

**Farmers' response to the evolution
towards globalisation: the case of cotton production in Mali**

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Abstract

Cotton production in Mali is analyzed to emphasize that globalization could be considered as the culmination of a process towards the liberalization of the economy of the cotton sector that was implemented during the last two decades. Some distance has become possible to observe farmers' reaction to this process through the examination of their cultivation practices. In spite of some diversity in their reaction, it is noted that neither cotton production, related incomes for farmers nor food security were negatively affected, at least in the short run. These outcome are actually achieved at the expense of maintaining production capacities in the mid-run. Correcting this undesirable effect would require carrying out new cultivation techniques with more robust economic efficiency towards hazards of various orders, as well as institutional innovations that would facilitate their sustainable adoption by farmers.

Key words : Mali, globalization, cotton, smallholder, farming practices, fertility

Resumen

El caso de la producción algodonera en el Mali está utilizado para ilustrar la idea de que la globalización puede ser considerada como el resultado de un proceso, extendido sobre cerca de dos decenios, de liberalización de la economía del sector algodón del país. Disponemos en tal caso de la perspectiva permitida por un cierto alejamiento en el tiempo para aprehender la reacción de los agricultores a través del análisis de sus prácticas culturales. Pese a una diversidad de respuestas de los agricultores, se puede notar que ni la producción algodonera, ni los ingresos monetarios que son sacados de ésta, ni la seguridad alimentaria, son negativamente afectados por la evolución hacia la globalización, por lo menos a corto plazo. Pues estos resultados son obtenidos en detrimento de las capacidades de producción a mediano plazo. La corrección de estos efectos negativos requiere en particular el desarrollo de técnicas nuevas, de eficacia económica más robusta frente a los azares de tipo diverso, pero igualmente innovaciones institucionales favoreciendo su adopción.

Palabras-claves : Mali, globalización, algodón, pequeño campesinato, prácticas culturales, fertilidad de los suelos

Introduction

The desire to develop cotton production in Mali dates back to the beginning of the century, with all the excesses that led to a real human drama (Roberts, 1996) and not the expected production performance. A system guaranteeing the cotton purchase price and the allocation of inputs was gradually installed from the 1950s onwards (generally referred to as the integrated system for reasons of simplification), and for some years Mali has been the leading cotton producing country south of the Sahara. The exporting of almost the entire production accounts for over 60% of the country's foreign exchange earnings. The positive effects of cotton production are often stressed for Mali and for all the franc zone African countries in which the same development has been observed. By the end of the 1980s, evaluation reports from the World Bank were laudatory and cotton development was presented as a "success story" in Mali (Hartmann, 1988). In Côte d'Ivoire, (Mcphail and Polti, 1988) emphasised the positive impacts of cotton on rural development. Cotton was an effective vector for the introduction of modern agriculture (Campagne and Raymond, 1994) which also benefited food crops. In francophone Sub-Saharan Africa (SSA) countries, no substitution of cotton for food crops was mentioned since cotton was grown as an additional crop with regard to existing cropping systems (Faure, 1992). The positive effect of cotton on food security has thus been reported frequently since the 1980s (Dioné, 1989, Raymond and Fok, 1994). From the institutional point of view, Mali was the first country in which the sale of seed cotton was transferred to villagers through the setting up of village associations trained for the purpose (Fok, 1993).

The organisation system and policy of cotton production in Mali have not remained immutable since the 1950s and marked developments have taken place in the past 25 years. This paper is aimed at showing that these developments correspond to a progressive matching to the globalisation concept as used today. We provide information on farmers' reactions to this evolution through analysis of their cultivation practices. Our research leads us to observe that the farmers do not display only a single response to this evolution. The effects are not only positive or only negative and do not lead to justifying or totally rejecting the changes in cotton policy.

Progressive matching to the globalisation concept

Globalisation or the accepted domination by rules of free trade economics

Globalisation is rarely defined. It is often mentioned as being the inescapable result of a set of phenomena such as the integration of trade following the lifting of tariff barriers, the present mobility of capital or the speed of technological change (Chambrier, 1997) or global consumerism driven by modern information and communication technologies. While recognising these more macroeconomic features, (Oman, 1994) considers that contemporary globalisation is a microeconomic phenomenon based on a change in the behaviour and strategies of firms. This microeconomic perception aimed at industrial undertakings nonetheless seems to be restrictive since globalisation is perceived as an overall economic concept whose impacts are felt by everybody in his daily life.

In the particular case of Africa, globalisation is sometimes perceived positively as the occasion for a rebirth (Shaw, 1995). In a more neutral manner, (Keet, 1998) stressed that globalisation is a real challenge for many developing countries that are obliged to handle numerous contradictions such as liberalism and protectionism, with "governments stuck in the

middle" (Rodrik, 1997). Many authors consider that this challenge is already lost and others think that globalisation is a general disaster (Amin, 1995) while (Tandon, 1997) sees it as a death threat to agriculture. Globalisation is often mentioned less dramatically as bearing risks of the disintegration of the state (Bach, 1995). Even when one accepts that globalisation may be a source of new opportunities, it is stressed that prior conditions must be fulfilled, such as a stable macroeconomic framework at national or pan-African level, etc.... (Abdul-Raheem, 1998).

Globalisation influences all economic activity and seems to us to be defined as the imposing of common, global economic rules on all the countries in the world. These economic rules are those of free trade and founded on co-ordination by the market alone—by an invisible hand—and on the disappearance of all state intervention that is thought to generate inefficient distortions.

Globalisation marks the triumph of the rules of the liberal economy through the world, resulting from a long process¹. Whereas liberalisation brings to mind an economic choice or an economic process tending towards the rules of free trade, we feel that globalisation marks the imposing of these rules. In other words, while liberalisation refers to a pathway, globalisation marks the culmination of this pathway.

Starting from this analysis, we can say that the dominating situation of the globalisation concept is the fruit of a process spread over a long period, initiated by specific events peculiar to a region of the world or to a country. For the countries of eastern Europe, this was the collapse of communism while it is initiated in most developing countries by application of the structural adjustment programme or SAP (Mengisteab, 1996, Ould-Mey, 1996).

We do not claim to provide a general demonstration of this conjecture, but we suggest that the analysis of the changes in policy concerning the cotton sector in Mali would tend to confirm our view.

Progressive liberalisation of the cotton industry in Mali

The true development of cotton in Mali followed the progressive establishment (Fok, 1993) in the period 1952-60 of an integrated system combining the purchase of seed cotton and the supply of inputs or equipment on credit at subsidised prices. This system has been considerably reworked for the past two decades following a series of institutional changes (Fok, 1997) and changes in the cotton policy.

The first change consisted of the setting up of village associations to take over the sale of seed cotton. This was an endogenous change initiated on an experimental basis in 1974 in particular circumstances to free small farmers of dependence on buying teams that could cheat them (Fok, 1993). This change was not the result of an initiative by representatives of bilateral or international funding institutions, which however supported it strongly afterwards. Neither was it oriented towards the 'less State' liberal economic principles. It consisted more of the externalisation of a service.

State withdrawal first started in the sale of farm products with the implementation of the SAP at the beginning of the 1980s. In 1984-85, the State ended the official sale of coarse grains at a fixed, guaranteed price that it had delegated to the *Compagnie Malienne pour le Développement des Textiles*² (CMDT). In 1986, the Malian government ceased its direct role

¹ Indeed, Oman (1994, 1996) makes a distinction between three waves of globalisation, one before World War 1, a second in 1950-60 and the third in progress since the 1980s

² A government-controlled company with 60% of the capital held by the Malian government and 40% by a French government-controlled entity, the CFDT.

in the sale of cotton fibre through a specific state body (*Société Malienne d'Import et d'Export*, SOMIEX) and transferred this function to the CMDT

Implementation of the SAP led to a decrease in subsidies for inputs and farm equipment. The effect of this reduction was visible above all in the cotton zone since this is where the use of inputs and draught cultivation equipment is concentrated³. The subsidies were phased out gradually. One can say that Malian farmers have paid real prices for their inputs (fertiliser and pesticides) since the end of the 1980s.

Two crises that occurred on the world cotton market during the second half of the 1980s led bilateral and international funding bodies to criticising the 'disconnection' of the prices paid to growers from the world price. This was at the origin of a new two-stage price mechanism⁴ implemented from 1989 to the present day. This raises the price barrier that could separate Malian smallholders from the world market. The application of this mechanism also confirmed the institutional recognition of the *Syndicat des producteurs cotonniers et de cultures vivrières* (SYCOV). This organism was founded⁵ in 1992 but the ground had been prepared by the village associations mentioned above. This was another endogenous initiative that led to a farming institution that just required recognition⁶ as such for a new price mechanism to be accepted.

The devaluation of the CFA franc in January 1994 marked another stage in the correction of barrier effects by rectifying the exchange rate of a currency considered to be overvalued. The current return of debate on the liberalisation of the marketing of seed cotton (Varangis, et al., 1995, Zolty, 1997), currently entrusted exclusively to the CMDT, should be understood as a new—possibly the final—stage in the process of evolution towards a totally free economy in the Mali cotton sector which the Malian Government is still strongly opposed to.

Examination of the institutional changes affecting the Malian cotton sector reveals a main line of evolution towards the application of a liberalised economy. The institutions created at the initiative of the sector and that subsequently received more or less confirmation from bilateral or international funding institutions finally accompanied the various stages of evolution. We consider that there has truly been a gradual matching of the functioning of the cotton sector to the globalisation concept. We do not think that this matching has been presented as such or that it has been consciously experienced as such by Malian stakeholders. As a result, globalisation is new only because it is proclaimed as such today, but it has served as the thread in the institutional changes in the cotton sector for nearly two decades. Similar processes to those described in Mali can be traced in all the cotton countries in the franc zone of Africa and so the conclusion that we have drawn for Mali can be extrapolated to the other countries.

In suggesting that matching the globalisation concept is a process that has been operating for a considerable length of time, we also wish to indicate that we can already assess farmers' response through the evolution of their cultivation practices from a certain distance.

³ Mali is known for having the highest level of animal draught cultivation in sub-Saharan Africa

⁴ This mechanism consists of the announcement of a guaranteed floor price before the crops are sown and the determination of a possible price supplement paid according to the export price of cotton fibre.

⁵ SYCOV was set up during the wave of democratisation following the overthrowing of the president of the republic of the time.

⁶ Indeed, the SYCOV is a signatory, like the Malian government and the CMDT, of a programme contract that sets among other things the procedure for the determination and stabilisation of the purchase price of seed cotton.

Farmers' response

Fairly well-known effects

There are research works that contribute to shedding light on farmers' response to evolution towards the application of globalisation. Production statistics show that cotton production has evolved considerably in the past two decades (Figure 1). The rate of production increase has been variable, but the period following the devaluation of the CFA franc corresponded to an increase in the annual growth rate (21.0% in 1961-70, 7.1% in 1971-1993 and 15.8% in 1994-99). This increase in production results mainly from the increase in the area under cotton since the yield has stagnated or even decreased in recent years.

The movement of seed cotton prices, adjusted by variation of the cost of the recommended technical package, is shown in Figure 2. This indicator displayed a 6.7% annual increase during the period 1973-93 and 17.4% in 1994-99. This movement, along with the production increase, can be interpreted as a confirmation of the positive response of supply to price; indeed price-elasticity of supply of 1.06 is observed in the period 1973-1993 and of 0.91 for 1994-99. It should be noted that the price factor was at its most favourable in the second period but the supply response was weakest. This should temper excessive confidence in the application of the price lever, as other studies have revealed weak or even negative supply response to price in sub-Saharan cotton production (Borataw, 1998, Opira Otto, 1997).

The area under cotton increased contributed strongly to the production growth but the value-added stagnated for a long time, both per unit area and at cotton farm holding scale (Figure 3). Devaluation caused this indicator of value-added to increase again, especially at farm holding level through an increase in the average area under cotton per farm, but yields decreased.

It is therefore not sufficient to assess the response of supply without examining the way in which this supply is obtained. We used several works (Berckmoes, et al., 1990, Fok, et al., 1999, Koné, et al., 1998), to establishing the evolution of the fertiliser dosage used in cotton growing in order to show the decrease since the application of the SAP (Figure 4), even if a certain degree of recovery has been observed since devaluation.

The features mentioned show that it is erroneous to assess the effect of globalisation solely through the continuation or ceasing of production, as led to by the Ricardo theory of comparative advantages or the more modern Hecksher-Ohlin-Robinson theory. With the concern of agricultural sustainability, it is also important to consider the way in which production is pursued.

The progress of cotton production does not seem to have weakened the food security of the rural populations concerned. The situation is good on all the holdings in the CMDT zone and especially on cotton holdings⁷ (Table 1).

In short, the movement towards globalisation has not penalised—at least in the short term—either the production level, the level of value-added per farm or the degree of food security. The 'mining' character of agricultural production is nevertheless aggravated. Studies show that the deficit of the mineral balance of the cropping systems increases (Table 2) as a result of the decrease in mineral fertiliser application to cotton fields, where levels have become insufficient to compensate the small or absent application to fields of cereal crops. This leads one to considering that a substantial proportion of the incomes of cotton farmers is derived from mining exploitation of the soil (Van der Pol, 1990) but it must be admitted that the

⁷ It should be noted that non-cotton farms can only meet their monetary requirements by drawing on a surplus of cereals, which is not the case for cotton farms.

situation is the same if not more marked for non-cotton farmers. The tendency towards non-conservation of soil fertility (only the chemical component is considered here) is a threat for the sustainability of farming systems in the medium term. In fact, most of the effects shown would also seem to result from changing dynamics of cropping systems.

Changing cropping systems

We performed a survey⁸ to obtain information on farmers' practices in the CMDT zone for two consecutive years in 1997-98 and 1998-99. The results can only be presented partially but confirm, for example, the continuation of a situation favourable for food security. They give closer knowledge of cropping systems dynamics.

Cotton as a crop is supported strongly but not by all. Cotton is not grown on 12% of the farms covered although half of them had planned to do so. Support of cotton is not blind as farmers who had planned to grow cotton can decide not to do so when the climatic conditions are not favourable. The role of cotton in crop rotations is fairly variable. In average, the cotton part is very close to the one recommended by the cotton company (1/3 of the total crop areas). However, a tendency for some farms to specialise in cotton production can be observed (Table 3) as a signal of strong addiction to cotton.

Maize is certainly playing an increasing role in rotations on average, but this average situation tends to hide a trend for maize growing for grain production in the more moist zones (Table 4). This should be related to the improvement of the grain market, and that of maize in particular; since the devaluation of the CFA franc (Boughton, et al., 1994, Sahel Institute, 1999). This is an indication of farmers' speed and ability to seize new opportunities, a reaction whose foundation was laid by previous extension operations for the intensification of maize (Fok, 2000).

Specialisation in millet or sorghum is weaker but perceptible nevertheless (Table 5). Fundamentally, the traditional 'cohabitation' of the three traditional grain crops (millet, sorghum and maize) is evolving, with a preferential choice being expressed for one or other of these cereals according to the geographic location of villages, likely in connection with their climatic conditions. We show a tendency for a decrease of millet whereas that of sorghum is more frequently reported. There is also a village that has devoted itself totally to maize for its cereal production.

Another important feature is the strong decrease in the intercropping of cereal crops. Whereas maize was only grown as an intercrop with small seed millet or sorghum, sole crops are now largely dominant. This is another changing traditional practice. However, the change may seem paradoxical. Whereas intercropping is usually presented as a way of limiting the negative aspects of climatic uncertainties (Shahabuddin and Mestelman, 1986, Traoré, 1987) and fluctuations in rainfall are just as marked if not more so than in the past, the adoption of the sole cropping of maize is surprising. There may have been a change in aversion to risk in cereal production in the cotton zone as a result of the security procured by the cash income from cotton. This is an indication on reduction of risk aversion that needs to be more documented.

Mineral fertiliser is applied above all to cotton and maize, two crops known to respond better to the use of this input (Table 7). However, considerable variation⁹ is observed in management of the mineral fertilisation of cotton fields (Figure 5), although there is an

⁸ A 1998/99 survey in 6 villages covered 85 farms.

⁹ Otherwise, all the plots would be concentrated in the central circle of the Figure 5.

average situation indicating respect of recommended doses¹⁰. The phenomenon of fertiliser application at lower than recommended doses is less common today than at the beginning of the 1990s (Djimraou, 1993). Cases of larger and smaller applications than the recommendations are both observed (zones 3 and 1 in Figure 5). NPK compound fertiliser is replaced by urea¹¹ (zone 2) in a significant number of cases.

The diversity of the practices observed in the mineral fertilisation of cotton shows that farmers do not form a group with a homogeneous strategy. However, farmers' practices may display considerable homogeneity. This is the case of the management of plant densities in cotton fields and in thinning management. Whereas the recommended density is 80,000 plants/ha, all fields converge towards a density of approximately 55,000 plants/ha after thinning, even if the density after sowing is very high (Figure 6). Late thinning is common (Figure 7) and the penalising effect of this on the yield is all the more marked when emergence is strong. A significant proportion of fields is also observed in which thinning is performed well after the first hoeing. We cannot tell whether these are direct effects of liberalisation. They may be indirect effects but this would only partially account for the phenomena observed¹². It is also possible that the latter result from poorer management by holding operators of the work carried out by family labour; this would reveal dissension within farms that may lead to the increasingly frequently observed splitting up of farms (CMDT, 1991).

Lessons for research and development

The evolution towards globalisation through the progressive liberalisation of the cotton sector economy has enhanced the increase in production or even the monetary incomes of holdings. It has also created new opportunities, such as the consolidation of the cash crop nature of maize that farmers know how to take advantage of. The dynamics of cropping systems is changing with regard to the traditional balances between the main cereal crops (maize, millet and sorghum) or between sole crops and intercropping with cereal. However, adaptation to this evolution is expressed by a downward trend in land productivity and at the expense of the conservation of natural resources (such as soil capital) and of sustainability in general. An agrarian dynamics is even starting, as is shown by the splitting-up of farms.

If evolution towards the globalisation principle is to be continued, an effort must be made to limit its negative effects. It is true that the present situation calls for the development of new techniques but it would be a mistake just to pass the problem on to researchers. Observation of the differences between crop densities and the recommended density, of late thinning and other features shows that the situation should be improved with regard to information and training for farmers.

However, it is true that a challenge has been set for researchers for the development of cultivation techniques that are more adapted to the constraints of climate, labour or farmers' risk aversion. Effective diffusion of information or training for farmers is only of real interest for the latter if the content is related to the constraints that they experience. The farmers will change the ways in which they use fertilisers or other expensive inputs if the economic effectiveness is rendered less sensitive to uncertainties of climate or other features.

¹⁰ The figures are 150 kg/ha and 50 kg/ha respectively for compound fertiliser and urea.

¹¹ This substitution may indicate the attraction of urea for farmers because of its effect on plant growth.

¹² For example, an increase in the area under cotton results in the late performance of certain cultural tasks but does not explain why thinning may be performed after the first hoeing.

This is not a technical paper and discussion of ways of taking up the challenge mentioned is intentionally very brief. A possible method consists of considering that merely adjusting existing techniques will not be sufficient. On the contrary, a complete re-examination of the present techniques can be envisaged, another view of the cotton plants in a field accepted and the relation between these plants and their environment analysed. Researchers must also provide tools for decision aid for the adoption of new techniques according to soil conditions, the changes in climatic conditions during the cropping period, etc... in combination with existing techniques. This requires knowledge of the way farmers operate and a true participative approach taking into account of this knowledge as much as possible in the development of new techniques.

It is also necessary to go beyond the mere perception of the need for new techniques. The conditions for the adoption of these techniques must be made feasible and acceptable so that they become true technical innovations through being effectively adopted by farmers. This leads to a need for institutional innovations (Fok, 1999). An example helps to show this. A phenomenon of resistance of an insect (*Helicoverpa armigera*) to a particular pesticide group (synthetic pyrethroids) is now to be managed in Mali. A technical perspective to deal with would rely only on the use of alternative chemical products (like endosulfan), but this management would not be sustainable in case of no-self-discipline in using alternative active-ingredient (with the threat of setting up new resistance towards such alternative ingredients). Hence, self-discipline requires institutional innovation between cotton farmers, cotton company and chemical providers.

Conclusion

Small cotton farmers in Mali have been connected to the world market since cotton production gained real impetus half a century ago. The state has played a buffer role in this connection through price and exchange policies, etc. for more than 30 years. This role of the state has changed gradually, with a decrease in direct or even indirect involvement in the cotton sector. This was a steady movement in the liberalisation of the economic functioning of the sector. Here, we can say that the past two decades have been a period of matching of functioning of the sector with the advent of globalisation. Similar changes observed in the other cotton countries in SSA lead us to extrapolate this consideration to the whole of the cotton sector in this part of Africa. It is thus not by chance that the notion of globalisation seems to be dominant to such an extent today since globalisation is the culmination of a liberalisation process that has been operating for a certain period of time.

Globalisation is not therefore a new situation for farmers but simply a continuation of a process to which they have been exposed for nearly twenty years in Mali. This point is important for understanding that we already have information of farmers' response to this evolution towards globalisation through their cultivation practices.

In the case of Mali—but we are inclined to think that this applies equally to most of the cotton countries in the franc zone in Africa—the movement towards globalisation has not harmed progress in cotton production or affected the increase in the overall monetary income drawn from it or the food security of cotton growers. In contrast, this favourable character of the variables in the short term is handicapped by the increasing fragility of medium term production capacity. There is then need to distinguish short run and long run effects of globalisation that most authors we referred above have overlooked. Adaptation to globalisation takes place through a change in cropping systems with cultivation techniques whose continuation will be a serious threat for agricultural sustainability. Within this change, some reduction in risk aversion is identified but this fact needs to be more documented.

In the strongly probable hypothesis of the continuation of the ongoing change towards globalisation, the correction of the medium term negative effects suggested means that researchers should develop new techniques to be designed in combination with the conditions enhancing their adoption, that is to say to operate with a combined view of technical innovations and institutional innovations. The proposing of new techniques more suited to farmers' real constraints will render effective the management of the information and training function for their benefit. We consider that successfully taking up the challenge of new techniques better matched to farmers' constraints today requires a thorough re-examination of present techniques and not just a simple adjustment.

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Table 1 : Favourable food surplus per inhabitant in the CMDT zone

<i>Farm type</i>	<i>Cotton growing</i>	<i>Non-cotton growing</i>
Advanced ox-draught equipped farms	170	122
Ox-draught equipped farms	156	244
Farms with no or little ox-draught equipped farms	25	67
Average	150	130

Note : food surplus defined after deduction of 250 kg/inhabitant/year

Source : CMDT, 1992

Table 2 : Trend of increased mineral unbalance under farmers' actual fertilising

	<i>Cotton-Maize-sorghum system</i>		<i>Peanau-millet-millet system</i>	
	<i>Actual fertilizing</i>	<i>Recommended fertilizing</i>	<i>Actual fertilizing</i>	
N balance (kg)	-27	-2	-35	
P balance (kg)	0	7	1	
K balance (kg)	-18	1	-28	
Ca balance (kg)	-35	-72	-4	

Source : F. van der Pol, 1991

Table 3 : Relative share of cotton in cropping systems

<i>Farm types</i>	<i>Average of 6 villages</i>	<i>Village of Danderesso</i>
Advanced ox-draught equipped farms	34%	47%
Ox-draught equipped farms	31%	42%
Farms with no or little ox-draught equipped farms	21%	44%
Manual farms	23%	37%
Average of all farm types	30%	42%

Note : relative share as defined by cotton area over total crop area

Table 4 : Maize contribution to rainfed cereal hectare and production

<i>Village</i>	<i>Contribution to hectareage</i>		<i>Contribution to production</i>	
	<i>Maize specialisation ?</i>		<i>Maize specialisation ?</i>	
	<i>No</i>	<i>Yes</i>	<i>No</i>	<i>Yes</i>
Dampela	23%		46%	
Danderesso	59%	100%	70%	100%
Kacienso	7%		11%	
Koudougouni	6%		7%	
Koumankou	30%		44%	
Ntena	12%		20%	
Average	18%	100%	28%	100%

Table 5 : Percentages of farms with various cereal specialisation

<i>Village</i>	<i>No millet nor sorghum</i>	<i>No sorghum</i>	<i>No millet</i>
Dampela	0%	8%	8%
Danderesso	73%	73%	100%
Kacienso	0%	0%	27%
Koudougouni	0%	0%	23%
Koumakou	0%	0%	80%
N'tena	0%	13%	67%

Table 6 : Percentages of cereal plots according to cropping types

	<i>Intercropping with other cereal</i>	<i>Monocropping</i>
Maize	23%	77%
Millet	1%	99%
Sorghum	5%	95%

Table 7 : Variation in cereal fertilisation

	<i>compound fertiliser</i>		<i>urea</i>	
	<i>Part of plots concerned</i>	<i>dosage (kg/ha)</i>	<i>Part of plots concerned</i>	<i>dosage (kg/ha)</i>
maize	69%	82	71%	46
millet	35%	55	21%	27
sorghum	30%	53	15%	42

Figure 1 : Seedcotton production and yield in Mali, CMDT zone

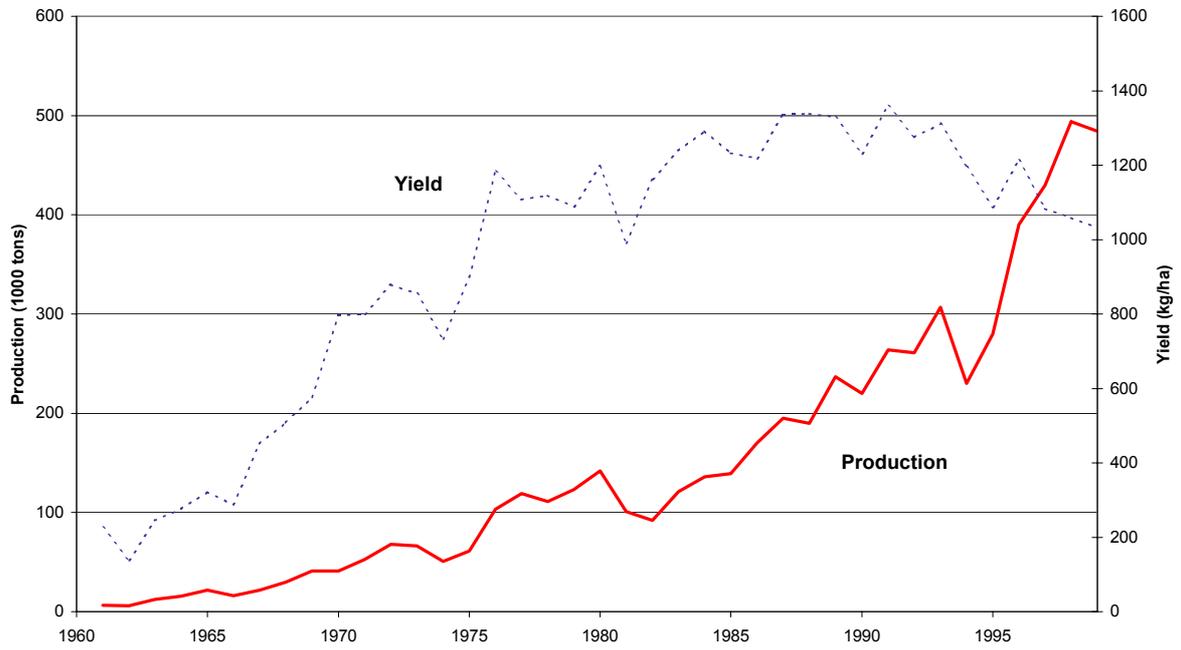


Figure 2 : Seedcotton price adjusted by variation of input costs

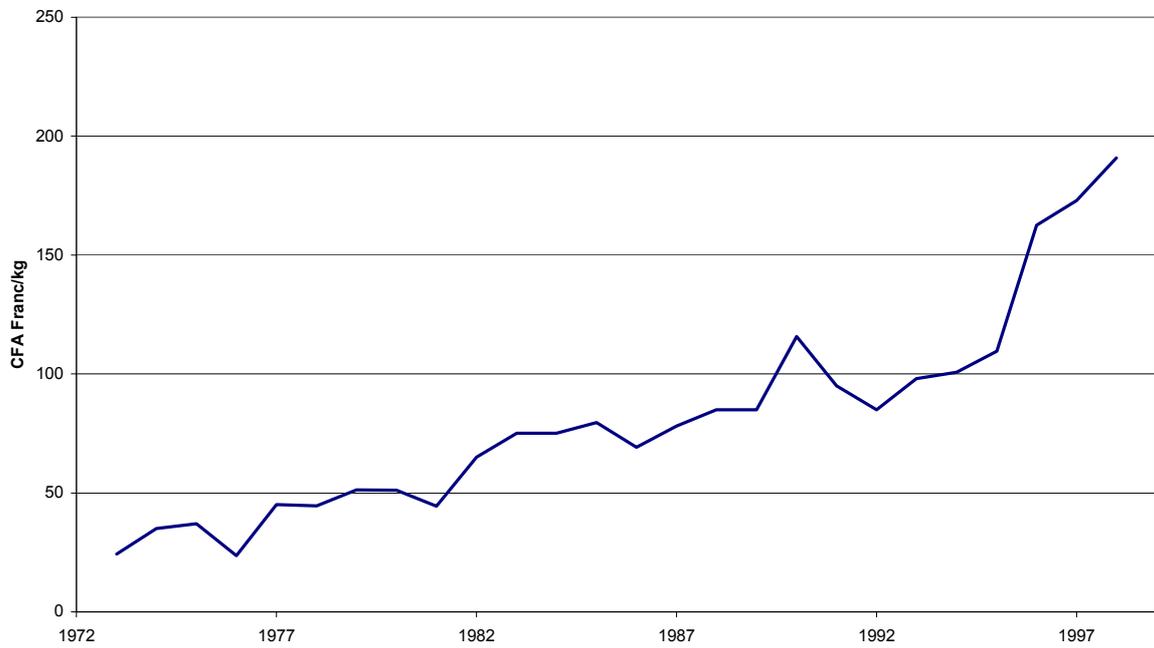


Figure 3 : Value added in cotton production

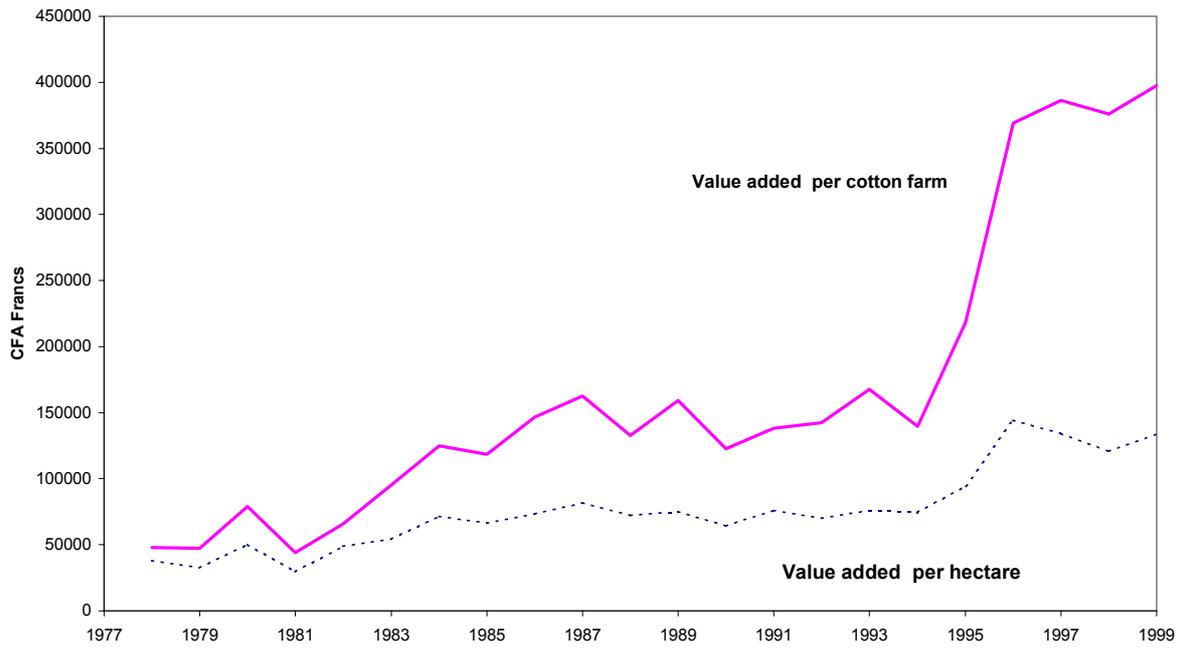


Figure 4 : Fluctuating trend of fertiliser dosage on cotton crop

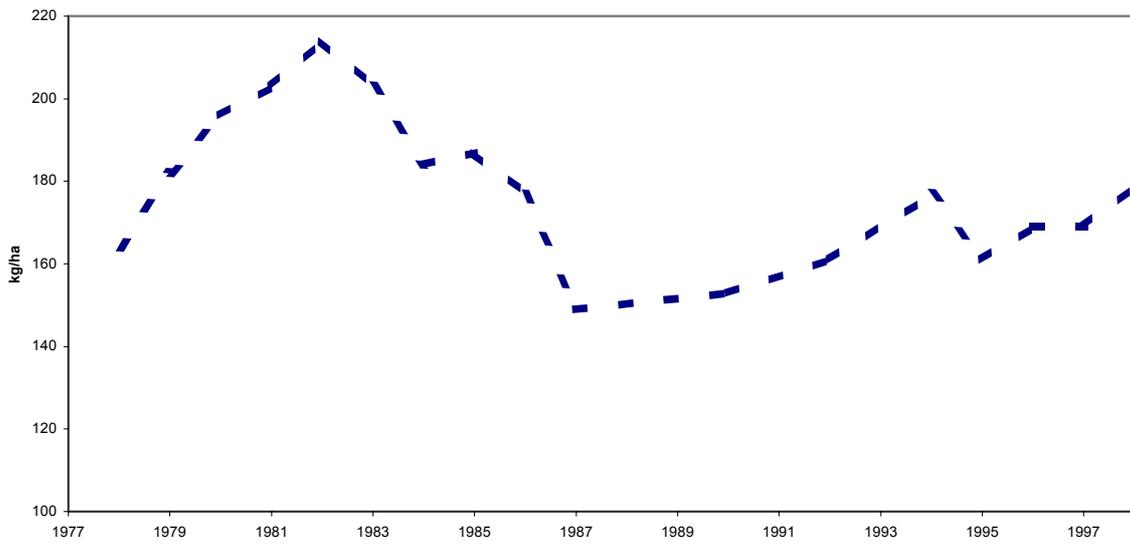


Figure 5 : Distribution of cotton plots according toused compound fertiliser and urea

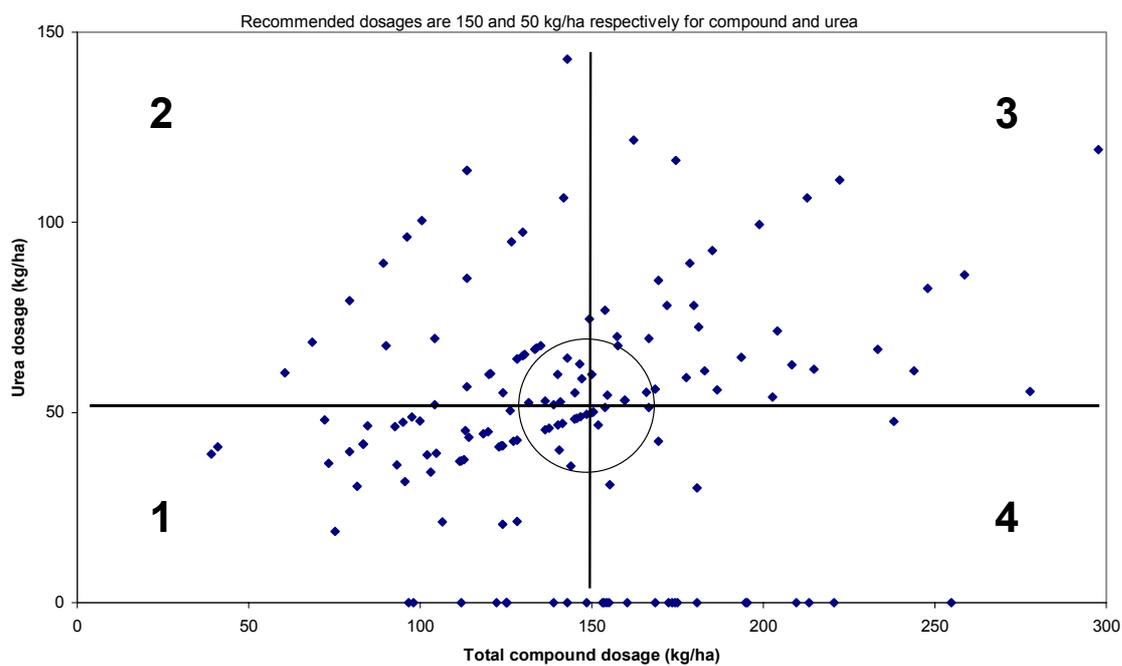


Figure 6 : Converging decrease of plant densities during thinning ioperations

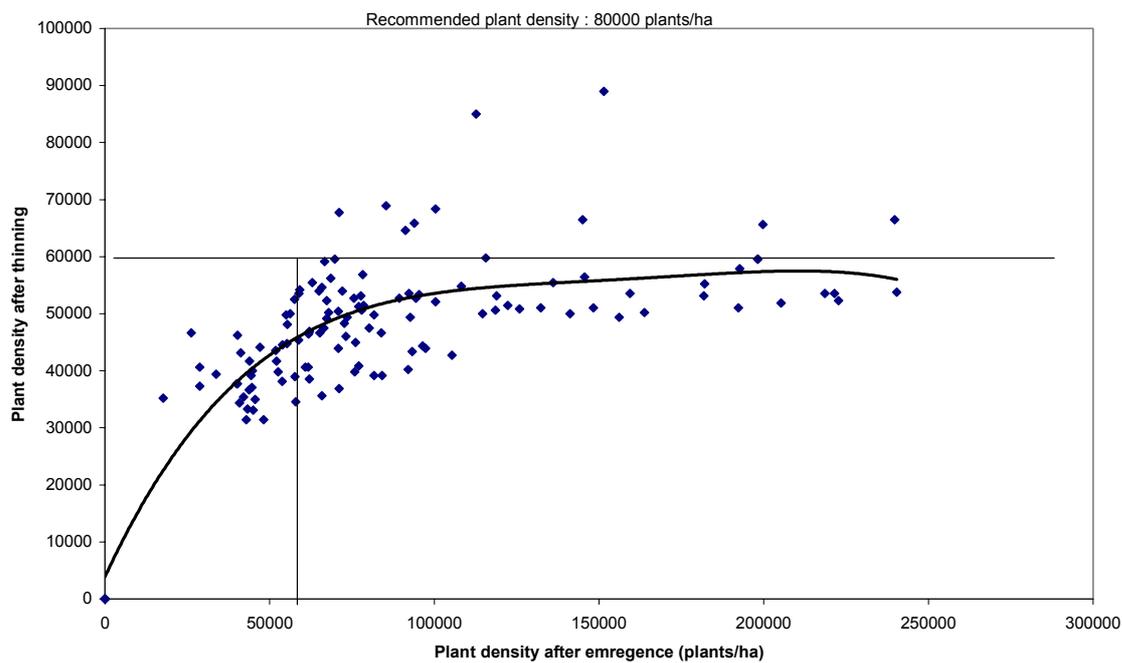


Figure 7 : Delay between thinning and first weeding

