

Vegetable Growers and Women Empowerment: Their Effect in Poverty Reduction in Region Korhogo (Côte d'Ivoire)

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Abstract

In Côte d'Ivoire, women occupy an important place in the agricultural sector, which is the basis of the country's economy. There is unanimous agreement on the essential role that these women must play through their empowerment for the country's development. Therefore, we must find appropriate solutions to the problem of women's empowerment in order to enable them to participate vigorously in the country's development. This study aims to address the problems of women's empowerment in agriculture by highlighting the potential opportunity that the practice of market gardening represents for women's empowerment. Based on a qualitative approach using ENV (2019) data, the Women's Empowerment in Agriculture Index (WEAI) shows that women producer of market garden produce are as self-reliant as their counterparts in other agricultural sub-sectors. In the same logic, the WEAI shows us that the practice of this crop has a positive effect on women's empowerment. By using these four (4) methods of effect determination, namely the Nearest Neighbour Method, Radius Method, Stratification Method and Kernel Method, the following values were obtained: 0.007; 0.039; 0.017; 0.027, which are all positive. The objective of the study is to determine the impact of market gardening on the empowerment of the women who practice it.

Keywords: empowerment, women, market gardening, WEAI

1. Introduction

Nowadays the eradication of poverty is one of the central objectives of economic policies. The poverty rate in Côte d'Ivoire, after having risen sharply from 10% to 51% of the population between 1985 and 2011, fell slightly in 2015 to 46% of the population (World Bank, 2017). This progress is justified by the commitment of the state of Côte d'Ivoire to fight against poverty through various policies, including the fight against discrimination, starting with gender inequality. More specifically, these measures will consist of promoting the empowerment of women by facilitating not only their access to production resources but also by granting them decision-making power both within the household (family) and leadership outside the home.

This study analyses the contribution of market gardening in the process of women's empowerment in the north of Côte d'Ivoire. Ivorian women are present in the agricultural sector, in this case in the market gardening sub-sector. What are the effects of the practice of market gardening in the process of women's economic empowerment in Côte d'Ivoire?

Our study is to analyse the impacts of market gardening on the empowerment of women in Côte d'Ivoire. For the realisation of this study, we set ourselves the following specific objectives:

- (1) Assess the level of women's economic empowerment according to the practice of market gardening through the sub-index of the five areas of empowerment (SDE) and the Gender Parity Index (GPI).
- (2) Construct the index of women's empowerment in the agricultural sector for women producers of market garden produce.
- (3) Analyse the effect of market gardening on women's empowerment through the propensity score.

The general hypothesis that we will seek to verify is the following: The practice of market gardening by women has a positive effect on their level of empowerment.

This general hypothesis can be subdivided into three specific hypotheses which are:

(1) Women working in the field of market gardening are more autonomous compared to those who are not according to the five areas of women's autonomy (SDE).

(2) The Women's Empowerment Index for Agriculture shows that women producers of market garden produce are more autonomous compared to those engaged in other crops.

(3) The practice of market gardening has a positive effect on women's empowerment.

This study will present the forms or nature of women's empowerment and the policies adopted by the Ivorian State in favour of women's empowerment.

Researchers believe that effective women's economic empowerment can only exist when women exercise their rights to control, benefit from, and control resources, assets, income and time. However, for women's economic empowerment to be meaningful, women must also have the autonomy and self-confidence to make changes in their own lives.

This includes the opportunity and power to initiate and influence decision-making while enjoying the same rights as men.

2. Literature Review

For Oxfam, women's economic empowerment is an end in itself, as is equality between women and men. Therefore, economic justice can only be achieved through an inclusive economic system that respects women's rights to control their income, assets and time. It is clear that greater representation of women in paid employment contributes to economic growth and development goals. Yet there is evidence that not all forms of economic growth are associated with increased opportunities for decent work and improved rights for women.

According to Thomas VELDKAMP, women's empowerment is a process by which a woman acquires by herself sufficient capacity to make important decisions at the political, economic, social and family levels.

Women's empowerment is therefore a process through which women's lives are transformed from a situation in which they have limited power due to gender inequality barriers to one in which they have the same power as men. The economic, social, personal and political aspects of women's empowerment are interrelated. Therefore, positive change in one aspect of women's lives cannot be sustainable without progress in the other areas.

The economic aspect is an essential component of women's empowerment as it relates to their ability to access and control productive resources and to be recognized as fully engaged actors in the economy. However, it should be noted that economic participation as such is not sufficient to ensure women's empowerment. It requires additional approaches that challenge the structural barriers that prevent women's empowerment in all aspects of society.

Statistical analysis of women's empowerment presents the level of women's empowerment according to certain variables. Thus, we show the effect of each of these variables determining women's empowerment on the two categories of women in our study presented in Table 1.

Table 1. Breakdown of women by membership of association

Practice of vegetable growing	Membership in a Cooperative Association	Number of surveyed women
No	12.93%	580
Yes	21.05%	95
Total	33.98%	675

Source: Author from ENV, 2019.

The analysis in Table 1 shows that of the 675 women in our sample, 21.05% of those who practice market gardening belong to a cooperative association compared to 12.93% of those who do not. We can only say that the practice of vegetable growing allows women to have a higher level of leadership. From this point of view, we note that the number of women who have control over their income is 67.37% who practise vegetable growing. In contrast, 62.93% of women who do not practise market gardening do not have control over their income.

On the question of decision-making to produce, we note that 48.42% of women producers of market garden produce decide for themselves what they should produce while we record 43.45% for those in other agricultural sub-sectors. Thus, we can say that women producers of market gardening are freer to decide which ones to produce compared to the others.

The concept of “independence” originates from the term “empowerment” which itself refers to the granting of more power to individuals or a group of people to act on the social, economic, political or ecological conditions they face. Empowerment is combined at two levels. The first level concerns changes in relation to the individual himself, while the second level concerns structural changes in the public sphere and in relation to others (Bacqué & Biewener, 2013; Calvès, 2009; Charlier & Caubergs, 2007; Hofmann & Marius-Gnanou, 2004; Kabeer, 2001; Oxaal & Baden, 1997; Parpart, Rai, & Staudt, 2003; Rai, 2007; Rowlands, 1995; Stromquist, 1988).

In order to present the characteristics and issues at each level, we use here the writings of Ninacs (2003) which, although published in a social work context, offers a relatively comprehensive and objective analysis in our view.

The individual level concerns the process of empowerment of an individual and involves four major stages (Ninacs, 2003). The first stage concerns the participation of the individual by allowing him/her to express him/herself but also to make a practical contribution according to the author. The latter is made possible by learning and mastering skills and know-how, which constitutes the second stage. The third stage addresses the issue of self-esteem. It is “a psychological transformation that cancels out internalized negative evaluations” (Ninacs, 2003) and aims to develop self-satisfaction, self-love, self-vision and confidence in oneself and one’s ability to act. Finally, the fourth stage is critical awareness, which is at the same time collective, social and political and requires the commitment of the individual’s personal responsibility (Ninacs, 2003). To do this, it puts forward the need for interaction, resources, time, but also a significant element in the eyes of the concerned person.

According to Ninacs (2003), the collective level can be of two kinds. Firstly, it can concern community empowerment, whereby communities increase their collective power. According to the author, this power is experienced both by the community and by the individual members who make it up and again involves four main stages: participation in the life of the community by all its members through the creation of places that allow it, synergy and the strengthening of individual skills, free, positive and effective communication and, finally, the development of a feeling of belonging to the community. The second and fourth steps are also highlighted by Klein (2008, 2011), who agrees with Ninacs (2003) on the need for community recognition of individual capacities and their articulation, the importance of integration into different networks by group members and the mutual support that results from the development of community capital that then allows for action on a larger scale.

Each of the elements of this community empowerment helps to reverse a state of disempowerment and when they are combined they result in an acquisition of power, but the author nevertheless stresses that a minimum degree of individual empowerment of certain members of this community is necessary (Ninacs, 2003).

Measuring the concept of empowerment is a task as complex as it is necessary. We propose to present the broad outlines of this task in the absence of an exhaustive and in-depth analysis which would require a paper of its own. For Oxaal and Baden (1997) the interest of this measure is twofold: to determine the level of empowerment already achieved by women and to analyse the effectiveness of the programmes set up.

While there is therefore a multitude of measurement indicators, each with its advantages and disadvantages, two of them, developed by the United Nations, are often mentioned: the Gender-related Development Index (GDI) and the Gender Empowerment Measure (GEM). The GDI measures countries’ performance in relation to the basic capabilities of citizens (defined by the Human Development Index) and then analyses gender inequalities (Oxaal & Baden, 1997). The GEM is a composite indicator that looks at the use of these capabilities by measuring, among other things, women’s participation in political and economic life (Bacqué & Biewener, 2013; Oxaal & Baden, 1997).

There is a debate on the difference between quantitative and qualitative analyses in the process of measuring empowerment (Narayan, 2005). However, the majority of the literature agrees that it is necessary to use both (Bacqué & Biewener, 2013; Calvès, 2009; Hofmann, 2000; Narayan, 2005; Oxaal & Baden, 1997), adjusting according to the questions (Narayan, 2005). The Canadian International Development Agency makes an important point. The measurement of empowerment can be qualitative or quantitative, but care must be taken to always analyse the results of measurements in a qualitative way in order to introduce a critical spirit and to take into account the subjective aspects of empowerment (Bacqué & Biewener, 2013; Oxaal & Baden, 1997). According to Narayan (2005), it is the path that is more important than the result; Hofmann (2000) and Oxaal and Baden (1997) argue in this respect for the use of diversified measurement indicators in order to be able to capture all the variables, their complexity and relationships. Hofmann (2000) goes even further, arguing that these indicators should come from a variety of sources: from the participants, from the organisation in charge of the project, and from external people (Greeley, Kabeer, Davies, & Hussein, 1992, cited in Hofmann, 2000, p. 10).

Narayan (2005), for her part, considers that a good measure of empowerment requires a clear definition of the variables and concepts involved in order to develop a precise and efficient framework for analysis.

In 2000, women's empowerment became one of the Millennium Development Goals, making it one of the top priorities for reducing poverty and making the world a better place (Bacqué & Biewener, 2013; Kabeer, 2005; United Nations, 2013). The UNDP has also developed one of the indices used to measure empowerment: the Gender Empowerment Measure (GEM), which is the index of women's participation in economic and political life. It makes it possible to measure gender equality in a given territory (Bacqué & Biewener, 2013).

For the World Bank, empowerment is a means of achieving economic efficiency where each individual must have the capacity to make effective and economically rational choices. Free markets, economic growth, productivity and investment are at the forefront here (Bacqué & Biewener, 2013).

Wong (2003) also criticises the World Bank for using power as an instrument to achieve this economic efficiency. No social transformation is envisaged or even desired, gender equality being a 'smart economy' according to Zoellick (2008), former president of the World Bank (2007-2012). Empowerment is regularly considered as a criterion of good governance, far from its transformative objectives (Bacqué & Biewener, 2013; Wong, 2003). For the World Bank, the future is being played out at the level of the private sector, and it is through the private sector that empowerment must pass. This economic rationality is, moreover, the main indicator for measuring empowerment for the World Bank (Bacqué & Biewener, 2013).

We will first construct an empowerment indicator and then in the second and last part we will determine the propensity score while linking the composite empowerment index to the propensity score in order to measure the effects of the practice of market gardening on women's empowerment. The construction of the composite empowerment index will be done as follows: calculate the 5DE (women's index according to the 5 areas of empowerment) sub-indices for the two categories of people (men and women) and GPI (Gender Parity Index) in our sample and then make a weighted summation of the coefficients 0.9 and 0.1 respectively of these two sub-indices to obtain the WEAI (Women's Empowerment Index for Market gardening in Côte d'Ivoire).

Thus, the Women's Empowerment in Agriculture Index (WEAI) allows us to assess the level of women's empowerment in market gardening through the WEAI). However, it does not measure the effects of market gardening on women's empowerment. In order to address this and determine the actual effect of these crops on women's empowerment, we use impact measurement methodologies and the Propensity Score.

In order to do so, we will use a binomial logistic model that will allow us to retain the significant variables that determine the practice of market gardening and that we will use to construct the propensity score before establishing the link between this score and the WEAI empowerment index.

3. Model Specification, Data Sources and Methodology Applied

3.1 Data Sources

These are therefore data from the survey on household living standards in Korogho in Côte d'Ivoire in 2019 (ENV, 2019), conducted by the National Institute of Statistics in region korogho in collaboration with the World Food Programme (WFP), AFRISTAT, the World Bank and UNICEF.

From this database we will extract the data constituting our variables of interest. In order to do this, we first construct an identifier that will allow us to identify each individual in a unique way (statistical unit) in each database according to the sectors of activity. Then we select our variables of interest which will also be presented in this study. Finally, we match the different databases concerned while retaining our individuals (men and women) with a market garden production unit according to the variables of interest.

In the context of our study we call individuals with a production unit any individual who devotes at least 8 hours a day to his or her production unit.

In the same way, we select a second base, this time made up of individuals working in agricultural sub-sectors other than market gardening, including those who have production units but who do not devote their full time to it, *i.e.*, at least 8 hours a day. In order to ensure that the proportions of women and men are strictly respected, a random sample is taken from our first base of 14317 individuals, which allows us to obtain a sample of 2025 individuals, 33.33% of whom are women, thus complying with the criteria of Yvette (2017), USAID and IFPRI, which have set up the WEAI index. For the calculation of the WEAI index, USAID defines five areas (5DEs) of empowerment based on their priority of nurturing the future. It should be noted that each of these five domains is composed of different indicators, all of which are qualitative, making a total of 10 (ten) variables to be retained for our study.

Production: Women's autonomy in the area of production will be measured not only by their participation in production decision making, so the variable production decision will be assigned a coefficient of 1/10 if the woman has the power of production decision, *i.e.*, she decides for herself what to produce, how to produce and 0 if not, but also by her response to the question of whether her production activities are defined by herself, which response will also be assigned a coefficient of 1/10 if yes and 0 if no.

Resources: The woman's answer to the question whether or not she owns the land on which she grows crops and also other factors of production will be given a score of 1/15 if yes and 0 if no. Then if the woman has bought, sold or transferred property, her answer receives a score of 1/15 and 0 if not. In the end, the woman may not be the owner of the production resources but has access to them, so if she has access, her answer is multiplied by 1/15 and by 0 if not.

Income: The income that the woman derives from her production is either managed by the woman unilaterally or in consultation with a third party. If she says she has total control over the management of this income from market gardening production then she receives a coefficient of 1/5 and 0 otherwise.

Leadership: Women's leadership will be measured by their level of involvement in society's activities. It will therefore be ensured that she is a member of an association and then given a value of 1/10 and 0 if not. In addition, if the woman is a member of an association herself and is a member of the board of the association then a weight of 1/10 is given to her answer, 0 if not.

Time: the time of every fulfilling person is subdivided into two main parts, namely leisure time and work time. If the woman says that she has leisure time that is quite distinct from work time, then her answers are each given the value 1/10 and 0 is not the case. It is important to specify here that working time is at least 8 hours of work/day and leisure time must be less than 6 hours/day. Of these five areas, USAID uses two sub-indexes to calculate the WEAI index, namely the 5DE sub-index and the GPI (Gender Parity Index) sub-index, which measures gender parity.

Therefore, the WEAI will be obtained by making a weighted sum of the 5DE and GPI sub-indexes.

2.2 Methodology Applied

There are two main points in this section: firstly, we will determine the level of empowerment of women who are in the field of market gardening as well as those who are not, and secondly, we will determine the effect of the practice of market gardening on women's empowerment.

Indeed, the first one concerns the description of the two sub-indices (the Women's Empowerment Index according to the five 5DE empowerment areas and the GPI gender parity index) as well as the Women's Empowerment Index in Agriculture.

Determining the 5DE sub-index will provide information on the level of women's empowerment according to the five areas of empowerment that we will describe in the rest of the work. As for the GPI, it will tell us how women are obviously subject to gender inequalities.

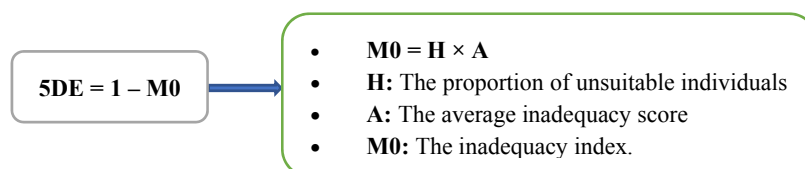
From these two sub-indices we will obtain the WEAI Women's Empowerment Index for Market gardening.

The second part of this section will be devoted to measuring the effect of market gardening on women's economic empowerment. This will allow us to determine which variables among the determinants of market gardening practice influence positively (the determinant that favours women's empowerment) and which influence negatively (the variable that hinders my wife's empowerment).

2.2.1 Description of the 5DE, GPI and WEAI Sub-indexes

(1) The 5DE Sub-index

The measurement of the five areas of empowerment (5DEs) is done through a number between 0 and 1 with the highest value (1) signifying greater empowerment. The formula for calculating the 5ED is as follows:



(2) The Proportion of Unsuitable Individuals H

While globally taking into account the 10 indicators, an individual is inadequate when the weighted sum of the values of the 10 indicators (inadequacy score) is strictly greater than 0.2 (20%). In other words, an individual is adequate when the inadequacy score for the 10 indicators is less than or equal to 0.2 (20%).

(3) The Average Inadequacy Score A

The average inadequacy score is the proportion of areas in which inadequate individuals did not achieve a satisfactory level. To reach a satisfactory level in a given domain, the inadequacy score of the domain's indicators will have to be less than or equal to 20%.

(4) The Inadequacy Index M0

Through this formula, it emerges that women's 5DE index can be improved by reducing the percentage of inadequate women (H) or the proportion of areas in which inadequate women do not have a satisfactory level.

(5) The GPI Sub-index

As for the Gender Parity Sub-Index (GPI), it reflects the percentage of women who have achieved the same level of autonomy as men in their households. For households where gender parity has not yet been achieved, the GPI sub-index shows the overall gap that women must close in order to reach the same level of autonomy as men.

The GPI is measured through a number between 0 and 1 with the highest value (1) signifying greater gender parity.

The formula for calculating the GPI index is:

$$GPI = 1 - (H_{GPI} \times I_{GPI})$$

H_{GPI}: the proportion of households without gender parity
I_{GPI}: the average empowerment gap

(6) The Proportion of Households Without Gender Parity H_{GPI}

It represents the proportion of households in which there is inequality between men and women. It is obtained by relating the number of households without gender parity to the total number of households. By summing these households, we obtain the total number of households without gender parity.

A household is classified as a gender-neutral household if the average scores of women are lower than the average scores of men in that household.

(7) The Average Empowerment Gap IGPI

It represents the difference between women's and men's level of empowerment, *i.e.*, it is the gap that women have to bridge in order to achieve the same level of autonomy as their male counterparts. This average gap is determined by relating the sum of the deficits observed at the level of the different households to the total number of households in which its differences are observed.

(8) Description of "Women's Empowerment in Agriculture Index" (WEAI)

Based on the two sub-indices 5DE and GPI, the Women's Empowerment in Agriculture Index (WEAI) is then an aggregate index that shows, on the one hand, the level of empowerment of women in their households and in the community and, on the other hand, the level of inequality between women and men within the household.

The 5DE empowerment index represents 90% of the value of the WEAI while the Gender Parity Index (GPI) has a contribution of 10%.

It is also important to specify that the WEAI is between 0 and 1, the closer the value is to 1 the higher the level of empowerment and therefore a value closer and closer to 0 reflects a lower level of empowerment.

This index (WEAI) is determined using the following formula:

$$WEAI = 0.9 \times 5DE + 0.1 \times GPI$$

5DE: The five areas of empowerment
GPI: The Gender Parity Index

Improvement in the 5DE or GPI index leads to an overall improvement in the Women's Empowerment in Agriculture Index (WEAI). Thus for an improvement in the level of women's empowerment one will have to act in such a way as to improve the gender parity sub-index that the GPI or that of the five 5DE empowerment areas.

This will be done through direct actions on the different variables that determine these sub-indexes that constitute the Women's Empowerment in Agriculture Index (WEAI).

2.2.2 The Methodology for Measuring the Effect: The Propensity Score

(1) Generality on the Methodology for Measuring Effects

Methods for the evaluation of socio-economic programmes and policies are essentially based on the comparison of individuals benefiting from the intervention, either the treatment or experimental group, with individuals not benefiting from it, or the control or monitoring group. Two types of methods can be used depending on whether or not individuals benefit from the intervention according to a random criterion. Randomized social experimentation is based on random selection of participants and random allocation of treatment, *i.e.*, random allocation of individuals to the control or treatment group (Altman & Bland, 1999; Banerjee & Duflo, 2009). Individuals' behaviours are then measured and compared according to the treatment conditions in order to test the hypothesis to be tested or, more generally, to answer the question of the effects of treatment on their behaviours. In addition to the factor to be tested, the arrangements outside the experimental treatment must be rigorously identical for both groups.

(2) Methodology Used for the Study

The dimensions to be retained in a study on empowerment depend on the field in which we are situated. As mentioned above, production, resources, income, leadership and time are the five (5) dimensions we will retain.

Thus, the selection of variables for these different dimensions was made using a Logistics model. The variables and dimensions used in the study are therefore recorded in the table below.

Table 2. Presentation of the variables selected for the study

Type of variable	Description of the variable	Nature of the variable
Treatment variable	(Practice or not) of market gardening	Discret (1 = oui, 0 = non)
Matching variable	Age of the woman	Continue
	Female age squared	Continue
	Marital status (single)	Discrete (1 = yes, 0 = no)
	Place of residence (rural)	Discrete (1 = yes, 0 = no)
	Level of education (reading and writing)	Discrete (1 = yes, 0 = no)
	Belonging to an association	Discrete (1 = yes, 0 = no)
	Ownership of the occupied land	Discrete (1 = yes, 0 = no)
	Production decision	Discrete (1 = yes, 0 = no)
	Investment decision	Discrete (1 = yes, 0 = no)
	Access to production resources	Discrete (1 = yes, 0 = no)
Result variable	Composite Empowerment Index	Continue

Table 3. Selected dimensions of empowerment

Domain	Indicator	Definition of domain	Name of the measurement variable
Production	Input into production decisions	This dimension concerns decisions in agricultural production, the more pressing of which refers to decision-making power. It asks about production decisions, <i>i.e.</i> , decisions concerning the type of crops to be produced, including food crops or cash crops, or those concerning the type of livestock farming, including livestock or fish farming, which are made unilaterally or in a concerted manner. In short, this dimension seeks to see whether individuals are free to choose what they wish to produce.	Production Decision (Prod_Decis)
	Autonomy in production		
Resources	Ownership of production goods or resources	This dimension concerns ownership of, access to, and decision-making power over productive resources such as land, livestock, agricultural equipment, credit and other consumer durables.	Property & Access to Production Resources (Acce_Res)
	Purchase, sale or transfer of goods		
	Access to productive resources		
Income	Controlling the use of income	This dimension questions the unilateral or concerted management of income and expenditure by our individual.	Investment Decision (Inves_Decis)
Leadership	Belonging to a group	This dimension concerns women's leadership, which is measured by whether or not they belong to an association and whether or not they are on the board of the association. This is in order to evaluate her right and her speaking in public in all her decision-making power in public.	Association
	Member of the board of a group		
Time	Work	This dimension concerns the allocation of time to production, domestic tasks and the satisfaction derived from time spent on leisure activities.	H_Work
	Leisure		H_Leisure

Source: Computed by the author.

Our methodological approach will be as follows: Firstly, it is a question of constructing a composite empowerment index which summarises the dimensions covered by this variable into a single indicator. Several methods exist for its construction, including the entropy approach and the inertia approach. In the framework of this study, the composite indicator was constructed using the inertia approach, in particular through Multiple Correspondence Analysis (MCA). The variables used to estimate this composite indicator are binary variables taking the value 1 if the woman has the attribute and the value 0 if not. The study was inspired by the methodology already used in several studies, including those by (Ki, 2005; Ayadi et al., 2007). Here, the objective is to summarise the information provided by these qualitative indicators into a single quantitative indicator.

The functional form of the index is:

$$ICAUTO_i = \sum_{j=1}^J \gamma_j I_{ji} \quad (1)$$

where, I_{ji} is the primary indicator j ($j = 1; J$) for individual i ($i = 1; N$); γ_j is the weight assigned to indicator j in the calculation of the ICAUTO composite index for individual j .

In order to construct a counterfactual for each woman cultivating vegetables, we use the available information on women cultivating other types of crops in order to remove any potential bias from the estimate. These counterfactuals will be obtained from a logistic regression based on the propensity score of each woman practitioner according to observable characteristics. Based on the causal impact model of (Rubin, 2006), the causal effect of treatment for the individual is defined as follows:

$$\Delta = Y_i^1 - Y_i^0 \quad (2)$$

where, Δ is the treatment effect i , where, $i = 1, 2, N$; variables that describe the level of women's empowerment conditional on the practice of market gardening.

In order to capture the effects of the average treatment on the treaty, the equation is modified as follows:

$$\Delta_{ATT} = E[(Y_i^1 - Y_i^0)/T_i = 1] = E(Y_i^1/T_i = 1) - E(Y_i^0/T_i = 1) \quad (3)$$

where, $E(Y_i^1/T_i = 1)$ is the difference between the expected outcome with and without treatment for women engaged in market gardening. $E(Y_i^0/T_i = 1)$ is the hypothetical outcome that would have resulted if the women had not practiced market gardening.

Then, the calculation of the average treatment effect on treaties (ATT) is performed using two estimators, namely the nearest neighbour method and the kernel matching method. Finally, the test of (Rosenbaum, 2002) is done in order to analyse the sensitivity of the estimators to the presence of unobservable characteristics and to check the robustness of the results.

3. Empirical Results and Interpretations

3.1 Results and Interpretations of the Assessment of Women's Empowerment Through the WEAI Index

Some descriptive statistics as well as results and interpretations of the impact of market gardening measured by the WEAI and Propensity Score methods are presented in this section.

Through these statistics we will show the qualitative and quantitative characteristics of women's empowerment as well as those of market gardening.

The descriptive statistics relate to the two main groups of households in the sample, including women market gardeners.

The sample for this work comes from the survey on the standard of living of the population carried out in 2019 in Korhogo, Côte d'Ivoire (ENV, 2019). It covers 2025 individuals, 66.66% of whom are men and 33.33% women. Of these 2025 individuals, only 14.07% (9.38% men and 4.69% women) practice market gardening, compared to 85.93% (57.28% men and 28.64% women) who do not.

Table 4. Distribution of women according to membership of an association

Vegetable growing culture	Sex		Grand total (%)
	Feminine (%)	Masculine (%)	
Do not practise	28.64%	57.28%	85.93%
Practise	4.69%	9.38%	14.07%
Grand Total (%)	33.33%	66.66%	100%

Source: Author from ENV, 2019.

We note that women who practice market gardening have more access to comparative production resources than those who do not.

In both cases, the vast majority of women have access to production resources, compared to a small minority who do not, with rates of 6% and 11%. It is therefore important to note that women who practice market gardening have greater access than those who do not, a difference of 5%.

3.2 Results and Interpretations of the WEAI

At this stage of the research, we present the results of the calculation of the Women's Empowerment Index for Market gardening (WEAI). To do so, we present the results of the sub-indices that are the empowerment index according to the five (5) 5DE empowerment domains and the gender parity index (GPI).

3.2.1 Level of Adequacy of Individuals

According to empirical data, an individual is globally inadequate (for the 10 5DE indicators) when the weighted sum of the values of the 10 indicators (inadequacy score) is greater than 20%. The results in Table 5 below show that the inadequacy rate in relation to the ten 5DE indicators is very high in the market gardening sector for both women and men, with 94.74% of women being inadequate compared to 96.32% of men.

In other words, more than 1.58% of women are involved in decision-making processes within their households. Thus, when it comes to market gardening, women participate better than men in decision-making processes related to the five areas of agricultural empowerment which are: i) production, ii) resources, iii) income, iv) leadership and v) time.

As regards the results of the empowerment index for women practising other types of crops, we refer to the results in Table 6 below which show that the rate of inadequacy in relation to the ten 5DE indicators is very high, as is the case for women practising market gardening, with 96.72% of women being inadequate compared to

93.97% of men. This shows that women are 2.75% more involved in decision-making processes within their households than men.

In addition, the proportion of unsuitable women in the market gardening sector is lower than in other types of crops. This means that these women have more decision-making power than women who do not grow vegetables. It can be concluded that the practice of market gardening gives more decision-making power to women.

3.2.2 Average Inadequacy Score

Considering the overall inadequacy of women (94.74%) in the field of market gardening, it is noted that they have not reached a satisfactory level in 60.73% of the fields (Table 1). In other words, out of the 5 areas of empowerment, it is in only 39.27% of the areas that these inadequate women participate fully in the decision-making processes concerning the operation of the farm. As for the overall inadequate men (96.32%), they participate fully in the decision-making processes concerning the operation of their farm in 52.66% of the areas.

On the other hand, women practising other types of crops did not reach a satisfactory level in 58.35% of the areas (Table 1). This would mean that, out of the 5 empowerment areas, these inadequate women participate fully in the decision-making processes concerning the operation of the farm in only 41.65% of the areas. As for the overall inadequate men (93.97%), they participate fully in the decision-making processes concerning the operation of their farm in 47.84% of the areas.

The mean inadequacy score shows that women who do not practice market gardening participate in 2.38% more areas than those who are in market gardening.

3.2.3 Mismatch Index and 5DE Empowerment Index

In the field of market gardening, taking into account both the proportion of unsuitable individuals and the proportion of areas in which these individuals have not achieved a satisfactory level of participation in the decision-making process, women overall have an unsuitability index of 0.575, while the unsuitability index for women not in market gardening is 0.564. It should be noted that women who are in the market gardening sector are the most adequate, a result that could indicate a negative effect of the market gardening culture on women's decision-making power. From these different proportions, we deduce the women's empowerment index according to the 5 domains (5DE). Thus, we record 0.425 for women who are in the market garden and 0.436 for those who are not.

We note here that the index is more or less the same for the two categories of women, with a lead of 0.011 in favour of women who practise other types of culture.

From this result we can conclude that hypothesis 1 of the analysis is not verified, in other words, the practice of market gardening does not allow women to be autonomous in the five (5) areas of empowerment which are: i) production, ii) resources, iii) income, iv) leadership and v) time.

3.2.4 Gender Parity and the Average Empowerment Gap

According to Table 1 there are 33.03% of households in the market gardening sector where gender parity is not respected, *i.e.*, in 33.03% of the households in our sample, women's inadequacy score is higher than men's, so to speak, women in these households are less involved in the decision-making process than men. It is in 66.97% of the households that women have the same or an higher level of participation in decision-making processes than men.

Furthermore, in households where gender parity is not respected, there is an average gap of 0.91% (in terms of the level of involvement in decision-making processes) that women have to make up in order to achieve the same level of autonomy as their male counterparts.

At the same time, Table 6 shows that 72% of women's households not in the market gardening sector respect gender parity. This suggests that in 72% of households where women do not practice market gardening, women have the same or higher level of participation in decision-making processes than men. They will therefore have to fill a gap of 0.9% to reach the same level as men.

Results on the gender parity indices according to the two tables, 0.997 for women who are in the market gardening sector and 0.998 for those who are not, we can conclude that the indices for these two categories of individuals are equal, with a difference of 0.1% in favour of women practising other types of crops.

From this analysis it emerges that our hypothesis 2 is not verified. This means that, according to the Gender Parity Index (GPI), women producing market garden crops do not enjoy greater gender parity than those producing other types of crops.

3.2.5 The Women's Empowerment in Agriculture Index (WEAI)

The 5DE empowerment index for women and the gender parity index (GPI) in the area of market gardening are 0.425 and 0.997 respectively, and 0.436 and 0.998 for women in other areas of agricultural production. It is important to note that neither of these two categories of women is autonomous according to the 5DE and that they each benefit from a very satisfactory gender parity.

Consequently, a major effort is still needed in the area of production in favour of women in order to make them autonomous in this area.

The gender parity index is satisfactory for these different categories of individuals.

The overall index of women's empowerment in the agricultural sector (WEAI) and more specifically in the market gardening sector (WEAI) in Côte d'Ivoire is estimated at 0.559 (Table 5) for the market gardening sector and 0.549 for the non-market gardening sector.

At the end of this study, whose objective was to assess the level of empowerment of women producers of market gardening crops as well as those in other agricultural fields, it must be noted that these two categories of women are autonomous in view of their empowerment indices in the agricultural field (WEAI = 0.549 and WEAI = 0.559), which are both higher than 0.5.

Thus the WEAI results invalidate hypothesis 3 because the index of women producing vegetable crops is supplanted by that of women producing other types of agricultural products.

Much remains to be done in terms of their empowerment in the five (5) areas (5DEs).

This is why much remains to be done at the level of their empowerment according to the five (5) areas (5DEs) and therefore a matter for reflection on better policies aimed at a total and definitive empowerment of women vis-a-vis their counterparts and society in a specific and general way.

Table 5. WEAI of women vegetable growers

Indices	Field of vegetable crop production	
	Women	Men
Proportion of unsuitable individuals (H)	94.74 %	96.32 %
Proportion of adequate individuals (1 - H)	5.26 %	3.68 %
Average inadequacy score (A)	60.73 %	47.34 %
Mismatch index ($M0 = H \times A$)	0.575	0.456
Empowerment Index 5DE ($5DE = 1 - M0$)	0.425	0.544
Number of individuals (N)	95	190
Proportion of households without gender parity HGPI	33.03%	
Proportion of households with gender parity ($1 - IGPI$)	66.97 %	
Average empowerment gap (IGPI)	0.91%	
GPI Index ($1 - HGPI \times IGPI$)	0.997	
Number of dual households (N')	72	
WEAI ($0.9 \times 5DE + 0.1 \times GPI$)	0.559	

Source: Author from ENV, 2019.

Table 6. WEAI of women who do not practice market gardening

Indices	Other areas of agricultural production	
	Women	Men
Proportion of adequate individuals (H)	96.72%	93.97%
Proportion of adequate individuals (1 – H)	3.28%	6.03%
Average inadequacy score (A)	58.35%	52.16%
Mismatch index ($M0 = H \times A$)	0.564	0.490
Empowerment Index 5DE ($5DE = 1 - M0$)	0.436	0.510
Number of individuals (N)	580	1160
Proportion of households without gender parity HGPI	28%	
Proportion of households with gender parity (1 – IGPI)	72 %	
Average empowerment gap (IGPI)	0.9%	
GPI Index ($1 - HGPI \times IGPI$)	0.998	
Number of dual households (N')	377	
WEAI ($0.9 \times 5DE + 0.1 \times GPI$)	0.549	

Source: Author from ENV, 2019.

4. Discussions

The application of the “Women’s Empowerment in Agriculture Index” (WEAI) in Côte d’Ivoire and more particularly in the field of market gardening reveals that the level of women’s empowerment varies according to several variables. At the global level, it appears that women participate little in decision-making. 5.26% of women are involved in the decision-making process within their households compared to 3.28% for women in other agricultural sub-sectors. It is men who are the main decision-makers in the operation of family farms.

Parity, on the other hand, shows that women in the market gardening sub-sector ($GPI = 0.997$) are partially dominated by those in the other sub-sectors ($GPI = 0.998$), it appears that market gardening does not allow women to increase their gender parity.

More specifically, women who practice market gardening have a higher index ($WEAI = 0.559$) than women who practice other types of cultivation ($WEAI = 0.549$) and are therefore more or less equal. It can be deduced from this that women who are in the fields of market gardening are more autonomous compared to those who practise in the other agricultural sub-sectors in Côte d’Ivoire.

Women’s powerlessness in the different areas of agricultural empowerment (production, resources, income, leadership and time) affects their likelihood of improving their living conditions. Indeed, a major contribution to the human rights approach to poverty reduction is the empowerment of the disadvantaged, *i.e.*, increasing their freedom of choice and action so that they can structure their own lives (United Nations, 2004). While the common feature of poverty cases is weak decision-making capacity, it can also be said that human rights empower individuals and communities by giving them rights that create legal obligations for others.

From the results of the assessment of women’s empowerment in agriculture we can only conclude on the effect of the practice of market gardening on women’s empowerment.

Therefore, we will use the propensity score in the following to measure the impact of market gardening production on women’s empowerment.

4.1 Result of Measuring the Impact of Market Gardening Practice on Women’s Empowerment Using the Propensity Score Methodology

At this level we will of course present the results of measuring the impact of market gardening on women’s empowerment using the propensity score. To do this, this section will be divided into three main steps:

First, we will present the results of the Multiple Correspondence Analysis (MCA), followed by the results of the logistic regression. Finally, we will end with the propensity score.

4.1.1 Multiple Correspondence Analysis (MCA)

It is important to recall here that this is a factorial correspondence analysis which studies the association between several qualitative variables such as ownership of production resources (Ownership_ress_Prod), women’s

control of income from production (Control_Revenue), decision-making power at the production level (Decision_Prod), women's leadership (Appart_Association) and women's leisure (Leisure).

The sample comprises a total of 675 individuals, all of whom are women, of whom 14.07% practice market gardening (treated individuals) against 85.93% who do not (control individuals). There are more individuals in the treatment group than in the control group, which is typical of the propensity score for which a large number is needed. Indeed 58.37% of the women in this sample have ownership over the production resources to which they have access, 63.56% have control over the income from production, 44.15% decide on their own what to produce and how to produce, 23.41% are members of an association. As far as leisure time is concerned, all the women in our sample do not have any leisure time, which leads us to remove this variable from the regression. The four other retained variables ($Q = 4$) for the CMA are discrete with two modalities each rated K.

Table 7. Multiple component analysis for the choice of axes to be retained

Dimension	Main inertia	Percent	Cumulative percent
Dim 1	0.3874	38.74	38.74
Dim 2	0.2526	25.26	64.01
Dim 3	0.2558	24.58	88.58
Dim 4	0.1142	11.42	100
Dim 5	1	100	

Note. Author from ENV, 2019.

The total inertia of the point cloud noted ϕ^2 depends on the number of modalities and variables introduced in the analysis.

With 675 observations and four axes we obtain a total noted inertia equal to 1

It is calculated according to the following formula: $\phi^2 = (K - Q)/Q = (8 - 4)/4 = 1$. The table below shows the different eigenvalues λ calculated, *i.e.*, at most $K - Q = 4$ non-zero eigenvalues. These eigenvalues are 0.3874358; 0.2526317; 0.2457593 and 0.1141732 for dimensions 1, 2, 3, 4 respectively. There is also a decrease of these eigenvalues with a sum equal to 1 which is the total inertia.

These eigenvalues are low, presaging a weak explanation of the total inertia with the variables taken into account. According to Benzécri, we can therefore discriminate by retaining only the eigenvalues that are higher than the average eigenvalue $\lambda_m = 1/Q = 0.25$. On the basis of this criterion we will retain only the first two dimensions, namely dimension 1 and dimension 2.

Table 8. Representations of the variables according to the selected dimensions

Categories		Overall			Dimension 1			Dimension 2		
		Mass	Quality	Inert	Coord	Sqcorr	Contrib	Coord	Sqcorr	Contrib
Production	No	0.140	0.771	0.110	1.25	0.776	0.136	0.132	0.006	0.001
	Yes	0.110	0.771	0.140	-1.581	0.766	0.172	-0.167	0.006	0.002
Resources	No	0.104	0.620	0.146	0.118	0.004	0.001	-1.850	0.617	0.179
	Yes	0.146	0.620	0.104	-0.084	0.004	0.001	1.319	0.617	0.128
Income	No	0.091	0.759	0.159	1.834	0.748	0.191	0.285	0.012	0.004
	Yes	0.159	0.759	0.091	-1.052	0.748	0.109	-0.164	0.012	0.002
Leadership	No	0.191	0.409	0.059	0.160	0.033	0.003	-0.675	0.376	0.044
	Yes	0.059	0.409	0.191	-0.524	0.033	0.010	2.209	0.376	0.143

Source: Author from ENV, 2015.

By summing the relative contributions of the modalities of the different variables we obtain the global contribution of the variables to the formation of the axes or point cloud.

Indeed the variables production decision (Decision_Prod) and income control (Control_Income) with respectively global contributions of 0.308 and 0.3 are the variables that participate at most in the formation of

axis 1. A relative analysis of the contribution of the modalities within these variables shows that at the level of these two variables even the “yes” modality with a contribution of 0.172 which translates that women have the power of decision in production for the variable Production Decision and “no” with a contribution of 0.191 for the fact that women are deprived of the power to control the income derived from their production represent the two modalities which participate best in the formation of the axis. With regard to axis 2, the variables Ownership of production resources (with a contribution of 0.307) and Association (with a contribution of 0.187) are the variables that best contribute to the formation of this axis. Within the variable Ownership of production resources, the “no” modality reflects the fact that women are not owners of the production resources which they use in their production activity, which contributes more to the formation of this axis. On the other hand, for the Association variable, it is the “yes” modality, reflecting the fact that women belong to an association, that best contributes to the formation of axis 2.

Thus the majority of the individuals represented on axis 1 have decision-making power in production and do not have control over their income from their production activity, while those on axis 2 mostly have no ownership over the resources used by them in their production activity and are members of an association.

4.1.2 Logistic Regression

It will make it possible to determine the meaning of the effect of the explanatory variables on the probability of practising market gardening and of belonging to the treated group (women who practise cultivation).

Table 9. Logistic regression between variables and market gardening practice

Market gardening practice	Coefficient	Std. Err	Z	P > z	[95% Conf. Interl.]	
Age	-0.019	0.008	-2.34	0.019	-0.034	-0.003
Residence	-0.727	0.341	-2.12	0.033	-1.395	-0.058
Association	-0.20	0.277	-0.72	0.471	-0.742	0.343
Access to the Resource	-0.606	0.447	-1.53	0.125	-1.563	0.632
Ownership of resources	0.180	0.231	0.78	0.437	-0.273	0.632
Production	0.237	0.226	1.05	0.293	-0.205	0.680
Constant	-0.970	0.340	-2.43	0.015	-1.753	-0.187

Source: Author from ENV, 2015.

According to the logistic regression, age, place of residence, membership of an association and access to production resources decrease the probability of practising market gardening, whereas the variables ownership of production resources and production decision increase the probability of practising market gardening. In other words, the fact that women own the production resources and are free to decide what they want to produce increases their probability of practising market gardening compared to women who do not have these attributes.

The fact that access to production resources reduces the probability of practising market gardening could be explained by the mode of access to these production resources, which are most often very expensive, which discourages women from getting involved in the field.

4.1.3 Effects of Market Gardening on the Likelihood of Women's Empowerment.

This third point will be an estimation of the effect of market gardening on the probability of women's empowerment through different methods including Nearest Neighbour, Radius Method, Stratification Method and Kernel Method. This estimation will allow us to see if the market gardening culture has a negative or positive effect on the probability of empowerment of the woman who practices it.

Table 10. Practice of market gardening and likelihood of women's empowerment

Method	ATT	Ecart-type	t-Student
Nearest Neighbour	0.007	0.039	0.173
Radius Method	0.039	0.044	0.874
Stratification Method	0.017	0.036	0.455
Kernel Method	0.027	0.037	0.744

Source: Author from ENV, 2019.

The counterfactuals for female beneficiaries were obtained from the logistic regression model based on the propensity score of each woman to benefit from microcredit according to observable characteristics. The Common Support shows that the matching of the sample by the score method is effective and of good quality because it eliminates a great deal of dissimilarity between women producers of market garden produce and those who produce other types of agricultural produce. Also, for the different estimates, the restriction to the common medium is validated by the data, thus ensuring that for each woman producer, there is at least one non-producer woman with a similar propensity score and therefore a similarity between treated and untreated individuals.

By using these four (4) methods of effect determination, namely the Nearest Neighbour Method, Radius Method, Stratification Method and Kernel Method, the following values were obtained: 0.007; 0.039; 0.017; 0.027, which are all positive. The objective of the study is to determine the impact of market gardening on the empowerment of the women who practice it, and it can be concluded that this impact is positive in view of the positive sign noted on all the values obtained. Therefore we can conclude that our general hypothesis that the practice of market gardening by women has a positive effect on their level of empowerment has been verified.

This could be explained by the fact that Ivorian society still remains rigid in the face of regulations and norms aimed at giving more authority and responsibility to women. This is the case with the appropriation of land, production resources, women's involvement in political and associative life, and control of income, which just remain attributes reserved for men. These results can therefore be taken as an assessment of the efforts made by the Ivorian government in favour of women working in the agricultural sector, which are still making timid progress.

5. Conclusion

The first step is to determine the Women's Empowerment in Agriculture Index (WEAI). According to these indices, both groups of women are autonomous, although women who produce market garden produce are more autonomous than those who produce other crops. It is important to note that this difference remains small, *i.e.*, 0.01 in favour of women producers of market garden produce and therefore the results are roughly equal. We conclude from this that our hypothesis 1, which states that the index of women's empowerment in agriculture shows that women producers of market garden produce are more autonomous compared to their counterparts who grow other crops, is partially verified. These results could be explained by the fact that these two groups of women belong to the sectors of activity, in this case the agricultural sector, and are therefore subject to the same realities (advantages and disadvantages) in their productive activity.

Measuring this impact was the subject of the second part of our work. Indeed, we have first of all, through an analysis of multiple correspondences, represented individuals on two main axes as variables. Thus, individuals with decision-making power and control over income are represented on axis 1 and then those with a high sense of leadership and ownership of the factors of production used in production are represented on axis 2.

A logistic regression then allowed us to retain the variables age, place of residence, dictated production decision, ownership of production resources, income control and leadership as determinants of market garden production.

After construction of the Composite Index of Autonomy (ICAUTO) we therefore estimated and verified the robustness of the Propensity Score. We were therefore able to measure the impact of market garden production on women's empowerment. It is important to note that the effect of market gardening on the probability of women's overall empowerment is significantly positive and is between 0.007 and 0.027. Our hypothesis 3 that the practice of market gardening has a positive effect on the empowerment of the women who practice it is verified.

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