

Perspectives on Growing Transgenic Cotton in Mali: Risks and Opportunities for Improving Yields and Revenues?

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By Dr. Amadou Aly Yattara,
Head, Cotton Program,
Sikasso CCRA BP 16.

amadou.yattara@ier.ml and/or amadoualyattara@yahoo.fr

1. The Importance of Cotton to the Country's Economy

The cotton sector plays a preeminent role in Mali's economy. It represents 8% of the GDP and 30 to 45% of export revenues, and employs about three million people in 178,615 small operations whose monetary revenues are furnished nearly entirely by cotton production. Each year, 85 to 123 billion CFA francs of gross income flow into the rural milieu and 5 to 10 billion in taxes are paid to the government (CMDT, 2006).

Furthermore, in rural areas, the income generated by this sector contributes to the implementation of the country's socioeconomic policy through the construction of social and health centers, schools, literacy centers, etc., by the rural residents themselves.

2. Status of Cotton Production

In Mali, cotton is produced under the supervision of the CMDT [Malian Textile Development Company] and the OHVN [Upper Niger Valley Agency] on about 500,000 ha per year, or 20% to 30 % of the agricultural areas planted by these two structures.

National production of seed cotton has increased regularly in the past few years. However, at the same time that production has increased, there has been stagnation or even a reduction in the average yield per hectare. In fact, analysis of the data from the CMDT's operational tracking show a continual drop in the average yields for cotton since the beginning of the 1990s. This has also been observed by farmers' organizations, training services (the CMDT and OHVN) and research services (IER [Institute for Rural Economy]). Average cotton yields for the CMDT zone, which were 1359 kg/ha in 1990, fell to 868 kg/ha by 2006.

In the absence of any specific diagnoses, a number of climatic, socioeconomic and agronomic causes have been advanced to explain this reduction in yield. Still, the impact of irregular rainfall, poor growing practices and insect attacks, including by the most dangerous, *Helicoverpa armigera*, seems fairly obvious as a contributing factor.

As far as the quality of seed cotton is concerned, in 2005-6 first-choice purchases represented 99.92%, second choice – 0.04% and third choice – 0.05%. However, it should be noted that the industrial classification of fibers after ginning does not confirm these data. For example, the gaps between the figures evaluated by farmers' groups when seed cotton is packaged and the industrial classification of the fibers after ginning was [sic] figured at 1,128,640,010 CFAF during the 2005-6 season compared to 2,349,271,645 CFAF and 3,820,828,615 CFAF in 2004-5 and 2003-4, respectively (CMDT, 2006).

3. Major Players and Participants in the Cotton Sector in Mali

Mali's cotton is produced by small operations organized into village associations (VAs). There can be several VAs in the same village. The VAs are responsible for determining the producers' minimum needs for production factors (fertilizers and insecticides), for contracting credit for the acquisition of the production factors (by offering a joint and several guarantee as security for the repayment of the collective loans), for weighing the cotton, and for distributing the profits from the sales, under the supervision of the CMDT and the OHVN.

Cotton producers are organized into trade unions (SYCOV [Malian Union of Cotton and Food Crop Producers], SYVAC [Union for the Improvement of Cotton and Food Crop Culture], SYPAMO [Union of Agricultural Producers of Western Mali] and SPCK [Union of Cotton Producers in Kita]) to uphold the members' interests. From 1994 to the present, the unions have been directly associated with management of the sector (IDB, 2004). They help set the level of marketable production and the prices paid to the producers, and track the real (reliable) cultivated areas through the village technical teams. They are also responsible for regularly and appropriately supplying industrial units with seed cotton once marketing begins, especially by improving the average loading level of trucks and the rotation rates. In the context of managing the "production factors" sub-sector, the unions also participate in developing terms of reference for the purchase of production factors, reviewing bids submitted, and awarding contracts.

Up until the recent past, research into all technologies for the development of production in the cotton sector was done by the IER through its specialized programs, including the cotton program, which were still receiving annual budget support in the amount of about 300 million CFAF for all of the various research activities, including the production of foundation seed. Since 2005, however, any other competent research and development institution can apply, on a contractual basis, for the provision of technical services and technology producers so as to remove the development constraints set forth in the CRRVA [Regional Research and Advisory Services Commissions] invitations to tender for research.

Transport is provided by the CMDT fleet and private operators. During the marketing process, seed cotton is transported at the same time as production factors, fiber, seeds and other products so as to minimize costs. It must be emphasized that the government has already decided gradually to withdraw the CMDT from transport activities.

Financing of the sector is provided by the local banking pool, with the BDM [Malian Development Bank] at the head of the line, supported by the external pool. Agricultural credit is provided by the BNDA¹, which grants loans to the VAs for purchasing agricultural production factors based on case files having received prior approval from the CMDT. This precautionary measure allows payments for the cotton to be made by transfer into the VAs' accounts.

Due to the limitations of the credit system through the CMDT and the inadequacies of BNDA interventions in the field, the Malian authorities have decided to diversify the credit institutions that are to provide farmers with a network of savings and credit institutions adapted to their needs. This is how *Kafo Jiginew* ("Granary Federation" in bamanankan, the

¹ The BNDA [National Agricultural Development Bank] was created at the beginning of the 1980s by the Malian authorities with assistance from the *Caisse Française de Développement* [French Development Fund]. Its usual calling is to become decentralized, collect farmers' savings, and gradually replace the CMDT for credit, which for a long time has been the CMDT's exclusive prerogative in the cotton zone of southern Mali.

most widely spoken national language), based in Koutiala, came to be created in 1988 in the form of an *association de droit local* [a type of non-profit governed by local laws].

The fiber produced in Mali is sold through the CMDT's Sales Management department in connection with a partner broker of DAGRIS [Development for Southern Agro-Industries], namely the "Compagnie Cottonnière COPACO" [COPACO Cotton Company] or by merchants.

Malian fiber is exported to every continent: 65% to Asia, 24% to Europe, 6% to the Americas and 4% to Africa. Malian mills (COMATEX-SA, BATEX-SA and FITINA-SA) process only about 1% of the national production.

4. The Organization of Seed Production

To ensure the sustainability of cotton production, the CMDT has a well-developed plan for producing seed of sufficient quality and in sufficient quantities. High-quality seed ensures the success of the crop and is a precondition for obtaining the agronomic and technological characteristics inherent in the variety cultivated.

The seed, which to date has been distributed "at no cost" to the producers, is produced from foundation seed² provided to the CMDT's Seed Production Division each year by the IER. It is then propagated on seed farms and by seed-producing farmers through a vast network extending over nearly all of the CMDT and OHVN regions.

In order to cover the CMDT's needs, it distributes 20,000 to 24,000 metric tons of seed per year, from all sources. A chemical delinting plant is operating in Sikasso and now for the first time has supplied delinted seed, which will be used for planting on farms during the 2007/08 season. With the production of delinted seed, the country's needs will decrease significantly from current levels. Improvements in seed quality are also expected.

The current seed propagation scheme is as follows.

² Pre-foundation and foundation seed propagation (G1-G2 and G3) provided each year by the IER are as follows:

- G1 self-fertilized lines: 15 to 30 created and/or introduced varieties,
- G2 in isolated plots without self-fertilization: about 20 varieties,
- G3 on isolated farm fields: 15 to 20 varieties publicly accessible or in advanced experimental stages.

Table 1: The various stages of seed propagation: description of the phases and specific instructions

Etapas ou vagues de multiplication	Variétés concernées	Caractérisation (description) du stade de multiplication et consignes particulières	Superficie. en m² ou ha	Lieu et Quantité probable de semence attendue	Responsable du suivi et du contrôle
G1	Nouvelles sorties de sélection et introductions	En général, la parcelle compte trois lignes dont les plants sont à autoféconder au maximum. Ce choix se justifie par la présence de plusieurs variétés se trouvant côte à côte. Pour les raisons d'insuffisance de la semence, on veillera toujours à semer dans de bonnes conditions d'humidité.	36 m ²	Station, 0,5 à 1kg	Recherche exclusivement
G2	variétés multipliées au stade précédent,	Les semences issues de G1, sont multipliées sur des parcelles isolées dans le domaine de la station et loin de toute autre culture de cotonnier. Les normes d'isolement sont de 150 m avec la présence d'un rideau végétal (mil, maïs, sorgho...), ou 300 m sans rideau.	900 à 1000 m ²	Station, 50 à 120 kg	Recherche exclusivement
G3	variétés déjà en vulgarisation ou susceptibles de l'être (expérimentation avancée)	Cette multiplication des semences produites en G2 est réalisée dans les environs immédiats de la station par des paysans multiplicateurs de très bon niveau de technicité. Afin de garantir les conditions d'une bonne production, tous les intrants sont avancés ou donnés gratuitement au paysan.	1 à 3 ha	Milieu paysan, 1 à 2,5 T	Recherche exclusivement
G4	Variétés proposées pour la vulgarisation	les semences produites en G3 sont multipliées dans les fermes semencières et sur un à plusieurs champs bien isolé(s) selon les normes et confié(s) à un ou plusieurs paysans de très bon niveau de technicité. Ces paysans doivent appartenir à un même village.	Une à plusieurs dizaines d'ha	Fermes ou milieu paysan, 35 à 70 T	CMDT avec appui recherche
R1	Variétés proposées pour la vulgarisation	Les semences produites en G4 sont à leur tour, multipliées sur une zone assez vaste bien circonscrite, indemne de la culture de toute autre variété, et à conditions climatiques sécurisées. Tous les paysans des exploitations de cette zone sont chargés de cette production.	Quelques centaines à 1000 ha	Milieu paysan, 600 à 1200 T	CMDT avec appui recherche

Etapes ou vagues de multiplication	Variétés concernées	Caractérisation (description) du stade de multiplication et consignes particulières	Superficie. en m² ou ha	Lieu et Quantité probable de semence attendue	Responsable du suivi et du contrôle
R2	Variétés vulgarisées	Même démarche que précédemment	milliers à dizaines de milliers ha	Milieu paysan, 10000 à 20000 T	CMDT
R3	Variétés vulgarisées	Même démarche que précédemment	dizaines à centaines de milliers ha	Milieu paysan, 160000 à 320000 T	CMDT
R4	Variétés vulgarisées	Même démarche que précédemment	centaines milliers ha	Milieu paysan, 160000 à 320000 T	CMDT

5. Current Assets and Constraints in Cotton Production

In Mali, cotton is produced as a rainfed crop in ecosystems that are relatively favorable for the crop (isohyets ranging from 750 mm in the north of the country to 1400 mm in the south) by producers whose strong base of technical knowledge allows them to be receptive to innovation and to quickly put new technical suggestions to work.

The rate of well-equipped farmers in the cotton zones is relatively high compared to the rest of the country. This allows seasonal plans to be completed within a fairly short period of time. Structures for training and specialized research also exist that are capable of producing innovations and ensuring that they are disseminated to the producers through the agricultural advisory service.

The relatively well-developed structure of the rural world, with the existence of producers' organizations based both on ancestral traditions of consultation, working in a farming society and mutual aid, and on more modern approaches of technical/economical management with literate and often trained leaders, are also advantages.

The existence of systems for supplying agricultural production factors and managing loans; the existence of mechanisms for setting and announcing a base purchase price that allows producers better to manage investment risks for the season; and the manual harvest practiced in Mali also number among the factors that contribute to secure, high-quality production.

Several studies have been conducted showing that the production costs for our cotton are competitive. Still, there have been real constraints in recent years. For example, production and productivity have become highly uncertain due to increasingly pronounced variations in the weather. Also, failure to apply the technical programs along with other socioeconomic difficulties observed in the cotton-producing zone have seriously affected the cotton sector's ability to compete. If appropriate solutions are not found and applied, we run the real risk of losing our competitiveness. This is a real worry because farmers and their families depend so heavily on the income from cotton.

In order to avoid such a prospect for a very large segment of our population (the producers) and for the country's economy, which also depends heavily on cotton, there is good reason to improve the productivity and quality of our cotton while awaiting the results of the cotton initiative set in motion in Cancun in 2003 by Benin, Burkina Faso, Mali and Chad to minimize the impact of the current depression on world exchanges, fiber prices and the dollar.

6. Project to Acquire Knowledge of the Risks and Benefits Related to the Use of Genetically Modified Cotton in Mali

In order to reverse the current trend of lower yields and lower incomes for the producing farmers, which also places Mali's economy in grave difficulty, we must seek quick, lasting solutions. It turns out that there is a new technology, based on the introduction of targeted genes of interest into the genome of a plant, that has made the creation of new varieties possible. Such "transgenic" varieties may provide solutions to the problems of managing excessive growth of grass in the fields and the cost of protecting plant health, which represents on average more than a third of the cost of the production factors applied to the cotton-growing industry in Mali. So improved competitiveness of the cotton could legitimately be hoped for.

However, introducing genetically modified varieties into Mali creates potential or established risks. These risks can be ecological, related to the artificial nature of the genetic transformations underlying these varieties, or associated with issues of the ownership of the seed and marketing rights. Mali is not prepared to evaluate and contain these risks.

Meanwhile, large segments of civil society, including the farmers' organizations, have publicly demonstrated and taken up the cause against the introduction of these varieties and even against any experimentation related to genetically modified organisms (GMOs). (CRA, 2006).

But alongside these highly unfavorable opinions of GMOs, meetings have been held with seed companies at the regional level, at the end of which resolutions had been made favoring the introduction of the GMOs (for example, the International Information Workshop on GMOs and Transgenic Cotton in Bobo-Dioulasso, September 9-11, 2003, arranged by SOFITEX [Textile Fiber Company of Burkina Faso] and Syngenta).

The Meeting of Experts at the ECOWAS Countries' Ministerial Conference on Biotechnology held in Bamako, Mali on June 21-23, 2005, then asked the member countries of ECOWAS to develop and adopt their national framework and laws on biosafety; to facilitate regional standardization of the biosafety system, with a view to creating the conditions for compliance with the precautionary principle when adopting biotechnologies and making use of the resulting products; and to implement the Regional Biosafety Strategic Plan for the benefit of and access to biotechnology in western Africa. The conference also requested that an independent fund for evaluating the socioeconomic impacts of using GMOs be set up. Such contradictory information helped inflame the debate.

The eminently complex nature of the technologies involved adds to the confusion. The few specialists are generally suspected of being advocates of introducing GMOs. The economic interests at stake are considerable, and often justify the mistrust of non-specialists.

Because of these recommendations, and being convinced that the confusion arises from a lack of objective information from a national source concerning the advantages and disadvantages for Mali of this introduction, the IER decided to write a project entitled "*Acquisition de connaissances sur les avantages et risques liés à l'utilisation du cotonnier génétiquement*

modifier au Mali" [Acquiring Knowledge of the Advantages and Disadvantages of Using Genetically Modified Cotton in Mali].

Its general objective is to gain knowledge of the potential positive and negative impacts of introducing and growing genetically modified cotton plants in Mali, and to disseminate this knowledge to Malian society in general and to those responsible for making decisions.

Its specific objectives are:

- to evaluate the effects of the genes introduced in current varieties of genetically modified cotton (protection against pests and herbicide resistance) under Mali's growing conditions;
- to evaluate the advantages and risks related to introducing GM cottons in Mali at the producer and country-wide levels;
- to disseminate the information gathered to Malian society in such a way as to improve the currently difficult dialogue between civil society and researchers on this topic;
- to train Malian executives in the techniques of molecular biology (without limiting the training to transgenic technologies) in order to better evaluate the impacts and advantages of introducing GM cottons into Mali.

In order to achieve these objectives, the following studies and accompaniment actions are contemplated.

- Evaluation of the effectiveness of the genes (toxin) carried by the transgenic varieties on the insect pests, beneficial insects and self-propagated cotton plants.
- Evaluation of the benefits and risks to farmers related to introducing GM cottons, through an understanding of the risks/benefits related to using GM cottons.
- Evaluation of the benefits to the country related to the introduction of GM cottons thanks to cotton's improved competitiveness due to increased income, but also risks due to restrictions on exportation, environmental risks such as resistance, the acceptability of GM cottons; property rights.
- Creation and strengthening of technical capabilities.
- Information: creation of a formal framework for sharing information with the partners, dissemination of the information through the media, arrangement of test site and laboratory visits.

Conclusions:

The importance of cotton growing to Mali's economy in general and the rural populations of cotton-growing areas in particular needs no further demonstration. However, the continual decrease in income due to low yields during recent years, and the very low fiber prices on the international market, demand innovative solutions, or there is a risk of seeing a significant portion of the economy collapse, with all of the resulting socioeconomic consequences.

Genetically modified cotton seems to be one of many ways to minimize costs and maximize profits. In any case, the fact that the areas occupied by this type of crop are increasing from year to year seems to indicate that there are advantages—which, however, there is good reason to verify for ourselves, because notwithstanding, this technology and its impacts are completely unknown to us.

Also, investigations to verify the biological effectiveness of the currently available toxins are absolutely necessary. The transformations that would have to occur in order for our varieties to acquire the sought-after properties if the results are positive will also require time and mastery of the tools. Moreover, even if we are successful, adoption [of the technology] is not reasonably possible without impact studies on all phases of production and on all the actions of the various stakeholders involved in the sector.

Implementation of the studies mentioned above should allow us to gain fairly clear ideas of the effectiveness of the genes (toxins) carried by the transgenic varieties on insect pests, beneficial insects, and self-propagated cotton plants; to form presumptive ideas about their socioeconomic and environmental repercussions; and so to decide with full knowledge of the facts whether or not it is necessary to adopt transgenic cotton.

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