[extract from an interview conducted on 05/01/2020 in Tchèlèkro with a market gardener].

> "I use Polytrine 180 EC to treat my plantation, to fight against insects. It is with the capsules of the cans, that I measure the dosage. This product is so strong, that I often feel breathing problems and dizziness during the use. As I don't have a sprayer, the treatment is done with a container. Instead of protective gloves, I use sachets to protect my hands. "[extract from an interview conducted on 07/01/2020 in Tchèlèkro with a market gardener].

The following table summarizes the respondents' comments:

Table 4: Health Risks

Workforce / Health Risks	Number of market gardeners	Frequency
Eye conditions	12	13
Lung conditions	50	53
Skin conditions	28	29
Poisonings	5	5
Total	95	100

Source: Our survey, January 2020

It was reported that farmers are using pesticides to improve production. This is *Cypercal 12EC,* combined with Urea and *NPK* to treat tomato plantations. The purpose of this mixture is to control pests and ensure good fruit growth. However, the use of chemical inputs has affected tomatoes, since they are intended to treat cotton crops. As a result, consumption of the fruit has caused intoxication (5%). The information also shows that there are no precautions or adequate protection for market gardeners. This is why they suffer from various ailments: eye problems (13%), bronchitis (53%), and skin problems (29%) in *Tchèlèkro*. This situation is explained by the level of education of the women, as they are mostly illiterate and have primary education. Also, poverty helps to understand this reality, as these women live in poverty. These results are discussed.

Discussion

The first axis relating to the importance of market gardening shows that *Tchèlèkro*'s producers are essentially adults, whose age varies between 40 and 60 years. This age group has years of experience. They have human capital (knowledge, know-how, and interpersonal skills) in their work, which they pass on to the younger generations. But these market gardeners, particularly illiterate, can neither read nor write. They have not received any training in the use of chemical inputs, hence the abusive and uncontrolled use of chemical products during the work of the women producers. This respondent said: "*The abundant use of inputs increases agricultural production. As a result, income is important. I cannot do without them.* "This lack of knowledge leads producers to minimize health and environmental risks, according to F. Adiko (2010) [1]. S. Wognin (2013) [20] agrees. For him, the informal nature, the high level of illiteracy and the absence of training programs on good practices in urban farming could justify the behavior of producers, who are not aware of the risks of contamination due to market gardening practices. These women are involved in market gardening because of its economic and socio-

cultural value. Indeed, the activity is a source of substantial income for women farmers, and a factor of mobility and social integration. This is the position of M.S. Akmel (2017) [2]. The author argues:

"Market gardening, an informal activity, is a source of wealth, as it provides income to producers. The observation and analysis of the remarks indicate an evolving trend, except for the months of May and June characterized by the rainy season. Thus from January to December 2016, they have increased from three million seven hundred and ten thousand francs (3, 710, 000) FCFA to ten million seventy thousand (10,070,000) FCFA, a growth of six million three hundred and sixty thousand (6,360,000) FCFA. To understand these figures, we take the example of December, where the monthly earnings are multiplied by the number of producers (95,000 x 106 = 10, 070,000 FCFA). These amounts of money corroborate those recorded by Zalle (1999a). For the author, the income declared in category 3 farms (68,864 F CFA) corresponds to that of category "B" and exceptional class civil servants (34,566 to 88,121 F CFA). In the face of unemployment and poverty, this income allows actors to improve their precarious living conditions. The economic importance of market gardening is justified by various authors.

The second axis, on the use of chemical inputs, shows that market gardeners use pesticides in Chèlèkro. As in many rural societies, the purchase and use of pesticides are socially constructed by the stakeholders. As documented by T.D. Doudou and S. A Adou (2018), users are influenced during the purchase of plant protection products by the expressions, which praise the availability of effective chemicals, within the stores. As a result, market gardeners buy from unqualified sellers. This is the position of M. Doumbia (2009) and M. Kanda (2014). These authors mention that market gardeners prefer to buy pesticides from vendors who are not licensed to sell them. This is the case for many vendors in Bouaké; this is supported by M. Kanda, (2013). The vendors make pesticides of dubious quality available to users. The purchase of these products is linked to social perceptions of effectiveness among market gardeners.

The third axis, which rhymes with health problems, justifies the link between the use of chemical inputs and certain diseases contracted by the women involved in the work. Data from the field show that some women producers suffer from eye diseases and respiratory problems. They also suffer from skin diseases. This uncomfortable situation is explained by women's risky behaviors. These include the systematic non-use of protective equipment, the purchase of unregistered inputs that are not adapted to market gardening, and the mixing of pesticides without any real knowledge of the degree of toxicity. The impact of chemical inputs on human health is confirmed by V. Sawadogo (2016) [19]. For him, the active ingredient *endosulfan* used by producers is suspected of disrupting the hormonal system of the human body and of leading to an increase in birth defects, sexual abnormalities and reproductive disabilities.

L. Multigner (2005) [13] agrees. The author affirms that, because of their intrinsic properties, pesticides represent a potential danger for humans in case of unexpected contact. Their use, professional or domestic, raises many questions about the deleterious consequences they could have on health. While the effects of acute intoxication are fairly well known, the long-term consequences of chronic exposure are much less well known. In vitro or in *vivo* toxicological approaches in animals are not always adapted to predict delayed adverse effects in human populations. To date, reproductive impairment, neurological disorders and cancer are the most frequently reported health effects associated with chronic pesticide exposure. What can we learn from this study?

Conclusion

Market gardening is an important activity for the women of *Tchèlèkro*, who are essentially illiterate, because it represents a source of income, a factor of mobility and social integration. However, it has caused health problems among women producers, due to the abusive and uncontrolled use of chemical inputs, and the lack of systematic use of protective equipment during work. The health impact of the use of chemical inputs in market gardening has been the subject of numerous scientific papers worldwide and in Africa. Thus, to protect the health of producers and consumers, the FAO (2002) [12] recommends organic agriculture, which is based on the use of bio-pesticides (organic manures and composting). Authors emphasize training and capacity building of farmers. The NAPA (2015) advocates capacity building in the production and use of bio-pesticides, sustainable fertility management and applying political-administrative measures. For the present work, a socio-anthropological study is needed to understand the perceptions of the populations, in relation to their living conditions, and the use of chemical inputs. This strategy will make it possible to involve producers in decision-making, with a view to adapting agricultural policies to producers' needs. This will help minimize health risks.

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