

PROJECT PROPOSAL

Improvement of the Marketability of Cotton Produced in the Zones Affected by Stickiness

IMPROVEMENT OF THE MARKETABILITY OF THE COTTON PRODUCED IN ZONES AFFECTED BY STICKINESS

Project Summary

<u>Sponsoring institution</u>	:	International Cotton Advisory Committee (ICAC)
<u>Recipient of grant</u>	:	ICAC
<u>Project Executing Agency</u>	:	Sudan Cotton Company (SCC)
<u>Supervisory Body</u>	:	ICAC
<u>Location of the project</u>	:	Sudan and France
<u>Duration</u>	:	3 years
<u>Objective and scope</u>	:	Stickiness in cotton is mainly caused by sugar like excretions of two insects (<i>Aphis gossypii</i> and <i>Bemisia tabaci</i>), and results in severe disruptions in the spinning processes, thereby increasing the cost of spinning and reducing the quality of yarn. Cotton producers are faced with severe price discounts when selling their cotton originating from areas suspected to be contaminated with stickiness. In order for cotton to maintain its competitiveness <i>vis á vis</i> synthetic fibres on the world markets, and to at least maintain acceptable profitability levels in production, efforts need to be undertaken to reduce the production and processing costs. While another Fund-assisted project focuses on the development of an integrated pest management system to reduce stickiness in the field, the present project aims at the development of reliable methods to separate sticky cotton from non-sticky cotton and the determination of threshold levels for sticky cotton processing under varying environmental conditions. These latter trials will take place under real production/factory conditions. The methodologies to be developed and the experiences gained in this project will be of benefit to all cotton-producing countries affected by stickiness in one or more of their cotton-production areas. The project will comprise the following three components: (a) testing and evaluating the process for classifying sticky cotton; (b) establishing the processability of sticky

cotton; and (c) evaluation of the financial viability of the processes, training, and dissemination of the process developed by the project.

<u>Estimated total cost</u>	:	USD 2,059,988
<u>Financing sought from the Fund</u>	:	USD 1,101,093 (equivalent to approximately SDR.....)
<u>Counterpart contribution</u>	:	Sudan Cotton Company USD 280,733 Agric. Research Corporation USD 67,499 CIRAD USD 358,787 Institut Textile de France USD 207,026 ICAC USD 15,285 Total USD 958,895

ABBREVIATIONS AND ACRONYMS

ARC	-	Agricultural Research Corporation
CIRAD-CA	-	Centre de Coopération Internationale en Recherche Agronomique pour le Développement - Département des Cultures Annuelles
ITF	-	Institute Textile de France
ITMF	-	International Textile Manufacturers Federation
SCC	-	Sudan Cotton Company

I. INTRODUCTION

A. Project Background

1. The Standing Committee of the International Cotton Advisory Committee agreed on November 16, 1993, to sponsor a project entitled: " Sticky Cotton: Possible Control Methods from Plant to Yarn". The project focused on the elimination of the causes of stickiness in the field, the development of forecasting methods for areas likely to be affected by stickiness, the development of methods for separating sticky cottons from non-sticky cottons, and on the development of methods to treat stickiness after ginning. The project was submitted to the Fund and reviewed by the Fund's Consultative Committee at its Tenth Meeting in January 1994.

2. The Committee acknowledged the importance of addressing the problem of stickiness in cotton and its importance in the context of maintaining or improving cotton's competitive position *vis á vis* synthetic products. The Committee was, however, of the opinion that the first two objectives of the project would likely overlap with activities (to be) undertaken in an ongoing project "Integrated Pest Management for Non-Sticky Cotton", which is being implemented in Israel and Egypt, with field activities in Zimbabwe and Ethiopia. The third and fourth objective, however, were considered to be relevant and the proposal should thus be adjusted accordingly. Furthermore, it was emphasized that a dissemination component was lacking in the project.

3. The ICAC has prepared a revised project proposal taking into account the observations made by the Committee. The revised proposal, now entitled "Improvement of the Marketability of the Cotton Produced in Zones Affected by Stickiness" was reviewed by the Committee at its Fourteenth Meeting in July 1995. The proposal now focused on two objectives, namely the development of a methodology for systematically measuring stickiness in cotton for the purpose of separating sticky parts from non-sticky parts of the production; and on the development of methods which will enable the use of varying degrees of sticky cotton for spinning. It was the Committee's view that, subject to the inclusion of an appropriate dissemination component, the project could be recommended for consideration and approval.

4. In December 1995, it appeared that the counterpart institute, originally foreseen to play a central role in the project, decided to withdraw due to uncertainties with regard to its changing legal status, which negatively influenced its ability to make longer term commitments in the framework of the present project. Steps were undertaken by both the ICAC and CIRAD in order to identify another collaborating institute which had the technical and institutional capacity to execute the project and which had a confirmed interest in the project as designed. The Sudan Cotton Company was subsequently identified as a suitable new partner in the project. The Consultative Committee, in its Seventeenth Meeting in September 1996, agreed that the implementation and dissemination arrangements foreseen in the project and the commitment of the Sudan Cotton Company to carry out the project work is satisfactory and the Committee therefore agreed to recommend the project for approval by the Executive Board.

B. Overview of Structural Conditions in the Cotton Market

5. The basis for world cotton demand is the consumption of textile fibres, which in turn depends on the growth of the world economy. In the 1990s world income is expected to rise about 3% per year, with increases in population of about 1.7% and per capita income gains of 1.2%. With this level of income growth, textile fibre consumption should rise 2% per year, with

per capita fibre use rising from 7.3 kgs in 1988 to 7.6 kgs in 2000. Cotton is expected to retain its current share of world fibre markets of 46%, but no gains in share are expected. Thus cotton demand and production are likely also to increase at a 2% rate.

6. Cotton is an annual crop, and thus imbalances between the level of world consumption and world production can be corrected in a year or two, as long as market signals are transmitted to producers. It is expected that world production will be in balance with world consumption in 2000, at a level which is about 30% higher than output in 1993/94.

7. World cotton prices fluctuate from year to year, primarily in response to changes in world stock levels. There has been no secular increase in cotton prices in the last twenty years, and international prices since 1973/74 have averaged about US 73 cents per pound of lint delivered in Europe. Recent increases in average prices (due to low world stocks of cotton) led to an average price of US 86 cents per pound for 1995/96, but based on current estimates the price is expected to come down to US 75 cents per pound in 1996/97 and US 72 cents per pound in 1997/98.

8. Cotton remains in intense competition with synthetic fibres. In the last 15 years, cotton has regained share of market lost to synthetics in developed countries, due to market development efforts of cotton-producing countries, competitive prices and shifting tastes of consumers toward natural products. As much of the fibre consumed at the level of the final consumer in developed countries is processed in developing countries, textile mill use of cotton in developing countries has grown at a relatively rapid rate of 4% per year. Cotton share of textile fibre consumption at the consumer level in developing countries, however, has declined in the last 15 years from 66% to around 58%, as higher income levels have permitted consumers in many countries the ability to expand their purchases of synthetics, which are usually more expensive than cotton. Recently, however, cotton has lost share in Japan and many European developed country markets, perhaps due to reduced expenditures for cotton market development by cotton-producing countries. Some further decline is expected in cotton's share of market in developed countries in the period to 2000. In developing countries, cotton's share may hold at 58% as gains in cotton consumption take place in higher income developing countries.

9. The location of cotton production and consumption continues to change. In recent years, there has been increasing concentration of world cotton production, with nearly three-quarters of the total now originating in five countries: China, USA, Uzbekistan, India and Pakistan. It is expected that developed countries will be an increasing source of raw materials for developing countries in the rest of the 1990s. Textile industries in developing countries are expected to expand in both cotton-producing and cotton-importing countries.

10. The restructuring of the economies and societies in Eastern Europe, the former USSR and South Africa, has led to sharp declines in textile industry activity in these countries and have had a profound impact on cotton markets in the last five years. Textile fibre consumption is expected to recover in many of these markets in the period to 2000, leading to renewed cotton trade flows. The elimination of the Multi Fibre Arrangement, the basis for import quotas for textile products from developing countries in the USA and Europe, should lead to a more rational geographic location of trade in the next 10-15 years. While agreements under the GATT Uruguay Round are not expected to have any major impact on government policies toward cotton, the environment for reducing trade barriers and subsidies in agriculture is improved and there may be further movement toward freer markets as a follow through to the GATT agreement. This may improve the prospects for cotton.

C. Consistency with the ICAC Strategy for Cotton Development

11. Stickiness in cotton is considered by the members of the ICAC as one of its key priority areas for study and research. As stickiness in cotton increases both production costs as well as processing costs (thereby also reducing producer prices), the Standing Committee of the ICAC has earlier recommended projects for financing by the Fund in the field of crop protection, while the present project is the highest ranked priority project focusing on the post-harvest side of combatting stickiness and damage control activities. Problems associated with the processing of contaminated cotton need to be resolved if cotton is to remain competitive with synthetic fibres while producers still receive remunerative prices. It is recognized by the ICAC members that many developed cotton-producing and -consuming countries have the expertise and the means to address these problems. However, most developing countries do not have the research capacity and the financial means to solve these key problems. It is these countries that are most subject to losses in income and loss of markets if solutions are not found. The ICAC has therefore acknowledged the importance of the exchange of technical information between member countries and close cooperation in the solution of mutual problems. The proposed project is an example of both ICAC's prioritization of activities and the recommended international cooperation.

D. Relevance of the Project to the Objectives and the Policies of the Fund

12. The project is focusing on measures to reduce losses in the value and quality of cotton, thereby improving its competitiveness. It relates to the development of methods to determine the quality of the cotton produced and the level of processability of contaminated cotton. It is expected to result in increased revenues for the producing countries. In line with the Fund's priorities, the project aims to improve the competitiveness of a natural product and to support research and development related to the processing of natural products for which synthetics and substitutes exist. It will thus strengthen the competitive position of cotton which is facing an increasing competition from synthetic fibres. Furthermore, the focal countries for adoption of the process to be developed are developing countries and the main centre of project operation is Sudan, which is a Least Developed Country, heavily dependent on cotton for its economic development. The results of the project will, however, be readily applicable in all other countries facing stickiness problems in the cotton-producing areas. It may thus be considered that the project is in line with the Fund's objectives and policies.

E. Previous Support to the Commodity

13. The first cotton project approved by the Executive Board for financing by the Fund, was a study in 9 major cotton-producing countries, analyzing the factors behind the differential performances of the cotton sector in those countries. That project, entitled "Study of Cotton Production Prospects for the Nineties" was implemented by the International Bank for Reconstruction and Development (World Bank) and was recently completed. The Fund is presently supporting three ongoing projects sponsored by the ICAC. The three projects are : "Integrated Pest Management for Non-Sticky Cotton" implemented in Israel, Egypt, Ethiopia, Zimbabwe; "Integrated Pest Management of the Boll Weevil in Argentina, Brazil and Paraguay; and "Genome Characterization of Whitefly-transmitted Geminiviruses of Cotton and Development of Virus-resistant Plants through Genetic Engineering and Conventional Breeding". Activities for this latter project take mainly place in Pakistan, the UK and the USA.

All three projects focus on (applied) research in the field of improving cotton production through the development and introduction of efficient and environmentally acceptable crop protection methods as well as developing disease/pest-resistant cotton varieties. The total amount of financing already expended and committed in relation to support for cotton projects amounts to SDR 4,938,593, i.e. 16.6% of the total CFC commitments (as at 31 August 1996).

II. PROJECT DESCRIPTION

A. Project Rationale and Objectives

14. The stickiness problem is very complex as the stickiness of the cotton can be due to *inter alia* the following factors: various contaminants (seed coat fragments, neps, insecticides, oil, etc.); physiological sugars, mainly composed of reducing sugars and nectary secretions; and entomological sugars composed of reducing and non-reducing sugars (honeydew). This latter cause of stickiness/contamination has, for the last few years, been by far the most prevalent form of contamination, and is subject of the research undertaken in the framework of the Fund-supported project in Israel, Egypt, Ethiopia and Zimbabwe, focusing on the reduction of stickiness through effective crop protection methods based on principles of effective integrated pest management. The present project has its focus on the post harvest stage of cotton production.

15. The occurrence of stickiness is not confined to one or a few countries. This phenomenon, which was of little importance in the beginning of the 1980s seems to have become generalized. A survey undertaken by the International Textile Manufacturers Federation (ITMF) involving 235 companies in 30 countries showed that the stickiness problem is increasing. According to the ITMF report "Cotton Contamination Survey 1995" 20% of the surveyed samples had some level of stickiness. Stickiness has therefore become a worldwide problem. Over the last few years all those involved in the cotton industry, from the producer to the spinner, have become increasingly concerned about the problems related to stickiness and have attempted to find a remedy.

16. Sticky cottons cause disruptions in the spinning process, fouling the cards, the brush tables, the feed trays and the rotors in open end spinning. Apart from the frequent stoppages which require cleaning of the machines, these honeydew deposits also cause irregularities in the card web, slivers and threads, and lead to the production of poor quality yarn. Once sticky cotton is there, the only solution is to isolate the sticky cotton from non-sticky cotton in order to save heavy economic losses to the growers in areas where the problem exists. Stickiness cannot be detected by observation of the cotton during harvesting or during the ginning process. The stickiness problem is usually detected during spinning. It is a time when nothing can be done except to spin whatever is available. In order to avoid unexpected obstructions of the spinning process, cotton spinners only pay the regular price for ginned cotton when they are certain that the cotton lint is clean and does not contain impurities which affect the spinning process. In case of any doubt they will offer only discounted prices for the 'suspect' cotton. These discounts, ranging from 5-30% of the price, are mostly applied indiscriminately to all cotton originating from an area considered to be affected by stickiness. The development of a method to establish an acceptable level of stickiness in cotton bales and to establish operational thresholds in the processing of sticky cotton will have the dual benefit of protecting growers against unjustified price discounting, and it will enable spinners to spin such a cotton through adjustments in the machinery and spinning conditions or through mixing with non-sticky cotton.

17. The **central objective** of the project is therefore to increase the return on cotton to producers through the development of reliable methods to establish the level of stickiness in cotton bales, and the establishment (under factory conditions) of operational thresholds for the processing of contaminated, sticky cotton. The establishment of processes to successfully deal with the problems of stickiness in cotton will not only raise prices of cotton in currently affected regions but will increase their quantity of marketable cotton.

B. Description of Project Components

18. The project comprises the following four components: (a) Testing and evaluation of methods for establishing the degree of stickiness in cotton production; (b) Development of a threshold to enable economical processing of sticky cotton; (c) Evaluation of the financial viability of the process developed under the project, training, dissemination of project results through presentations, publications and technology transfer; and (d) Project coordination, supervision and evaluation.

(a) Testing and evaluation of methods for establishing the degree of stickiness in cotton

19. Studies will be conducted to test, evaluate and monitor stickiness in cotton in order to separate sticky cotton from non-sticky cotton, and establish the degree of stickiness. The studies will be conducted jointly by staff of the Sudan Cotton Company (SCC), the Cotton Programme of the Agricultural Research Corporation (ARC) of Sudan; the Cotton Programme of CIRAD-CA; and Institut Textile de France (ITF). The SCT-CIRAD thermodetector, developed by the Cotton Technology Laboratory of CIRAD-CA, will be used to analyze stickiness. The detection of cotton stickiness using the thermodetection method is based on the deposit of sticky substances onto two aluminium sheets. The cotton sample is heated via a hot plate and releases its humidity. This humidity is absorbed by the honeydew which then sticks to the aluminium sheets during a second, cold-press, phase. The number of sticky points counted is a measure for the level of stickiness of the sample. This thermodetector has been recognized by the International Textile Manufacturers Federation as a reference method to measure stickiness in cotton. Six units are envisaged to be required for the purpose of the project. The units will be placed in different locations in SCC and ARC premises in the country, in accordance with the minimum requirements for the necessary measurement capacity. Of these six units only three will be financed by the Fund, the three other units will be financed by the SCC.

20. Investigations and measurements will focus on the determination of the level of stickiness in cotton from different production areas. Measurement and determination of the degree of stickiness would be carried out for different qualities. The present situation for the cotton classification is:

- seedcotton: classification based on 3 grades for the Acala types and 6 grades plus half grades for the long and extra long staple. The seed cotton is ginned according to grades.
- lint: the bales are classified on the base of one sample per bale by human classers (grade and staple length).
- in addition around 1000 commercial samples per year are evaluated by ARC for length (with fibrograph), strength (with stelometers and pressley), fineness and

maturity (with FMT), and stickiness (with minicard). The SCC has recently ordered an HVI (High Volume Instrument) Zellweger Uster to complete the equipment of the ARC cotton research laboratory.

The separation of sticky cotton from non-sticky cotton and the evaluation of the degree of stickiness will be undertaken under different ginning methods (roller ginning and saw ginning). For each ginning method approximately 500 bales (a total of 1000 bales will therefore be covered) will be tested by taking and testing at least 16 samples per bale, for stickiness. Out of the 500 bales tested for each ginning method, 60 bales will be selected for tests under component (b) below. For all bales tested, the relationship between the level of stickiness and the level of infestation by white flies and aphids (which are the main causes of stickiness) will be investigated. Variations due to sampling techniques will be analyzed and eliminated/minimized for both roller and saw ginned cotton. Once reliable measurements have been obtained, efforts will be undertaken to establish the minimum number of readings required to measure the stickiness levels for both roller ginned and saw ginned cotton with an acceptable level of accuracy. Based on the test results bales will be separated into low, medium and high stickiness and offered for sale. Ultimately the project findings will be used to formulate a strategy for the implementation of a stickiness determination programme at the national level, through the testing of 5% each of the representative samples for both saw ginned and roller ginned cotton. About 30,000 bales will be tested annually. Corroborative re-tests will be undertaken on 2,000 to 3,000 samples by an independent laboratory (of *Cotton Incorporated, Raleigh, USA*) without charge to the project. Finally attention will be given to the implications for cotton export management. Instead of one category of cotton now exported, at least two but possibly more categories of cotton will be offered for sale (free of stickiness, and (in one or more grades) sticky cotton). In this way premiums will be obtained for high quality cotton which hitherto has been subject to generalized pricing and has suffered from unnecessary discounting for stickiness.

21. In order to achieve the objective of developing, testing and evaluating reliable methods for establishing the level of stickiness in cotton bales, the following outputs need to be produced through the implementation of the described activities.

Output 1.1 Investigate stickiness in cotton coming from different producing areas (Medium staple, Long and Extra Long Staple areas for both roller and saw ginned cotton).

Activity 1.1.1 Bale samples from various areas famous for producing sticky cotton in Sudan will be collected, for roller ginned cotton. Around 500 bales will be tested using at least 16 samples per bale (one sample per layer of fiber).

Activity 1.1.2 Bale samples from various areas famous for producing sticky cotton in Sudan will be collected, for saw ginned cotton. Around 500 bales will be tested using at least 16 samples per bale (one sample per layer of fiber).

Activity 1.1.3 Using the thermodetector, samples will be analyzed for stickiness.

Activity 1.1.4 60 bales will be chosen for the objective 2.

Activity 1.1.5 For the 1000 bales tested (500 for roller ginned cotton and 500 for the saw ginned cotton) the relation between the level of stickiness and the level of infestation by white flies and aphids will be investigated.

Output 1.2 Variation due to sampling techniques will be investigated and eliminated/minimized for both roller and saw ginned cotton.

Activity 1.2.1 Methods will be determined and perfected to take samples and also take measurements of the samples in respect of stickiness of cotton for roller ginned cotton.

Activity 1.2.2 Methods will be determined and perfected to take samples and also take measurements of the samples in respect of stickiness of cotton for saw ginned cotton.

Output 1.3 The minimum number of tests required to know the actual level of stickiness from a given sample or produce will be determined.

Activity 1.3.1 For uniform measurements and better reproducibility of the results, the minimum number of readings required to measure the stickiness level will be established for the roller ginned cotton.

Activity 1.3.2 For uniform measurements and better reproducibility of the results, the minimum number of readings required to measure the stickiness level will be established for the saw ginned cotton.

Output 1.4 Bales with low, medium and high stickiness will be separated and offered for sale accordingly.

Activity 1.4.1 Studies will be undertaken to assess the extent of variability in the level of stickiness from one bale to the other.

Output 1.5 A full package will be decided to determine the actual level of stickiness for all the produce in the country.

Activity 1.5.1 A strategy to monitor and evaluate the stickiness will be finalized.

Activity 1.5.2 The results will be applied on representative sample of the produce for roller ginned cotton (around 5% of the roller ginned cotton bales will be tested).

Activity 1.5.3 The results will be applied on representative sample of the produce for saw ginned cotton (around 5% of the saw ginned cotton bales will be tested).

Activity 1.5.4 The Sudan cotton production is around 600,000 bales per year, the representative sample of the production (5%) will represent around 30,000 bales. Two to three thousand samples will be retested by an independent laboratory (Cotton Incorporated, Raleigh, USA) free of charge.

Activity 1.5.5 The bale management for export will be studied as the number of categories for sell will be at least multiplied by two (free of stickiness bales and sticky bales).

(b) Development of a threshold to enable economical processing of sticky cotton

22. Methods for neutralizing stickiness are under development by CIRAD. The laboratory work carried out so far indicated that stickiness can be neutralized to a large extent without affecting the quality of cotton so treated. Employing a neutralizing process requires additional time and cost and should only be used if financially advantageous. The establishment of the thresholds for spinning sticky cotton will therefore be of major advantage to the spinning industry. The main focus of this component is to establish such a threshold.

23. Main activities envisaged to be implemented under this component will take place in France in the facilities of the Institut Textile de France, where in close consultation with CIRAD, research activities will focus on the impact of varying degrees of stickiness on the spinning process (at factory scale) and on the variables which influence this impact. Sticky cottons disrupt the spinning process by sticking to various parts of the spinning machines. The problem varies depending on the stage of the process leading to the production of the yarn. Cotton fibre preparation (beating, mixing, opening, cleaning) is affected greatly if the quantity of sticky cotton involved is very large (several hundred kilograms). Stickiness has a considerable effect during carding and leads to irregularities in card slivers or, in extreme cases, renders carding impossible. The machines must then be stopped and cleaned. As far as the drawing frames, brush frames and spinning machines are concerned, the honeydew is deposited onto the rollers (feed, draw, etc.) and causes yarn irregularities and breakages. Rotor spinning suffers from problems such as the frequent fouling of the feed tables and rotors, which requires machines to be stopped repeatedly and cleaned. The result is lower yarn quality and higher production costs.

24. Activities related to developing after-ginning measures as foreseen in the project will be largely based on experiences gained by CIRAD in earlier work on the neutralization of stickiness in cotton (in particular the impact of pressure, heat and humidity which has been studied and applied under laboratory conditions). Research that made use of the SCT-Thermodetector has revealed that the number of sticky points of the samples being tested fluctuates depending on the relative humidity of the ambient air. Results in the 55% to 65% range seem to be stable. Outside this range there is a marked fall in the number of sticky points. The maximum sticky potential is therefore expressed between 55 and 65% relative humidity, which means that there are 2 ways of neutralizing stickiness: drying or humidification. The so-called TNCC9 of **neutralizing** stickiness developed by CIRAD uses the same combination of factors as the thermodetector, i.e. pressure, heat, humidity. A brief summary description of this method is given in Appendix V.

25. The activities to be undertaken in the framework of the project will cover the determination of the impact of the use of sticky cotton on the spinning process as well as on the

quality of the yarn and the resulting product. The threshold levels for the use of sticky cotton that will still yield an acceptable quality for different end products will be established. Also tests will be undertaken to assess to what extent sticky cotton can be blended with non-sticky cotton to obtain an acceptable level of quality, which will allow spinning without disrupting the regular spinning process. The tests will differentiate between conventional (ring) and rotor spinning, and will be effected in varying atmospheric conditions in order to establish the impact of different moisture and temperature levels. All tests will be performed under industrial conditions, and will use the lint from the 60 bales classified as to the degree of stickiness in component (a) above (approximately 13,500 kg). Quality tests will be undertaken in the ITF and CIRAD laboratories using certified measuring equipment and described procedures for the establishment of the properties/deficiencies to be determined.

26. In the framework of this components, the following outputs will be produced through undertaking the described activities.

Output 2.1 The effects of spinning sticky cotton on the spinning process and quality of yarn or resulting product will be determined. About 400 kg of each cotton (about 2 bales) will be required from preparation to drawing. 100 kg of lint will be sufficient for the spinning process. All tests (on 30 x 2 bales) will be performed under industrial conditions. Breakages at different steps in the process will be counted and the production process will be evaluated through spinning.

Laboratory tests will consist of measurements of

! fiber length and strength characteristics, measured on an HVI Zellweger-Uster line (on raw fiber and card sliver), maturity and fineness, using a Shirley Maturity Meter.

! level of stickiness established using a SCT sticky cotton detector at each step in production from bale to the second drawing, to evaluate any variation that occurs during the production process.

! regularity at each step in the production process (card sliver to yarn) using a Uster Tester II regularimeter, and the strength of the yarn produced (Super web apparatus).

! classimat, to classify the different defects (Uster, Classimat II).

The level of stickiness during spinning will thus be evaluated:

! firstly by qualitative analysis of the stickiness during different steps in the production process

! and secondly by the quantitative analysis of the laboratory tests in comparison with non sticky cottons.

The same cotton batches will be used in rotor spinning. The controls performed during the production process and the laboratory tests carried out will be the same as for the conventional spinning process. The quality of the yarn from the resulting product will be determined by making use of the method developed by the Cotton Technology Laboratory of CIRAD-CA that differentiates between neps according to their different origins, seed coat fragments, fiber neps, sticky neps and stem or leaves fragment neps defects. This method will be used to count

the number of neps induced by stickiness in the industrial yarn.

Identification and enumeration of the yarn neps

The method consists of regularimetry tests performed on a Uster UT3 regularimeter. The settings chosen will be as follows: speed 50m/mn, thin (-50%), thick (+50%), neps (200%).

These settings will be used for the two regularimeter tests, i.e. normal test and detailed analysis.

! Normal test to get the total number of neps.

! Detailed analysis: a detailed analysis of neps will be performed to identify the different neps observed. Each imperfection is examined in detail with the help of a magnifying glass and strong lighting. The yarn is stopped during a given period of time (20 seconds), then is loosened to obtain the stabilization during 5 seconds before the reading. Imperfections will be classified as seed coat fragments, fiber neps (entangled fibers and sticky neps), fragments such as leaves. Percentages obtained for each type of imperfection will be adjusted to total neps on 1,000 m to obtain the number of neps per type of imperfection on 1,000 m.

Activity 2.1.1 Cotton with known levels of stickiness will be spun on **ring** and **rotor** spinning machines (industrial scale).

Activity 2.1.2 The effects of spinning sticky cotton on the spinning process and resultant yarn quality will be established.

Output 2.2 Stickiness thresholds for spinning will be established.

Activity 2.2.1 It will be determined that what levels of stickiness are economically acceptable to spin on ring and rotor spinning machines (industrial scale). A level of stickiness which should not be spun without treatment will be established.

Output 2.3 Blends of sticky cotton with non-sticky cotton will be prepared such that stickiness will not be a problem during spinning. One way of using sticky cottons would be to mix them with non sticky cottons in order to obtain a mix whose stickiness is below the critical spinning threshold. The proportions of each type of cotton would depend upon the potential stickiness of the contaminated cotton which depends on at least 2 factors:

! the number of sticky points measured on the sticky cotton detector
! the distribution and size of these sticky points.

Five types of cotton (among the 30 employed in the industrial spinning tests) will be used (for example with 25, 50, 75, 100 and 150 sticky points). These cottons will be mixed in various proportions with non sticky cotton.

The number of sticky points along with their size and distribution will be studied.

Activity 2.3.1 Mixes of cottons from different origins (sticky and non sticky) will be prepared.

Activity 2.3.2 Cotton mixes will be measured with stickiness detector and standards will be established which will be helpful for the spinners to mix sticky cotton with non-sticky cotton without having any effect on the spinning process (ring and rotor) and the yarn quality.

Output 2.4 The effect of atmospheric moisture on cotton stickiness will be established. The relative humidity of the air is known to have an effect on the spinning of sticky cottons. Spinners use this property in an empirical manner. The aim of this study is to determine the critical threshold for the relative humidity of the air during spinning cottons of different stickiness levels (number of sticky points and their sizes).

Six types of cotton (among the 30 employed in the industrial spinning tests) will be used. The study of the spinning process (microspinning) under different relative humidity conditions, will be performed using conventional and rotor spinning techniques for three types of yarn counts.

All the disruptions that occur during the yam production process (carding, drawing, spinning, rotors) will be evaluated (deposit of sticky points on various parts of the machines, yarn winding, yam breakages, etc.). Yarn strength and regularity will be measured. Different types of neps will be identified, counted and studied.

Activity 2.4.1 The effect of atmospheric humidity on the process of spinning sticky cotton and yarn quality will be established.

(c) Evaluation of the financial viability of the process, training, dissemination of project results through presentations, publications and technology transfer

27. On the basis of relevant financial and production data, obtained in the course of the project, a comprehensive financial analysis will be prepared in the third project year. This analysis will establish the financial and economic viability of the processes using the Sudan situation as a practical case study. A model for making projections of benefits to other countries wishing to adopt the processes will be included in the report. The risks will also be clearly stated.

28. The achievements of the project will be documented in regular progress reporting to the ICAC and the Fund, but above all in technical reports which will be presented at relevant meetings organized in the framework of global ICAC meetings or in workshops and seminars organized by other organizations (e.g., the African Cotton Research Network-ACREN, the Conference des Responsables de la Recherche Agronomique Africain-CORAF and the Interregional Cooperative Research Network on Cotton for the Mediterranean and Middle East Regions).

29. In order to provide hands-on exposure to the methods used in the project, be it with regard to activities related to the determination of the levels of stickiness in cotton bales or to the

processing of sticky cotton, a provision is made in the project budget for a training/visiting programme in the third project year for technicians from interested developing countries. The modality for the programme as well as the determination of the number of participants will be determined by the PEA and the Supervisory Body in close consultation with the Fund. A provision has also been made for an international workshop to be organized in Sudan towards the end of the project for dissemination of the project results. Given the close link with the earlier mentioned Fund-financed Integrated Pest Management project in Israel, Egypt, Ethiopia and Zimbabwe, representatives from that project are envisaged to participate in the presentations and discussions of the results of the present project where considered relevant. In preparation for this workshop, a handbook describing the project results as well as the methodologies and techniques used in the project will be published in three languages (English, French and Spanish) and be made available, at a price to be determined, to commercial and non-commercial operators. This publication will be the property of the Fund.

30. The objective of the component is to be achieved through the following outputs and activities.

Output 3.1 Providing information on project activities and results to other cotton-producing countries in Africa

Activity 3.1.1 Dissemination of information on project activities and results annually through the network of cotton-producing countries in Africa.

Activity 3.1.2 Dissemination of information on project activities and results annually through the network of cotton-producing countries in Africa through the Mediterranean network.

Output 3.2 Providing information on project activities and results to cotton-producing countries outside of Africa

Activity 3.2.1 Annual workshop on efforts to combat stickiness and its effects conducted as a part of the meeting of the Committee on Cotton Production Research of the International Cotton Advisory Committee, held at Plenary Meetings, and attended by researchers from member countries and observers.

Activity 3.2.2 Organization of a training/visitors programme for groups of selected staff at interested organizations.

Activity 3.2.3 Organization of an international workshop to disseminate the results of the project.

Output 3.3 Financial Analysis Report

Activity 3.3.1 Throughout the duration of the project, data will be collected related to present production, grading, pricing and marketing of cotton as well as with regard to the use and cost of the new methodology resulting in different qualities of cotton in as far as related to stickiness levels.

Activity 3.3.2 Based on the data gathered through Activity 3.3.1, all inclusive financial and detailed analysis will be prepared by the PEA, possibly in cooperation with an international specialist in the field, on the viability in economic/financial terms of the stickiness detection process and the development of the after-ginning methods to enable processing of sticky cotton.

Output 3.4 Publication of a handbook for commercial utilization of project findings.

Activity 3.4.1 In preparation for the workshop in Activity 3.2.3, a handbook will be prepared in English regarding procedures necessary for the separation of sticky cotton from non-sticky cotton.

(d) Project coordination, supervision and evaluation

The Project Executing Agency for the project will be the Sudan Cotton Company (SCC), which will be the responsible institute for the overall implementation and day-to-day management of the project. It will coordinate the activities to be undertaken in the different components of the project and will ensure that they are planned and implemented in such a manner that they are contributing effectively and efficiently to the achievement of the described objectives of the project. The PEA will receive management support from CIRAD when and where necessary, during the scheduled visits of the CIRAD principal investigator (who is the Head of CIRAD-CA) to Sudan. The PEA will prepare annual work programmes and budgets, six-monthly progress reports and annual monitoring reports, and administer the project financially. A technical evaluation of the project, foreseen in the third project year, will be organized in consultation with the Fund and the Supervisory Body, and a Project Completion Report will be prepared by the end of the project.

C. Benefits

31. It is envisaged that successfully implemented tests will lead to the establishment of reliable and accepted methods of determining the level of stickiness in individual cotton bales, which will reverse the current practice of indiscriminate price discounts. A major benefit of the project will be found in the fact that cotton-producing countries will be able to have access to the techniques and methodologies used in this project and these are envisaged to be directly applicable in other countries.

32. The main benefit of a successfully implemented project is ultimately to be found in the rationalization of price discounts on the basis of the degree of stickiness instead of the present practice of indiscriminate price discounts on cotton producers in areas suspected to be contaminated with stickiness. Establishment of reliable stickiness levels in cotton bales offered for sale should enable the selling party to obtain better prices for his lots. An indicative example may provide an illustration of the benefits to the producer. For Sudan, the annual cotton fibre production is approximately 110,000 tons, which can be valued at a average CIF Europe price of

approximately USD 2,000/ton. With an estimated discount due to stickiness of 7.5 % (the average between the conservative estimates of the regular discounts amounting to 5 - 10%), the loss resulting from indiscriminate discounting is approximately USD 16,500,000 (namely 110,000 tons x USD 2,000 x 7.5%). If the sticky part could be separated from the non-sticky part of the production, and only the sticky part of the cotton production would be faced with a price discount, then (supposing that 80% of the production is not affected) the loss would be largely reduced to USD 3,300,000 (calculated as 110,000 tons x 20% x USD 2,000 x 7.5%). Once the degree of stickiness can be established, this can be factored into cotton quality determination and prices determined accordingly.

33. The financial savings from increasing the utilization of the sticky portion of the cotton production will depend on the results of the research. Severely sticky cotton has very little value to the textile mill and such cotton may be sold for non-spinning uses at perhaps one third of its spinning value. The establishment of a threshold for spinning sticky cotton and the development of methods to spin the sticky cotton provide a possibility for using severely sticky cotton through mixing with better cotton to obtain an acceptable threshold. Advice on such mixing will be a subject of techno-economic evaluation of this aspect in the financial viability of the process to be carried out under the project.

34. The project includes a calculation of financial returns of adopting the technology using the Sudan as a real case study.

D. Project Target Beneficiaries

35. The initial, direct, beneficiaries will be the two key institutes in Sudan that play a central role in the project, namely the Sudan Cotton Company and the Agricultural Research Corporation, as they will have the immediate benefits from material and scientific resources made available through the project. Staff of these institutes will be exposed to improved and sometimes novel technologies and techniques. The project strengthens these institutions.

36. The ultimate beneficiaries will be the individual cotton producers, not only in Sudan but in all member countries of the Fund and ICAC presently facing indiscriminate price discounts ranging from 5 to 30% for their crops when they are considered to be produced in an area affected by stickiness. The project therefore is expected to lead to an increase in income, both at producer level and at country level, for these countries. In the latter case, this should have a positive impact on the foreign exchange earnings. In addition, the results of the improved processing techniques to be experimented with at factory level, are expected to lead to a reduction of cost of spinning cotton, which is in the interest of the spinning industry world-wide. Once the stickiness level is factored into the quality level of cotton and price determined accordingly, the cotton farmers will benefit from better pricing of their cotton.

E. Project Costs and Financing

37. The project costs have been estimated at USD 2,059,988 over three years. The summary cost table, by component, is given below in Table 1. A summary cost table reflecting the expenditures by year for each component is provided in Appendix II Table 1. A detailed cost table, providing the indicative quantities and related amount for the inputs to the project, is provided in Appendix II, Table 2. The use of the funds thus earmarked for expenditures per expenditure category by project component will be in accordance with the relevant procedures of

the Fund. The project would be financed by a grant contribution of USD 1,101,093 (53% of the total project costs) from the Fund, while the counterpart contributions are estimated at USD 958,895. The proposed financing plan for the project is shown in Table 2 below.

Table 1
Summary Project Cost by Component
(USD 000)

Component	Total Base Cost	% of Total
a. Development of an evaluation method	941	46%
b. Anti-stickiness measures	824	40%
c. Dissemination	122	6%
d. Project management	72	3%
Sub total	1959	95%
Contingencies	101	5%
Total	2060	100%

Table 2
Proposed Financing Plan
(USD 000)

Component	CFC	SCC	ARC	CIRAD	ITF	ICAC	Total Base Cost
a. Development of an evaluation method	444	281	67	149			941
b. Anti-stickiness measures	378	29		210	207		824
c. Dissemination	122						122
d. Project management	57					15	72

Contingencies	101						101
Total	1102	310	67	359	207	15	2060
% Financed	53.4 %	15.0%	3.2%	17.4%	10%	1%	100%

F. Procurement, Disbursement, Accounts and Audit

38. **Procurement** will be in accordance with the Fund's Rules and Regulations for the Procurement of Goods and Services of the Second Account for all items financed by the Fund. Since only specialized machinery and equipment will be procured, and since the source of supply is limited, there will be no need for procurements under International Competitive Bidding (ICB). Contracts with a value of USD 5,000 or more but less than USD 50,000 will be procured following International Shopping or Local Competitive Bidding procedures. For contracts valued at less than USD 5,000, Local Shopping procedures will apply. Consultants will be procured following acceptable international procedures.

39. **Disbursement** against the purchase of items with a value of USD 250 or more will be fully documented. Other expenditures will be disbursed against certified Statements of Expenditure (SOE). Documentation for withdrawals under SOE need not be forwarded to the Fund but will be retained in a central location by the PEA and the participating institutions for review during monitoring and supervision missions and for authentication by the auditors. Since the PEA and the collaborating institutions will not be in a position to pre-finance expenditures eligible for Fund financing, a Project Account will be opened by the PEA in a bank satisfactory to the Fund, and in a convertible currency. The Fund will make an initial deposit of the equivalent of USD 100,000 equivalent to an estimated six months= worth of expenditures eligible for the Fund's financing less those expenditures that can be disbursed directly. The Project Account will be replenished in accordance with the Fund's procedures for operating a Project Account. Based on agreed work programme and allocation of responsibilities, the PEA shall provide funds from the Project Account to collaborating institutions for the implementation of their part of the programme. The Supervisory Body will ensure, prior to first disbursement of the Project and Grant Agreements that the inputs of the collaborating countries and institutions are confirmed in the quantity foreseen under the project.

40. **Accounts and Audit:** The PEA and the involved collaborating institutions will maintain independent and appropriate financial records and accounts in accordance with internationally acceptable accounting practices. All financial records and statements, including those for the Project Account, will be audited annually by independent auditors acceptable to the Fund. The audited accounts and the auditor's report, including separate opinions on the Statements of Expenditure and on the utilization of the funds in the Project Account, will be submitted within three months after the end of the project's fiscal year.

G. Organization and Management

41. The **International Cotton Advisory Committee (ICAC)** is the designated international commodity body for cotton and will act as the Supervisory Body for the project. The experiences of the Fund with the ICAC in supervising projects have been satisfactory and do not necessitate a

different modality than followed until now.

42. The **Sudan Cotton Company (SCC)** will be the Project Executing Agency. The Sudan Cotton Company has a mandate to support and promote cotton production and its activities cover the pre-production stages (e.g., supplying inputs to farmers, including pre-financing thereof); production (provision of advice to farmers, introduction of new and improved varieties, etc.); as well as the post harvest stage (ginning, marketing, etc.). The Sudan Cotton Company is a semi-private public corporation which jointly with agricultural production corporations collaborates with over 250,000 growers all over the country. The Director-General of the SCC will be directly responsible for the effective implementation and management of the project.

43. As the Project Executing Agency, the Sudan Cotton Company will prepare and submit to the Fund and the Supervisory Body an integrated annual work plan and implementation schedule, linking all activities envisaged to be undertaken under each component in a logical time frame. Due emphasis will be given to adequate reflection of the interactive nature of activities under the components. The work plan will include the incorporation of measurable and quantifiable milestones which will enable adequate progress monitoring.

44. The second Sudanese organization involved in the project will be the **Agricultural Research Corporation**, which will focus on the project activities in its Wad Medani research centre. More than 250 scientists are involved in its regular activities, which cover beside cotton, cereals and other leguminous crops, also sustainability and environmental conservation, cropping systems, and technology for agribusiness. With regard to cotton, its main activities are focused on *inter alia* cotton breeding, fibre technology, integrated pest management, mechanization and agro-economics. In the Agricultural Research Corporation, the national coordinator for cotton research has been designated as the responsible officer for the implementation of the activities as assigned to the ARC (identification of the incidence of stickiness problems in different cotton-producing regions, establishing quantities of cotton from each region, identification of cotton bales by region of production).

45. Two organizations from France will be closely involved in project activities. **CIRAD (Centre de Coopération Internationale en Recherche Agronomique pour le Développement)** is the well known agricultural research institute with its scientific base in Montpellier. CIRAD-CA (the CIRAD department for annual crops) has developed specific expertise in cotton research, covering both production and processing. The Head of the Cotton Technology Laboratory of CIRAD-CA will be the main counterpart for the SCC in the project and will provide technical and where necessary managerial backstopping to the project. The **Institute Textile de France (ITF)** is an industrial research centre, which assists the textile industry to upgrade its machinery and to improve their production processes. It conducts innovative research next to undertaking activities in the field of technical assistance, standardization/certification, training, etc. The Regional Director of the ITF will act as coordinator for the involvement of the ITF in the project. The ITF will be responsible for the organization and the carrying out of the activities related to testing and evaluation of spinning of sticky cotton and the establishment of the threshold for spinning sticky cotton. The **Cotton Incorporated, Raleigh, USA** will carry out re-testing of 2,000-3,000 cotton bales to certify the correctness of the stickiness grade ascribed to Sudan cotton under the project.

46. The schedule of implementation is reflected in Appendix III and the work plan is shown in Appendix IV.

H. Monitoring, Reports and Supervision

47. The PEA will submit to the Fund and Supervisory Body six-monthly progress reports and annual monitoring reports which will analyze the progress made by the project against the targets set in the annual work programmes and as reflected in the project's final appraisal report. Variances will be accounted for and remedial actions will be proposed if required.

48. A technical evaluation is scheduled to be undertaken. The PEA shall organize and assist in the implementation of this evaluation (scheduled to take place approximately two years after the start of the project). The PEA will submit a Project Completion Report to highlight the project achievements, constraints and experiences gained in the design and implementation of the project. This report will include a summary assessment of the financial benefits resulting from the project achievements as well as guidelines to implement the recommendations of the project in other countries. The report, along with the final project accounts and audit, will be submitted to the Supervisory Body and the Fund. The Supervisory Body will prepare an annual supervision report and submit this report to the Fund with a copy to the PEA.

I. Risks

49. The technical and management risks of the project are limited as the technology to be tried has been fully tested at semi-commercial level and the involved institutions are experienced and committed to the project. There is the risk that the additional costs of classifying cotton by degree of stickiness may outweigh the increased price received by producers. The adoption of the technology will depend on the financial viability of the process to be developed. The project has included the calculation of the financial return of the process to the producing countries.