

Micro-Parcellization and Intensification Practices in Women's Market Gardening in Korhogo (Côte d'Ivoire)

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Abstract:

In northern Côte d'Ivoire, particularly in the department of Korhogo, demographic pressure and changes in land tenure systems are forcing farmers to develop specific strategies to boost their productivity. The objective of this research is to analyze the intensification practices of women market gardeners in response to challenges related to access to land and other productive resources. The study was conducted in three sub-prefectures (Korhogo, Guiembé, and Dassoumboho) among 150 women producers. The results reveal extreme micro-parcellization, with 84.6% of plots not exceeding 0.25 hectares. Only 5% of women farmers hold land titles. This fragmentation of plots into small units reflects the dynamics of impoverishment in rural areas, as women represent 68% of the rural workforce but own less than 15% of the land. Faced with these constraints, women farmers are developing diversified and territorially differentiated intensification strategies. The use of plant protection products varies from village to village: K-OPTIMAL in Fodontioho, herbicides in Guiembé, PACHA 25 EC in Kapounon. Plant protection treatment is diversified with the use of PACHA 25 EC and INCA 45 WG (17.88% each). Fertilization combines chemical fertilizers NPK (51%) and urea (49%), and organic fertilizers (cow dung: 51.8%, chicken droppings: 46.1%). This research highlights the emergence of specialized technical areas and women's capacity for innovation. The intensification practices observed are part of a climate-smart agriculture and women's empowerment approach adapted to local environmental and socioeconomic constraints.

Key words: Korhogo, micro-parcellization, women market gardeners, intensification practices, climate-smart agriculture.

1. Introduction:

1.1. Context of the study

For several decades, African agriculture has been undergoing major transformations linked to increasing demographic pressure and changes in land tenure systems (Jayne et al., 2014). In Côte d'Ivoire, as in most West African countries, these changes have resulted in an intensification of peri-urban agricultural production, particularly in the market gardening sector (Levasseur et al., 2007).

This dynamic is accompanied by a reconfiguration of traditional agricultural practices towards more intensive systems, gradually integrating technological innovations and new approaches to resource management (Bellon-Maurel & Huyghe, 2016).

In Côte d'Ivoire, market gardening has specific characteristics that make it a strategic sector for food security and the local economy. Functional analysis of this sector reveals complex issues

related to access to resources, production practices and market dynamics (Dosso et al., 2013). These transformations are part of a broader context of agricultural transitions marked by processes of specialization and adaptation to environmental and economic constraints (Sib, 2014, pp. 47-60; Gagné, 2024, p. 17).

The department of Korhogo, located in the north of Côte d'Ivoire, perfectly illustrates these dynamics of change. This area, characterized by increasing land pressures and challenges related to the sustainable management of natural resources, constitutes a privileged laboratory for observing the changes underway in West African agriculture. Indeed, the sub-prefectures of Korhogo such as Dassoumboho, Komborodougou and Tioniaradougou record a total abandonment rate of 100%, lastingly compromising the management of natural resources. Across Korhogo as a whole, the massive abandonment of fallow land by 82% of producers deprives the soils of the regeneration periods necessary for their fertility (Silway & Anoh, 2019). Land issues are of particular importance there, particularly in the context of complex relationships between local communities and migratory dynamics (Chauveau & Bobo, 2005).

1.2. Problem of the study

At the heart of these agricultural transformations, women occupy a central but often overlooked role in the market gardening sector. Despite their contribution to food production, they face significant structural constraints, particularly in terms of access to land and productive resources (AFD, 2024). This situation raises fundamental questions about the adaptation strategies developed by women farmers in the face of land constraints and productivity demands.

Micro-parcellization, a phenomenon characterized by the progressive subdivision of agricultural land into smaller and smaller units, is one of the responses to increasing land pressure. This phenomenon, observed in many regions of Africa, poses particular challenges in terms of productive efficiency and sustainability of agricultural

systems (Colin et al., 2022). This land fragmentation is accompanied by an intensification of agricultural practices illustrated by the combination of lack of training (85% of untrained women farmers) and the inappropriate use of plant protection products creates a vicious circle where the ineffectiveness of treatments pushes producers to increase doses and frequency of application, compromising the economic profitability of farms (Sika, 2020, p. 122). This situation is aggravated by the lack of protective equipment among 95% of women farmers and the use of unapproved products for market gardening (52% of products used), generating major health risks and a progressive degradation of the quality of soils and ecosystems (Kawachi & Berkman, 2001, pp. 463-464; CSDH, 2008, p. 163; Sib, 2014, p. 38). In the context of women's market gardening, this dynamic raises specific questions about the modalities of intensification of agricultural practices in small areas. Moreover, the adoption of these practices by African smallholders, and particularly by women, remains a complex process due to multiple socioeconomic and cultural factors (Mandipaza, 2022). This reality is particularly marked in the Ivorian context where customary land tenure systems continue to influence agricultural practices (Chauveau and Colin, 2010). Faced with this observation, several questions emerge: how do women market gardeners adapt to the constraints of micro-parcellization? What strategies do they develop to maintain and improve their productivity on reduced areas? To what extent do these strategies contribute to strengthening their economic and social resilience? Finally, what are the factors that promote or hinder the adoption of sustainable agricultural practices in this specific context?

The objective of this research is to analyze the intensification practices of women market gardeners in the face of environmental and economic constraints. It is part of an interdisciplinary approach combining the technical, socio-economic and cultural dimensions of these agricultural transformations, thus

contributing to a better understanding of the contemporary challenges of family farming in West Africa.

2. Materials and methods:

2.1. Presentation of the site and framing of the study

The study was carried out in the department of Korhogo and more precisely in the sub-prefectures of Korhogo (Fodontioho: 8 km from Korhogo), Guiembé (Guiembé Commune: 35 km from Korhogo), and Dassoumboho (Kapounon: 28 km from Korhogo). These localities are full of women's groups involved in market gardening production, with more than 10 years of experience, whose main goal is to fight poverty and improve their income. In addition, they are part of the intervention zone of the NGO ARK "Animation Rurale de Korhogo" (ARK), and identified among the best market gardening producing localities in the department of Korhogo by the NGO which works for sustainable management of natural resources. Since its creation in 1972, the ARK has capitalized on more than 50 years of experience in the fields of support for farmers' organizations, professionalization of agriculture, traditional and alternative education, health and development, women's entrepreneurship, land security or governance, access to water and small-scale irrigation, training of several generations of farmers, promotion of agroecology, etc.

The framing of the study took place following meetings with agricultural and rural development partners (ANADER, OCPV and MEMINADERPV), representatives of producers and traders (market garden products, inputs, phytosanitary products, etc.) and influential NGOs in the agricultural sector. These meetings made it possible to validate the methodology, the timetable and the list of users of the cultivation sites and other resource persons to be met. This step was decisive in that it allowed to smooth out a certain number of difficulties and thus ensure a smooth conduct of the field study. Finally, a field visit made it possible to contact food groups,

individual actors, large traders within the markets, operating in the food sector and who are present in the study area.

2.2. Study data collection and analysis process

Information related to the conduct of this study was obtained through the collection of secondary and primary data.

Regarding the second stage relating to the collection of primary data, a field visit was carried out to interact with the actors involved in the market gardening product chain from pre-production to consumption. It allowed to collect all useful quantitative and qualitative data. This phase of the work was carried out through a questionnaire (closed and open types) allowing to extract the maximum amount of information necessary for the study. These collection tools were administered to the actors of the market gardening value chain.

The data collection work took place in the department of Korhogo, particularly in the localities of Fodontioho (Korhogo Sub-prefecture), Guiémbé (Guiémbé Sub-prefecture) and Kapounon (Dassoumboho Sub-prefecture) from October 1 to 7, 2023 in administrative workplaces, production sites, market gardeners' markets and homes.

A questionnaire survey of 150 market gardeners in each of the localities. To select the people surveyed, the sample was constituted according to the method recommended by Rea and Parker (2014). This is a sampling method which consisted of ensuring the representativeness of a sample by assigning it a structure similar to that of the basic population. This method is based on the existence of a statistical base on the basic population of market gardeners in the Korhogo Department. Indeed, it is certain to encounter a significant number of people who practice this activity in specific places such as green spaces or unfinished construction land belonging to structures or individuals and undivided land (lowlands, waterways, etc.).

Thus, the method of defining the sample size was established as follows:

$$n = \frac{t_p^2 \times P(1 - P) \times N}{t_p^2 \times P(1 - P) + (N - 1) \times y^2}$$

Or,

n: sample size

N: size of the target population (number of households, users, etc.), actual or estimated (here N is equal to 168 producers)

P: expected proportion of a response or actual proportion. It is set to 0.5 by default; this allows for the largest possible sample.

tp: sampling confidence interval. tp is equal to 1.65 for a 90% confidence interval.

y: margin of sampling error set at 10%.

Numerical application of the formula resulted in the required sample size of 49 producers.

The people encountered on the agricultural sites listed in the three privileged localities, namely

Fodontioho, Guiembé and Kapounon, were questioned intuitively. Thus, the collection activities resulted in 150 respondents.

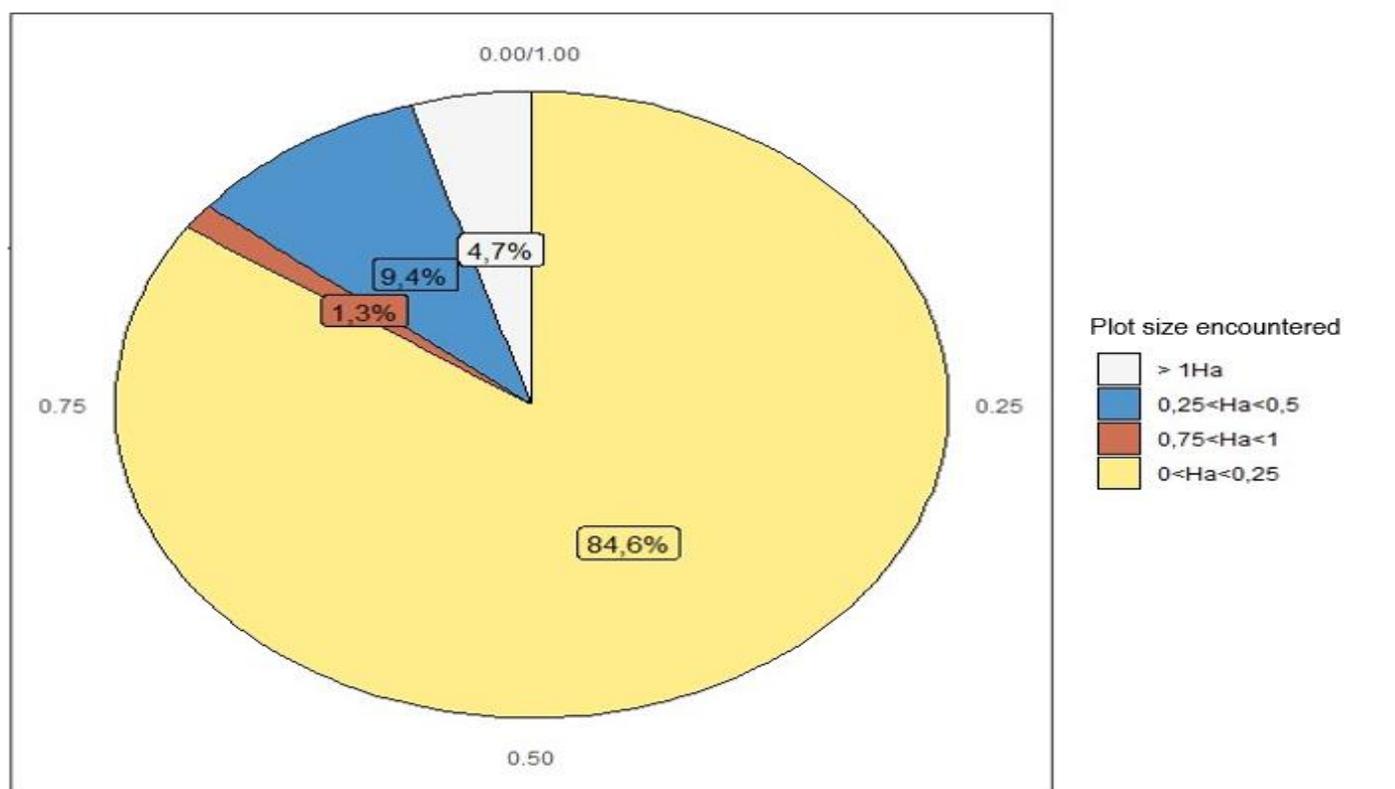
The data obtained were statistically analyzed. STATISTICA 10.1 software was used for flat and cross-tabulation. Flat tabulations allow us to give the share or percentage of each survey modality relative to a factor in each locality. The results obtained from these analyses were interpreted and cross-read.

3. Results:

3.1. Cultivated areas

Across all the villages visited, the cultivated sites are subdivided according to the number of producers who are members of the women's groups. Thus, the latter work on individual plots. In 84.6% of cases, market garden plots are generally small in size, not exceeding 0.25 hectares, as shown in figure 1.

Figure 1: Distribution of plots sizes encountered



Source: Survey data, 2023

In rural areas, access to land is governed by customary law. With the exception of land that is part of the state domain, all customary land belongs to indigenous families. Individual families bequeath it to their heirs or any other claimant, either free of charge or for a fee. In the villages studied, land appears to be largely bequeathed for market gardening, with an acquisition rate of 77%.

As in other regions, the right to land and therefore the right to land ownership is frequently claimed by women, who are increasingly involved in the production and marketing of market garden crops. But this important role played by women in the sector remains precarious because even if they occupy a few plots of land, their rate of land title

deed holding is not high. Figure 4 shows that only 5% of the women producers interviewed have a title deed for the land they cultivate. In the villages visited, the problem of accessibility to arable land is a limiting factor for the production and marketing activities of women's groups.

3.2. Use of phytosanitary products

Across all villages, phytopathological control and crop protection actions are intensified due to the relative increase in disease outbreaks and pest attacks. Thus, the analysis of Table 1 shows that the majority of respondents use PACHA 25 EC and INCA 45 WG (equal percentages, i.e. 17.88%). This majority is followed by that of respondents using herbicide (14.96%) and that of respondents using K-OPTIMAL (11.31%).

Table 1: Proportion of types of phytosanitary products used

Types of phytosanitary products	Number	Percentage
GALIST	1	0.36
Cotton Product	2	0.73
ADAMA	4	1.46
Chemical	4	1.46
Biological	6	2.19
Unknown	10	3.65
Pesticide	12	4.38
Fungicide	14	5.11
JACOBIA-AF-CHEM	25	9.12
Insecticide	26	9.49
K-OPTIMAL	31	11.31
Herbicide	41	14.96
INCA 45 WG	49	17.88
PACHA 25 EC	49	17.88

Source: Survey data, 2023

By bringing the analysis of the types of phytosanitary products back to the village scale, it appears that the types of phytosanitary products are varied (Table 2). Thus, in Fodontioho, the producers treated the plots the most with K-OPTIMAL and JACOBIA-AF-CHEM at

respective rates of 43.1% and 33.3%. In Guiembé, herbicide and insecticide are the most used with respective rates of 39.8% and 25.2%. In Kapounon, PACHA 25 EC and INCA 45 WC are applied with equal percentages, i.e. 50%.

Table 2: Distribution of types of phytosanitary products used by village

Types of phytosanitary products	Villages visited		
	Fodontioho	Guiembé	Kapounon
GALIST	1.4%		
Cotton Product	2.8%		
ADAMA	5.6%		
Chemical		3.9%	
Biological		5.8%	
Unknown	13.9%		
Pesticide		11.7%	
Fungicide		13.6%	
JACOBIA-AF-CHEM	33.3%		
Insecticide		25.2%	
K-OPTIMAL	43.1%		
Herbicide		39.8%	
INCA 45 WG			50%
PACHA 25 EC			50%

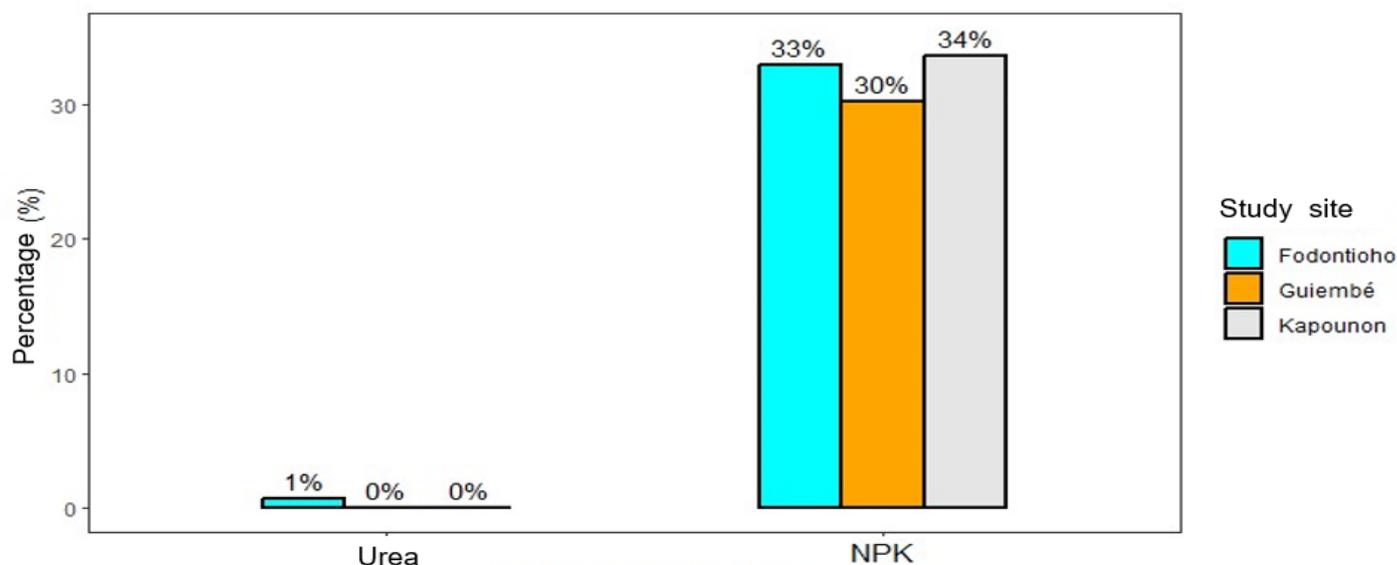
Source: Survey data, 2023

3.3. Use of fertilizers

In the villages studied, both chemical and organic fertilizers are used for the treatment of most market garden crops such as tomatoes, eggplant, chili peppers, okra and cabbage. NPK users

represent the majority of people who treat with both products (51%) and thus constitute 34% of the cases of the respondents in Kapounon, 33% in Fodontioho and 20% in Guiembé. The distribution of respondents on the use of types of chemical fertilizers by village is given in Figure 2 below.

Figure 2: Proportion of producers using chemical fertilizers



Source: Survey data, 2023

Among those who use chemical fertilizers, more than the majority (51% of the total number) treat their plots with NPK and the rest use Urea (49% of the total number).

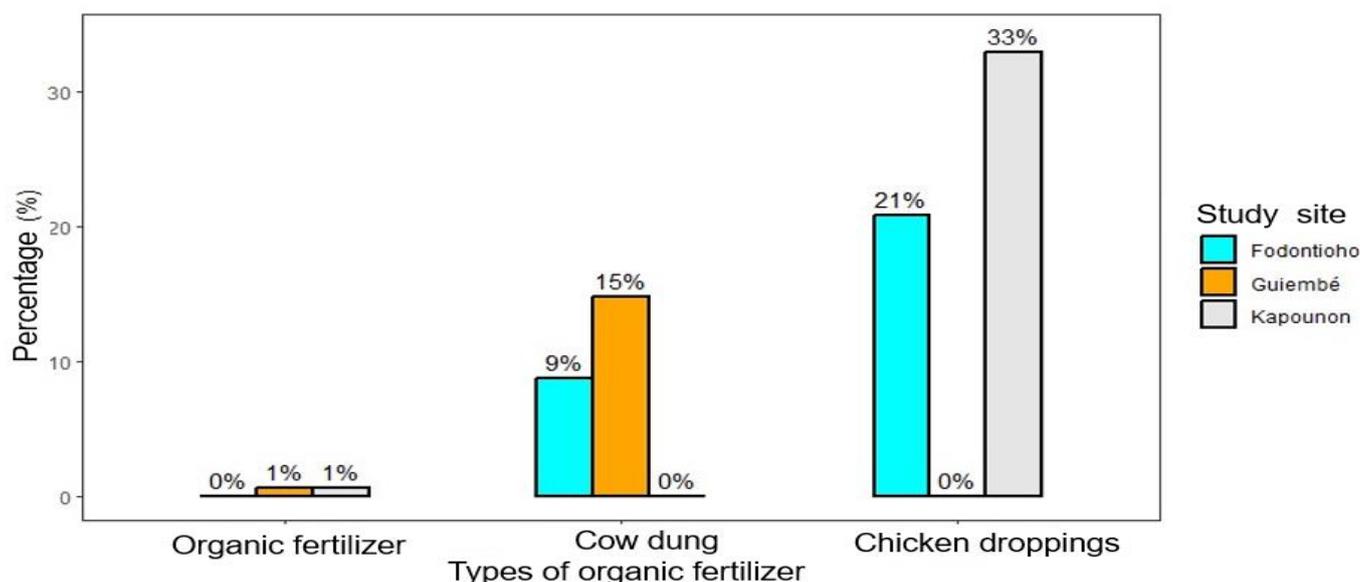
In villages, agricultural support structures play a key role in raising awareness among women producer groups about the use of organic fertilizers such as chicken droppings in market gardening for reasons of hygiene and minimizing nutrient losses. In addition to improving the quality of production, the use of farm litter in the treatment of market garden plots is justified by the need to better control production costs related to

the fertilization of cultivated land. The distribution of organic fertilizers surveyed according to typology was established based on cow dung, chicken droppings and fertilizer.

From the analysis, it is noted that the fertilization of the plots is based mostly on cow dung (51.8%). Secondly, comes the use of chicken droppings as organic fertilizer applied for the treatment of vegetable crops (46.1%).

The following Figure 3 illustrates these statistics relating to the study sites on which organic fertilizers are used.

Figure 3: Proportion of producers using organic fertilizers



Source: Survey data, 2023

According to this figure relating to the study sites on which organic fertilizers, the distribution by village reveals that the majority of respondents who use chicken droppings are present in Kapounon (33%) and Fodontioho (21%). These rates are relatively very high for most people who deal with cow dung in Guiembé (15%) and Fodontioho (9%). For the category "Organic fertilizer" which is present in Guiembé and Kapounon with only very low proportions in Kapounon and Guiembé (1%).

4. Discussion:

This quantitative study on the evolution of market gardening production in the three villages of the Korhogo department (Fodontioho, Guiembé and Kapounon) between 2022 and 2023 reveals complex dynamics of adaptation to economic and environmental constraints.

4.1. Land insecurity and gender inequalities in women's market gardening

The results show that market gardening sites in the Korhogo sub-prefectures have small cultivated areas, often at the limit of accessibility for women producers. With 84.6% of plots not exceeding 0.25 hectares, this analysis highlights a situation of extreme micro-parcellization, aggravated by the low rate of land ownership (only 5% of women producers). In Côte d'Ivoire, this extreme fragmentation of agricultural land into units of 0.01 to 2 hectares reflects a land crisis characteristic of agrarian tensions in sub-Saharan Africa (Jayne et al., 2014, pp. 12-14; Levasseur et al., 2007, p. 246; Chauveau & Bobo, 2005, pp. 250, 263). The explanatory factors for this micro-parcellization remain demographic pressure and the progressive monetization of the rural economy. Indeed, land dynamics in Africa characterized by the scarcity of arable land are transforming traditional modes of access to land, which perfectly illustrates the processes of "peasant proletarianization" and the intensification of conflicts over use (Chauveau & Colin, 2010; Bernstein, 2010, pp. 117-119; Colin et al., 2022). This state of affairs contributes to structurally

limiting the productive capacity and economic empowerment of women.

Furthermore, the low proportion of women holding land titles (only 5%) is a striking indicator of gender inequalities in access to land resources (FAO, 2011). This study confirms a striking disparity regarding the land vulnerability of women producers. Thus, in Africa, women represent 68% of the agricultural workforce but hold less than 15% of the land, thus revealing their structural precariousness (AFD, 2024; UN Women, 2024, p. 9).

4.2. Agricultural intensification and dependence on inputs from women's market gardening

Analysis of the results highlights a diversified use of phytosanitary products (PACHA 25 EC and INCA 25 WG at 50% each) and chemical fertilizers (NPK at 51% and Urea at 49%). The diversification of agricultural intensification practices constitutes a strategy allowing producers to optimize inputs to improve the sustainability and profitability of crops. This trend is part of a national strategy for the modernization of market gardening in Côte d'Ivoire (Sika, 2020, pp. 119-126; Dosso et al., 2023, p. 71).

The study also presents a differentiated distribution of practices according to the villages with the adoption of K-OPTIMAL in Fodontioho, the predominant use of herbicides in Guiembé and the use of PACHA 25 EC in Kapounon. This spatial differentiation of agricultural practices in the localities of Korhogo illustrates the existence of specialized technical territories. This territorial specialization generally results from the adoption of adaptation strategies in the face of the uncertainty inherent in the agricultural system such as the fluctuation of prices of chemical inputs (Gaigné, 2004, pp. 17-18; Sigaut, 1994). However, the optimization of agricultural practices according to specific local characteristics can also lead to the specialization of territories. From this perspective, the transition towards specialized agricultural territories is explained by the gradual abandonment of technical and

organizational innovations integrated in rural areas without taking into account certain socio-cultural aspects (Mandipaza, 2022; Bellon-Maurel & Huyghe, 2016, p. 160).

Furthermore, the coexistence of chemical and organic fertilizers in market gardening practices in the three villages is part of a dynamic of rational management of agricultural risks. These practices express the adaptation logic deployed by small African producers in response to the ecological and economic constraints structuring their production space (Shilomboleni et al., 2024). In this study, the majority use of NPK (51%) compared to Urea (49%) seems to reflect the determining influence of agricultural supervision structures and distribution networks on the choices of producers. Indeed, this trend is linked to the fact that the adoption of agricultural technical innovations is conditioned by the availability of economic resources of smallholders in Africa, and particularly by the free distribution of these fertilizers in the villages studied (Branca et al., 2022; Soro, 2025).

Regarding organic fertilizers, the simultaneous adoption of 51.8% cow dung and 46.1% chicken droppings suggests a diversification approach motivated by production cost control. This strategy thus constitutes a response to the challenges of sustainability and food security. This analysis shows the importance of pragmatic adaptation to the specific needs of different types of farmers in the implementation of effective interventions (Finizola e Silva et al., 2024). In addition, the use of organic fertilizers promotes the development of natural and animal resources accessible to women producers in each village of Korhogo. This approach reflects the emergence of climate-smart agriculture practices adjusted to the socioeconomic constraints of African smallholder farmers (Oduniyi et al., 2022).

Conclusion:

This study highlights the complex adaptation strategies developed by women market gardeners in the Korhogo department in the face of the challenges of micro-parcellization. The analysis of

agricultural practices in the villages of Fodontioho, Giembé and Kapounon reveals that producers deploy diversified and differentiated agricultural intensification strategies, despite major structural land challenges. The results confirm the land insecurity of women while revealing their ability to use agricultural inputs. The coexistence of chemical and organic fertilizers expresses an adaptive economic rationality in the face of constraints of cost and availability of inputs. This diversification allows women to resist the challenges of the system and shows the emergence of technical zones adapted to the resources of each locality. The study shows that micro-parcellization, far from being a limiting factor, constitutes a catalyst for organizational and technical innovations. In other words, women are transforming their spatial constraints into advantages for more intensive and sustainable agriculture, demonstrating their adaptability despite male domination of arable land. Ultimately, the findings open up various avenues for research on rural women and farming. First, it is important to work toward institutionalizing their land rights, designing technical innovations tailored to the constraints of micro-parcellization, and examining the modalities of transmitting empirical knowledge. Finally, it is important to understand the mechanisms by which their economic empowerment is likely to transform the patriarchal systems governing land appropriation.

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