

PROJECT PROPOSAL

Assessment of the Impact and Main Dynamics of Cotton
Diseases Affecting in Particular Small Scale Production Systems
in Eastern and Southern Africa

FAST TRACK PROJECT

Assessment of the Impact and Main Dynamics of Cotton Diseases Affecting in Particular Small Scale Production Systems in Eastern and Southern Africa

PROJECT SUMMARY

Title:	Assessment of the Impact and Main Dynamics of Cotton Diseases Affecting in Particular Small Scale Production Systems in Eastern and Southern Africa
Duration:	Six months
Location:	Southern and Eastern Africa
Nature of Project:	Survey of the nature, prevalence and economic significance of major cotton diseases in the region, particularly effecting small cotton producers.
Brief description:	A study will be undertaken by an experienced consultant in close consultation and co-operation with national experts, to make an inventory/assessment of the importance of cotton diseases effecting small-scale cotton production in the region. Diseases to be covered are <i>inter alia</i> Fusarium wilt, Verticillium wilt, Bacterial Blight and Alternaria Leaf Spot. The study will result in data collection on both impact of prevalent cotton diseases as well as provide an assessment of national capabilities and capacities to undertake applied (or even more basic) research and to provide information/expertise for direct use by small farmers. It is envisaged that the country reports and a consolidated report will be presented and discussed at a regional workshop to be held in one of the CFC member countries. The outcome of the workshop should be (if deemed appropriate) national or regional initiatives or even plans to combat the main cotton diseases.
Estimated total cost:	USD70,000
Financing sought from the Fund:	USD 57,500
Counterpart contribution:	USD12,500
Project Executing Agency:	Southern Eastern African Cotton Forum (SEACF)
Supervisory Body:	International Cotton Advisory Committee (ICAC)

This Fast Track proposal originates from the recommendation of the Consultative Committee when reviewing a proposal from the Southern and Eastern African Cotton Forum (SEACF), which is an informal network of cotton research organizations/institutes focusing on production research. The SEACF works under the auspices of the ICAC, but membership is open to all cotton producing countries in the region. There is no membership fee. The chairmanship is currently with South Africa.

In reviewing the submitted proposal, the Consultative Committee recommended that a study be conducted in the framework of the Fast Track procedure, possibly followed by a regional workshop, in order to determine the nature, scale and economic significance of cotton diseases in the Southern and Eastern African region. The countries currently proposed to be included in the study are Ethiopia, South

Africa, Sudan, Tanzania, Uganda and Zimbabwe. Sudan and Ethiopia have been added on the recommendation from the Consultative Committee.

The Natural Resources Institute (NRI) of UK has an experience of working in the region and also has the expertise in cotton diseases. ICAC contacted NRI who has confirmed to the ICAC to collaborate in the project. NRI will be consulted by SEACF in the collection of required information on cotton diseases in various countries, analysis of the current situation and a NRI expert will be invited to attend the workshop. The NRI contact person will be Dr. Rory Hillocks from the Sustainable Agriculture Group based at the Medway Campus of the University of Greenwich. Dr. Hillocks a known to most people active in the SEACF.

Broad Project Cost and Financing

Estimated project budget is as follows:

Provisional CFC contribution	USD 57,500
Workshop/Consultant	USD 15,000
Support for national studies	USD 12,000
Support for national experts for attending the workshop	USD 17,500
CFC/ICAC participation	USD 7,000
Publication of proceedings (possibly as CFC Technical Paper)	USD 2,500
Contingency	USD 3,500

Expected counterpart contribution

Organizational costs	USD 12,500
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Expected Co-financing

If available, more country participants can be supported and the country studies and/or the consolidated study can be published.

Assessment of the Impact and Main Dynamics of Cotton Diseases Affecting in Particular Small Scale Production Systems in Eastern and Southern Africa

- 1. Project title:** Assessment of the Impact and Main Dynamics of Cotton Diseases Affecting in Particular Small Scale Production Systems in Eastern and Southern Africa
- 2. Duration:** Six months
- 3. Location:** Ethiopia, South Africa, Sudan, Tanzania, Uganda and Zimbabwe

4. Nature of project

This project (fast track) will concentrate on gathering information on the status and relative importance of cotton diseases in the southern and eastern African cotton-growing region.

5. Brief description

A survey of the incidence and distribution of cotton diseases in the SEA region will be conducted by means of a questionnaire. In each of the participating countries, national co-ordinators will be responsible for the distribution, completion and collection of information in his/her country. After completion, the questionnaires will be sent back to the national co-ordinator who will analyse and summarize the data. The project will be concluded with a workshop under the leadership of the General Co-ordinator (Chairman of SEACF). Based on the results of the survey, the need for a more advanced project will be determined.

6. Total estimated cost

Broad Project Cost and Financing

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Expected counterpart contribution

Organizational costs	USD 12,500
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Mode of financing sought from the fund

Grant

7. Project executing agency

The project will be implemented by the Secretariat of the Southern and Eastern Cotton Forum. The current address of the SEACF Secretariat is

Dr. G. D. Joubert
Chairman SEACF
Director of Industrial Crops Institute
Private Bag X 82075
Rustenburg
SOUTH AFRICA
Telephone 27-14-5363150
Fax 27-14-5363113
Email DIRECTOR@NITK1.AGRIC.ZA

8. Supervisory body

International Cotton Advisory Committee will be the supervisory body for the project.

9. Estimated starting date

1 May 2002.

10. INSTITUTIONS INVOLVED AND RESPONSIBILITIES

General co-ordinator

Dr. G. D. Joubert
Chairman, Southern and Eastern African Cotton Forum
Director of the Institute for Industrial Crops
Private Bag X 82075
Rustenburg
SOUTH AFRICA
Telephone 27-14-5363150
Fax 27-14-5363113
Email DIRECTOR@NITK1.AGRIC.ZA

National Co-ordinators

Tanzania

Dr. T. H. Kibani
ARI-Ukiriguru
Box 1433
Mwanza
Tanzania
TANZANIA
Tel 255-68-550215
Fax 255-68-550214
Email UKIRIGURU@AFRICAONLINE.CO.TZ

Uganda

Dr. Lastus K Serunjogi (Cotton Breeder)
Mr JP Takan (On study leave)
National Agricultural Research Organization
Serere Agricultural and Animal Production Research
PO Soroti
UGANDA
Tel 256-45-61192
Fax 256-45614444
Email: <ddgr@infocom.co.ug> <corsu@infocom.co.ug>

Zimbabwe

Mr. R.F. E. Jarvis/Mr. D. Mutetwa
Quton Seed Company
100 Prince Edward Street,
Milton Park,
Harare,
Zimbabwe
Tel 263-4-707636
Fax 263-4.707636
Email quton@cottco.co.zw

Mr. Nyamande Mapope
Cotton Research Institute
Private Bag 765
Kadoma
ZIMBABWE
Tel 263-68-24331
Fax 263-68-24229
Email ZIMCOTT@AFRICAONLINE.CO.ZW

South Africa

Ms. A Swanepoel
Agricultural Research Council – Institute for Industrial Crops

Private Bag X 82075
Rustenburg 0300
SOUTH AFRICA
Tel 27-14-5363150
Fax 27-14-5363113
Email ANNETTE@NITK1.AGRIC.ZA

Sudan

Dr. Abdin M. Ali
Director General
The Sudan Cotton Company
PO Box 1762 Kht
Khartoum
SUDAN
Tel: 249-11-775755, 771567
Fax: 249-11-770703
Email sccl@sudanmail.net

Ethiopia

Dr. Geremew Terefe
IRA, Melke Were Research Centre
PO Box 2003
Addis Ababa
ETHIOPIA
Tel: 251-1-611222
Fax: 251-1-611222
Email WARC@TELECOM.NET.ET

The General Coordinator will be responsible for the administration, management, co-ordination and implementation of the project. The collaborating institutions will each be responsible for the surveys that have to be conducted locally in each country. The identified responsible researchers will conduct the cotton disease surveys by means of a standardized questionnaire. The questionnaire will be developed in consultation with the collaborating countries. All data collected by the collaborating institutions will be sent to the SEACF Secretariat where the data will be analysed and summarized for discussion at the workshop.

A. PROJECT OBJECTIVES AND RATIONALE

The objective of the project is to assess the local knowledge of the status of cotton diseases in the region, with reference to distribution and incidence (economic importance). These results will be used as the basis to established the need for further projects that will deal with the development of strategies for cotton disease management in an effort to reduce yield losses in the region particular small scale farmers.

Cotton is susceptible to a variety of plant pathogens and many of the most important cotton diseases like bacterial blight, Fusarium- and Verticillium wilt, Alternaria leaf spot and various boll rots are widely distributed in the cotton-growing areas of the region. Cotton diseases can adversely affect seed quality. Both bacterial blight and Fusarium wilt diseases are seed-borne. If seed multiplication blocks get infected with the pathogen one or both of these diseases, serious yield losses can be expected during the following season. The effect of diseases on cotton yield and quality is usually underestimated. There exists a misconception among farmers and even extension officers that it is possible to "live with" cotton diseases. One of the reasons for this is that it is commonly seen in cotton infected with a certain disease that plants still bear bolls, but what the uninformed does not know is that these infected plants are seriously reducing yield and have a negative effect on fibre quality. In terms of fibre quality, it is mainly fibre characteristics like length, strength and sometimes colour that is affected by these diseases.

Data reflecting disease incidence and economic impact from some of the participating countries are presented in (Table 1). No data for Uganda, Ethiopia and Sudan could be obtained. This is one of the aspects that we want to address with this project. Some data is available for South Africa, Zimbabwe and Tanzania. The most recent data available for Zimbabwe (1983/84) indicated that in the middleveld region, where the variety G501, that had some resistance to

Verticillium wilt, was grown, 78% of the crops were infested with Verticillium wilt. In the lowveld region where a susceptible variety, K602, was grown under dry land conditions, the disease was kept at bay by the higher prevalent temperatures of the region. However, under irrigated conditions in the lowveld area 22% of the crop was affected. In Tanzania it was found that there is a dramatic increase in the incidence of Fusarium wilt. Surveys conducted since 1969 indicate that there is an average increase of 8% in the incidence of Fusarium wilt in the cotton crop. It was found in a survey that was conducted during the 1998/99 cotton season in South Africa that 37% of the ~ 99,000 ha cotton that was harvested, was infested with *Verticillium dahliae*, the pathogen of Verticillium wilt. In South Africa, Verticillium wilt was always considered as only a problem under irrigated conditions, but it was found that the disease is just as serious and common in rain fed cotton. It has also been established that the disease is rapidly spreading throughout the small-scale communities. Losses due to infection in infested fields can vary between 30% and 70%; 100% yield losses are seldom observed. Research conducted by the ARC indicated that under irrigated conditions yield would be reduced by 12 kg/ha for each percentage of plants that are infected with Verticillium wilt and by 4 kg/ha for dry-land conditions. Some of the varieties currently grown in South Africa have resistance to bacterial blight, but losses up to 46% have been recorded in susceptible varieties. In South Africa, in the Makatini Flats area, boll rots cause annually a yield reduction of 5-12% per hectare. Although comprehensive data is not available for all diseases in all of the collaborating countries, it could be assumed that the figures for the percentage loss per ha that has been calculated for South Africa would be applicable for the other countries as well. From those figures it can clearly be seen that the occurrence of cotton diseases does indeed have a serious effect on yield. If only one boll per plant can be saved, it will cause a dramatic increase in yield and will result in a higher income for the farmer.

In many of the cotton-growing countries in the Southern and Eastern African region, cotton is a smallholder crop where the producers own land from 0.5 to 10 ha in size. In these countries, cotton is a very important agricultural export earner. Cotton is usually grown in rotation with other crops. As a land opening crop, it promotes food production by improving yields in subsequent crops by leaving well-prepared land for cereals such as millet, sorghum, sesame, groundnuts and peas. However, the production per hectare is very low and averages between 200 kg and 600 kg seed cotton per hectare. Production statistics for Zimbabwe, Tanzania, Uganda, South Africa, Ethiopia and Sudan for the last 10 years are summarised in Tables 2 to 5. Over the past 10 years production remained more or less constant in South Africa, Sudan and Ethiopia, there was a steady grow in Zimbabwe, and was very variable in Tanzania and Uganda (Fig. 1). Although there is an increase in cotton lint production in Zimbabwe, the data is very variable between the different cotton growing seasons (Fig. 2). The data for the average yield (kg/ha) presented in Fig. 3, clearly show that there is a slight improvement in the average yield per hectare in Zimbabwe, Uganda and South Africa. In Tanzania there was a steady decline since 1996. Average yields remained more or less constant in Ethiopia and Sudan. From this data it can clearly be seen, that although area harvested has increased overall for all four countries over the last 10 years, there was not a significant increase in lint produced. In general, low production could be attributed to inadequate application of fertilizers, poor land cultivation, poor pest management practices, the fact that production is almost entirely dependent on rainfall and lastly the occurrence of cotton diseases. Plant diseases are among the major factors that reduce cotton yield and adversely affect fibre quality in the Southern and Eastern African region and this results in a loss of income.

Cotton was introduced in 1903 in Uganda and has grown to be a very important crop to the people of Uganda both from social and economic view points as it is grown in 30 of the 56 administrative districts. It generates disposable cash income to farmers in rural settings and supports rural based industries where over 85% of the Ugandan population reside. It provides employment and source of raw material in the production of edible oils, soap, textiles and seed cake for feeding livestock among others. Cotton is mainly produced by small holders and with acreage ranging between 0.5 and 1 ha. However, in some areas like Kasese, farmers have started group farming of about 20 ha. The cotton crop is entirely produced under rain fed conditions. Over the years cotton production has steadily decrease, but since 1992 the government of Uganda designed strategies and action programmes to improve the agricultural prospects for the cotton crop and amongst these strategies is a research programme on various agronomic aspects of cotton. Since then the national average yield of seed cotton improved from 250 kg/ha to 600 kg/ha. Yields of up to 2500 kg/ha are also recorded in the rich volcanic soils in

the area of Mt Rwenzori. Lint ginning GOT also improved from 32% to 35%. The cotton industry of Uganda is aiming to develop higher yielding varieties, varieties with GOT in the order of 40% and varieties with disease resistance. This will increase the profitability of cotton. Until recently mainly two varieties were grown in Uganda: BPA (Bukalasa Pedigree Albar) and SATU (Serere Albar Type Uganda). BPA is a medium long staple variety and is produced in the southern cotton growing districts in the vicinity of Lake Victoria where the soils are more fertile, and the country is more humid and has less severe dry seasons. SATU was produced in the northern region which produces shorter cotton, which although have very good quality, is of lower quality than that of cotton produced in the Lake Victoria area. The growing of SATU was discontinued in order to promote BPA, the longer staple cotton and to ensure uniformity and easier quality control in the production of lint and yarn. BPA is generally susceptible to diseases like bacterial blight and the fungal wilts (*Fusarium* and *Verticillium*). Disease susceptibility can have a negative impact on yield and fibre quality. Cotton monoculture with one variety is a potential threat to sustainable cotton production, because this practice rapidly increases bacterial and fungal populations in the field and also leads to an increase in virulence of the pathogens.

Cotton is grown in 13 of the 21 regions in Tanzania mainland. Approximately 40% of the Tanzanian population grow cotton as their sole cash crop and depend on it for their livelihood. The cotton growing areas is divided into two zones namely, the West Cotton Growing area and the East Cotton Growing area. These two areas differ in terms of weather conditions. Currently three varieties, UK77, UK 82 and UK 91, are grown in Tanzania (UK=Ukiriguru and the number refers to the year it was released). The area under cotton production remained very stable over the last 10 years and is approximately 400 000 ha. Seed cotton yield remains very low at 300 to 400 kg/ha. Average yields are approximately 1,100 kg/ha with GOT % between 38% and 39.6%. All three of these varieties has certain levels of susceptibility to bacterial blight and Fusarium wilt.

Small-scale farmers produce more than 80% of the Zimbabwean cotton crop. Zimbabwe is one of the largest cotton producing countries on the African continent. Area harvested has increased steadily over the last 10 years from 230 000 ha to approximately 400,000 ha. Lint production has also increased from 70,000 metric tons to 100 000 metric tons. Average seed cotton yield remained very stable over the years and is in the order of 800 kg/ha to 900 kg/ha. Many varieties are grown in Zimbabwe. All varieties have excellent resistance to bacterial blight, but all are to some extent susceptible to *Verticillium* and *Fusarium* wilt.

In South Africa, cotton is grown in eight different regions spread all over the country. South Africa plants on average 90 000 ha of cotton and produces 40 000 metric tons average. In South Africa the small-scale farmer contribute on average 12% of the entire cotton crop. An average of 5 000 ha of cotton is produced by small scale farmers with an average seed cotton yield of 600 kg/ha under dry land (rain fed) conditions and 1,600 kg under irrigated conditions. Currently the majority of cotton produced by the small-scale farmer is grown on the Makatini Flats in the KwaZulu-Natal province. Cotton SA (formerly operating as the Cotton Board) has embarked on extensive programmes to promote cotton as a crop for the small-scale farmer. Diseases like bacterial blight, *Verticillium* wilt and false mildew are currently causing serious yield and quality losses in South Africa, especially among the small-scale farmer. The small-scale farmer is currently constraint by lack of knowledge on cotton production, as well as disease and insect control in the crop. A lack of experienced/trained extension officers is also a constraint.

This project would provide a strong base to:

- Create awareness of the presence and economic impact of cotton diseases on yield and sustainable income for small farmers
- Start developing research methodologies and training for participating countries.
 - Varieties with disease resistance
 - Higher quality seed
- Disease management and control will ensure better yields and fibre qualities
- Sustainable cotton production will be ensured.
- Sustainable use agricultural soils will be ensured.
- An increase in yield and fibre quality will ensure a larger income for the small farmer, which will lead to the upliftment of the people.
- An increase in cotton production in the region will ensure a sustainable income for the farmers.

B. RELEVANT PREVIOUS WORK IN THE FIELD OF THE CURRENT PROJECT

Due to the constraints (eg. lack of trained/experienced cotton plant pathologists) highlighted during the SEACF meetings held in Malawi 1999 and Zimbabwe 2000, very little work has been done on issues like epidemiology and yield loss assessment (economic importance) in the region. Research in the field of cotton pathology in the regions has been focused mainly on resistance breeding to these diseases.

The Agricultural Research Council (ARC) in South Africa is currently conducting extensive research on the epidemiology of cotton diseases. This work is focussing on diseases like Verticillium wilt, Fusarium wilt, bacterial blight, Alternaria leaf spot, false mildew and seedling diseases. The work includes the determination of infection and economic threshold values, alternative control measures (crop rotation, biological control and bio-fumigation), the development of cultivars with tolerance to these diseases. The ARC has also developed various techniques to evaluate cotton germplasm in both fields and greenhouses for resistance to various cotton diseases. The research is also focusing on stress inducing factors that play a role in disease incidence and severity. Furthermore, the ARC is also conducting extensive surveys on the seasonal status of cotton diseases on all cotton cultivars registered in South Africa. Cultivar trials are conducted in all the cotton-growing areas of South Africa and the trials are planted under both irrigation and dry land (rain-fed) conditions. The Agricultural Research Council already have a wide range of experience and broad knowledge base available on cotton pathology.

C. PROJECT COMPONENTS

Component 1	Survey of the occurrence of cotton diseases in the Southern and Eastern African Region
Objective	To establish the relative economic importance and distribution of cotton diseases in the Southern and Eastern African region.
Output	Prioritise the relative importance of cotton diseases in the region and establish the possible need for future projects on disease control measures.
Activity 1	Compile and dispatch questionnaires on cotton production and diseases to all the participating countries.
Activity 2	Complete questionnaires.
Activity 3	Collect questionnaires
Activity 4	Map the cotton-growing areas in every participating country and analyse and summarize data.
Activity 5	Publish a report on the findings.
Activity 6	Arrange a workshop to make known the results of the survey and to determine the possibility of future research projects on disease control.

D. BENEFITS AND BENEFICIARIES

The proposed project aims to collect basic information on cotton diseases in the Southern and Eastern African region and this information will also be applicable in many of the other cotton growing countries. The outcome of this study will determine give a clear indication of the economic status of cotton diseases in the region. With knowledge, ability to correctly identify cotton diseases and a better understanding of the dynamics of cotton diseases in the region, the respective cotton industries can embark on an active control programme for these diseases. This will eventually lead to an increase in cotton yields and quality.

Although it is not proposed that this project will be executed in all the cotton growing countries in the region, all of these countries will benefit from this project. The type of information that will be collected will not only be beneficial to resource poor farmers, but to commercial farmers as well.

E. ENVIRONMENTAL ASPECTS

This project will have no effect on the environment.

F. PROJECT COST AND FINANCING

TOTAL COST (USD)		70,000
	Ethiopia	5,000
	South Africa	5,000
	Sudan	5,000
	Tanzania	5,000
	Uganda	4,500
	Zimbabwe	5,000
	Workshop Materials, venue, photocopy, etc	15,000
	CFC/ICAC participation in the workshop	7,000
	Publication of proceedings of the workshop	2,500
	Contingencies	3,500
Loan from CFC	Ethiopia	0
	South Africa	0
	Sudan	0
	Tanzania	0
	Uganda	0
	Zimbabwe	0
Co-financing	Ethiopia	0
	South Africa	0
	Sudan	0
	Tanzania	0
	Uganda	0
	Zimbabwe	0
Counter part contribution	Ethiopia	2,000
	South Africa	2,500
	Sudan	2,000
	Tanzania	2,000
	Uganda	2,000
	Zimbabwe	2,000

G. WORK PLAN

	S.AFRICA	ZIMBABWE	TANZANIA	UGANDA	ETHIOPIA	SUDAN
Activity 1	Compile questionnaire and dispatch to collaborators					
Activity 2	Complete questionnaire	Complete questionnaire	Complete questionnaire	Complete questionnaire	Complete questionnaire	Complete questionnaire
Activity 3	Co-ordinate collection of questionnaire					
Activity 4	Analyse and summarize data					
Activity 5	Publish report on survey findings					
Activity 6	Arrange and chair workshop	Attend workshop	Attend workshop	Attend workshop	Attend workshop	Attend workshop

H. SUPERVISION PROCESS

Direct contact (email) will be established between the supervisory body, project executing agency and collaborators. The project-executing agency will keep the supervisory body up-to-date with the progress of the distribution, completion and collection of the questionnaires.

I. RISK ASSESSMENT

- Communication is a big problem in certain African countries. Not all researchers at certain institutions have easy access to fax and email facilities. This may put a constraint on day-to-day management of the project and could hamper the transfer of data between collaborating countries and the project executing country.

Table 1. *Disease incidence in Zimbabwe, Tanzania and South Africa.

Disease	Zimbabwe (1983/84)		Tanzania (1988)		South Africa (2000/2001)	
	% Production area infested	% Loss per ha	% Production area infested	% Loss per ha	% Production area infested	% Loss per ha
Seedling disease	N/A		N/A		32	2
Bacterial blight	0	0	N/A		74	46
Alternaria I-spot	53		N/A		85	3
False mildew	N/A		N/A		15	2
Verticillium wilt	78		N/A		37	30-70
Fusarium wilt	N/A		37		2	38
Boll rots	N/A		N/A		65	8-12

* Data not available for Uganda, Sudan and Ethiopia.

Table 2: Area, Production and Yield in South and Tanzania 1990/91 to 2000/01

Year	South Africa			Tanzania		
	Area (ha)	Production (Ton lint)	Yield (Kg/ha)	Area (ha)	Production (Ton lint)	Yield (Kg/ha)
1990	127,000	49,000	391	450,000	85,000	189
1991	79,000	20,000	258	430,000	96,000	223
1992	54,000	15,000	280	344,000	45,000	131
1993	82,000	27,000	330	172,000	40,000	233
1994	67,000	24,000	359	344,000	82,000	238
1995	110,000	45,000	405	283,000	87,000	307
1996	116,000	31,000	269	350,000	62,000	177
1997	111,000	43,000	386	180,000	36,000	200
1998	137,000	50,000	363	250,000	35,000	140
1999	85,000	28,000	329	182,000	41,000	225
2000	73,000	35,000	476	420,000	91,000	217

Table 3: Area, Production and Yield in Uganda and Zimbabwe 1990/91 to 2000/01

Year	Uganda			Zimbabwe		
	Area (ha)	Production (Ton lint)	Yield (Kg/ha)	Area (ha)	Production (Ton lint)	Yield (Kg/ha)
1990	89,000	8,000	91	273,000	72,000	262
1991	134,000	7,000	55	235,000	21,000	88
1992	174,000	9,000	53	246,000	75,000	304
1993	71,000	5,000	65	230,000	60,000	261
1994	74,000	6,000	82	194,000	38,000	194
1995	120,000	10,000	87	264,000	104,000	394
1996	95,000	20,000	211	313,000	101,000	322
1997	38,000	7,000	186	315,000	105,000	334
1998	250,000	15,000	61	320,000	115,000	359
1999	202,000	22,000	107	330,000	118,000	358
2000	206,000	24,000	116	391,000	102,000	261

Table 4: Area, Production and Yield in Ethiopia and Sudan 1990/91 to 2000/01

Year	Ethiopia			Sudan		
	Area (ha)	Production (Ton lint)	Yield (Kg/ha)	Area (ha)	Production (Ton lint)	Yield (Kg/ha)
1990	36,000	19,000	528	209,000	83,000	397
1991	40,000	12,000	300	147,000	90,000	608
1992	40,000	10,000	250	123,000	56,000	457
1993	41,000	15,000	366	110,000	47,000	425
1994	42,000	14,000	333	175,000	83,000	476
1995	42,000	15,000	357	240,000	106,000	440
1996	42,000	15,000	357	279,000	100,000	359
1997	42,000	15,000	357	177,000	88,000	497
1998	80,000	15,000	188	117,000	55,000	473
1999	43,000	15,000	349	163,000	52,000	323
2000	44,000	14,000	322	169,000	74,000	434

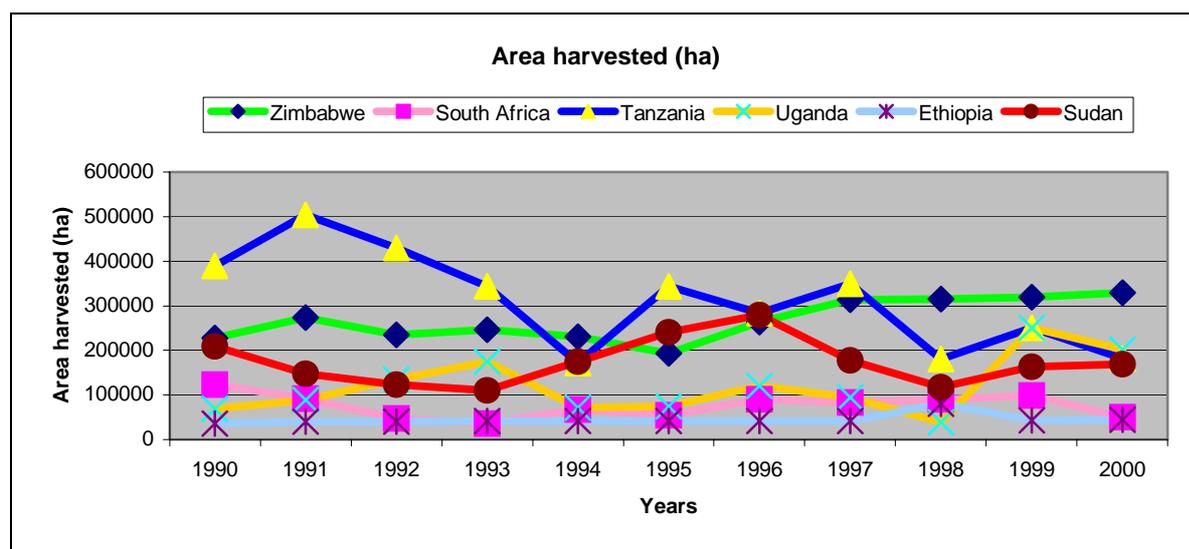


Fig. 1. Total area harvested from 1990 to 2001 in Zimbabwe, Tanzania, Uganda, South Africa, Ethiopia and Sudan.

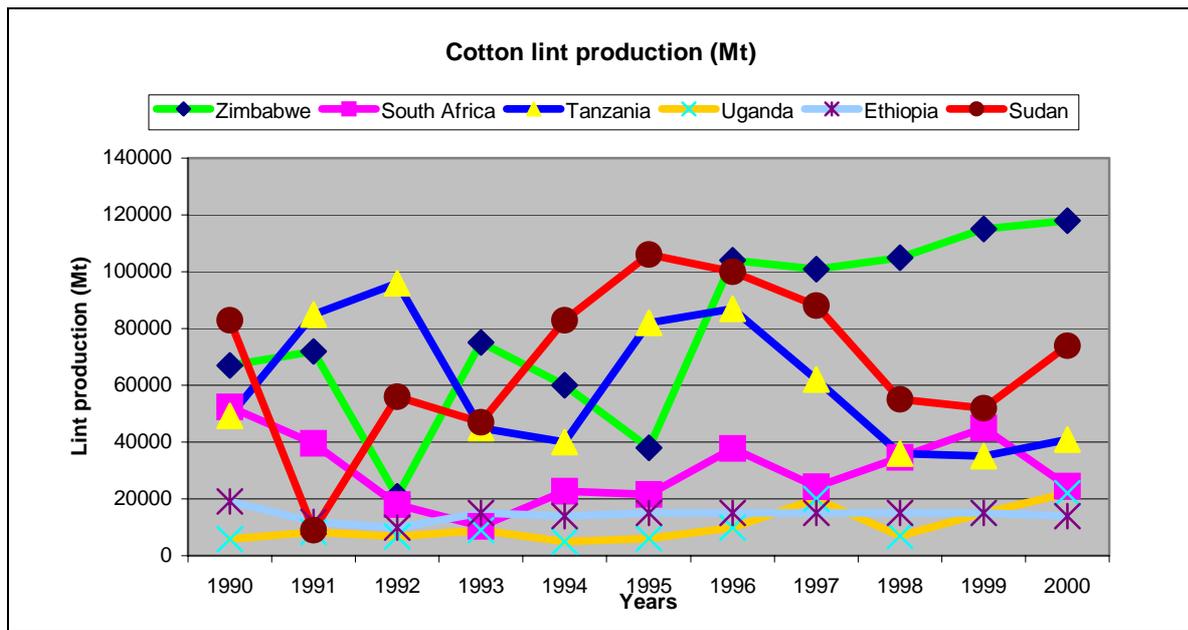


Fig. 2. Total cotton lint production from 1990 to 2001 in Zimbabwe, Tanzania, Uganda, South Africa, Ethiopia and Sudan.

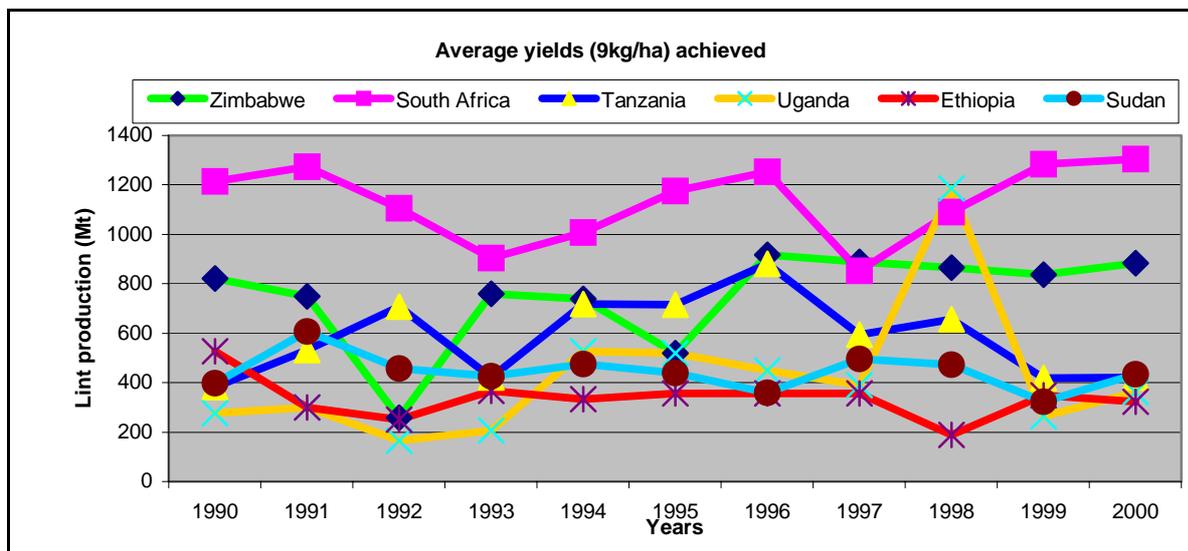


Fig. 3. Average yields (kg/hectare) achieved from 1990 to 2000 in Zimbabwe, Tanzania, Uganda, South Africa, Ethiopia and Sudan.