Quest Journals
Journal of Research in Agriculture and Animal Science
Volume 8 ~ Issue 10 (2021) pp: 71-78
ISSN(Online) : 2321-9459
www.questjournals.org

Research Paper

Boom in cotton production in the commune of banikoara la commune de Banikoara

PARAPE OTO ISSA Abdou-Raouf[1], ASSOUNI Janvier[2], GOUNOU Zénabou,[3]KISSIRA Aboubakar[4]

[1] *Laboratoire d'Analyse et de Recherches sur les Dynamiques Economiques et Sociales (LARDES) Université de Parakou*

[1,2,3,4]*Laboratoire d'Etudes des Dynamiques Urbaines et Régionales (LEDUR)*
Université de Parakou

ABSTRACT
This chapter aims to assess the economic profitability of cotton production in the commune of Banikoara. To do this, 350 cotton-producing households were surveyed and data was collected using a survey questionnaire.
The profitability indicators were calculated and the Student mean comparison test was carried out for each indicator to compare the average of conventional cotton producers to that of organic cotton producers. The results showed that producers perceive climate change through several parameters including rainfall, wind, temperature, plants and animals. The results also showed that conventional cotton production is economically more profitable in terms of net margin, average labor productivity, benefit-cost ratio and internal rate of return than organic cotton production. Also, there is a clear difference between the average sown area of conventional cotton producers (7.42 ha) and that of organic cotton producers (1.97 ha) and the producer who produced conventional cotton offers a better yield than other producer. This article highlights the necessary adoption of a public policy to encourage the financing of cotton production in general and that of conventional production in Benin.

KEYWORDS: *Economic profitability, net margin, agricultural production, cotton, Banikoara.*

Received 17 October, 2021; Revised: 30 October, 2021; Accepted 01 November, 2021 © The author(s) 2021. Published with open access at www.questjournals.org

I. INTRODUCTION:

The cotton sector is the basis of the rural and agro-industrial economy in Benin. Its contribution, in terms of value added, is estimated at 13% of GDP. It accounts for approximately 70% of the total value of exports and 35% of tax revenues (excluding customs). It is a key strategic tool in the fight against poverty, given that annual purchases of seed cotton represent approximately 70 billion CFA francs, which are paid annually to more than 300,000 farmers, thus indirectly providing cash income to approximately three million people (AMBASSADE DE FRANCE, 2002). Cotton is grown by about one-third of the farmers in Benin and occupies about 20 percent of the cultivated area. The main production areas are the north and center of the country. Cotton production in Benin is constantly increasing. Since the beginning of the 1980s, production has increased more than twenty times to reach a national production of about 400,000 tons of seed cotton in 2003/04, or 160,000 tons of cotton fiber of a good quality recognized internationally after ginning. African cotton is produced by sixty-five countries, including 28 African countries. Together, the 28 African countries contribute 1,085,000 tons of cotton to world production per year (E. Aho and G. Capo Chichi 2017). Thus, cotton cultivation has become a strategic activity, a lung of the economy of some countries such as Sudan, Egypt, Mali, Chad, Benin and Burkina Faso (Compaoré, 2006). Little value is still added locally to this quality product. Almost all of Benin's cotton fiber is exported. Processing of cotton fiber by local textile industries is estimated at about 2 percent

II. STUDY FRAMEWORK AND RESEARCH METHODOLOGY

2-1 Study framework

The commune of Banikoara is a commune recognized as very active in cotton production, hence its name "the capital of white gold" in Benin. It is located between 10°50 and 11°45 North Latitude and between 2° and 2°55 East Longitude, it covers an area of 4383km² of which about 50% is occupied by the W Park.

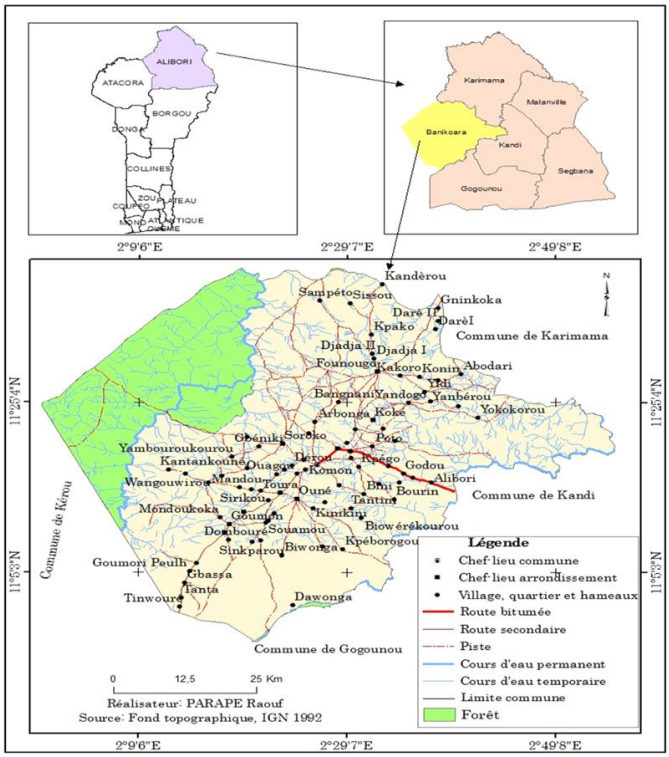

Figure 1: Map of the geographical location of the commune of Banikoara

III. RESEARCH METHODOLOGY

In order to obtain convincing results, we will measure the level of economic and financial profitability of farms. Several indicators of economic profitability inspired by the work of Yabi (2010), Yegbemey (2010), and Paraïso*et al.* (2012) willbeused. These are:

Net Margin MN

The net production margin is obtained according to Yabi (2010), Yegbemey (2010), Paraïso*et al.* (2012) by deducting the total costs (TC) from the gross product in value (GPV) or by deducting the fixed costs (FC) from the gross margin (GM). It is expressed in F CFA/ha by the following formula:

MN= PBV - CT = PBV - CV -CF= MB -CF

Net Average Labor Productivity

LMP is defined as the net margin per unit of family labor used for production (Yabi, 2010; Yegbemey, 2010; Paraïso*et al.* , 2012).

Mathematically, it is expressed by the following formula:

PML =

With MN the net margin of the production activity (in FCFA/ha), MO the total amount of family labor used (HJ/ha) and PML the average net labor productivity in FCFA/HJ.

The estimation of family labor is done by taking into account the effort provided by each of the components of the household, i.e. men, women and children. The work is therefore quantified using the method proposed by Adégbola*et al*. (2005) cited by Yegbemey (2010). Thus, the total number of workers in man-equivalent is given by the following formula

SD = (number of males) + 0.75 * (number of females) + 0.50 * (number of children aged 6-14)

For the conversion into man-days (h.d.), it was multiplied by *the* total duration (Td) of the operation (in hours) divided by 8. It was considered as a unit of work, equivalent to a man-day, the work done during a day (of 08 hours) by a normal laborer, paid by task. The formula can be written :

Internal Rate of Return (IRR)

The internal rate of return or IRR expresses the net margin per unit of total capital invested (Yabi, 2010; Yegbemey, 2010; Paraïso*et al.* , 2012). The total capital invested is the sum of total production costs and the value of family labor. This rate (IRR) is expressed by the formula:

TRI=

With MN the net margin of the production activity (in FCFA/ha) and VMO the value of family labor (in FCAFA/ha). VMO is obtained by multiplying the physical quantity of total family labor by the average price p of hired labor in the study area. Thus, the internal rate of return is expressed in %. It is possible for a great rigor of financial analysis to deduct from the net margin, the value of family labor (producer's salary). It follows that :

IRR =

Profit/Cost ratio or B/C

It is a financial analysis indicator par excellence. It expresses the total financial gain obtained by the investment of a monetary unit (e.g. 1 CFA franc). Let B be the set of profits obtained after a total investment C. It follows that :

$$B/C = \frac{B}{C}$$

In agricultural economics, B is denoted by the gross product obtained in value terms and C by the total of all costs expressed in value terms, including family labour. Thus, if GVP is the gross product by value, TC the total costs that do not take into account the value of family labor, and MOV the total value of family labor used, we have :

$$B/C = \frac{PBV}{(CT + MOV)}$$

In practice, MOV is obtained by multiplying the physical quantity of total family labor by the average price *p* of hired labor in the study area. In economic profitability analysis, the interpretation of B/C is done by comparing it to the value 1. Thus, we have the followingtwo (2) cases:

- If B/C>1, then 1 franc invested generates more than 1 franc CFA as profit, and the activity is said to be economically profitable.

If, on the other hand, B/C<1, then 1 franc invested generates less than 1 franc cfa as profit, and the activity is not economically profitable, because the producer earns less than he invests.

After the calculation of these indicators, a Student's t test will be performed for each indicator to compare the average of conventional cotton producers with that of organic cotton producers.

As its name indicates, the comparison of means test is used to compare two means from two independent population groups G1 and G2. It is assumed that G1 has the theoretical mean $\boldsymbol{\mu 1}$ and the variance ***v1*** and G2 has the theoretical mean $\boldsymbol{\mu 2}$ and the variance ***v2***. From the estimates calculated on two samples of respective sizes ***n1*** *and* ***n2*** from the two groups of populations. The hypotheses of this statistical test are:

H1: $\boldsymbol{\mu 1 = \mu 2}$.

H2: $\boldsymbol{\mu 1 \neq \mu 2}$.

If the p-value calculated during the test is lower than the conceded risk of error, then we can reject the H0 hypothesis. This means that the two means are significantly different from each other. If the p-value is higher, we accept the H0 hypothesis.

Second, descriptive statistics (proportions) will be used to identify the utilities of income from cotton production in the commune of Banikoara. The chi-square test will be used to determine whether the utility varies from organic to conventional cotton producers.

Indeed, the statistical test of Khi-2 is a non-parametric test which allows to know if two qualitative random variables X1 and X2 (or made qualitative by grouping): X1 has *l* modalities and X2 has *c* modalities are dependent or if the distribution of the modalities of the variable X2 is not the same in each of the *l* sub-populations constituted by the individuals who take one of the *l* modalities of the variable X1.The values taken by these two variables for *n* individuals are known, and these data are generally presented in a contingency table, also called the table of observed numbers, and this observed table is compared with the theoretical table of distribution of the *n* individuals calculated under the hypothesis of independence of the two variables.

The hypotheses are H0: the variables X1 and X2 are independent and H1: the variables are not independent.

The test statistic under H0 is as follows:

$$^2 = \Sigma\Sigma\ (Oij - Tij)^2 / Tij$$

Where Oij represents the observed number of people and Tij represents the theoretical number of people calculated under H0, for modality i of X1 and j of X2.

Under H0, the test statistic follows a Chi-2 distribution with *(l - 1) (c - 1)* degrees of freedom.

Finally, the calculated value of 2 is compared with that of the table of critical values of 2 which corresponds to the degree of freedom (ddl) obtained and to the significance level which is generally 5%. If the calculated value

of 2 is higher than the one read in the table, Ho is rejected at the 5% level. That is to say that at this threshold, the 2 does not allow us to establish any dependence between the characters. Or we can use the significance of the test (p - value) to draw the final conclusion of the test. Thus, when the significance of the test is lower than the threshold of significance (or threshold of conceded error) we reject the hypothesis H0 and when the p - value is higher than the threshold of significance we accept the hypothesis H1.
The chi-square test is valid if the theoretical number of participants is greater than 5. When these conditions are not met, the Fisher exact test can be used, which is performed in almost the same way as the Chi-square test.

3-1 Data collected

Data on the quantities and prices of inputs to cotton production at the level of the households surveyed; on the quantity of cotton produced and the selling price of the crop; and on the different uses of the income from cotton production

3-1-1 Collection tools and method

Interview guide, Semi-structured interview
Research on the net

3-2 Analysis tools

Descriptive statistics, student's mean comparison test and Chi-2 test of independence
Sampling
For this research work, the statistical units are the cotton-producing farm households. There are several villages in the commune of Banikoara that are taken into account in this study. The selection of these villages is justified by the fact that they are among the most cotton-producing villages in the commune of Banikoara
Results and discussion

3.2.1 Quantitative characteristics

Descriptive statistics on some quantitative characteristics of producers are presented in Table III below.

Table I: Some descriptive statistics on selected quantitative characteristics.

Features	Average	Standard deviation	Median	Minimum	Maximum
Age	41	9,74	40	24	64
Experience in agriculture	17	8,92	15	3	38
Household size					
Male	7	4,18	6	1	22
Woman	6	3,69	6	1	22
Set	13	7,23	11	3	36
Agricultural assets					
Male	6	3,35	5	1	17
Woman	5	3,28	4	0	22
Set	10	5,9	9	2	33

Source: Based on data collected in the field in 2020

The analysis of Table III shows that the average age of the producers surveyed is 41 years (±9.74), and half of them are under 40 years old. The remaining half are over 41 years old. They have been in agriculture for an average of 17 years (±8.92). Thus, the median experience in agriculture is 15 years. The producers surveyed for this research work are experienced.
The households of the producers surveyed have an average of 13 (±7.23) persons, of which 7 (±4.18) are men and 6 (±3.69) are women.
Family labor is a necessary output in agriculture. It is derived from farm assets. The surveyed producers have an average of 10 (±5.90) farm workers overall, and more specifically, the surveyed producers have an average of 6 (±3.35) male farm workers and 5 (±3.28) female farm workers. The majority of individuals belonging to the surveyed producers' households are therefore involved in agricultural activities.

3.2.2 Farm characteristics.

- **Farm size and area planted**

Without cultivable land there is no agriculture. Table III shows the different characteristics of the farms. These are the size of the farm and the area sown, accompanied by their descriptive statistics.

Table II: Some descriptive statistics on farm size and area planted.

Features	Average	Standard deviation	Median	Minimum	Maximum
Size of the farm	31,50	20,79	25,5	4,5	96,75
Area planted	17,66	13,09	12,63	4	67

Source: Based on data collected in the field in 2020

On average, the producers surveyed have 31 (±20.78) ha of cultivable land. The smallest area of cultivable land among the producers surveyed is 4.5 ha and the largest area of cultivable land is estimated at 96.75 ha. Half of the producers surveyed have cultivable land under 25.5 ha and the remaining half have cultivable land over 25.5 ha.

This arable land is developed if, and only if, it is sown. On average, the producers surveyed had 17.66 (±13.09) ha under cultivation. Half of the producers surveyed sowed an area of less than 12.63 ha and half of the remaining producers sowed an area of more than 12.63 ha. This information shows the level of cultivable space taken up by the cotton crop

- **Equipment (carts and tractors)**

Table III: Distribution of producers surveyed according to cart ownership, tractor ownership

Features	Workforce	Percentages (%)
Possession of a cart		
No	55	15,71
A cart	280	80,00
Twocarts	15	4,29
Tractorownership		
No	340	97,14
A tractor	10	2,86
Twotractors	0	0
Ownership of cart and tractor		
Yes	300	85,71
No	50	14,29

Source: Based on data collected in the field in 2020

Of the producers surveyed, 84.29% have at least one cart. Of those producers with at least one cart, most (94.22%) have only one cart.

With regard to tractor ownership, only 10 producers out of 350 surveyed (2.86%) have a tractor.

Only 50 of the 350 producers surveyed (14.29%) do not own carts and tractors.

IV. RESULTS

4.1 Fads and reasons for cotton production in the commune of Banikoara

1-1-1 Economic profitability of cotton production in the commune of Banikoara

Area planted and yield per hectare for cotton

Table IV: Some descriptive statistics of area sown and yield by type of cotton grown

Features	Type of cotton	Workforce	Average	Standard deviation	Minimum	Maximum
Area planted (in ha)	Conventional	250	7,42	3,72	3	20
	Biological	100	1,97	0,85	0,5	3
	Set	**350**	**5,86**	**4,02**	**0,5**	**20**
Yield (Kg/ha)	Conventional	250	1302,85	332,53	666,67	2000
	Biological	100	755,83	129,78	500	960
	Set	**350**	**1146,56**	**380,67**	**500**	**2000**

Source: Based on data collected in the field in 2020

For all the producers surveyed, the average area planted was 5.86 ha (±4.02). For conventional cotton producers, the average area sown was 7.42 ha (±3.72), while for their counterparts who grow organic cotton, it was 1.97 ha (±0.85). According to Student's mean comparison test, at the 1% threshold, the average area sown by conventional cotton producers is statistically different from that of organic cotton producers ($t = 14.47$; ddl = 348; p-value = 0.00). Thus, the average area sown by conventional cotton producers is three times higher than that of organic cotton producers. This difference can be explained by the fact that organic cotton production is more or less tedious and requires a lot of rigor.

As for yield, the average is 1146.56 kg/ha (±380.67) among all the producers surveyed. For conventional cotton, the average yield is 1302.85 kg/ha (±332.53) compared to 755.83 kg/ha (±129.78) for organic cotton. These two average yields are significantly different at the 1% threshold (t = 15.96; ddl = 348; p-value = 0.00).

4-1-2 Gross product in value and total production cost

The table below shows the value of production and the total cost of production of the producers surveyed according to the type of cotton grown.

Table V: Some descriptive statistics of the gross product in value and the total cost of production according to the type of cotton grown

Features	Type of cotton	Workforce	Average	Standard deviation	Minimum	Maximum
Gross Value Product (Fcfa/ha)	Conventional	250	345253,90	88120,07	176666,70	530000
	Biological	100	250935,50	43087,43	166000	318720
	Set	**350**	**318305,80**	**88811,70**	**166000**	**530000**
Total cost of production (Fcfa/ha)	Conventional	250	184824,00	223524,10	18071,75	1484101
	Biological	100	126590,50	59734,38	50409,54	298501
	Set	**350**	**168185,90**	**193269,80**	**18071,75**	**1484101**

Source: Based on data collected in the field in 2020.

The gross product in value or production in value is nothing more than the selling price of the production or harvest. From the analysis of this table, it appears that the gross product in value is on average 318305.80 Fcfa /ha (±88811.70) for all the producers surveyed. Specifically, for conventional cotton producers, the average production in value is 345253.90 Fcfa/ha (±88120.07). For organic cotton producers, this average production in value is estimated at 250935.50 Fcfa/ha (±43087.43). According to the Student's t test, the average selling price of production among conventional cotton producers is statistically different at the 1% threshold from that of their organic cotton producer counterpart (t = 10.22; ddl = 348; p-value = 0.000). Despite the high cost of the purchase price per kilogram of organic cotton compared to the purchase price per kilogram of conventional cotton, the superiority of the average gross product in value of conventional producers can be explained by the fact that the latter have a high yield.

The average total production cost for the producers surveyed was estimated at 168185.90 Fcfa/ha (±193269.80). For conventional cotton production, they spent an average of 184824 Fcfa/ha (±223524.10), while for organic cotton production, the average total expenditure was estimated at 126590.50 Fcfa/ha (±59734.38). These two average expenditures are significantly different at the 1% threshold (t = 2.57; ddl = 348; p-value = 0.010).

Net Margin

Table VI: Some descriptive statistics of net margin by type of cotton grown

Indicator	Type of cotton	Workforce	Average	Standard deviation	Minimum	Maximum
Net margin (Fcfa/ha)	Conventional	250	160429,90	244022,40	-1113101	499993,30
	Biological	100	124344,90	69918,61	-132501	232843,70
	Set	**350**	**150119,90**	**210090,50**	**-1113101**	**499993,30**
t = 1.45; ddl = 348; p-value = 0.14						

Source: Based on data collected in the field in 2020.

For the producers surveyed, cotton cultivation generates an average net margin of 150119.90 Fcfa/ha (±210090.50). Among conventional cotton producers, the average net margin is estimated at 160,429.90 Fcfa/ha (±24,4022.40); while among their colleagues who produce organic cotton, the average net margin is 12,434.90 Fcfa/ha (±69918.61).

The net margin is positive overall for both conventional and organic cotton producers, so cotton production is economically profitable from a profit perspective, in general, for both conventional and organic cotton production.

The average net margin from conventional production, at the 10% threshold, is not significantly different from that from organic cotton production (t = 1.45; ddl = 348; p-value = 0.14). Thus, the net margin does not discriminate between conventional and organic cotton production.

Average net labor productivity

Table VII: Some descriptive statistics of average net labor productivity by type of cotton grown.

Indicator	Type of cotton	Workforce	Average	Standard deviation	Minimum	Maximum
Average net laborproductivity	Conventional	250	4612,81	5832,70	-14875,5	18684,21
	Biological	100	3466,69	3245,18	-899,4976	11769,69
	Set	**350**	**4260,16**	**5197,96**	**-14875,5**	**18684,21**
t = 3.42; ddl = 348; p-value = 0.000						

Source: Based on data collected in the field in 2020

Average net labor productivity is the daily wage of family labor involved in cotton production. For all the producers surveyed, a farm worker is paid an average of 4260.16 Fcfa (±5197.96) per day. For conventional cotton producers, the average productivity of family labor was 4612.81 Fcfa/man-day (±5832.70), while for their organic cotton counterparts, family labor was paid an average of 3466.69 Fcfa (±3245.18) per day.

The average remuneration of family labor, overall, among conventional cotton producers and among organic cotton producers; are all higher than the opportunity cost of labor in the commune of Banikoara, which is estimated at 1,500 Fcfa/man-day. Under these conditions, cotton production in general, cotton production and organic cotton production are economically profitable from the point of view of wage remuneration.

According to Student's means comparison test, at the 1% threshold, the average daily wage of farm workers for conventional cotton production is statistically different from that for organic cotton production (t = 3.42; ddl = 348; p-value = 0.000).

Benefit-cost ratio

Table VIII: Some descriptive statistics of the benefit-cost ratio according to the type of cotton grown

Indicator	Type of cotton	Workforce	Average	Standard deviation	Minimum	Maximum
Profit to Cost Ratio	Conventional	250	3,90	3,64	0,25	17,66
	Biological	100	2,34	0,91	0,56	4,53
	Set	**350**	**3,45**	**3,20**	**0,25**	**17,66**
t = 4.22; ddl = 348; p-value = 0.000						

Source: Based on data collected in the field in 2020

Cotton production among all the producers surveyed yields an average gain of 3.45 CFA francs (±3.20) for 1 CFA franc invested. For conventional cotton producers, 1 Fcfa invested yields an average of 3.90 Fcfa (±3.64), while for organic cotton production, 1 Fcfa invested generates an average gain of 2.34 Fcfa (±0.91).

These average returns on investment are greater than 1 CFA franc, so cotton production in general, and conventional and organic cotton in particular, are economically profitable. Producers earn more than the amount invested.

The average cost-benefit ratio of conventional cotton producers, at the 1% threshold, is significantly different from the average cost-benefit ratio of their fellow organic cotton producers (t = 4.22; ddl = 348; p-value = 0.000).

Internal rate of return

Table: Some descriptive statistics of the internal rate of return according to the type of cotton grown

Indicator	Type of cotton	Workforce	Average	Standard deviation	Minimum	Maximum
Internal rate of return	Conventional	250	0,31	1,08	-0,85	0,99
	Biological	100	0,24	0,61	-0,79	0,97
	Set	**350**	**0,29**	**0,97**	**-0,85**	**0,99**
t = 0.53; ddl = 348; p-value = 0.60						

Source: Based on data collected in the field in 2020

The average internal rate of return for cotton production overall is 29% (±0.97). In conventional cotton production, the average internal rate of return is 31% (±1.08) while in organic cotton production, the average internal rate of return is 24% (±1.08). All of these average internal rates of return are greater than or equal to 24%, which is the annual interest rate applied by the microfinance institutions in the study area. Thus, cotton production in general, conventional cotton and organic cotton are economically profitable from the point of view of interest rate and capital investment.

According to Student's comparison of means test, the average rates of return from conventional cotton production is not statistically different from that from organic cotton production (t = 0.53; ddl = 348; p-value = 0.60).

V. DISCUSSIONS

The objective of this discussion is to show that regardless of the type of cotton produced, cotton production is profitable from a theoretical standpoint. Therefore, in view of the results obtained, cotton producers in general, devote themselves to cotton production because of its profitability. Thus, our results agree with those of S. P. HOUTONDJI, (2018) who says that the yield of conventional cotton is significantly ($p<0.01$) higher than that of organic cotton (628.12 kg/ha for conventional cotton against 444.76 kg/ha for organic cotton). The gross margin was positive for both the organic and conventional systems in all three agro-ecological zones. Similar results were obtained by P. T. AGBOHESSI et *al*. (2011) who showed that the gross product of conventional cotton (289,730 Fcfa/ha) is higher than the gross product of organic cotton (139,515 Fcfa/ha). Similarly, these same results are obtained by a study done by OBEPAB (2002) in Djidja, Glazoué and Kandi, which shows that the gross product generated on a hectare of conventional cotton is also higher than those generated on a hectare of organic cotton.

It should be remembered that the costs of health risks, on the producer and on the environment are not taken into account. The question that arises is whether, after including these different risk charges, cotton production would be truly profitable?

VI. CONCLUSION

The average area planted and the yield of conventional cotton producers is three times higher than that of organic cotton producers. This difference can be explained by the fact that the production of organic cotton is more or less tedious and requires a lot of rigor. Also the production of cotton is economically profitable from the point of view of profit for the production of conventional cotton and the production of organic cotton. It should be noted that cotton production provides an average gain of 3.45 Fcfa (±3.20) for 1 Fcfa invested. Thus, they earn more than the amount invested. From an interest point of view, cotton production is economically profitable because the interest rate and the capital investment are greater than 1. But why are cotton producers living in a precarious situation in Banikora? Are there other parameters that economic theory does not take into account? We will try to continue our research on these questions.

BIBLIOGRAPHY

[1]. AGBOHESSI Prudencio T.; IMOROU TOKO Ibrahim YABI Jacob A. ; DASSOUNDO-ASSOGBA Jonas F.C. and KESTEMONT Patrick / Int. J. Biol. Chem. Sci. 5(5): 1828-1841, 2011

[2]. HOUNTONDJI Sagbo Paul, TOVIGNAN Silvère D., SODJINOU Epiphane, Ann. UP, Série Sci. Nat. Agron. December 2018; Vol.8 (No.2): 27-38

[3]. OBEPAB (Beninese Organization for the Promotion of Beninese Agriculture). 2002. Coton au Bénin, Rapport de Consultation sur le Coton Conventionnel et le Coton Biologique au Bénin. A Report for PAN UK's Pesticides Poverty and Livelihoods Project. Presse Locale: Cotonou, 36p

[4]. YABI, A. J., (2010).Analysis of the determinants of the economic profitability of activities carried out by rural women in the commune of Gogounou in North Benin. Annales des SciencesAgronomiques 14 (2) 221-239.

[5]. YEGBEMEY, R. N., (2010). Analysis of the economic performance of rice farms in the commune of Malanville. Thesis of Agronomy Engineer/University of Parakou, Parakou, Benin 75 pp.

[6]. YEGBEMEY, R. N., YABI Jacob A., AIHOUNTON G. D. B., PARAÏSO A., (2014). Simultaneous modeling of climate change perception and adaptation: the case of maize producers in Northern Benin (West Africa). CahAgric 23: 177-87. doi: 10.1684/agr.2014.0697

[7]. YEGBEMEY R. N., (2014). Adaptation to climate change and sustainable agriculture in West Africa: A case study of maize farming in Benin. Thesis for Obtaining PhD degree. Giessen University in Germany. 223p.