SUDAN

PROSPECTS OF INCREASING COTTON PRODUCTIVITY IN SUDAN

THE SUDAN COTTON COMPANY LTD.

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INTRODUCTION:

Sudan with an area of 2.5 million square kilometers is the largest country in Africa. The Country has great-untapped potentialities for agricultural development. About one third of the total area is suitable for crop or pastoral production, but only small fraction of this land is under intensive use. Despite this fact the country is heavily dependent on agriculture. The agricultural sector dominates the economy. It provides the livelihood for over 80% of the population and accounts for more than 40% of G.D.P, on average and also provides a big share of inputs for the country's agro-industries. Main agricultural products are cotton, sesame, gum Arabic, livestock and other products. Recently the country has proven potential resources in minerals and petroleum, and now oil exports constitute the bulk of the total export earnings of the country.

Cotton is one of the most important crops produced in Sudan. It was the main foreign exchange earner contributing considerably to foreign exchange proceeds before the oil. More than three hundred thousand families in the Sudan depend on cotton for earning their livelihood. Several other thousands are engaged in Cotton related activities. Cotton is grown in Sudan under various topographical and environmental conditions, utilizing various methods of irrigation, and using different applications of chemical inputs. It is cultivated in clay soil in Gezira scheme, in silt soil in Tokar of Eastern Sudan and in heavy clay soil in Nuba Mountains area of Western Sudan.
Categorized by system of irrigation it is grown by gravity and pumps in Gezira, Rahad, New Halfa (Girba), White Nile , Blue Nile ,and Suki Scheme , by flood in Tokar Delta and by rain in Nuba Mountains . Chemical inputs applications vary from moderate in some places to zero in others
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PRODUCTION DURING THE LAST 5 YEARS :--

Sudan Cotton Area

Variety	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010
	In thousand feddans				
Extra long staple Barakat	188	204	81	59	22
Medium staple Acala	197	175	42	144	33
Nour	18	2	0	0	0
HAMD	0	0	0	0	4
Total	403	381	123	203	59
% Share of ELS	46,7%	53.5%	65.9%	29%	37.3%
% Share of MS	48.9%	45.9%	34.1%	71%	55.9%
% Share of Nour	4.4%	0.6%	0%	0%	0%
% Share of HAMD	0%	0.6%	0%	0%	6.8%

2009/2010 Cotton crop season has been very sensitive to the international financial and economic crisis .farmers felt the impact of the above mentioned crisis , as elsewhere in the developing countries . The following factors played major role in structuring farmers decision to grow cotton :-

1/The slack demand for cotton in the international market specially for the long staple cotton .

2/The disappointing price level received by farmers in 2008/2009 season and the great uncertainty regarding prospects for 2009/2010 .

3/ The increasing costs of production specially for imported inputs (Fertilizers , insecticides etc) , And hence dimishing profits to cotton farmers .

Based on the above mentioned reasons the farmers shiftd other competing crops benefiting from the support given to them by the gezira act for 2005 . The figures for sown areas in irrigated zones show a marked decline in areas compared to last season .

measures to improve the cotton sector and agriculture in general :-

An agricultural revival program is addressing all agricultural problems in the country with special reference to the cotton crop .A high ranking committee headed by H.E. the vice president, has intensively reviewed the situation of agriculture in the Sudan and determined areas needing government support The revival programme is based on the following nine key indicators of success .

l/ Creating an appropriate atmosphere for a sustainable development of agricultural production.

A conducive environment for increasing production and productivity consists of concerted macro and sectoral policies, sustainable management of natural resources and establishment of adequate infrastructure.

2/ Capacity building of producers and institutions :

Low efficiency of manpower is the most important factor contributing to the low agricultural productivity in the country, and it is a major challenge to agricultural revival. This problem is aggravated by the fact that agricultural institutions are deficient in technical and administrative capabilities. Therefore, the agricultural revival programme fowsed on building individual and institutional capacities .

3/ Addressing the issues of agricultural lands :-

The existing procedures and practices which control land use are not conducive to agricultural development. On the contrary these procedures and practices have jeopardized agricultural

investment, especially foreign investment. To rectify this situation so many actions were proposed .

- Study the existing land laws in consultation with the representatives of rural communities and derive lessons from successful local and international experiences.
- Implement land use policies .

4/ Developing support services :

The provision of supporting services, and the rehabilitation and development of the research systems and infrastructure, the training of scientists and building their capacities to cope with the rapid scientific developments at the local, regional and international levels, are key factors for agricultural development. To strengthen and upgrade these support services the following actions must be taken:

- Introduce up-to-date equipment and technologies
- Fill the shortages in trained scientists and ensure continuity and transfer of knowledge and experiences between generations in the scientific community.
- Keep scientists abreast of new technologies
- Enable research centers to prepare strategies for applied scientific research to serve the revival programme.
- Link scientists working in government institutions with those working in educational and scientific
research institutes.
- Render the village the centre for dissemination of information and distribution of inputs,
agricultural services, credit, training and extension through:
- Establish markets equipped with up-to-date technologies to ensure quality control,
implementation of sanitary and phytosanitory and food safety measures.
- Build capacities in the area of information and communication technologies with a view to supporting the decision making process and disseminating information to producers, scientists and politicians.

5/ Development and modernization of agricultural systems :

Agricultural systems, including infrastructure, policies for resource management, technologies and husbandry practices remained stagnant for long and did not benefit from scientific breakthroughs in agricultural sciences. The revival programme seeks to make use of international technological innovations to improve and modernize these systems .

6/ Protecting and developing natural resources :-

Natural resources are the most valuable assets of the country. If used rationally, these assets could induce sustainable socio-economic development. To play this role, natural resources should be developed and protected with a view to meeting the needs of the present and future generations.

7/ Agricultural industrialization

Agricultural industrialization adds value to agricultural commodities, increase revenues from agricultural enterprises and strengthens the forward and backward linkages between the agricultural and industrial sectors through the complementarity of production chains, specialization, product differentiation and quality control. To achieve a breakthrough in agricultural industrialization, the following actions must be taken:

- Build the capacities of the agricultural sector .
- Improve the forward and backward linkages between the agricultural and industrial sectors with a special emphasis on agro-based and agricultural and livestock food industries, which add the highest values to the gross domestic product, and on small scale rural industries.
- Rehabilitate and modernize idle capacities in the agro-based industries

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8/ Implementation of quality control and safety measures

9/ Establishment of international partnerships.

International partnerships are important instruments for implementing the projects and programmes of the agricultural revival. Implementation of all above recommendations is steadily taking its place .

<u>THE ROLE OF COTTON RESEARCH</u> :--

Cotton farming is a livelihood issue and a way of life for more than 300,000 Sudanese farmers. The intensive labor demand in cotton farming and cotton–based industries provides employment, reduces poverty, improves lives and encourages settlement in rural areas. As the Cotton Research Program (CRP) marked its 100th year (Massey Jubilee) in 2004, it had already formed various recommendations on early maturing varieties, cultural practices, pest management and fibre quality improvement. However, adoption at the farm level was disappointing, with yield averaging 400-450 kg lint/ha. as compared to ideal yield (as per research results) of 1200-1500 kg lint/ha and world average of 700 kg lint/ha. To reverse this trend and to bridge the gap between research and the farm, future research should embark upon precision agriculture, where site–specific approach rather than general blanket recommendations should be promoted. However, farmers should have a better understanding of the physiology of cotton and how it relates to input use. Combined with technical follow-up, and financial, social and policy measures that enhance attended farming, farmers will be able to optimize the benefits from adopting these new early maturing varieties.

Framework of the Cotton Research Program:-

1. Variety improvement.
2. Cotton stickiness and testing technology
3. Agronomy and crop physiology

The objectives of the program are:

1. Varietal improvement for higher yields, earliness, disease and insect resistance.
2. Diversification of intrinsic quality by breeding new styles and variants having different balances of fiber characteristics, measuring up to the progress in the textile and spinning technology.
3. Vertical upgrading of productivity via generation of multidisciplinary technological packages that fit into the integrated crop management (ICM) strategy and with concomitant reduction in production cost.

Variety improvement

Breeding

The number of released varieties and registered lines to date totaled above 50. However, only 7 varieties are currently grown either commercially or in limited propagation plots. These are: Barakat 90(EFC), Barakat S(EFC), Shambat-B(FC), Nour (HA), Barac (67)B (MC), Albar(57) 12(CC) and Acrain(CC).Encouraging research efforts have been exerted to replace the long grown current varieties, hence, hundreds of lines are in the pipe line, emerging from crossing and selection programs of the individual breeders. Biotechnological research is focused on production of doubled haploid cotton and molecular tagging of useful traits for DNA marker- assisted selection. We are especially interested to incorporate the double haploid (DH) technology in our hybrid-breeding project. Through DH, we can fix the hybrid vigour and overcome the problem of hybrid seed production . The program also contains very promising advanced lines resistant to the new race (post-Barakat) of the bacterial blight, in addition to Fusaruim Wilt resistance. Morphological characters such as okra leaf, hairiness and frego-bracts that reduce the insect-pest damage has also been a focused research area. In seasons (2005 and 2006) , nine varieties were released as listed hereunder:

A- Siddig (Sudan Pima) :

It is a selection from a cross between Barakat –90 and Pima. This is a Fusarium Wilt resistance variety . It is an extra – fine count cultivar's excelling Barakat-90 , in length strength and fineness.

B- Hadi (Okra-leaf Barakat):

It is a selection from a cross between Barakat-90 and Pima Okra. It is a fine count cultivar's , early maturing, and high yielding and has better (GOT) as compared to Barakat 90.

C- Kheiralla:

This is a high count Acala (HCA), jassid resistance , excelling Nour(93) in yield and fineness. It is a bacterial blight resistance and harboring less whiteflies (lower stickiness) .

D- Hamid: (BB-82)

This a medium count, high yielding, early maturing genotype that showed resistance to bacterial blight, jassid, low preference to whitefly and harboring less population of ABW, emerged as a suitable choice for short duration low management system. Hence it can be recommended for Integrated Crop Management (ICM) due to its open canopy, low leaf area, medium hairiness and earliness. It can also be fitted into short-season production system in rain-fed areas, where problems of late drought are anticipated.

E- Knight (BB-90)

This a medium count cultivar's .Because of its additional improvements in yield, resistance to bacterial blight, and yarn strength, BB90 is recommended for irrigated areas, to cater for bacterial blight in areas more prone to high disease incidence (B2B3B6B7B9) and to enhance the deteriorating fiber bundle strength of medium staple cotton .

F- Abdin:

The fine-count cotton variety Abdin, derived from the cross (Barac (67) B × BLCABPD8S-1-90) F_1 × (Shambat collection 19-95-1 × CAHUGARPIH-1-88) F_1, was evaluated across ten environments in the Sudan in 2003-2005. Abdin gave average lint yield advantage over Shambat-B of 61%. It had a ginning out turn percentage of 36.0 compared to 29.0 for Shambat-B. It has a growth period of 150-160 days, 15-25 days earlier than Shambat-B. Abdin possesses ($B_2B_3B_6B_7$) gene combination that confers resistance to both bacterial blight disease races prevalent in the Sudan and had a higher degree of tolerance to jassids. The fibre testing data revealed that Abdin has a sizeable increase in fibre strength and count spinning product as compared to Shambat-B. Therefore, it measures up to the progress in spinning and textile industry. Abdin emerged as a suitable cultivar's for bridging the fine-count cotton quality gap that has been created via the commercial withdrawal of Shambat-B owing to its ginning problems.

G- Burhan:

Burhan gave average lint yield advantage over Albar A (57) 12, Almac (80) 15 and Acrain of 37%, 29% and 21 %, respectively. Stability measures found Burhan to be most stable, and widely adaptable to rain-fed cotton growing areas of the Sudan. Burhan showed highly resistant reaction to bacterial blight disease and has a higher degree of tolerance to jassids. It has a growth period of 135-140 days, 10-15 days earlier than Albar A (57) 12. Since Burhan has a shorter growth period, it can best be suited for rain-fed areas more prone to late drought problems.

H. Khalifa:

Khalifa excelled Albar (57) 12, Almac (80) 15 and Acrain by 32%, 30% and 30 % and 50%, 41% and 32 % for seed cotton and lint yield, respectively. Khalifa was found adaptable to cotton growing areas of the tested environments and had stable seed cotton and lint yield. Khalifa was found earlier than other genotypes tested as demonstrated by its shorter days to first flowering. Khalifa was resistant to both old and new races of Xanthomonas compestris pv malvacearum. Thus, the high stable seed cotton and lint yield, adaptability to the testing environments, earliness of maturity and blight resistance of Khalifa make it suitable cultivar's for commercial production in rain-fed areas of Southern Kordofan and Blue Nile regions of the Sudan.

I. Wager :

Wager gave average seed cotton and lint yield advantage over Shambat-B, Barac (67) B and Nour, of 36%, 25% and 15%; and 73%, 21% and 16%, respectively and gave comparable seed cotton and lint yield to Hamid. Moreover, Wager exhibited higher ginning out turn surpassing that of Hamid. Wager was adaptable over a wide range of environments and had stable seed cotton and lint yield. Wager had longer fiber length; higher spinning value and better micronaire value than Hamid. Wager had fewer days to first flowering and boll opening and earlier in maturity compared to the commercial varieties and had fewer mean days to last picking (145) compared to 180, 165 and 165 for Nour, Barac (67) B and Shambat B, respectively. Wager excelled all tested genotypes at Gadarief rain fed area, producing 68% seed cotton and lint yield advantage over the traditional cotton variety Acrain.

Genetic resource management

Evaluation of Shambat Collection

This is one of world richest Gene Bank for cotton. It includes about 800 accessions of wild, semi-wild and cultivated species. Every season about 50-80 accessions being characterized. Morphological, phenological and yield-related characteristics have been documented for about 200-250 of wild and cultivated collection and the process is continuing.

Variety maintenance

Maintaining an existing cultivar's is more important than development of a new one. For program reason, due emphasis is put on variety maintenance, and it is one of the major concerns of the program. Nevertheless, seed mixtures have been reported, despite presence of morphological differences and color markers.

Seed production

Cottonseed multiplication and certification is receiving top priority by the Cotton Research Program (CRP). The program is continuing the organization of intensive training courses on this subject for the seed production staff in the various cotton-growing corporations. It also provides breeder seed and supervises the production of foundation seed

Cotton Stickiness and Testing Technology

Fiber testing:

All the material from single plant selections through lines and varieties are tested for stickiness, lint out turn and quality characteristics. The laboratory also performs studies on spin ability (classical and open-end micro-spinning) and determines yarn strength and defects (neps and irregularities).

Stickiness:

The following research efforts are in progress to alleviate this problem:-

. Effect of soil moisture , sowing date and picking time on stickiness.

. Testing facilities to detect stickiness levels (physical and chemical):

- Mini-card
- SCT.
- Chemical test of total soluble sugars.

. Research into methods likely to improve the spinning process and the quality of the yarn depending on the sticky potential of the cotton.

. Future mapping of zones varying in stickiness indices.

. Fibre quality as affected by seed multiplication:

. Effect of varying cottonseed multiplication sources on fiber quality of the commercial varieties.

Agronomy and crop physiology

The development of agronomic practices that improve crop productivity and quality while also reducing production costs has been the focus of several research activities . The recent advent of the short duration varieties had been a significant achievement and may resemble the road map for sustaining cotton productivity. Experimentation with these varieties revealed that four sprays of the conventional insecticides (pyrethroids at 2.5litre/ha) can be reduced to only one selective spray (Spinosad at 0.25 litre/ha) with concomitant improvement in fibre quality as had been indicated by the low stickiness levels. The optimum fertilizer rate that can meet the metabolic needs of the new varieties was found to be only 43 kg N/ha. Therefore, production cost can drastically be contained because insecticides represent 30-40% and fertilizers about 25-30% of the total cost. Moreover, the minimum use of selective as compared to the broad-spectrum insecticides may pave the way for future cotton production without insecticides, hence, diverse natural enemies are still in place and can gradually be multiplied to over balance the insect pests. Thus, a non-pollutant environment for sustaining cotton productivity and improving life quality can easily be availed. Accordingly , timing and proper rates of fertilizer and insecticide application, scheduled irrigation, recommended plant population and their interactions with the phonology of the crop, as well as the farmers daily attendance to their cotton plants, are all critical in maximizing source to sink balance and in improving yield. If such understanding materializes and is supported by attended farming, the stagnation in cotton productivity will definitely be reversed .