African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 4, Issue 1, 2021 (pp. 36-57)
www.abjournals.org

TYPOLOGY AND ECONOMIC PROFITABILITY OF FARMS IN MALI: CASE OF COTTON PRODUCERS IN THE CMDT ZONES OF FANA AND KOUTIALA

Dr. Lassana Toure[1], Dr. Ousmane Konipo[2] and Atoumane Diagne[3]

[1]Lecturer-Researcher at the University of Ségou, Email:lassana.toure@mesrs.ml

[2]Lecturer-Researcher at the University of Ségou, Email:ouskonipo@gmail.com

[3]Economic Statistical Engineer, Email:atoumane@live.fr

ABSTRACT: *This paper reports an analysis of the operating account and the economic profitability of farms according to the typology of cotton farmers in the CMDT zones of Fana and Koutiala in Mali, highlighting the causes of the level of profitability. The methodological approach adopted was first of all a descriptive and inferential analysis of the socio-demographic characteristics of the farms, the farm account and the economic profitability by type of farm (well-equipped, equipped and less equipped). It has been found that only well-equipped farms make a positive profit if we value family labour and organic manure. The other types of farms had difficulty covering the costs involved in seed cotton production. Cotton farmers use far too much family labour (10 people on average) without seeing their profits increase exponentially. As a result, the productivity of family labour is extremely low (almost 216 FCFA of Average Labour Remuneration Rate on average overall), making the activity economically unprofitable from this point of view. Moreover, producers of the equipped or less equipped type have negative IRRs (respectively -15% and -36%) as opposed to the well-equipped type with an IRR of 26%. Therefore, only producers of the well-equipped type have an economically profitable activity from the point of view of capital productivity, considering the 12% threshold set by credit institutions. At the end of this investigation, we propose to train cotton farmers in farm management by helping them to better optimise their production costs; reorient some active members of the household towards other income-generating activities; grant access to equipment credit for both well-equipped and less-equipped farms so that they can increase their yields and net cotton profits; and easily grant access to land to farms, especially well-equipped ones, so that they can sow more land.*

KEYWORDS: Export Crops, Profitability Indicators, CMDT, Fana, Koutiala

INTRODUCTION

From the colonial period to the present day, through the years of independence, Malian agriculture has gone through several phases in its evolution to adapt to the different social, economic, environmental and political situations that affect its development. Thus, from traditional production systems in the context of subsistence family farming with rudimentary equipment (daba, hoe asine), we are now in a phase of semi-modernity with the introduction of more efficient equipment (plough, seed drill, tractor, harrow, husker, etc.).

It is in this context that the Agricultural Orientation Law (LOA) was born in 2006 through a long participatory process within the framework of a consultation exercise that mobilised all

the actors concerned, from the grassroots to the highest levels of the State. One of the major innovations of the LOA is the formal recognition of agricultural occupations and the definition of the status of farmers and farms.

With the formal recognition and securing of agricultural professions, the agricultural sector that employs the largest number of workers should take its rightful place in the national economy. The agricultural holding is defined as a production unit, having as its support agriculture, fishing, forestry or related activities. It should have a clear legal status. Today, family farming is the mainstay of Mali's economy, both in terms of the number of people mobilised around the activities of the agricultural sector and the fact that it is thanks to it that the domestic market is satisfied, as long as the agro-ecological and climatic conditions are generous.

At present, the question of a better typology of farms is being raised, based on a categorisation that allows us to properly situate their economic and legal nature, the type of law that governs them and the conditions of translation from civil law to commercial law. The typology still in force within the Malian Textile Development Company (CMDT) is divided into 5 categories: the motorised type refers to holdings with a working tractor; type A refers to holdings with two coupled crop units, each with at least one pair of oxen, a plough, a seed drill and a cart; type B refers to holdings with only one coupled crop unit; type C refers to holdings with only an incomplete coupling; and type D refers to those in which the only tools are manual.

As a reminder in this study, we have retained three types of operation: the equipped properties include type A and the motorised type; the equipped properties include type B; and the less equipped properties include type C and type D. This is due to the low representativeness of the motorised type and a tendency for type D to disappear.

In the CMDT zones of Fana and Koutiala, agricultural production is carried out by small family farms numbering 78,889, cultivating an average of 10 ha, of which 3 ha are reserved for cotton (1/3), the rest being cereals (maize, millet, sorghum and rainfed rice) and legumes (groundnuts, cowpeas) (CMDT, 2019).

In recent years, there has been a steady decline in the repayment rate for all types of credit, despite the many awareness-raising campaigns on compliance with the criteria for granting agricultural credit. This regression is due to the over-indebtedness of cotton producers and/or their Cotton Producers' Cooperative Societies (SCPCs) as a result of declining cotton yields and the poor application of the solidarity bond within farmers' organisations (CMDT, 2018a), as well as poor farm management, bad weather conditions and low and unstable international cotton prices (Paraïso et al., 2012). This situation demotivates some good cotton producers and could not continue at the risk of some SCPCs running out of funding for inputs, i.e. stopping cotton cultivation at the zone level, where three and a half million people live directly from cotton revenues.

Following these different reasons, it would be important to identify the characteristics of cotton growers and the profitability of farms according to the typology of cotton growers in the CMDT zones of Fana and Koutiala by highlighting the causes of the level of economic profitability. In a first section, the study area, the sampling method and the study methodology will be presented. We will then examine the socio-economic characteristics of the farms, analyse the items in the Generation of Income Account and elaborate it by type of farm. Finally, we will

study the economic profitability indicators, highlighting the reasons for the non-profitability of the activity. The analyses will be based on the survey which covered 400 farms in the two zones of Fana and Koutiala.

MATERIALS: STUDY AREA AND DATA COLLECTED

In Mali, the cotton zone is still very large and each locality has its own reality. Our 2019 survey on the operating characteristics of cotton producers in Mali took into account the CMDT zone of Koutiala for its seniority (first CMDT zone) and the CMDT zone of Fana for reasons of accessibility, because it is close to the capital (Bamako) and to be able to reach more credit institutions.

The survey concerned 400 farms spread between the 2 CMDT zones, i.e. 176 in Fana and 224 in Koutiala. The 400 farms are divided between the different types of farms (well-equipped, equipped, less equipped) by weighting the relative importance of each category in the total population. Thus, a stratification proportional to size is applied in this survey. The stratification variables are the area and the type of farm.

This survey was carried out using a simple stratified sample (taking into account the different types of producers) and representative of the CMDT zones of Koutiala and Fana. On the farms, questions were addressed to the farm managers or farm members most involved in farm management. The questions focused on production systems (crop and livestock systems) and their results, the level of equipment, the history of the farm, the sources of financing for agricultural activities, the debt situation, the financial situation, relations with Farmers' Organisations (FOs) and Credit Institutions (CIs), and alternative strategies for dealing with credit management problems.

METHOD

Factors of production

In Production Economics, the factors of production are the different entities, natural persons or economic objects, whose services are used in production operations. Factors of production are components of the enterprise (Paraïso et al. 2012). Four factors of production are classically distinguished on the farm: labour, land, capital and intermediate consumption.

- **Land:** This corresponds to the amount of land available to the cotton producer. It is expressed in hectares. For farmers, land is the main physical capital.

- **Work:** Four types of labour have generally been identified:

  - **Permanent workers:** These are workers who are paid monthly throughout the agricultural season. For PO managers, these workers spend an average of 35% on cotton cultivation and work an average of 5 months on the farm.

Permanent worker costs for cotton per farm = number of permanent workers*number of months paid in 2019*monthly wage.

- **Daily workers:** These are workers who are paid per working day.

Daily labour costs for cotton per farm = number of daily workers*number of days paid in 2019*daily amount.

- **Groups of workers**: These are usually groups of men or women who intervene on the farms as a service, as required by the producers.

Group costs per farm = number of worker groups*daily amount*number of days worked.

- **Family labour:** For the valuation of family labour, we took the number of active members in the farm and multiplied it by the monthly salary of the permanent workers for 6 months. According to the leaders of the POs, the majority of the family labour is mobilised for an average of 6 months with a standard deviation of 2 months, before going back to town.

- The capital:

Bornier (2003) proposes two different conceptions of capital. "The first one, called material, considers capital as a collection of objects that improve the productivity of labour and land. A tractor, a plough, are thus capital goods, and it is easy to understand how such tools increase productivity. However, this conception does not fully explain why a large number of heterogeneous objects should be grouped together in this single category of capital. Another, more unifying conception interprets capital as a homogeneous whole, the measure of which is a value, not a collection of objects. This value or these funds available to the enterprise contributes to production in so far as it enables the enterprise to remunerate the factors of production, to make them subsist, before selling the product of their activities. Having capital then means being able to make advances, to make expenditures that will only later lead to a finished product and sales". (Paraïso et al., 2010).

- **Depreciation:** We have opted for straight-line depreciation by dividing the purchase price by the useful life communicated by the manufacturers.

- **Livestock Cattle:** It corresponds to the number of farmers who declare having access to the Cattle herd (Ploughing oxen, Bulls, Cows, Bulls, Heifers and Calves)**.** It therefore takes a value between 0 and 1.

- **Other livestock:** This corresponds to the number of farmers who declare having access to livestock other than cattle (sheep, goats, horses, donkeys and pigs). It therefore takes a value between 0 and 1.

- Intermediate consumption:

- **Organic manure:** For the valorisation of organic manure, for the majority of farms, this input is obtained free of charge. We have valorised it taking into account the work of Leloup (1994) and Van der Hoerk et al (1996), in which case the areas sown are fed with a number of carts. For these authors, a cart weighs between 150 and 200 kg, and 1 kg weighs between 15 and 25 FCFA.

- **Inputs (seeds, fertilisers, pesticides, herbicides**): At the level of the Rural Management Centres (RMCs) and the Cotton Producers' Cooperative Societies

(SCPCs), memos on input prices are filed with the general secretaries by CMDT. Also, a document is held by each PO manager. This document contains information on the quantities, costs of inputs, area sown to cotton and production per farm recorded in it. For the calculation of the input cost per farm, our barometer was this information.

Statistical analysis of the typology of farms

We used descriptive and inferential statistical tools such as mean, frequencies, standard deviation and coefficient of variation, Student, ANOVA and Tukey tests to analyse the socio-economic characteristics of farmers. For the items in the Farm Account, we also statistically compared the averages of the amounts of production factors and producer profits by type of farm.

The Student, ANOVA and Tukey tests were used to compare average gross margins per ha, gross margins per working day and rates of return on capital at the 1% and 5% thresholds for each type of farm.

The calculation of descriptive statistics (frequencies, means and standard deviations) for each variable and tests for comparing the means of the economic profitability indicators were carried out using SPSS Version 22 and STATA version 16 software.

Estimation of economic profitability indicators

- Gross Margin (MB) and Gross Income (GI) from Production

According to Ayena M. and Yabi A. J. (2013); Paraïso et al. (2012) and Yègbémey (2012), the gross margin is obtained by deducting the variable costs (VC) per hectare from the gross product value (GPV) per hectare. The Gross Income of the agricultural sector or activity was obtained by multiplying the gross margin per unit area by the production area.

- Net Margin (NM) and Net Income (NI) from Production

According to Ayena M. and Yabi A. J. (2013); Paraïso et al. (2012) and Yègbémey (2012), the net production margin was obtained by deducting from the gross product value (GPV) per hectare, the total costs (TC) per hectare, or by deducting from the gross margin the fixed costs (FC) per hectare. The net income of the agricultural industry or activity was obtained by multiplying the net margin per unit area by the area of production.

The net margin is still called net profit or profit. For the purposes of this research, we define net cotton income or cotton profit as the difference between the value of production and production costs.

- Average net labour productivity (ANLP)

According to Ayena M. and Yabi A. J. (2013); Paraïso et al. (2012) and Yègbémey (2012), average net labour productivity (*ANLP)* or *Average Labour Remuneration Rate (ALRR)* in FCFA/HJ is given by the following formula:

ANLP=MN/MOF

With MN the net margin of the production activity (in FCFA/ha) and MOF the total quantity of family labour used (in HJ/ha). "In economic profitability analysis, the ANLP is interpreted

by comparing it to the price p of a Man-Day (HJ) of paid salaried labour in the study zone" (Yègbémey, 2010 cited by Paraïso et al., 2012).

- Internal Rate of Return (IRR)

By definition, "Profitability is the ratio of income earned or expected to be earned to the resources employed. It is also the ability of capital to generate income" (FAO, 2005 cited by Paraïso et al., 2012). The Internal Rate of Return or IRR, which is nothing more than the productivity of capital, expresses the net margin per unit of total capital invested (Paraïso et al., 2010). In this case, total invested capital is nothing more than the sum of total production costs, including the value of family labour.

RESULTS AND DISCUSSION

Socio-demographic characteristics of respondents

Gender, age and experience in cotton production

According to the gender of the farm managers, we note that all the farm managers in our sample are men with a workforce of 400, i.e. 100% of the sample. Thus, in our villages surveyed, there are no female heads of farms. The information captured is that women do not run a farm or work on a farm. This is explained by the traditional social organisation in these villages with very limited access to land for women who, according to custom, do not inherit the land.

Table 1 below shows that the average age of the farm managers in our sample is 56 years with a dispersion around the average of 15 years (thus a variation coefficient of 27%). This result explains why the majority of farm managers are of a high age, despite the difference between the maximum age of 102 and the minimum age of 20. It is not uncommon nowadays for some young people to become heads of farms through family breakdown, which may justify the minimum age of heads of farms at 20.

Table 1: Age and cotton production experience of farm managers

Variables	Number	Average	Standard deviation
Age of farm managers	400	56	15
Number of years of experience of farm managers in cotton production	400	25	13

Source: Authors using 2019 Survey data.

The same scenario can be seen in the average number of years of experience in cotton production, which is 25 years with a dispersion around the average of 13 years (thus a coefficient of variation of 52%). We also note that there is a positive correlation between age and year of experience (61%). Comparing this with the average age of the population in Mali (17 years), we can confirm that the age of the individuals in our sample is high.

Level of training of farm managers

Noting the low level of training in its areas of intervention, CMDT had set up a programme in relation to training: construction of classrooms, literacy training for producers. However, with the refocusing of its activities from 2001, CMDT withdrew from training. This component has remained in the hands of NGOs, which present programmes that are often not adapted to the level of the producers (Diakité, 2009). For this work, we focused on the level of training of farm managers, as they are the ones who make decisions at farm level (see Table 2).

For all types of farms, the number of farmers without any level of training remains high (28% for the well-equipped type, 35% for the equipped type and 42% for the less equipped type). We note that well-equipped farms have the highest number of literate farmers (31%), we also note that most producers stop studying before secondary level.

Table 2: Level of training of farm managers by type of holding

Level of training of farm managers	Typology			Total
	Well Equipped	Equipped	Less Equipped	
No level	28%	35%	42%	33%
Alphabetised	31%	24%	24%	28%
Primary	24%	20%	12%	21%
Secondary	8%	9%	11%	9%
Koranic	9%	11%	9%	10%
Total	100%	100%	100%	100%

Source: Authors using 2019 Survey data.

An analysis of this situation by CMDT zone indicates some variation from one region to another. Table 3 shows that the highest literacy rate is recorded in Koutiala, with 42% of farms literate, compared to only 10% in Fana. This is explained by the fact that Koutiala is the old cotton basin of Mali, and therefore an area that benefited (in training) long before the others. It is in the CMDT zone of Fana that we find relatively the largest number of illiterate people with 35% of the farms.

Table 3: Level of training by CMDT zone

Level of training of farm managers	Zone		Total
	Koutiala	Fana	
No level	30%	35%	33%
Alphabetised	42%	10%	28%
Primary	18%	25%	21%
Secondary	4%	15%	9%
Koranic	5%	15%	10%
Total	100%	100%	100%

Source: Authors using 2019 Survey data.

But, according to the producers, since the disengagement of CMDT, training (literacy, etc.) has become rare if not non-existent. The 99% of our sample confirm that they have not received any training from NGOs in the last 5 years against 1% who say they have received training from NGOs. This situation deserves special attention, because with the ageing of farm managers (who have not received training), the non-extension of new techniques and technologies will encounter serious problems in the very near future.

Marital status

Analysis of Figure 1 shows us that almost 60% of the sample are polygamous married, 39% of the sample are monogamous married and the rest are single with 1% of the sample. In rural areas, having several children provides retirement and permanent labour and to do so requires several women. Knowing that the majority of the children's burdens rest on the mothers who take care of them.

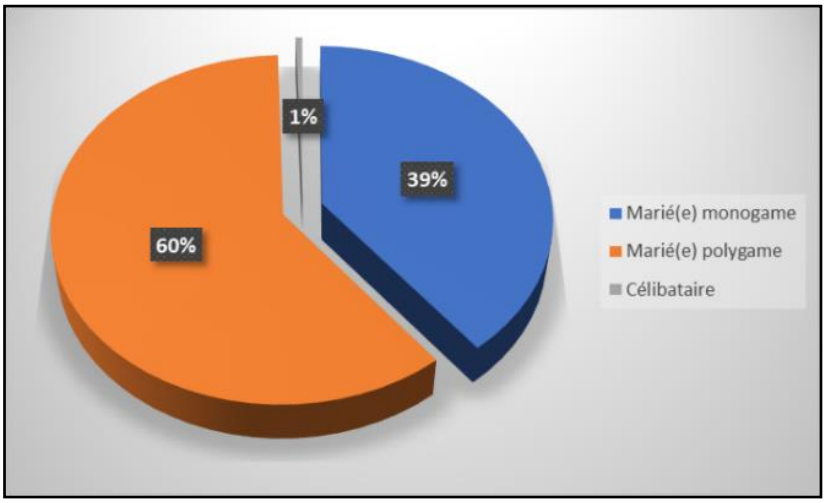

Figure 1: Marital status of farm managers (in percentage)

Source: Authors using 2019 Survey data.

After each cotton marketing year, a wave of marriage follows with the income from cotton, which explains the low percentage of heads of farms living alone (single). Furthermore, our investigations have shown that getting married in these surveyed villages is easy and without too much expense.

Average population per farm

Table 4 provides information on the average size of members on the farms surveyed, which is 23 people with a dispersion around the average of 17. This average is well above the national average of 8 per household (INSTAT-Mali, 2020). This trend reflects the average size of active members per household equal to 10 and a variation around the average of 8, with a maximum number of active members of 53. These results relate to the marital status of heads of households as more than half are married polygamous, which leads to an increase in the birth rate in the village, and also to the culture of the extended family in Mali where children, even when married, always remain with their parents. Furthermore, using a one-factor ANOVA test

analysis between marital status and number of active members, the test statistic is 4.8, with a critical probability of 0.03. This remains very significant at the 5% threshold.

Table 4: Number of average members of the head of the household

Population	Average	Standard deviation
Number of members on the farm	23	17
Number of active members in the household	10	8

Source: Authors using 2019 Survey data.

Typology of farms

Level of equipment

Table 5: Equipment level by type of operation

Warranty Equipment	Well Equipped		Equipped		Less Equipped	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Number of Tractors	1	0	0	0	0	0
Number of Tiller	1	1	1	0	0	0
Number Plough	2	2	2	1	1	1
Number of carts	2	1	1	1	1	1
Number of Draught oxen	7	8	3	2	2	1
Number of Cattle	12	16	4	7	3	3
Number of goats	15	49	7	8	7	7
Numbers of Sheep	12	18	6	6	4	5
Number of permanent buildings	3	2	1	2	0	0
Planted area (ha)	27	69	11	27	4	12
Area of cultivable land (ha)	24	18	11	8	2	7
Number of vehicles	2	2	1	1	0	0
Number of motorbikes	2	3	1	2	1	1

Source: Authors using 2019 Survey data.

We find that large farms have an average of 2 full hitches (7 plough oxen, 2 ploughs, etc.). This situation could be explained by the fact that in Fana and Koutiala the producers had the chance to benefit from favourable equipment conditions when the sector was doing well.

Area, production and yield per hectare for cotton and others

Table 6 shows us that less equipped producers have the smallest area under cotton (on average 2 ha), and well-equipped producers have the largest area under cotton (on average 7 ha),

followed by equipped producers with an average area of 3 ha. The difference is statistically significant according to the typology of producers (F=51.06; p=0.00).

Table 6: Production indicators by type of operation in 2018-2019

Labels	Well Equipped		Equipped		Less Equipped	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Area sown for cotton	7	5	3	2	2	1
Total area sown in 2019	23	22	10	6	9	6
Total area available	26	16	13	8	13	7
Production in Kg of cotton	5712	4921	1999	1661	1341	1022
Yield/ha (cotton)	843	329	725	443	539	302

Source: Authors using 2019 Survey data.

When analysing the yield per hectare (Cotton) of producers, it can be seen that well-equipped farms and equipped farms have much higher yields than less equipped farms. This is explained by the fact that these two types of farms have more means of production than the less equipped ones. However, the difference between the three groups is significant (F = 10.96; p = 0.00). It can therefore be concluded that the type of farm influences the yield of the producers.

Area and yield per hectare for other crops

During the survey, we found that producers grow other crops in addition to cotton, the main ones being: maize, millet, upland rice, groundnuts, sesame, sorghum and Wandzou.

Table 7 shows that well-equipped producers have on average the largest areas of other crops, compared to equipped and less equipped producers, as in the case of cotton. It also shows that groundnuts and Wandzou are grown exclusively by well-equipped producers. Also, sorghum is produced only by the well-equipped and the well-equipped.

Table 7: Area in ha of other crops by farm type in 2018-2019

Areas	Well-equipped		Equipped		Less Equipped	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Corn	4	4	2	1	1	1
Mil	5	5	3	2	3	2
Rainfed rice	1	1	1	1	1	0
Peanut	1	1	-	-	-	-
Sesame	2	2	1	1	1	1
Sorghum	1	1	1	1	-	-
Wandzou	1	1	-	-	-	-

Source: Authors using 2019 Survey data.

The difference in average between farm types is statistically significant for maize and millet. On the other hand, it is not globally significant for upland rice and sesame.

Table 8 shows the yields of other crops by type of producer operation in 2018-2019. This table shows that well-equipped producers achieve the highest yields relative to the other two types across all major crops. Less equipped and equipped producers, taken together, have good yields of maize, millet, upland rice compared to equipped producers. This result is due to the fact that the less equipped farms do not achieve a good yield in cotton, and therefore devote a large majority of the sown areas, 70%, to the cultivation of cereals that do not require a large quantity of fertilisers such as cotton. It should be added that these crops are generally used for the farms' own consumption and a small portion is sold (mainly maize) to meet certain needs. The other crops are grown on a small scale as shown in Table 8. The main problem with these crops is price flexibility.

Table 8: Yield per ha of other crops by farm type in 2018-2019

Yield	Well Equipped		Equipped		Less Equipped	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
But	2133	3213	1924	1743	2635	3140
Mil	1078	1244	896	338	897	355
Rainfed rice	1697	3245	559	265	650	71
Peanut	1312	1064	-	-	-	-
Sesame	528	653	369	341	400	551
Sorghum	973	417	929	625	-	-
Wandzou	714	641	-	-	-	-

Source: Authors using 2019 Survey data.

In the case of maize, it is primarily the basis for on-farm feeding and it is the surplus that is sold on a market where the price is not guaranteed. In addition to seasonal variations, the price can be subject to significant variations during the same day on the same market. For crops such as groundnuts and sorghum, the price is very low during harvest periods (because supply exceeds demand). This is true for all other agricultural products. Despite this low price, most producers are forced to sell off their crops to meet the family's needs, making the activity financially unprofitable. (Koné, 2016; Sanogo, 2018). The test of comparing averages is not significant between farm types for maize, millet, upland rice and sesame. On the other hand, it is significant between farm types for sorghum.

Labour factors in the operation

In the cotton zone, labour input is divided into permanent workers, day labourers and groups of workers.

Costs of permanent employees

These are workers who are mobilised on the farm throughout the agricultural season with a monthly salary. Table 9 shows that well-equipped farms spent more resources to pay permanent workers compared to equipped farms (168,077 FCFA > 156,346 FCFA). It also shows that the

less equipped do not use permanent workers, which is explained by the fact that this type of human resources requires a certain stable availability of cash over time.

Table 9: Costs of permanent employees by type of operation in FCFA in 2018-2019

Typology	Average	Standard deviation
Well Equipped	168 077	218 113
Equipped	156 346	124 176
Less Equipped	-	-
Total	160 256	158 742

Source: Authors using 2019 Survey data.

The difference in averages is not statistically significant between the types of farms.

Daily employee costs

At the beginning of the campaign, some producers hire young people. Payment for these young people is made on a daily basis, and the terms of the contract are fixed by mutual agreement between the farmers and the young recruits. Table 10 shows the average costs of daily employees by type of farm in 2018-2019.

Table 10: Costs of daily employees by type of operation in FCFA in 2018-2019

Typology	Average	Standard deviation
Well Equipped	10 513	10 671
Equipped	17 778	20 903
Less Equipped	14 679	12 453
Total	14 023	16 436

Source: Authors using 2019 Survey data.

Equipped farms recorded higher daily costs (17,778 FCFA) compared to less equipped (14,679 FCFA) and well-equipped (10,513 FCFA) farms. This result can be explained by the fact that well-equipped farms receive several applicants, given their production capacity, and therefore pay less per day than the other two types. The ANOVA test of difference in average is not significant ($F=2.56$; $p=0.0653$).

Costs of groups of workers

Worker groups are in great demand in CMDT areas, as the cost is very affordable. Table 11 shows the average costs of groups of workers by type of operation in CFAF in 2018-2019.

There is evidence that it is the well-equipped farms that have paid out more cash to pay groups of workers than other types of producers.

Table 11: Costs of groups of workers by type of operation in FCFA in 2018-2019

Typology	Average	Standard deviation
Well Equipped	43720	48525
Equipped	24560	21069
Less Equipped	27389	19471
Total	34410	38512

Source: Authors using 2019 Survey data.

The ANOVA test is globally significant (F=11.13; p=0.00). The type of operation influences the average costs of groups of workers.

Family labour force (MOF)

The family labour factor represents the main human resource on cotton farms in CMDT zones. Thus, to value the family labour factor, we multiplied the amount paid per month to the permanent employee by the number of active members on the farm, and by the number of months paid per year to the permanent employees. Table 12 shows the valuation of family labour by type of farm in CFAF in 2018-2019.

We note that the family labour factor is paid less among the least equipped compared to the other two categories.

Table 12: Valuation of family labour by type of farm in CFA francs in 2018-2019

Typology	Average	Standard deviation
Well Equipped	389227	261238
Equipped	226647	161793
Less Equipped	222727	168213
Total	305175	230728

Source: Authors using 2019 Survey data.

The difference in average between the types of farms is statistically significant.

Depreciation of agricultural equipment

Table 13 shows the depreciation of agricultural equipment by type of farm. In our case, we used straight-line depreciation by dividing the acquisition price of the physical assets by the life span reported by producers and manufacturers.

An analysis by type of farm shows that the cost of depreciation is higher for farms of the well-equipped type than for the other two types. This situation is identical to that of the study carried out by Koné (2016). The difference in average is statistically significant between farm types.

Table 13: Depreciation of agricultural equipment by type of farm in CFAF in 2018-2019

Typology	Average	Standard deviation
Well Equipped	65635	143166
Equipped	43390	85141
Less Equipped	26929	19974
Total	52821	115087

Source: Authors using 2019 Survey data.

Input Costs

Farms source their agricultural inputs from their cooperatives under the supervision of CMDT. For the 2018-2019 season, the supply of agricultural inputs to farms has often been hampered by certain difficulties. Among these, Figure 2 below reveals a number of constraints.

The majority of farms (more than 60%) have no constraints in terms of supply and this result is not surprising because the villages surveyed are well organised with the presence of several POs whose objective is to facilitate supply. On the other hand, 23% complained about delays in supply, 10% about storage problems, 7% said that the quantities of inputs are insufficient. Table 14 shows the cost of agricultural inputs by type of farm in CFAF.

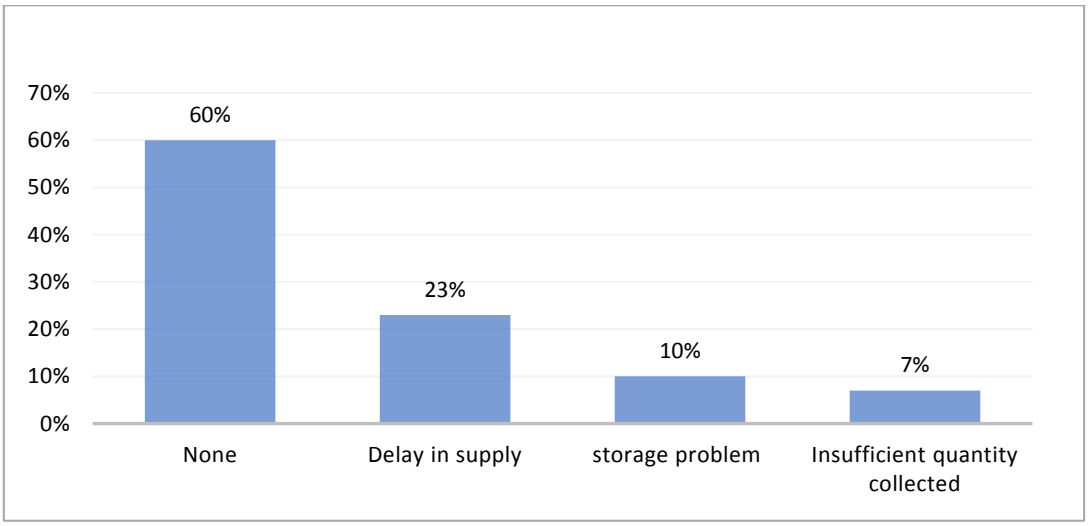

Figure 2: Constraints in the supply of agricultural inputs in 2018-2019

Source: Authors using 2019 Survey data.

Table 14: Costs of agricultural inputs by type of farm in CFAF in 2018-2019

Typology	Average	Standard deviation
Well Equipped	483140	447500
Equipped	221498	401281
Less Equipped	186091	141795
Total	345473	431130

Source: Authors using 2019 Survey data.

Well-equipped farms were found to spend more on inputs compared to the other two categories. This result seems logical since the well-equipped properties have more surface area compared to the other two. The ANOVA test of difference in average between farm types is significant.

Valuation of the cost of organic manure (CIFO)

Most farmers apply organic manure to their fields, they produce locally and the manure is transported to their fields by carts. The reasons cited by cotton farmers for practising organic fertilisation were to improve and maintain soil fertility over a long period. A large proportion of producers consider this input to be free.

Table 15 shows the valuation of organic manure by type of farm in FCFA. It can be seen that the less equipped producers produced less organic manure compared to the other categories. The difference in average is statistically significant.

Table 15: Valuation of organic manure by type of farm in FCFA in 2018-2019

Typology	Average	Standard deviation
Well Equipped	104450	72680
Equipped	84296	66538
Less Equipped	74944	65049
Total	93316	70195

Source: Authors using 2019 Survey data.

Economic profitability by type of operation

Net margin and net income

As a reminder, in the framework of this research, we define net cotton income or cotton profit as the difference between the value of production and production costs (see Table 18 of the Generation of Income Account in the Annex).

Over the last fourteen years, from 2005 to 2019, the profit of seed cotton has been strongly affected by the price of seed cotton and the price of inputs, combined with a drop in yields. In other words, the producer price reached its peak in the 2011-2012, 2012-2013 and 2018-2019 seasons. These moments coincide with the period when Mali regains its position as the leader in production in West Africa. This explains a strong positive correlation between the quantity produced and the price of seed cotton.

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 4, Issue 1, 2021 (pp. 36-57)

www.abjournals.org

We note in table 16 that only well-equipped producers have a positive profit with valuation of the cost of family labour and the cost of organic fertiliser, i.e. 324,402 FCFA with a net margin of 8,604 FCFA per hectare on average.

Producers of the less equipped type have the lowest net profit with valorisation of family labour and the lowest cost of organic fertiliser (-207,661 FCFA) with a net margin of -85,458 FCFA per hectare on average.

As far as equipped producers are concerned, the net profit with valuation of the cost of family labour and the cost of family organic manure is also negative (-121,475 FCFA) with a net margin of -63,908 FCFA per hectare on average. In total, on average, the farms have a positive profit with valorisation of the cost of family labour and the cost of organic manure (87,665 FCFA) with a net margin of -30,517 FCFA per hectare on average. The net margins are negative because of the very high production costs. In short, in the two CMDT zones, the 43% have a positive net profit.

We note that well-equipped farms have much higher profits compared to equipped and less equipped farms. This situation is due to the fact that this type of farm has more means of production than the well-equipped and less well-equipped ones, with a cost of capital goods in the farm of 98,452 FCFA on average against 65,085 FCFA and 40,393 FCFA respectively (see Table 17 in the Appendix). As a result, well-equipped farms have higher yields. The other farms do not produce enough cotton to cover expenses initially and then make a profit.

Moreover, the analysis of Student, ANOVA and Tukey's tests of average profits per type of farm shows that there is a significant difference between net cotton revenues, with valuation of the cost of family labour and the cost of organic manure (strong difference between the well-equipped type compared to other types of farms).

Table 16: Indicators of economic profitability by type of operation

Indicators	Well-equipped		Equipped		Less equipped		Together	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Gross margin (GM)	30750	127674	-37290	162879	-68336	94173	-6852	146404
Gross Income (GI)	422854	870164	-56390	481141	-167268	240619	166896	730343
Net Margin (NM)	8604	142550	-63908	164366	-85458	92998	-30517	153773
Net Income (NI)	324402	879446	-121475	488485	-207661	238728	87665	731419
Average Rate of Labour Remuneration (ARLR)	1138	2984	-578	2495	-1036	1200	216	2815
Internal Rate of Return (IRR)	0.26	0.70	-0.15	0.59	-0.36	0.39	0.03	0.67

Source: Authors using 2019 Survey data.

We find that standard deviations are extremely high in terms of profits for all types of producers. This is due to a large gap between the minimum and maximum values.

Productivity of the family workforce: Labour productivity

Comparing the Average Labour Remuneration Rate to the price of a man-day (HJ) of paid labour in the study area, here 1547 FCFA which is the estimated average daily pay of workers, the activity is not economically profitable for any type of farm (nearly 216 FCFA of Average Labour Remuneration Rate on average overall, or 22% of the total).

Cotton producers do not have a high enough net margin. The net profit is barely close to the cost of family labour, which is on average FCFA 389,227, FCFA 226,647 and FCFA 222,727 respectively for well-equipped and less-equipped farms. In addition, cotton producers use far too much family labour (10 people on average) without, however, seeing their profits increase exponentially. This is due to the fact that most family members come to work on the farm because they have no other means of earning an income. Cotton is the main cash crop in the study area. However, the number of active members in the household should be reduced by deploying some in other income-generating activities.

However, well-equipped farms have an Average Labour Remuneration Rate of 1,138 FCFA francs on average, which is close to the reference threshold. The use of agricultural equipment is one of the reasons for their average labour productivity level compared to other farms (equipped and less equipped type).

Internal rate of return: Capital productivity

Considering the interest rate applied by the banks in the study zone, which is 12%, the activity is not economically profitable from the point of view of TC capital investment because the IRR is only 3% in all CMDT zones, so only 38% exceed the reference threshold. Only producers of the well-equipped type have a positive IRR of 26% on average, whose activity is economically profitable considering the 12% threshold set by credit institutions. On the other hand, producers of the equipped or less equipped type have negative IRRs (respectively -15% and -36% on average). Their activity is not economically profitable from the point of view of capital productivity.

The only explanation for this situation, although obvious, seems to come from the more significant use of material goods on the farm for producers of the well-equipped type compared to other farms (equipped and less equipped type). Indeed, this allows them to have higher agricultural yields, and therefore higher net incomes. Normally, these well-equipped type farms could sow more land and still get enough profit to be profitable.

CONCLUSION

The overall aim of this study was to analyse the operating account and the economic profitability of farms according to the typology of cotton growers in the CMDT zones of Fana and Koutiala in Mali, highlighting the causes of the level of profitability. It was carried out using a database resulting from a survey carried out in the CMDT zones of Fana and Koutiala among 400 cotton producers. The methodological approach adopted was first of all a descriptive and inferential analysis of the socio-demographic characteristics of the farms, the

farm account and the economic profitability by type of farm (well-equipped, equipped and less equipped).

The analyses show that the number of operators with no level of training remains high (28% for the well-equipped type, 35% for the equipped type and 42% for the less equipped type). We note that the well-equipped farms have the highest number of literate farmers (31%), we also note that most producers stop studying before secondary level.

This situation deserves special attention, because with the ageing of the farm managers (who had benefited from micro-project and literacy training with NGOs), the popularisation of new techniques and technologies will encounter serious problems in the very near future.

The average age of the farm managers in our sample is 56 years with an average number of years of experience in cotton production of 25 years. Nearly 60% of the cotton farmers are polygamous married, 39% are monogamous married and the rest are single with 1% of the total.

It has been found that only well-equipped farms make a positive profit if we value family labour and organic manure. The other types of farms, with the level of yield recorded, had difficulty covering the costs involved in seed cotton production. This is much more accentuated in the less equipped type of farms. This is why some authors (Keita, 2008) have given thought to the need to reorient this type of farm to other crops.

Moreover, cotton farmers use far too much family labour (10 people on average) without seeing their profits increase exponentially. As a result, the productivity of family labour is extremely low (almost 216 FCFA of Average Labour Remuneration Rate on average overall), making the activity economically unprofitable from this point of view. Moreover, producers of the equipped or less equipped type have negative IRRs (respectively -15% and -36% on average) as opposed to the well-equipped type with an average IRR of 26%. Therefore, only producers of the well-equipped type have an economically profitable activity from the point of view of capital productivity, considering the 12% threshold set by credit institutions.

In summary, the number of cotton producers with a positive net profit corresponds to 43% while those with an economically profitable activity according to labour and capital productivity represent 22% and 38% of the total respectively.

At the end of this investigation, we propose these policy recommendations so that farms can be profitable from every point of view:

- Train cotton farmers in farm management, helping them to better optimise their production costs because cotton input costs alone exceed net income on average on most farms.
- Reorient some active members of the household to other crops or other income-generating activities. This is because the farm does not rightly remunerate the workers in the household with the income obtained after the harvest.
- Provide access to equipment credit for equipped and less-equipped farms so that they can increase their yields and net cotton profits. The profitability of the activity of well-equipped farms suggests the need to provide equipment to poorly equipped farms.

- Easily grant access to land to farms, especially those equipped to sow more land because they have an economically profitable IRR.

REFERENCES

ADEGEYE, A. J. & DITTOH, J. S. (1985). Essential of Agricultural Economics. Ibadan: Impact Publishers Nigeria, Ltd. 183p.

AHO, N. & KOSSOU, D. (1997). Précis of tropical agriculture. Base et éléments d'application, les éditions du flamboyant, Cotonou. 464p.

ANANG, B. T., BÄCKMAN, S. & SIPILÄINEN, T. (2016). Agricultural microcredit and technical efficiency: The case of smallholder rice farmers in Northern Ghana. Journal of Agriculture and Rural Development in the Tropics and Subtropics; 17(2), pp. 189-202.

AYENA, M. & YABI, A. J. (2013). Typology and Economic Profitability of Farms Participating in Family Farm Consulting, 4th International Conference of the African Association of Agricultural Economists, September 22-25, 2013, Hammamet, Tunisia.

BNDA. (2018). Activity Report. Ordinary and Extraordinary General Meeting of 13 May 2019. 40p.

BORNIER, J. M. (2003). Economics course. Professional website of Professor Jean Magnan de Bornier. URL: https://docplayer.fr/15360087-3-les-decisions-de-production.html consulted on 15 December 2020.

CAMARA, M. (2016). Assets and limitations of the cotton sector in Mali. PhD thesis: University of Toulon - France. 321p.

CIRAD-GRET. (2002). Ministry of Foreign Affairs, Mémento de l'Agronome, 1691p.

CMDT. (2018a), Monitoring and Evaluation Report for the Campaign 2015-2016, 2016-2017, 2017 2018, 2018-2019.

CMDT. (2018b), Annual Report of Campaign Activities, 2015-2016, 2016-2017, 2017-2018, 2018-2019.

CMDT. (2019). Evaluation of the Final Remuneration of Cotton-Grain Producers for the 2018/2019 campaign. 42p.

CPI. (2019). Evaluation of the final remuneration of seedcotton producers for the 2018/2019 season. Final report.

DARBELET, M. & LAUGINE, J. M. (1990). Economie d'entreprise 1 P. 374-375, Edit. Foucher.

DAY, H. R. (1965). An approach to the study of agricultural production. In: Économie rurale. N°66, 1965. pp. 49-64.

DIAKITE, L., DEMBELE, E. K. & BARRY, M. A. (2009). Provision of agricultural services in the cotton-growing areas of West and Central Africa (WCA). Study report, ENDA DIAPOL. 55p.

EAC. (2014). Integrated Agricultural Business Survey. Planning and Statistics Unit, National Institute of Statistics, National Directorate of Agriculture.

ECHAUDEMAISON, C. D., BAZUREAU, F., BOSC, S., CENDRON, J. P., COMBEMALE, P. & FAUGERE, J. P. (1990). Dictionary of economics and social science. Edit. Les préférences NATHAN, p. 332.

EKOU, N. (2006). Measuring the technical efficiency of women food crop farmers in Côte d'Ivoire. Économie rurale. Journals open Edition. 16p.

FOX, J. F., SHEIK, L. & KNIPS, V. (2004). L'élevage et l'intégration régionale en Afrique de l'Ouest, Ministère des Affaires étrangères - FAO-CIRAD, 37p.

INSTAT-Mali. (2020). Official statistics of Mali, URL: https://www.instat-mali.org/fr consulted on 20 December 20 2020.

IPC & UNPC. (2008). The evolution of Producer Organisations in the cotton sector. Rapport final.

KEITA, M. S. (2008). Situation of the Malian cotton sector. Pôle Rural AFD/Bamako. 5p.

LEAPH (Laboratory of Applied Entomology and Hytopharmacy). (2009). Study report on the impacts of the use of chemical pesticides in the cotton zone in the Commune of Ouaké. 72p.

NUBUKPO, K. & KEITA, M. S. (2005). The impact on the Malian economy of the new seed cotton pricing mechanism. OXFAM International study report. Bamako, Mali. 42p.

OUEDRAOGO, A. L. (1997). Analyse la rentabilité financière et des stratégies d'allocation des ressources de production maraîchers de la région ouest du BURKINA FASO, PhD Thesis: Centre Ivoirien de Recherches Economiques et Sociales, Université de Cocody - Abjidian, CÔTE D'IVOIRE, 138p

PARAÏSO, A., SOSSOU A., YÈGBÉMEY, R. & BIAOU, G. (2012). Economic and financial profitability of cotton production in Ouaké in North-West Benin. Annales des Sciences Agronomiques; 16 (1), pp. 91-105, ISSN 1659-5009.

PARAÏSO, A., SOSSOU, A., YÈGBÉMEY, R. & BIAOU, G. (2010). Analysis of the profitability of fonio (Digitaria exilis) production in the commune of Boukombe in Benin. IVth Scientific Day of the University of Lomé. Togo, 25-28 October 2010.

PENOT, E. (2009). Economic calculations with the Olympe software within the framework of reference farm networks and definitions for the PAMPA project, Working Paper No. 3 RIME-PAMPA, CIRAD ES, UMR 85 innovation/URP SCRID, September 2009.

SILUE, N. Z., DAO, D., VALERIE KOUAME, H. K. & KONE, M. (2019). Analyse de la rentabilité économique des systèmes de production à base d'igname : cas des sites de Leo et Midebdo au Burkina Faso, Economie des systèmes de production d'igname, Agronomie Africaine; 31 (1), pp. 1-14.

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 Sciences Agronomiques; 14 (2), pp. 221-239.

YÈGBÉMEY, R. N. (2010). Economic analysis of rice farms in the commune of Malanville. Thesis of agricultural engineer, Faculty of Agronomy/University of Parakou, Parakou, Benin. 75p.

YOUR, P. & WANKPO, E. (2004). Cotton production in Benin. FUPRO - Benin, AgriStudies Number: 15.4.04 2794. The Netherlands and Benin, 56p.

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 4, Issue 1, 2021 (pp. 36-57)

ANNEX

Table 17: Production costs by farm type

Costs	N	Average	Standard deviation	Minimum	Maximum
ALL PRODUCERS					
variable costs	400	788204	611529	94395	5576880
fixed costs	400	79231	172630	0	2934819
total costs	400	867435	668386	110174	5657398
WELL-EQUIPPED PRODUCERS					
variable costs	194	1033710	660326	179015	4775990
fixed costs	194	98452	214748	16756	2934819
total costs	194	1132162	726152	202681	5161964
TEAM-TYPE PRODUCERS					
variable costs	173	566101	477084	94395	5576880
fixed costs	173	65085	127711	0	1693050
total costs	173	631186	519569	110174	5657398
PRODUCERS OF THE LESS EQUIPPED TYPE					
variable costs	33	509285	312052	133775	1483336
fixed costs	33	40393	29961	4429	110970
total costs	33	549678	329102	166061	1568800

Source: Authors using 2019 Survey data.

Table 18: Operating account by type of producer in CFAF in 2018-2019

Indicators	Well-equipped		Equipped		Less equipped		Together	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Production (Kg)	5712	4921	1999	1661	1341	1022	3745	4083
Price of seed cotton (FCFA/Kg)	**255**	-	**255**	-	**255**	-	**255**	-
Value of production (FCFA)	1456564	1254875	509711	423511	342017	260733	955100	1041075
Depreciation of equipment (FCFA)	98452	214748	65085	127711	40393	29961	79231	172630
Cotton input costs (FCFA)	483140	447500	221498	401281	186091	141795	345473	431130

Cost of organic manure (FCFA)	103912	72878	83321	66764	74944	65049	92616	70394
Daily employee costs (FCFA)	3143	7544	5447	14130	3114	8137	4137	10964
Cost of groups of workers (FCFA)	40114	48009	21153	21318	22409	20570	30453	37854
Costs of permanent employees (FCFA)	14175	39076	8035	38631	0	0	10350	37419
Family labour force (FCFA)	389227	261238	226647	161793	222727	168213	305175	230728
Production costs (FCFA)	1132162	726152	631186	519569	549678	329102	867435	668386
Gross profit (FCFA)	**422854**	**870164**	**-56390**	**481141**	**-167268**	**240619**	**166896**	**730343**
Net profit (FCFA)	**324402**	**879446**	**-121475**	**488485**	**-207661**	**238728**	**87665**	**731419**

Source: Authors using 2019 Survey data.