Influence of the types of fertilizers on the economic performance of the market garden production in Parakou town, Northern Benin.

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Abstract- Given the pronounced degradation in recent years, it appears imperative to develop production techniques promoting conservation / improvement of the structure and composition of the soil. This study aims to analyze the influence of the types of fertilizers on the economic performance of the market garden production in the town of Parakou. This study is specifically interested in the culture of carrot. To achieve this, a survey was conducted among sixty (60) farmers chosen randomly in this Municipality. The data collected were related to demographics and spending and revenue generation according to the types of fertilizers (chemical and biological). These data were collected on the basis of a questionnaire addressed to individually sampled producers. The information collected was analyzed using SPSS software v. 20. It follows that the carrot production is economically and financially profitable in the town of Parakou. Moreover, economic performance indicators calculated (net margin, average labor productivity, internal rate of return and the benefit / cost) indicate that organic fertilizers improve more the profitability of this production.

Keyword- Influence; type of fertilizer, performance, carrot, Parakou.

1 INTRODUCTION

Food security remains today a concern for all countries around the world since the food coverage remains inadequate [1]. Since the 1990s in the analyzes, the fruit and vegetable sector has emerged as a major source of agricultural growth and poverty reduction [2]. This sector contributes over 33% of global agricultural output and employs more than 800 million agricultural assets [3]. According to a study carried out by the United Nations Development Program (UNDP), this activity is practiced in over 90 cities in 31 countries in Southeast Asia, the Middle East, Europe, Sub-Saharan Africa, South America, Central, North and West Indies [4]. Introduced since colonial times in West Africa, market gardening has taken a particular momentum with the development of cities and the increasing demand for fresh produce [5]. Today, great part of world's population (around 54%) live in urban areas, a figure expected to rise to 66% in 2050 [6]. Benin, one of West African countries didn't remain on the sidelines of this phenomenon with an urbanization rate experienced a remarkable evolution and has already reached 44.9% in 2011 [7]. This rapid acceleration of urbanization leads to increased food insecurity and a deteriorating environmental

quality in major cities of Benin [8]. During these ten (10) years, we are witnessing the expansion of many garden spaces in the slums and peri-urban areas [9]. Vegetable production has become an activity responding effectively to urban food demand [10]. According to [11] and [12], market gardening is a great way to fight against poverty and malnutrition. However, its profitability is influenced by several parameters that proves compelling analysis to improve production. According to [13], The type of fertilizer used is an element influencing agricultural production in general. In view of this, one wonders if this factor could also have an effect on the performance of the market garden production. It is in this perspective that this work aimed at studying the influence of various types of fertilizers on the economic performance of the market garden production in the town of Parakou. Specifically, the study analyze firstly the profitability of market gardening Parakou and secondly, appreciate the influence of categories of fertilizer market gardening Parakou.

2 Methodology

2.1 Presentation and selection of the study area

This study focuses on the town of Parakou, (north-Benin) precisely in the department of Borgou. Head of the department and northern capital, the town is located at 9 ° 21 'north latitude and 2 ° 36' east longitude, at an average altitude of 350m. It covers an area of 441 km2 and is an important crossroads of major highways (Cotonou-Public and hinterland countries). Subdivided into three districts, the city is limited to the north by the municipality of N'Dali, south, east and west by the commune Tchaourou. According to RGPH4, the population of the Parakou city increased from 149,819 inhabitants in 2002 to 255,478 inhabitants in 2013. In Parakou, climate is tropical and humid (Climate South Sudanese). It is characterized by the alternation of a rainy season (May to October) and a dry season (November to April). Concerning the soils , Parakou is characterized by a predominance of light-textured soils of substantial thickness due to the weakness of erosion. The Borgou economy in general and its capital in particular is mainly based on trade, tourism, crafts, livestock, fisheries and agriculture. Parakou, cosmopolitan town, harbours many market gardeners farmers especially because of its river system consists of a large number of rivers and shoals, tributaries of the right bank of the Okpara. The research sites included in the study (Banikanni, Tokokpè-Kara, Zongo II Sourou-Wansirou) were selected based on the following criteria: (i) the presence of the producers of vegetable crops using organic fertilizers as well as chemical; (ii) the accessibility of sites and (iii) the distance between sites.

2.2 Sampling

In this study, carrot producers are the units of observation. Four (04) production sites were selected for further investigation due to the small number of sites and the number of vegetable growers per site (increased drought and drying up of rivers leading many market gardeners to move towards off-farm activities). Given the resources and time allocated to study a sample of 60 producers was selected randomly in order to give equal chance to all market gardeners to be part of the sample. The list of producers for each site was obtained from the secretaries of producer groups. Table 1 shows the composition of the sample per market garden sites:

Table 1: Sample Composition per market garden site

Sites	Banikanni	Sourou	Zongo II	Tokokpè-Kara	Total
Number of respondents / Sites	15	15	15	15	**60**

Source: Survey Results, 2017

2.3 Materials and methods

2.3.1 Materials

In achieving the objectives of this study, a survey form was developed to collect information on sociodemographic factors of market gardeners (sex, educational level, marital status, Ethnic, Religious), production volum, the area sown, price of sale, production expenses (purchase of fertilizer, urea, pesticides, labor, tools / equipment, taxes and dues), the daily rate, the number of hours / day, and categories of fertilizer used.

2.3.2. Methods

Data were collected through individual interviews with survey questionnaires. These data were included in a database with the Access software 2016 and then exported into SPSS v20 software 32bits for analysis. The calculations, averages, standard deviations, minimum and maximum were used both for the presentation of the sociodemographic characteristics of producers and the analysis of the profitability of market gardening; The Student t test was used to analyze the relationship between the type of fertilizer used and the profitability of the market garden production.

Analysis of the profitability of production was carried out on the basis of some economic indicators of profitability. The choice of these indicators draws on the work of [14], [15], [16] and [17]. Four (04) indicators were used: the net margin of production, the average productivity of family labor, the internal rate of return and the benefit / cost.

Net Margin (NM): Net production margin is obtained by deducting from the Gross Product Value (GPV) the total costs (TC) or by deducting from the Gross Margin (GM) Fixed Costs (FC) [15]. it is expressed by the following formula :

NM = GPV - TC = GPV - VC - FC = GM - FC

It is expressed in FCFA / unit area. In this study, the unit area considered is the m².

If NM > 0, then it is concluded that the gross product value arrives to cover both fixed costs that variable costs. Market gardening is economically profitable in Parakou.

By cons, if NM < 0, then the gross product value cannot cover the overall costs of production. In this case, the production is not economically profitable.

Note that VC (variable costs) represent expenditures for the purchase of inputs (fertilizers, insecticides, pesticides and labor) and fixed costs FC correspond to expenses incurred by the operation but not related to production volume ; These are mainly capital expenditures. FC is determined by applying a linear damping rate to the total value acquisition equipment. This rate corresponds to the inverse of the lifetime of the equipment [18].

The lifetime and cost vary from one tool to another. The tools used on various market garden sites are: the hoe; little hoe, watering can, wheelbarrow. Table 2 presents the useful lives and the respective costs of the tools used:

Table 2: Lifetimes (year) and cost tools (CFA) used

Tools	Hoe	Little Hoe	watering	Wheelbarrow
Lifetimes	3	5	3	5
Couts	2 .500	1,000	10,000	12,000

Source: Survey Results, 2017

Average Net Productivity of Labor (APL): It is defined as the net margin per family labor unit used for production [17]. Mathematically, it is expressed by the formula:

APL = NM / FL

With APL Average net Productivity of Labor (family labor in FCFA / HJ).

This is the daily labor remuneration adult active in the operation.

NM: net margin in CFA / m².

FL: family labor used in HJ / m².

If APL > p (p = daily wage paid to a man-day in the study area), then the activity is profitable from the standpoint of paid salary. Otherwise, it is not.

The daily wage paid to a man-day (hj) is 1300 CFA francs in the study area.

Internal Rate of Return: According to [14], The internal rate of return which is nothing but capital productivity, can be determined by the following formula:

IRR = (NM-FLV) / (TC + FLV)
FLV: Family Labor Value
IRR: Internal Rate of Return is in %. It measures the net margin per unit of capital invested. In this case, the investment corresponds to the total production costs [15]. It also determines the ability of an operating return on capital invested. It is performed by comparing the interest rates applied by institutions i banking or microfinance. In the study area, i is equal to 12%. So if IRR > i, the activity is economically profitable on investment point of view. The producer manages to best his investment; if he had made a loan, he could pay the annuity from his margin net. So, he can make loans from microfinance institutions to expand his exploitation. But if IRR < i, the activity is not profitable from the standpoint investment. Producer better go save than to invest in the production.

Benefit / Cost ratio or B / C: In rural economy, it expresses the total financial gain obtained by the investment of a monetary unit (1 CFA franc, for example). It is given by the formula [16] below:
B / C = GPV / (TC + FLV)
In analysis of economic efficiency, the interpretation of the B / C is done by comparing the value to 1. If B / C > 1, it can be concluded that 1 franc invested generates more than 1 CFA franc as profit, and The activity is called economically profitable. If, against the B / C <1, then 1 franc invested generates fewer 1 CFA franc as profit, and the activity is considered unprofitable because the producer earns less his invests.

3 RESULTS AND DISCUSSION

3.1 Demographics characteristics of respondents

Qualitative variables are used to characterize the sample surveyed. The table below presents descriptive statistics of these variables.

Table 3: Descriptive statistics of variables

Variables (%)	Modalities	absolute frequencies (relative frequency)
Sex	M	36 (60)
	F	24 (40)
	Married)	30 (50)
	Single	18 (30)

Marital status	Divorcee)	3 (5)
	Widower widow	9 (15)
Religion	Christian	15 (25)
	Muslim	28 (46.6)
	Atheist	8 (13.4)
	Other	9 (15)
Ethnic group	Fon	6 (10)
	Bariba	27 (45)
	Dendi	10 (16.7)
	Nago	6 (10)
	Peul	2 (3.3)
	Other	9 (15)
Level of education	No	30 (50)
	Primary	7 (11.7)
	Secondary	20 (33.3)
	University	3 (5)

Source: Survey Results, 2017

The sample of respondents is made up of both men and women. However, a slight male dominance is noted. This is explained by the abandonment of gardening activities of these women because of the drought. In the study area, we find (06) six races with a dominance of Bariba. The observation units are predominantly Muslim and married for most. This is justified by the fact that Parakou since its origin is recognized as a Muslim majority city. The level of education is of great importance in the management of operations. In addition, market gardening is as a job opportunity for this population with low level of education [19]. In the study area, all levels of education are represented. However, most producers have no level of education.

3.2 Economic performance of carrot production

3.2.1 Yields carrot production
The carrot yields in the study area vary around 1kg / m². Note that chemical production gives the highest yields (Table 4). However, the difference between the yields of the carrot according to the types of fertilizer is not statistically significant (p> 0.10). According to the farmers's explanations, production of carrots is not too demanding on soil fertility, but rather permanent water availability. Therefore, the performance difference is not felt when going from a cultural practice to another.

Table 4: carrot Yields (Kg / m²) according to the types of fertilizer

Yield (Kg / m²)	Types of fertilizer		Together	Significances
	Biological	Chemical		

| 0.882 | 0.978 | 0.9303 | 0.83 |

Source: Survey Results, 2017

3.2.2 Variable costs, Fixed Costs Total Costs and carrot production

Analysis of the results presented in Table 5 shows that the costs of carrot production as a whole are particularly high. By the analysis according to the types of fertilizers used, it is found that the production based on chemical fertilizers has some higher variable costs as biological and this difference is statistically significant at the 1% level ($p < 0.01$). However, the variable costs in the market garden production are mainly related to the acquisition of pesticides and seeds. These results are explained by the fact that in the production based on chemical fertilizers, chemical fertilizers are purchased and require significant capital. Unlike production based on organic fertilizers which used organic fertilizers (compost, animal manure, etc.) that are self-produced by market gardeners. Table 5 also reveals that there is no significant difference between the fixed production costs according to the types of fertilizers ($p > 0.10$). The total cost is only a sum of fixed costs and variable costs, they behave exactly as the variable costs described above.

Table 5: carrot production costs (fcfa / m²) according to the types of fertilizer

Costs (fcfa / m²)	Types of fertilizer		Together	Significances
	Biological	Chemical		
VC	21.753	55.797	38.775	0.000
FC	39.717	48.903	44.320	0.183
TC	61.490	104.700	83.095	0.000

Source: Survey Results, 2017

The results for the net margin, family labor valorization, capital and the Costs / Benefits ratio are reported in Table 6.

Table 6: Economic performance indicators by type of fertilizer

Performance indicators	Types of fertilizer		Together	significances
	Biological	Chemical		
NM	203.17624	139.96648	171.57136	0.002
APL	1589.93	1117.78	1353.8607	0.055
IRR	1.655	-0.362	0.2567	0.196
B / C	1.5619	0.9514	1.2567	0.012

Source: Survey Results, 2017

Net Margin (NM): Table 6 shows that all net margins are positive. This means that gross products value arrive to cover production costs (variable costs and fixed costs). The production of carrot is economically profitable. This result concords with that obtained by [16] who found that the market garden production is economically profitable on net margin perspective. However, there are

disparities depending on the type of fertilizer used. Net margin for the carrot production based on organic fertilizers is higher than production based on chemical fertilizers. The difference between the net margins is statistically significant at the 1% level ($p < 0.01$). The carrot production using organic fertilizer is more profitable than those using chemical fertilizers.

Average Productivity of Labor (APL): It is found that the average labor productivity in the carrot production as a whole is greater than the opportunity cost of labor is 1300 FCFA in the study area. This indicates that the carrot production provides good remuneration of family labor to the farmer. It is therefore advantageous for him to produce on his own account rather than sell his labor force to the outside. These results confirm those obtained by [15].
Production with organic fertilizer has a higher average labor productivity than the cost of labor in the town of Parakou (1589.93> 1300) as opposed to the production based on chemical fertilizers (1117.78 <1300). The production based on chemical fertilizers is not profitable from the standpoint average labor productivity. Furthermore, a comparison of average labor productivities of the two types of fertilizer shows that production using organic fertilizers is higher profitable than production-based on chemical fertilizers. This difference is statistically significant at 10% level ($p < 0.10$).

Internal Rate of Return (IRR): The internal rate of the carrot return is greater than the interest rate in the study area (25.67% > 12%). The carrot production is thus economically profitable (IRR perspective). Thus, if the carrot producers had to make loans at microfinance institutions for their vegetable production, they could repay the interest payable.
Production based on organic fertilizer has a greater IRR than the interest rate used in the commune of Parakou (16.55%> 12%) as opposed to production based on chemical-fertilizers (-36.20%<12%). The production based on chemical fertilizers is not profitable from the standpoint internal rate of return. Moreover, a comparison between the internal rates of return of the two types of fertilizer shows that production using organic fertilizers is higher than that using chemical fertilizers. Note that this difference is not statistically significant ($p > 0.10$).

Benefit / cost ratio (B / C): The benefit / cost obtained is greater than 1. The production of the carrot is financially profitable from the standpoint benefit / cost ratio. Therefore, when farmers invest 1 FCFA, they earn on average 1.25 FCFA. These results are in the same direction then [16] who found that the market garden production is financially profitable in the North East of Benin.
 Production with organic fertilizer has a cost / benefit ratio (1.5619) Greater than 1 unlike production based chemical fertilizers (0.9514). The production based on chemical fertilizers is not profitable from the standpoint benefit / cost ratio. Moreover, comparing the benefit / cost ratio of the two types of fertilizer, it is showed that the production with organic fertilizers is higher profitable than production based on chemical fertilizers. This difference is statistically significant at the 5% level ($p < 0.05$).

4 CONCLUSION

The production of the carrot is economically and financially profitable in the town of Parakou. It appears from analyzes that organic fertilizers improve more the profitability of this production. The calculated indicators (net margin, average labor productivity, internal rate of return and the benefit / cost) are more efficient to the production based on organic fertilizers. So, the market gardeners of the commune of Parakou should resort to the use of organic fertilizers to improve the profitability of their production. In addition, the use of organic fertilizers allows farmers to maintain / improve soil fertility.

5 REFERENCES

[1] S. Bognini, ''Cultures maraichères et sécurité alimentaire en milieu rurale'', Thèse d'ingénieur agronome, p. 116, 2010.

[2] MAHRH, ''Analyse de la filière maraichage au Burkina Faso,'' Burkina Faso, p.112, 2007.

[3] M. Kanda, S. Akpavi, K. Wala, G, Djaneye-Boundjou, and K. Akpagana, ''Diversité des espèces cultivées et contraintes à la production en agriculture maraîchère au Togo,''.*Int. J. Biol. Chem. Sci.,* vol. 8, no. 1, pp.115-127, 2014.

[4] M. Koc, R. Macrae, J. A. Lun, and J. Welsh, ''Armer les Villes contre la Faim : Systèmes Alimentaires Urbains Durables,'' *CRDI*, p. 260, 2006.

[5] D. Kone, G. Cisse, C. Seignez, and C. Holliger, ''Le lagunage à macrophytes et l'irrigation en maraîchage : étude d'une station expérimentale à Ouagadougou,'' *Info CREPA 31*, pp. 4-10, 2000.

[6] COSELAG, ''Co-Conception des critères de Sélection variétale des légumineuses à graines pour des systèmes agricoles et agro-alimentaires durables,'' Paris, p.129, 2016

[7] MUHA, ''Budget programme 2016-2018,'' Bénin, p. 125, 2015.

[8] K. E. Agbossou, M. S. Sanny, B. Zokpodo, B. Ahamide, and H. J. Guedegbe, ''Evaluation qualitative de quelques légumes sur le périmètre maraîcher de Houéyiho, à Cotonou au sud-Bénin'', Bulletin de la Recherche Agronomique du Benin, no 42, p.12, 2003.

[9] ILC et AGTER, ''Pressions commerciales sur la terre dans le monde : problématique et cadre conceptuel d'étude pour l'ILC'', Rapport, p. 27, 2009.

[10] A. Singbo, T. Nouhoheflin, and L. Idrissou, ''Etude des perceptions sur les ravageurs des légumes dans les zones urbaines et périurbaines du sud Bénin,'' Projet Légumes de qualité, Rapport d'activités, IITA-INRAB-OBEPAB, p.21, 2004.

[11] Muzingu, B., ''Dynamiques d'une agriculture urbaine à Kinshasa RDC Alternative à l'insécurité alimentaire : Cas de la filière maraîchère,'' Gembloux, Mémoire présenté en vue de l'obtention du Diplôme interuniversitaire d'études approfondies en Développement,

Environnement et Sociétés (FUSAGX, UCL, ULg, FUL et FUCAM), p. 75, 2005.

[12] Tollens, E., ''Les défis : Sécurité alimentaire et cultures de rente pour l'exportation Principales orientations et avantages comparatifs de l'Agriculture en R.D. Congo," Département d'Economie Agricole et de l'Environnement, Katholieke Universiteit Leuven, Working Paper, no 86, p. 76, 2004.

[13] Ouattara, B., ''Analyse diagnostic du statut organique et de l'état structural des sols des agrosystèmes cotonniers de l'ouest du Burkina Faso (Terroir de Bondoukui),'' Thèse de Doctorat en sciences naturelles, Université Polytechnique de Bobo Dioulasso, Institut du Développement Rural, p. 186, 2009.

[14] A. Paraïso, J. A. Yabi, A. Sossou, and R. Yegbemey, ''Rentabilité économique et financière de la production cotonnière à Ouaké au Nord-Est du Bénin,'' *Annales des Sciences Agronomique,* vol.16, no 1, pp. 91-105, 2012.

[15] J. A. Yabi, A. Paraïso, R. L. Ayena, and R. Yegbemey, '' Rentabilité économique de production agricole sous pratiques culturales de gestion de la fertilité des sols dans la commune de Ouaké au Nord-Ouest du Bénin, ''*Annales des Sciences Agronomique,* vol.16, no 2, pp. 229-242, 2012.

[16] D. Biaou, J. A. Yabi, R. N. Yegbemey, and G. Biaou, '' Performances technique et économique des pratiques culturales de gestion et de conservation de la fertilité des sols en production maraîchère dans la commune de Malanville, Nord Bénin,'' *International Journal of Innovation and Scientific Research,* vol. 21, no. 1, pp. 201-211, 2016.

[17] M. Ayena, and A. J. Yabi, '' Effets du Conseil à l'Exploitation Familiale (CEF) sur les performances économiques des exploitations bénéficiaires à Banikoara au Nord-Benin'', Invited paper presented at the 4th International Conference of the African Association of Agricultural Economists, Hammamet, Tunisia, September 22-25, p.14, 2013.

[18] A. J. Yabi, ''Analyse des déterminants de la rentabilité économique des activités menées par les femmes rurales dans la commune de Gogounou au Nord-Bénin,'' *Annales des Sciences Agronomique,* vol.14, no 2, pp. 221-239, 2010.

[19] B. A. Mushagalusa, V.P Birindwa, M. E. Muyambo, M. N. Kasanda, and M. F. J. Nkulu, ''Production des cultures maraichères à Lubumbashi : analyse comparative de la rentabilité de chou pommé et chou de chine,'' *International Journal of Innovation and Scientific Research,* vol. 14, no 1.pp. 55-61, 2015.