
Comparing conventional and certified organic cotton supply chains: the case of Mali

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Abstract: The certified organic cotton supply chain is compared to the conventional cotton supply chain in Mali. The most important differences between the two supply chains are highlighted in this study. Switching to organic production may offer a range of potential advantages to cotton farmers, including lower expenses for farm inputs, healthier soils, diverse sources of income, and higher prices. A comparison of the gross margins of both production methods indicates that Mali organic cotton may be able to offer higher gross margins than conventional cotton farming.

Keywords: green supply chain; gross margin for cotton; market coordination mechanisms; environmental impact; sustainable farming.

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1 Introduction

In the contemporary clothing market, fashion, performance, and price are not the only considerations for consumers when they choose clothes. Another significant element for consumers is ‘well being’, a factor determined by the contents of a fabric, which make it feel good to wear (Borland, 2004): a need that organic cotton may address. Organic cotton is used especially in baby clothes, undergarments, t-shirts, bed linen, and feminine protection products; this market is undergoing significant growth. With a market share of 1% (Sanders et al., 2006), organic cotton is still a niche market. However, if the growth of the organic food market is any indication, it is a niche that is likely to expand.

A number of studies investigated issues relating to the organic cotton supply chain (e.g., Chouinard and Brown, 1997; Meyer, 2000; Meyer and Hohmann, 2000; Goldbach et al., 2003; Kogg, 2003; Forman and Jørgensen, 2004). These studies focus on the potential of ‘ecotextiles’ to offer competitive advantages in the highly competitive world textile sector. Indeed, the textile sector can be characterised not only by its intensive competitive dynamic but also by the significant environmental and social problems linked to the production of conventional cotton. However, linking sustainability issues with strategic competitive advantages is a challenge, as selling ecotextiles beyond a niche requires special competencies in organising the value chain, cost reduction, and implementing green issues in the marketing strategy. Only very few studies focus on the potential impact organic cotton may have in the Third World and especially in Africa. So far, this topic has been addressed mainly by NGOs (e.g., Helvetas, 2004, 2006). This paper contributes to this new research field by presenting the case of organic cotton cultivation in Mali, a West African country. The key characteristics of conventional and organic cotton production will be reviewed; the structure of the organic cotton supply chain and of the conventional cotton supply chain in Mali will be compared; and the gross margins for organic cotton production in Mali will be compared to that of conventional cotton.

2 Characteristics of organic and conventional cotton production and market structure

2.1 Organic and conventional cotton production

For the purposes of this research, conventional cotton designates any cotton that is not organic. The biggest sustainability challenge in conventional cotton production is its need for high levels of chemicals, many of which are potentially harmful to the environment. According to the Pesticide Action Network (PAN, 2005),¹ “each year cotton producers around the world use nearly US \$2.6 billion worth of pesticides”, which represents more than 10% of the world’s pesticide use. In an average growing season, the cotton plant can

be sprayed 8–10 times. In the USA, cotton farmers use an average of 159 kg of chemicals per hectare, making cotton the fourth most heavily fertilised crop after corn, winter wheat, and soybeans (USDA, 2003). Clearly, growing conventional cotton can have a considerable impact on the environment. Transgenic cottons, such as Bt cotton, are not necessarily a satisfactory alternative. The Bt cotton plants produce the *Bacillus Thuringiensis* toxins, which could possibly kill susceptible pests when they attack the plants (Grain, 2004).² However, studies have shown that from the second year onwards, Bt cotton may need insecticides, and farmers may have to spray more than once (Naranjo and Ellsworth, 2002; Thirtle et al., 2003). Thus, the effectiveness of Bt cotton in reducing the use of harmful chemicals needs to be established in long-term studies, a need emphasised in a report by the FAO, which points out that

“the existing literature on the impacts of transgenic crops in developing countries is quite limited, primarily because these crops have been grown for only a few years and in a few countries.” (FAO, 2004, p.43)

Growing organic cotton eliminates toxic chemicals and relies on natural, biological methods that have a far less damaging impact on the environment. This means that the costs of external inputs can be reduced dramatically. For example, in India, input costs for growing cotton have been reduced by 60% following the conversion to organic farming (Upadhyay and Bhamoriya, 2004). However, since herbicides are not used, manual weeding results in high labour requirements. While manual labour represents a major challenge for the spread of organic cotton in Western Countries, it might represent an opportunity for developing countries, where there generally is sufficient inexpensive labour available. The renunciation of synthetic fertilisers and the introduction of soil fertility management measures such as crop rotation or composting, must be implemented with the aim of building a ‘closed loop’ material cycle (Chouinard and Brown, 1997). Shifting from mono-cropping to crop rotation not only improves soil fertility, it also helps to control pests. A standard recommendation for an effective rotation is a minimum two-year planting of a non-host species. For example, the results of a long-term study in Alabama on organic cotton (USA) show that by using annual winter legumes, cotton yields were equivalent to those grown using nitrogen fertiliser (Guerena and Sullivan, 2003). The study found a 11% yield increase for a two-year cotton-legume-corn rotation, compared to continuous cotton grown with legumes each year. However, devoting an area to other crops means that less cotton can be grown, resulting in a loss in revenue from cotton, which must be compensated to some extent by the other crops. This is the case especially during the conversion phase, which can last up to four years wherein yields can be reduced by up to 50% (Meyer and Hohmann, 2000).

2.2 *The structure of the market for cotton*

The market for conventional cotton is characterised by spot-market transactions and the product is traded anonymously on commodity exchanges around the world (Meyer and Hohmann, 2000). The supply chain of conventional cotton is linked across a number of actors, through whom the market coordinates the flow using price (Abernathy et al., 1999; Seuring, 2001, 2004). For example, interaction between the fibre producer and spinner is based merely on price. Interactions between spinners and fabric producers, as well as between clothing producers and wholesalers, are based on price and

negotiation. There is no global coordination within this chain; therefore, it is based entirely on the market scenarios.

This is not the case with organic cotton, which is a good market with a low demand level (Meyer, 2000). Chouinard and Brown (1997) report that many existing fabric vendors refused to undertake development of organic cotton replacements, resisting the production of the small quantities wanted by the firm Patagonia, and citing a lack of supplier alternatives. The yarn spinners did not have sources for organic cotton, and there was some scepticism about the market potential. Therefore, Patagonia's staff had to create linkages along the entire supply chain. A similar situation is reported by Meyer and Hohmann (2000, p.64): who note that for organic cotton, the "company instead binds its suppliers and customers closer to itself and is equally willing to bind itself to them". Obviously, the organic cotton supply chain has a specific coordination mechanism, which is separate and different from the market (Goldbach et al., 2003).

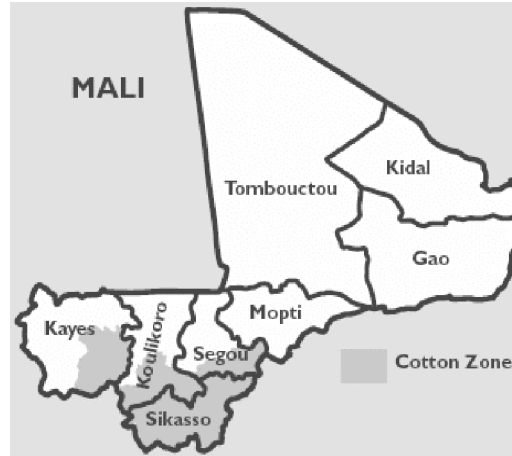
3 The supply chain of conventional cotton vs. organic cotton in Mali

3.1 Method

Mali is one of the ten poorest countries in the world and most of its twelve million citizens are subsistence farmers (CIA, BBC, World Bank). Seventy percent of the population living below the poverty line is found in rural areas (Reardon et al., 1999). Farmers have small plots, between one and seven hectares, with the average around five hectares. They grow corn and millet for food and cotton as a cash crop (Wikipedia.org). The climate is subtropical to arid, and the irrigated farmland is confined to the riverside of the Niger River. Cotton is Mali's second biggest export (after gold) representing 38% of total earnings in 2002. Thus, cotton is a major contributor to the GNP, and its role has been expanding in recent years, making Mali's economy vulnerable to the fluctuations in world prices for cotton. Some 22% of the population in 162,000 households/farms live in the cotton region in the south of the country (World Bank, 2000). The official unemployment rate is around 15% but some research (Traore, 2003) estimates a rate of above 20%.

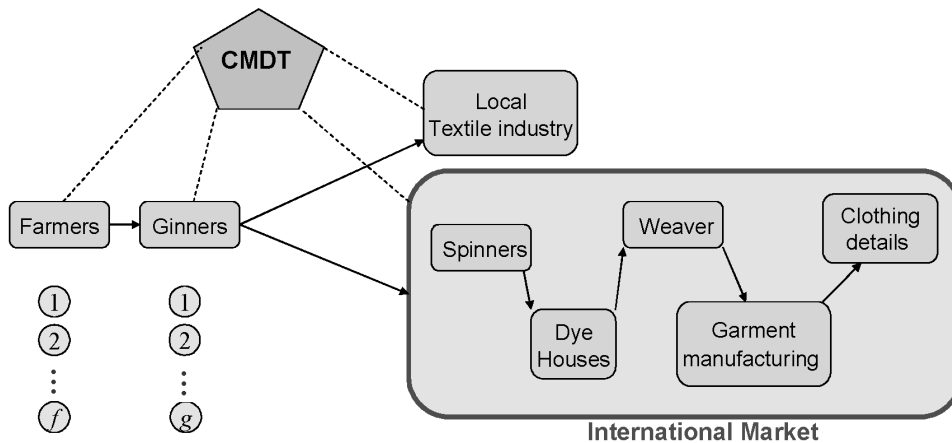
We used secondary data for the conventional cotton available from different sources, such as published academic papers and books, documents and reports edited by World Bank, FAO, IMF, and other NGOs. In addition, we collected primary data from farmers cultivating organic cotton in Mali during the fall of 2005. First, we contacted the leaders of two villages in the Koulikoro region (Figure 1) with whom we discussed the purpose of the research project and the nature of data we were looking for from the farmers. We assured them of anonymity and the scientific use of data as a unique purpose. The leaders introduced us to five farmers cultivating conventional cotton and five others cultivating organic cotton. Interviews were conducted via telephone by one of the co-authors who is originally from Mali and speaks Bambara and French. The data collected concerned the process of cultivating the cotton [conventional (Figure 2)/organic (discussed in the next section)], their suppliers, customers, and financial figures (revenues, costs, debts, aids, etc.).

Figure 1 Mali and its cotton producing regions



Source: CMDT

Figure 2 The supply chain of conventional cotton grown in Mali



3.2 The organic cotton supply chain originating in Mali

The certified organic cotton program in Mali was set up by Helvetas, a Swiss NGO, which was looking to establish relationships between buyers in Europe and sellers in the developing countries. The Mali program started in 2000, and certified organic cotton production started in 2002 with 174 farmers. The number of participating farmers increased to 588 in 2004 and to 1,748 in 2005 (Helvetas, 2004, 2006; Organic Exchange, 2006). The organic cotton is produced in two regions: Kolondieba and Yanfolila (Merceron et al., 2005).

Helvetas not only coordinates the programme, but also provides technical assistance, instructing the farmers on methods of how to resolve problems during the cultivation cycle. For example, they offer advice on finding affordable organic fertilisers like compost, on using organic insecticides like Kaby oil and Mpeku oil, on transforming their farms into integrated organic units, and on adopting crop rotation to help the

recovery of the soil. Typically, a two-year cotton/sesame seed rotation is adopted to support soil recovery. Helvetas also organises the certification of the farmers. Helvetas works in close collaboration with CMDT (Malian Company for the Development of Textiles), which provides the organic farmers with the cotton seeds, and the bio-pesticides (Koby oil and Mpeku oil) for free. CMDT is a government institution that holds the exclusive marketing rights for cotton in Mali.

After the harvest, CMDT buys the organic cotton from the farmers, according to a price determined each season (in 2003, the price was 20% higher than the price of conventional cotton). CMDT then transports the organic cotton to the ginner plant. After ginning, the cotton is packed and labelled as organic cotton before being sold to Paul Reinhardt AG, a Swiss company selected by Helvetas. From Mali, the cotton is sent to India, to be treated at two sites in Tirupur, in the Indian state of Tamil Nadu. In Tirupur, the cotton is used to manufacture t-shirts, which then are sold through Swiss clothing retailers such as Switcher SA or Migros in Switzerland and other European countries. The whole supply chain is coordinated by Helvetas and Ecocert, an independent German certification agency, which certifies that the cotton is organic and stays organic throughout the supply chain.

3.3 The conventional cotton supply chain originating in Mali

In Mali, cotton is produced on 500,000 hectares. The concession regime managed by the CMDT means that individual smallholders are obliged to sell all their cotton to CMDT, which in return, commits to purchase the entire crop at prices fixed every year by the government. CMDT is a trader in the international cotton market and serves as an intermediary between the market and the farmer. After ginning the cotton, CMDT sells the vast majority of the cotton on the international market. From this point onward, it is hard to ascertain the cotton's destination. A small quantity of the cotton is sold to the local industry, where local artisans transform it into garments for sale in Mali. Despite the fact that the concession regime does not give farmers access to the cotton market, sometimes, if farmers need money, they sell their cotton at a lower price to another party, for example, a local merchant.

4 The economics of cultivating conventional and organic cotton in Mali

4.1 Gross margin calculation for cotton production

To analyse the economics of cultivating conventional and organic cotton, we compared the two kinds of farming systems in terms of the farm soil yields, the quality of cotton, the costs of inputs (mainly fertilisers and chemicals), and the profit or earnings obtained (see Figure 3).

To assess the gross margin of cotton production, the yield per hectare must be estimated. Figure 4 shows the by-hectare yield trend of the two kinds of cotton. The yield of organic cotton is approximately half that achieved in conventional farming, which is in line with the observations of Meyer and Homann (2000, p.67), who note that "organic agriculture in the conversion phase (first one to four years) can reduce harvests by up to 50% depending on the soil contamination and structure".

Figure 3 Farmer inputs for conventional and organic cotton

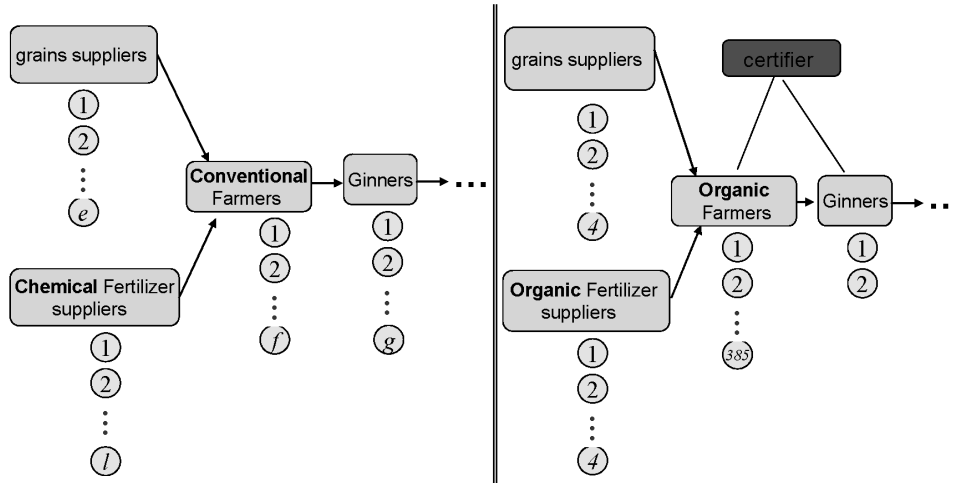
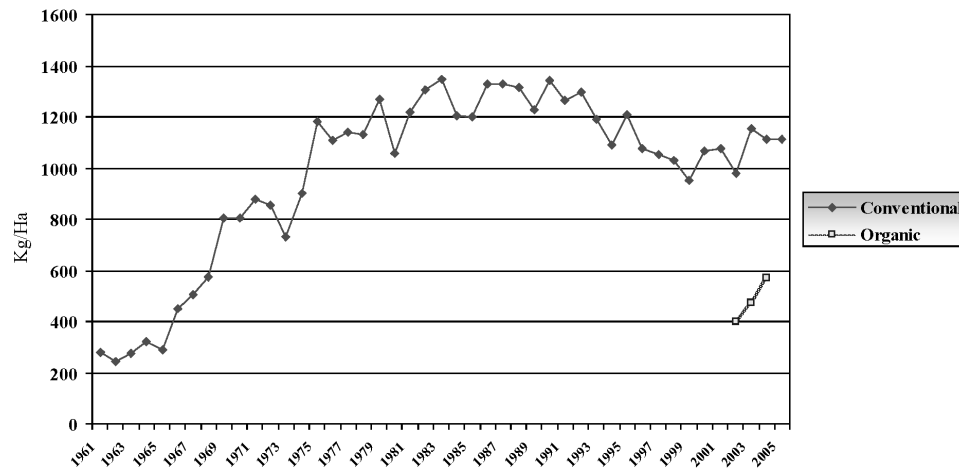


Figure 4 Average yields for cotton seed in Mali from 1961–2005



Even though the average yield of organic cotton is low (570 kg/ha) in comparison with conventional cotton, there is large variation in farm yields in the case of organic cotton in Mali. According to Helvetas (2004), 120 farmers (out of a total of 561, i.e., 21%) had an average yield of 700 kg/ha, 50 farmers (9%) passed the 1,000 kg/ha, and 16 farmers (3%) had an average yield higher than 1,500 kg/ha.

The Malian organic cotton is of excellent quality, with 97% of the crop being rated ‘first choice’. There is no published data on the quality of the conventional cotton.

The determination of the earnings or profit for the farms is always very difficult because of a lack of or inconsistencies in the data. The comparison between farming systems is complicated also by the reference system, or which basis of comparison to choose in view of the diversity of how farmers use the input variables: labour, fixed costs in terms of equipment, land, livestock, size of cultivated land, the age of the system (newly converted vs. established organic system), and even the size of the household.

Additionally, the problem of comparing organic and conventional cotton is compounded by the fact that organic cotton farming only started three years ago in Mali, while conventional cotton farming started more than 30 years ago. The following working assumptions underlie the economic assessment:

- Agricultural agents in 2004 recommended that conventional cotton farmers use the following quantities of fertiliser and chemicals per hectare: 150 kg of fertiliser, 50 kg of urea, 4 litres of insecticide, and a small bag of fungicide. This recommendation costs the farmer US \$113/ha. These figures come from a local agricultural agent and are corroborated by Nubukpo and Keita (2005).
- The conventional cotton farmer has a long-term average yield per hectare of 1,127 kg/ha (arithmetic average from 1990 to 2004, FAOSTAT, 2006).
- Despite the recommendations, farmers frequently use only half the recommended amounts due to the expenses involved. The lower rate of application of external inputs therefore cost the farmers US \$56.50/ha. The lower application rate results in 20% lower yield. Hence, for this scenario, the yield will be 900 kg/ha.
- The two kinds of farmers use the same kind of agricultural equipment (plough, cart, etc.). Therefore, they have the same amount of amortisation. We assumed an average amortisation of US \$51.50.
- The organic cotton farmers' use ten times more hired labour than the conventional cotton farmer. We used the average costs for hired labour US \$2.5/ha as calculated by Nubukpo and Keita (2005).
- Organic cotton farmers have an average yield of 570 kg/ha (Helvetas, 2004).
- Organic cotton farmers are not paying for the organic input they use. In Mali, the cotton seeds are produced by a few farmers chosen by CMDT. The farmers producing seeds are paid US \$9.70/ton as a bonus. The seeds then are offered to the farmers for free.
- All organic cotton produced in Mali has an excellent quality ('first choice').
- The price paid to the farmers for organic cotton is US \$0.50/kg.
- The price paid to the farmer of conventional cotton is as follow: 'first choice': is US \$0.41/kg; second choice is US \$0.36/kg; third choice is US \$0.29/kg. Because the quality of distribution of conventional cotton is not available, we calculated the average price of the three categories at US \$0.36/kg for conventional cotton.
- Cost of certification: these costs are paid by Helvetas. Individual Malian farmers could not pay the fees and handle the process of the certification for two reasons. The first reason is purely economic: the fees are too high if paid by individual farmers. For example, Ecocert asks US \$800 for a selling volume less than or equal to US \$50,000, and the fees increase slightly with a growing sales volume. So, grouping organic cotton from many farmers helps controlling the costs for certification. The second reason concerns the process of certification, which demands some expertise and a minimum effort. This process could not be handled easily by the Malian farmers who are generally not very educated and who also are adjusting to the new process of cultivating organic cotton.

Based on these hypotheses, two scenarios for conventional cotton production and three scenarios for organic cotton production were formulated:

- Scenario I considers the case where conventional cotton farmers follows the recommendation of the agricultural extension agent concerning the use of the fertilisers and the insecticides. This scenario represents the farmers who are relatively wealthy. They do not have a problem financing their need for chemicals. According to our estimation combined with the information provided by Nubukpo and Keita (2005), this is the case for some 35% of the cotton farmers in Mali.
- Scenario II considers the general practices of conventional cotton farmers in Mali who often uses half the quantity of fertilisers and insecticides recommended by the agricultural extension agent. Approximately 45% of the farmers fall into this category.
- Scenario III considers organic cotton farmers' lower yields registered in 2004, which was 570 kg/ha.
- Scenario IV reflects the situation when organic cotton farmers' yields are equivalent to 848 kg/ha, which represents the mid-point between the current average organic cotton yield and the current average conventional cotton yield.
- Scenario V reflects the situation wherein organic cotton farmers and conventional cotton farmers have the same yields (1,125 kg/ha). This assumption is very ambitious but seems achievable given that 121 farmers achieved a yield 1,000 kg and 1,500 kg/ha (Helvetas, 2006).
- Scenario VI is an alternative setting, where we tried to find the yield of organic cotton given the same operating profit.

Table 1 shows the profit-and-loss statement of organic and conventional cotton farmers for 2004 in the six scenarios.

Table 1 Gross margins of organic and conventional cotton production in Mali

Scenario	Conventional		Organic			
	I	II	III	IV	V	VI
Yield (kg/ha)	1,125	788	570	788	1,125	637
Price (US\$/kg)	0.36	0.36	0.50	0.50	0.50	0.50
Revenue in US\$/ha	410	287	285	394	563	318.5
<i>Production cost</i>						
Chemicals US\$/ha	109.70	58.85	–	–	–	–
Labour hired US\$/ha	2.42	7.27	21.82	21.82	29.00	21.82
Family labour, US\$/ha	25.54	25.54	25.54	25.54	25.54	25.54
Amortisation/ha	50.00	50.00	50.00	50.00	50.00	50.00
Total costs (US\$/ha)	187.66	141.66	97.36	97.36	104.54	97.36
Gross margin (US\$/ha)	222.34	145.34	187.64	296.64	458.46	221.14

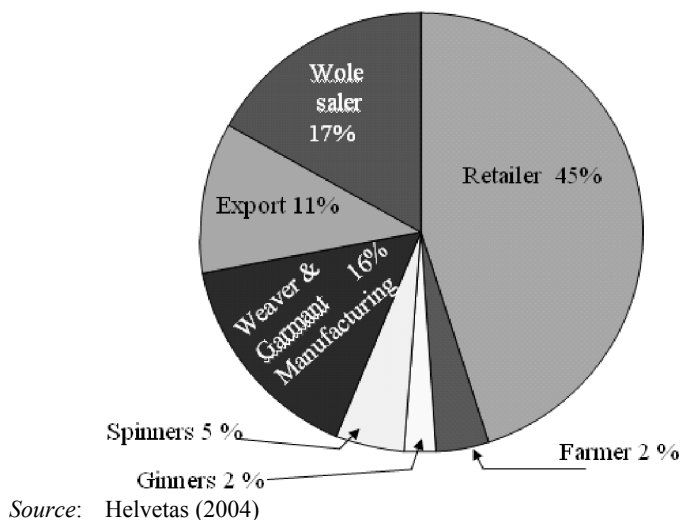
The situation of farmers in Scenario I is comparable to the farmers producing organic cotton. The organic farmers may generate a similar profit to the farmers in Scenario I if the average organic yield is increased from 570 kg/ha to 637 kg/ha, according to Scenario VI. The organic yield would have to increase by 11.7%, which is achievable. For the long-term and when the conversion phase of the organic cultivation is over, the profit of the organic farmers will be much higher than the conventional farmers' profit, and they will be able to hire up to ten times the local labour as conventional cotton farmers. Thus, organic cotton has the potential to create jobs in rural areas, where the unemployment rate can reach 20% (Traore, 2003).

Growing cotton may also have a beneficial impact on the women's labour market, since 39% of organic cotton farmers are women (Helvetas, 2004) and women's unemployment rate reaches 31% (Traore, 2003).

4.2 Share of farmers in the value of the end product

The revenue received by the farmer represents 4% of the price paid by the customers for a textile garment (see Figure 5).

Figure 5 Distribution of the t-shirt price through the cotton supply chain



5 Discussion and concluding remarks

The main observations of our study are that:

- Switching to organic cotton in Mali could result in an increase in farmers' profits in the mid- to long-term. This might be the case in many developing countries, especially in western Africa, where the wages paid are similar to the wages in Mali.
- Mali needs to find the means to increase soil fertility, since the country experienced a decline of cotton seed yields over the last 15 years. Farming organic cotton may be a solution.

- Contrary to the conventional cotton supply chain, there is no spot market yet for organic cotton. Thus, specific coordination mechanisms must be formed and implemented within the organic cotton supply chain. For the time being, CMDT and Helvetas are playing a central role within the conventional and organic Malian cotton supply chains respectively. However, their objectives and the mechanisms of coordination that they are using are very different. In Mali, CMDT aims at helping farmers improve their economic performance by offering them the possibility to sell their cotton at a better price (set by the government not by the international market). It acts as an intermediary between the farmers and the international market for conventional cotton. In the case of Helvetas, the objectives are more long term and focused on the sustainable development by the improvement of both the economic and ecological performance of the Malian cotton farmers. By imposing product standards, Helvetas sets the environmental criteria for all the supply chain members (farmers, ginners, manufacturers, etc.). Consequently, its level of control is higher within the organic cotton supply chain.

Even if farmers receive a relatively low share of the final product's price, it is still advantageous because they and their families will avoid exposure to toxic products. Furthermore, the 20% premium price for the organic cotton is extra revenue for the farmers. As we pointed out earlier, switching to organic cotton increases the farmers' profits in this case. Also, almost all of the organic cotton produced in 2004 was of excellent quality, and the average yield of cotton has increased every year since the program was implemented (Helvetas, 2004), while conventional cotton farming experienced yield decreases in this period. Also, with organic farming, the farmers will improve the fertility of their soil. As a former Rural Development official in Mali pointed out, the massive use of synthetic fertilisers in the CMDT regions has a "cohort of ominous consequences on fertility [...]", and calls for

"a better mastery of the fertility of soils, a considerable decrease in the employment of synthetic fertilisers, an increase sustained by the yield of the soils, or even a re-adaptation of the pesticides to our soils and to our cultures."
(Keita, 2005)

For these reasons, if these findings hold for the long-term, organic cotton should continue to be promoted in Mali, as it promises diverse benefits for its farming communities. Chouinard and Brown (1997, pp.124, 125) support this view in their research on the manufacturer Patagonia. According to them, the environmental costs of conventional cotton in the form "of adverse health effects, loss of soil productivity, and ecosystem disruptions" out-weigh the price differential between conventional and organic raw cotton. Meyer and Homann (2004) also reported that some of the organic cotton projects of Remei were profitable. However, before generalising these findings to cover all developing countries, more research is needed.

New research in this area should deal with more cases and evaluate the performance of each experience to furnish more quantitative analyses of the organic supply chain. Analyses at a country level might provide a clearer idea of comparative parameters of an organic cotton program and conventional cotton production. The case of transgenic cotton should be studied in all its aspects. More studies on organic cotton are necessary to increase our understanding of the particularities of both organic and conventional supply chains, and to propose models and other tools for measuring its overall economic, ecological, and social benefits.

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Notes

¹PAN is a network that challenges global proliferation of pesticides.

²GRAIN is an international NGO which promotes sustainable management and use of agricultural biodiversity.

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