



CHA Cotton Seed Improvement Program

Cottonseed Sector Study

Mission report in Tanzania
October 15th-25th, 2018



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Survey of the Tanzanian Cotton seed system

Dates	October 15 to October 25, 2018
Main purpose of the mission	<p>Survey of the Cotton seed system in Tanzania</p> <p>Alliance: Mr. Boaz OGOLA (General Manager)</p> <p>Biosustain: Dr. Riyaz HAIDER (Director), Mr. Leonard MTAMA (Agronomist)</p> <p>Birchand Group: Mr. Arshad JETHA (Public Relation Officer)</p> <p>Mwabusalu cooperative: Ruben IDAYA (Farmer), Mugoma MLISHA (Progressive farmer), Bundala MIHAWA (Progressive farmer), Mwandu LUKATA (Progressive Farmer), Nhungo SAALUM (Farmer), Charles X (AMCOS)</p> <p>Mwabusalu Rais Office: Mr. Wilson LUCHAGULA (Acting village executive officer)</p> <p>Ministry of Agriculture: Mr. Jumanne SOLUBANA (Mwabusalu Ward Agricultural Officer), Ndunga MAKANIKA (Village Agricultural Officer)</p> <p>Quton: Mr. Pradyu CHAUHAN (Country Head), Shailendra BAGRAO (to be confirmed as Country Head), Raymond NDAROWA (Acting Manager of the delinting plant), Gracious GARAMUKAMOA, Mrs. Pendo MATULANYA (Quality control)</p> <p>Tanzania Cotton Board (TCB): Mr. Marco MTUNGA (DG), Mr. Prosper KULAYA (Planning and M&E Officer), Mrs Sharifa SALUM and Mr. Frugens IRUNGA (Cotton classifiers)</p> <p>Tanzanian Agricultural Research Institute (TARI): Dr. Furaha P. MROSSO (Entomologist, National Cotton Coordinator); Dr. Deusdedit P. MLAY (Agronomist); Georgia BUCHUKUNDI (Technician Plant Breeder); Paul KIBINZA and Joyce RUZZO (Phytopathologists); Grace MWIRA (Technician Agronomy); C.J. MAGANGA (Social scientist); Mohamed I. SHEMAHONGE (Agronomist); Seperatus KAMUNTU (Plant Breeder); Mr. Robert KILEO (Agronomist); Dr. George SONDA (Social scientist); Mrs. Epifania TEMU (Entomologist); E.L. KIBINDA (Geomatics)</p> <p>Tanzanian Official Seed Certification Institute (TOSCI): Mr. Gregory Jeremiah MWANISHI and Albert MANG'WATA (Seed inspectors)</p>
People met	
Itinerary	Ukiriguru, Mwanza, Bariadi, Mwabusalu, Singida, Shinyanza, Mwanza
Authors	Jacques LANÇON (Cirad), Everina LUKONGE (TARI)
Dissemination	<p>CHA: to be completed</p> <p>Cirad: B. BACHELIER, J.M. LACAPE, M. GIBAND, P. GRARD (DR), DGD-RS</p> <p>TARI: to be completed</p> <p>+ all the people met during the consultancy?</p>

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Our thanks go also:

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- to the Director General of TCB, Dr. Marco MTUNGA, and his staff for their very active and efficient support,
- and finally to all the stakeholders we could met and who did not hesitate to share very valuable and information on their activity.

Executive summary

- **Objective of the mission.** It accounted for the first Phase of a CHA-Cirad contract funded by BMZ (Germany) aiming at strengthening the Cottonseed sectors in Tanzania, Burkina-Faso, Ivory-Coast and Zambia. This mission had the objective of ‘implementing a cottonseed sector study in Tanzania’. It was conducted by Dr. J. LANÇON for Cirad and Dr. E. LUKONGE for TARI.
- **Implementation of the mission.** The mission was implemented between the 15th and the 25th of October 2018. The team, composed of Dr LANÇON and Dr LUKONGE seconded by Dr MROSSO, chose to concentrate to the major part of the cotton growing area, located in the North-West of Tanzania. It could visit several cotton districts and met a diversity of actors along the road



Figure 2. Major cotton production area in Tanzania (© Wikipedia).

Mwanza, Mara, Shinyanga, Simiyu and Singida Regions.

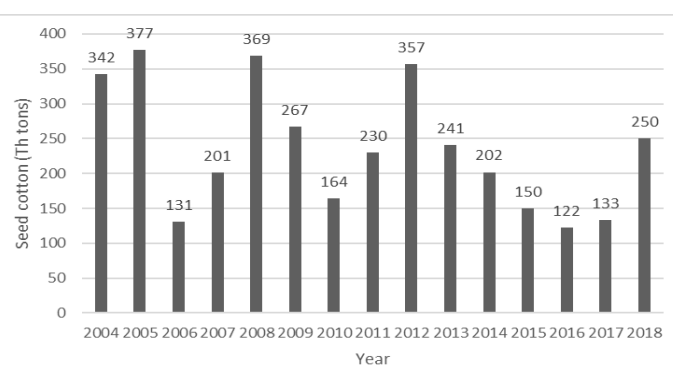


Figure 1. Seed cotton production in Tanzania from 2004 to 2018.

- **Cotton sector.** In brief, after the seed cotton production had experienced a pick in 2005 with 375,000 tons of seed cotton (Fig. 1), the cotton sector (Fig. 2) had to face very erratic production levels, going down to 130,000 tons in 2006 and even 122,000 in 2016. A boost production at 600,000 tons had been estimated early in the 2018 season from the area planted. Unfortunately it was not achieved and ended getting up to only 250,000 tons with an average SC yield of 500-600 kg/ha, due to various factors including an outbreak of *S. frugiperda* and Thrips, poor control of pests, excessive rainfall during the fruiting period, and local incidence of *Fusarium* wilt (FW). As a consequence, several private companies resigned from cotton, especially ginners (from more than 45 to about 25 now). The role of the Tanzanian Cotton Board (TCB) was also strengthened as a major coordination, concertation and regulatory body. From the total quantity of fiber nationally produced, about 20% of the fiber produced nationally has been processed by the local textile industry (23 small companies), where the rest is exported. Most of the seeds obtained after ginning are crushed for oil and cottonseed cakes. Finally it must be noted that Tanzania is the major producer of organic cotton in Africa, although it is still of very limited economic importance (less than 1%). Either in Tanzania, about 60% of the seed cotton produced is ginned in plants equipped with Roller gins, the rest being saw ginned.

- **Cottonseed sector.** TCB plays a coordination and regulatory role in contractualizing with all the cottonseed producers (farmers, research and private companies). Only the Fusarium wilt (FW) free areas (eg Meatu and Igunga districts and Singida region) are producing seed for the whole country. The seedcotton they produce is bought by the Ginners authorized by TCB through the AMCOS (Agricultural Marketing Cooperative Society). The ginned seeds separated for planting in the next season, are carried to Bariadi, where Quton operates a delinting plant able to produce 8-10,000 tons of delinted seeds per season and pack the seeds in a 4 kg bags (dose for an acre), which is enough to cover about 800,000 - 1,000,000 ha. The seeds are then available for the ginners to distribute to the farmers. TOSCI (Tanzanian Official Seed Control Institute) is controlling the quality of the seed released to the farmers. Recently, cotton research has developed two varieties, namely UK 171 and UK 173. The two varieties presently grown are UKM08 released in 2008 and representing 60% of the growing area (90% expected in 2019) and UK91 to be phased out soon.
- **Challenges.** Several challenges were already identified as:
 1. **Statistics:** as planted areas are not accurately known, yields cannot be precisely estimated and compared from year to year.
 2. **Productivity:** the low level of yield does not generate sufficient value to be distributed among the stakeholders (farmers included), as well to provide an adequate level of service such as extension, research, inputs *etc.*
 3. **Pest control:** it is estimated that about 60% loss of the cotton crop was observed in the 2017/18 season because of difficulty to control the cotton pests (Jassids, Thrips and *Spodoptera frugiperda*).
 4. **Disease control:** the continuous spread of *Fusarium* wilt could jeopardize the whole cotton sector.
 5. **Seed multiplication:** little control of the seed multiplication system in previous years and, in particular, 'wild' recycling of commercial seeds for planting, led to slow dissemination of the lastly released variety, risks of genetic mixture as well as an increase in FW incidence across the country.
 6. **Research:** the sub programme on breeding is not sufficiently financed or equipped, the germplasm used by the breeders lacks of genetic diversity.
- **Preliminary propositions.** Every challenges identified in the previous paragraph will have to be addressed during Phase 2 of the consultancy program. Some of them require different skills than the ones mobilized by the present consultancy. Some however, are more directly relevant to our subject and propositions can be submitted to further discussion and prioritization:

General:

1. **FW:** launch a program of mitigation in affected areas
2. **Soil fertility:** improve the effectiveness of the manure applied (composting)
3. **Organic cotton:** evaluate scientifically the efficiency of products proposed as alternatives to synthetic insecticides

Seed multiplication:

4. **FW:** make sure that the 'free of FW' zones remain free (no seed or soil entry)
5. **Planification:** improve the estimates of seedcotton needs
6. **Quality:** map the aptitude of the different regions

Plant Breeding:

7. **Focus:** elaborate ToRs for more specific and diversified breeding programs in coordination with the CC actors (different zones, organic...)
8. **Diversity:** facilitate the access to more diversified genetic material, at the regional level (West African countries with East and South African countries) as well as international
9. **Equipment:** network with local actors (*e.g.* Alliance) to benefit of their skill in servicing the ginning equipment
10. **Mutualization:** open a dialog with other breeding programs at eco-regional African level for increased global efficiency

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Simplified program

- October 15-16: travel from Montpellier to Mwanza
- October 16-18: visits in Mwanza area (TARI, Quton, TCB, Birchand, TOSCI)
- October 19-22: field visits (Alliance, Quton, Mwabusalu farmers, Biosustain, TCB)
- October 23: work at TARI
- October 24-25: travel from Mwanza to Montpellier

→ *Detailed program at Annex 1.*

ToR of the mission

This paragraph is a transcription of the ToR included in the CHA-Cirad contract.

Problematic

Pure varieties with high yield and fiber quality potential and high quality cottonseed are major factors to increase cotton productivity and value of the product harvested. Currently the cottonseed produced and supplied in most African countries is below international standards because of poor seed multiplication and dissemination systems and cotton ginneries are also contributing to that in recovering seed and reproducing it out of control. Furthermore, there is a challenge of research funding as public research support has been low for a long period of time: this has affected the improved variety development and maintenance (basic research) processes. But considering the long term trend, productivity in cotton based on the genetic source has barely increased over the last three decades thus resulting into diversity decline.

The CHA ambition

The Cotton expert House Africa (CHA) will support the cotton research and the cotton development companies in four African countries to recover the purity of the local cotton varieties and the introduction of a seed multiplication scheme.

The objective of this Cotton Seed Improvement Program is integral part of the overarching project implemented by the CHA to foster economic, social and ecological sustainability in the African cotton sector. Among other complementary activities, the target will be achieved by introducing technical innovations in the

field of improved cotton growing technologies. Precisely 300.000 African small farmers in four countries will increase the productivity of their cotton yield per hectare by 30% through the introduction of improved cottonseed. The current cotton yields in Africa are in the range of 300kg up to 1400kg per hectare (value differs from country to country). The current yield represents the baseline to assess the 30% increase in productivity.

The joint program

To reach the targets described above, CHA will assign CIRAD in cooperation with national cotton research institutes, cotton development and ginning companies in four countries. After a detailed assessment of the existing status quo of the cottonseed situation and available local cotton varieties (Phase 1 of the program), CIRAD in cooperation with the relevant African partners will develop a plan for the period of 2.5 years to improve the cottonseed (Phase 2). Subsequently, local cotton varieties will be re-established and a seed multiplication program in four African countries, two from South-East Africa and two in West and Central Africa will be set-up (Phase 3). The four countries are Zambia, Tanzania, Côte d'Ivoire and Burkina Faso

Objective of the mission

The mission aims at implementing a Cottonseed Sector Study in Tanzania (Phase 1 of the program).

To do that, the Cirad expert, Dr. Jacques LANÇON, with the active support of the TARI expert, Dr Everina LUKONGE, will:

1. Select cooperation partners/stakeholders involved in the national seed multiplication and breeding activities
2. Complete the CHA-Cirad questionnaire 'Data collection form for cottonseed sector study'
3. Provide an inventory of cotton variety usage
4. Highlight challenges and propose interventions on the different levels: frame conditions of cotton production, plant breeding, seed multiplication, seed processing and storage, marketing, regulatory procedures, seed use by cotton farmers

Research

TARI

Creation. The Tanzanian Agricultural Research Institute (TARI) was formed in 2016 by merging a number of regional and sectorial research stations, including Ukiriguru ARI, which were previously directly managed by the Department of Research and Development (DRD) under the Ministry of Agriculture.

Mission. The Institute is responsible for conducting, regulating and coordinating all agricultural research activities in the Tanzania (mainland).

Governance. The institute has its own governing body. The Board is composed of the Chairman (appointed by the President), and nine members appointed by the Minister of Agriculture and representing (i) the Ministry, (ii) the agriculture Universities, (iii) a private agricultural research Institute, (iv) the Local Government Authorities, (v) the Tanzania Commission for Science and Technology, (vi) the Tanzania

Livestock Research Institute (TLRI), (vii) the Attorney-General's Chambers, (viii) the farmers' organizations (2), and (ix) the agribusiness organizations.

Strategy. To serve its strategy, the Institute is in charge of ensuring the Secretariat of a National Agricultural Research Consultative Forum composed of (a) a prominent agriculturist appointed by the Minister (Chairman), and representatives of the National Agricultural Research System (NARS) including the Ministry of agriculture, public and private research institutes, higher learning institutions, TLRI, Local Government authorities, Farmers organizations, Agribusiness, the Tanzania Commission for Science and Technology, the National Environmental Management Council, the Ministries responsible for planning, for trade and industries, for forestry. This forum may form committees.

Cotton research at TARI. The main objective of TARI is to develop appropriate agricultural technologies that contribute to increased agricultural productivity, hence improved income and food security in Tanzania with special attention to improved productivity of the agricultural land, crops, environmental management and farm mechanization. The cotton sub programme has 5 research sections each dealing with a specific objective however, researchers from all sections they develop the technologies in collaboration (team working). Sections are Breeding, Entomology, Agronomy, Pathology and Fibre technology.

Group of scientists

- Organisation: **TARI (Tanzanian Agricultural Research Institute)**
- Date of the interview: **16/10**
- Place: **Ukiriguru**
- Persons interviewed: scientists in a group

Major opportunities for cotton production. In 2017-18, the area planted with cotton raised from 400,000 ha to 1 Mo ha, but the production was only 250,000 tons instead of at least 600,000 expected. Enough land in the Western Cotton Growing Area (WCGA) which produces about 97% of the National cotton crop. Cotton has been identified by the government as one of the 5 important crops to serve as promoter for industrialization. It benefits of a special legal body to coordinate the actors, the Tanzanian Cotton Board. Market available.

Major constraints to cotton production. Biotic constraints : *Fusarium* wilt due to *Fusarium oxysporum* cv *variegatus* (Fov or FW¹) and Bacterial blight, and insect pests such as *Helicoverpa armigera* and *Spodoptera frugiperda*, Efficiency of pesticides seems to drop. Little input use and pb of soil fertility. A bottleneck of labour is because mechanisation (oxen drawn) that improves the speed of land preparation, weed management *etc.* is not generalized within communities. Cotton actors look sometimes not sufficiently coordinated. The extension services are not operating the way they should because they are few and most of them do not have working facilities (like transport) and lack of capacity. Climate change makes weather



Figure 3. At TARI Ukiriguru Cotton Research Station. Left to right: Dr. F. Mrosso, Mrs G. Buchukundi, the consultant, and Mr. S. Kamuntu.

¹ There are two major FW free zones: Meatu (Mwanbusalu) and Igunga districts (as well as Singida region)

unpredictable and emphasizes the need to engage for irrigation. Price too low (production costs are high) 1100 TSh (50 cts).

→ *Comment 1. Note the importance of Fusarium wilt and Jassids attacks (to be confirmed), which have to be followed by mitigation (organization) and adaptation (breeding) measures. Knowing where the infestation occurs and its intensity (map). Organizing the seed production process with no entry in the fusarium-free zone. Looking for exotic genetic material for fusarium and hairiness (jassids resistance) eg from Australia (Sicot) or USA (Deltapine). The Cirad genebank located in Agropolis (ARCAD) could facilitate the access to genetic diversity for breeding.*

→ *Comment 2. The possible occurrence of H. armigera or S. frugiperda resistance to insecticides has to be monitored through trials and, if possible, tests on the pests themselves.*

Breeding

- Organisation: **TARI**
- Date of the interview: **16/10** and **23/10**
- Place: **Mwanza**
- Persons interviewed: Mrs Georgia **BUCHUKUNDI** (Technician Plant Breeder), Dr Everina **LUKONGE** (Plant Breeder), Mr. Seperatus **KAMUNTU** (Plant Breeder).

Present varieties.

- UKM08, covers about 60% of the whole CGA in 2018, and is expected to cover 90% of Tanzania in 2018-19 season. It was released in 2008 when it surpassed UK91 in GOT (42%) and in seed cotton yield (2,500 kg/ha).
- UK 91 still maintained in some areas because of UKM08 seed shortage

Breeding program. Either Breeders have released two varieties (UK 171 and UK 173) which are more or less than UKM 08 but UK 173 has many hairs in the leaf so that can be the added advantage. Therefore, from the situation observed in 207/18 season on jassids attack, breeding programme is aiming at multiplication strategies for the UK 173 for Jassids resistance and also evaluating for other varieties that can perform well and better than the present ones which have shown some limitations. At the institute, Breeding programme has no specific program for organic.

→ *Comment 3. Priority setting and terms of reference or set of specifications (SoS). Within the limits of the available resources, it would be useful to specify those for a limited number of breeding programs (see Text Box 1). The construction of the SoS need contribution of the beneficiaries, the resource providers and technical experts (scientists) as the variety is only one element of a global system.*

→ *Comment 4. Considering the importance of organic or sustainable cotton in Tanzania, there is a need for a multidisciplinary program that includes testing some of the innovative components (test of insecticides / breeding program ? based on diversity, glandless or barbadense or diploids?)*

Germplasm collection. Some genetic diversity in the collection is maintained at the institute where rejuvenation is done every after 2 seasons to maintain variability because no storage facility (cold room). Population maintenance (from crosses) and Seed exchange, ie with Uganda research institution, Cirad



Figure 4. Roller gin used by the breeding program.

(mission by B. Hau in years 2000), EMBRAPA (5 years ago), IER (4 varieties from Mali this year (2018), (NTA 344, NTA 93-15, NTA - 8/6 and L 100).

→ *Comment 5. A regional breeding network should be promoted. It could associate countries with significant breeding programs. Its main objective would be (a) to exchange genetic material and (b) to promote the idea of a Cotton Center of Excellence (but where and its role?). The potential members could be NRI of Benin, Burkina, Ivory-Coast, Mali, Tanzania, Zambia, Zimbabwe, etc.. Cirad genebank and National genebank could play a role in (i) maintaining the national germplasms for the network and (ii) facilitating the exchange of genetic material worldwide.*

Text box 1 - Defining the Set of Specifications in breeding (J. Lançon, 2009)

From: Plates-formes multi-acteurs. Un exemple de plate-forme appliquée à l'innovation variétale et illustrée sur bananier et plantain. INRAB Ed., 75 pp.

The set of specifications (SoS) is the reference technical document for the partners of a varietal innovation platform. It describes the set of constraints to be faced, and the objective prioritized by the partners. The SoS must emerge from a 'co-construction' process which ensures that the views and knowledge of all major stakeholders and beneficiaries are taken into account.

It includes four elements (see example in table 1):

- the breeding objective (somehow, the ideotype shared by the partners);
- the breeding criteria, linked with the set of constraints to be overcome, they drive the selection of genotypes, varieties or lines, adapted to the objective;
- the resources needed to achieve the full programme must be clearly identified;
- finally, evaluation criteria will help to determine the performance of the programme

Diversity generation. 40 crosses in 2018, including parents with some level of FW resistance/tolerance (Albar 56, HN 3476 and DeltaOp), good hairiness (UK 91), good micronaire (UK 08), as well as the commercial variety UKM08. It is possible that hair in excess might help to control Jassids but also promote whiteflies and possibly sticky cotton which does not occur at present.

Selection. After crossing all seeds are planted in a Single plant selection plot where selfing is done to avoid out crossing. At different stages selection is done and after harvesting the evaluation and selection is done from F1 to F5.

Evaluation. The plants that performs better are advanced to other superior levels termed as Preliminary Yield Trial (at Ukiriguru on station) and Secondary Yield Trials at 4 sites with UKM08 as a control. On Farm Trials are the very advanced levels for agro ecological evaluation and farmers assessment and preference then selection, this is done in 4 districts and 4 farmers as rep per district. On Farm Trials compare the performance of the advanced lines under Sprayed/Fertilized vs Unsprayed/Unfertilized conditions. The first objective of the on-farm design is to evaluate the candidates in real conditions and with farmers (participatory evaluation). The second is to evaluate if some are better suited in poorer environments. However, in general, there is no significant interaction, the best varieties work well in both environments.

→ *Comment 6. Besides the yield itself, the on farm trials provide a good opportunity to evaluate the susceptibility of a given line to pests, prior to its dissemination. Entomologists should be closely associated to the monitoring of these on-farm tests.*

Table 1. An example of Set of Specification (SoS) for the development of a cotton variety.

Items of the SoS	Description
Breeding objective	A cotton variety adapted to sowing as a second cycle crop (after maize or cowpea), rainfed, mechanised, high planting density, with GOT and quality equal to the commercial variety, for the Savalou region (Benin) where labour is becoming scarce (mechanical harvest)
Breeding criteria	Fast settling, short internodes, reduced height, limited vegetative growth, grouped boll opening, GOT superior to 44%, seed index superior to 8,5g, length > 27,5 mm, Micronaire > 4,2, +b < 10, tolerance to Bacterial blight and Jassids (hairiness)
Evaluation criteria	Levels acceptable in comparison with the commercial variety
Resources	Germplasm: MAR, Chaco 520, Rockett (<i>etc.</i>), and local varieties Finance: they must be guaranteed by the client-partners for the course of the program, at least 10 years Others (land, analysis of fiber, <i>etc.</i>): ...

Collaborations. With EMBRAPA and University of Dar es salaam (UDSM) on BB resistance. Mahyco has tested some Hybrids.

→ *Comment 7. On specific focused programs (FW resistance, fiber length improvement, Jassid resistance, a project combining biotechnology and conventional could be elaborated with Cirad with an objective of faster result.*

Fusarium wilt. In the whole of the WCGAs, about 50% of the plots might be infected, with a maximum of 50-60 plants/ac (in patches if the soil has been contaminated or rather in single plants when it came with the seed). The only measure to prevent its dissemination is related to seed production and distribution. It could be possible to train the farmers but there are not enough extension staff to do so and finance shortage.

Seed multiplication. Prior to liberalization (mid 1990s), the Cotton Board was taking care of the multiplication of 2 different varieties: one to be grown in the North of the WCGA *eg* UK91 and one for the South *eg* UK82. With liberalization, the scheme was not maintained and ginners were in charge of providing the seeds to the farmers in the area where they bought the seed cotton. Hence, mixing of varieties and dissemination of FW, diminution of GOT and quality were observed. In 2006, it was decided to maintain only one variety for the whole of WCGA (UK91). By contract, the ginners played a key role in the implementation of the multiplication system, as they provide training, input, chemicals and seed in their ward, which they also monitor. The input costs are deducted from the crop purchased. TCB / AMCOS (Agricultural Marketing Cooperative Societies) play a coordination role in ensuring the SC is brought to the authorized ginners. A supplementary generation of seed might be needed if there are not enough seeds produced as Certified, *eg* when the production of Basic seed has not been sufficient to cover the area needed to produce the C1. Such seeds are called Certified 2. When seed are not enough, ginners recirculate fuzzy commercial seeds... which contributes to build FW in the CGA.

Phytopathology

- Organisation: **TARI**
- Date of the interview: **18/10**
- Place: **Ukiriguru**
- Persons interviewed: Mrs Joyce **RUZZO** (Phytopathologist) + Mr. **KABONI** (GIS)

Survey of FW. The disease has been first identified in the 19ies. Some partial survey is conducted every year. The survey is conducted in 30 days for a district and mobilizes a team of 7 people (GIS, Soil scientist, Phytopathologist, Extensionists, 5 farmers per village) as each farm has to be visited before deciding if the area has to be excluded from seed multiplication.

Results of the surveys. They were initiated in 2011 with the wards of Bariadi district intended for the production of seeds (Quton) : FW was found in 2 wards while the others were free. In 2012, the Maswa district was found totally infected, as well as Bunda in 2013 and Kahama in 2015 with many areas and many plants (up to 150 plants/ac). In 2014, Meatu was found FW free as well as Mwabusalu and kept for seed production. Igunga, Nzega and Urambo are also FW free (not big producers).

Observations. FW develops more in sandy soils (acidic) and red clay (acidic and compact), where it may also be linked with nematodes, than in more fertile black and alkaline cotton soils. It is specifically serious in the historical Lake zone, where the production tends to decrease, and less in the Western and Central zones, which are rather new to cotton. In some areas (Bariadi district and Mara region) the level of infection is very low. FW also affects other crops, particularly Pigeon pea.

Recommendations. Breeding to create a resistant variety resistant, Dressing (Cuprous oxide / Bronopol), Seeds obtained from infected areas should not be used for planting (see also Text Box 2).

Breeding. Tests are conducted on advanced lines in a contaminated sandy plot of the research station and the results are quoted as % of plants expressing the symptoms. UK91 seems slightly more tolerant (40%) than UKM08. The testing is conducted for 15 strains and 4 advanced lines with 4 replicates.

Bacterial blight is

also inoculated on stem and boll (with a needle). UK91 and UK 08 are resistant to BB, as well as UKM08.



Figure 5. Left: Mrs J. Ruzzo and Mr. Kaboni (TARI).

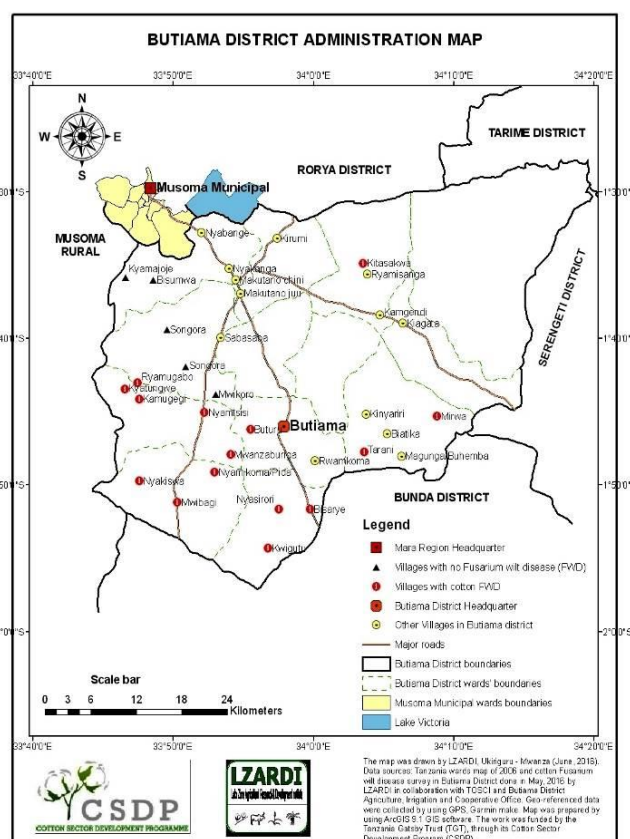


Figure 6. Map of FW survey in the Bunda district (© TARI).

→ *Comment 8. FW may be a big threat to the crop. A multi-disciplinary approach is suggested including extensive survey by phytopathologists, breeding possibly using a combination of conventional and biotechnology methods to speed up the results, agronomy (cropping system, see text box 2) and sensitization program (emergency measures / incentives or insurance for eradication).*

Text box 2 – FW: an example of what TARI recommends from the surveys

- Itilima District should not be used as seed source. The seeds for cotton production should be obtained from other districts which are *Fusarium wilt* disease free.
- The cotton seeds from this District Council have to be crushed into oil.
- The cotton seeds from Itilima district should not be distributed to farmers for planting in order to avoid further disease spread within the district and other neighboring districts like Meatu.
- Economic measures to be taken into account in order to avoid further spread of *Fusarium wilt* disease include: crop rotation of at least three years cycle; planting of disease free seeds; keeping cotton farms clean; educating farmers about the disease and when identified in their farms, affected plants should be uprooted and burned.
- Sensitization of farmer through demonstration plots on proper agronomic practices; this could reduce the number of farmers practicing broadcasting, mixed cropping and late weeding.

Text box 3 – Possible measures to reduce the impact of FW

From its appearance in 1993, *Fusarium oxysporum* f. sp. *vasinfectum* (FW) has become a serious threat for cotton growing in Tanzania. It is a stress-related disease, occurring especially in acidic or low fertility soils, with an optimum growth between 23 and 27°C. It can be transmitted by (a) infected soil borne by boots, vehicles, farm equipment, (b) water (overland flows) and (c) seeds.

In Australia, it has become one of the major constraints to cotton growing and can lead to abandon entire fields.

To prevent the disease:

- Create resistant varieties

To prevent its transmission:

- Distribute only FW free material (from Meatu and Ilunga districts)
- Avoid the movements of vehicles from infected to free regions (or clean the wheels)

To slow down the building of inoculum in lightly infected plots (small patches)

- Uproot the infected plants and the surrounding ones at least 1 m apart
- Let them dry and then burn
- Add high N content manure
- Lime with $\text{Ca}(\text{OH})_2$ to increase pH up to 7-7.5 (or Calcium Nitrate)
- Use only FW free seeds
- Avoid growing susceptible cotton varieties
- Avoid rotation with soybean or mungbean

To restore the capacity of plots that are heavily infected plots:

- Uproot the infected plants and the surrounding ones at least 1 m apart
- Let them dry and then burn
- If possible, plant something in the open space to prevent erosion
- Avoid growing cotton (at least until fertility restoration and resistant varieties are available)
- Limit the movements in and out the field to limit soil contamination
- Restore the fertility of the plot (animal and green manure)

Agronomy

- Organisation: **TARI**
- Date of the interview: **18/10**
- Place: **Ukiriguru**
- Persons interviewed: Mr. Robert **KILEO** (Senior agronomist)

Mineral fertilization. Evaluation Trial: types and rates (recommendations for P modified, from Triple Super Phosphate or DiAmmonium Phosphate), 15 kgP/ha up to 20 or 30 kgP (decline in response). Basic compound brings 15 kgP (to 28), 30 kgN (to be increased to 55 or 60 and split), no K (but could be added). Tests are conducted on station (Ukiriguru) and substation (Kanziga (Misungwi district), Mwanhala (Nzega district) and Bwanga (Chato district)), mostly on sandy loam, as well as on-farm (Meatu, Kahama, Nzega, Bwanga, Misungwi, Chato districts). There is a clear response to N, with an increase of 30% of the crop, but the economic benefit has not been estimated (cost of urea 70000 TSh/50kg, 3000 TSh/kgN against yield increase at

1100TSh/kg SC). Fertilizer used to be provided through cooperatives in the seventies-eighties, system collapsed with privatization (competition among ginners). Compound also tested with secondary elements and micronutrients: to be launched with a private company (Yara international company).

Plant spacing and planting patterns. Suitability of increasing the recommendation which is 90 cm x 40 cm spacing, 2 plants per hole (55000 pls/ha), to 65000 plts/ha in some soils.

Tillage trials. Minimum/conservation agriculture (with GA Africa), open furrows, cover crops (*Dolichos lablab*, consumed to be controlled like *Mucuna*). Basin successful, when supplemented with herbicide (to control weeds), furrows (ripper) efficient to control water but it must be associated with herbicide as it promotes weeds. Cover crops are promising, but problematic to maintain due to cattle (*Dolichos*, *Crotalaria*, Pigeon pea).

Weed control. Test on pre-emergence herbicides.

Socio-economy

- Organisation: **TARI**
- Date of the interview: **18/10**
- Place: **Ukiriguru**
- Persons interviewed: Dr. George **SONDA** (Socio-economics)

Value chain analysis (2011). Cotton is very important to households: dependent for livelihood. Price share to farmers could be better if other element of the chain taken into account (value of the oil and cakes).

Cotton seed sector. Not well organized (before each Ginner had to save 15% for seed). Up to recently, seed could be delivered too late and in insufficient quantity. Farmers lost confidence (sand, water, scales, insecticides), although it is a guaranteed market, all is paid at once (buy cows with the money).



Figure 7. Right: Dr. R. Kileo (TARI)

Private actors

Ginning

- Organisation: **Alliance**
- Date of the interview: **18/10**
- Place: **Bariadi**
- Persons interviewed: Mr. Boaz **OGOLA** (General Manager)

History. Founded in 1999, Alliance is primarily a ginning company, but it is also involved in development programs for its contracted farmers. It has worked with COMPACI or CMIA (Cotton Made in Africa) on sustainable cotton (BMZ and BMGF), and CHA on organic cotton or Gatsby Africa.

Activity. Alliance runs 2 ginneries for a capacity of about 100,000 tons in 6 months: a roller plant with 40 ginning machines with automatic feeding adapted from Lumus (capacity of 6000 tons/month), and a saw plant (4 units) with a capacity of 10000 tons/month. It has ginned about 15000 tons of SC this year, below 10% of its full capacity.



Figure 8. Roller ginning plant.

→ *Maintenance: Alliance employs very qualified people which could be mobilized to maintain also the ginning material used by research.*

Alliance had 54000 contract farmers in 2012, representing an area of 119000 ha. Now it has

23000 around the ginnery, and the presence of FW does not allow seed production. The contracts are passed with the Farmers Business Groups with a facilitation by AMCOS (Cooperatives). Their yield is estimated at 1135 kg/ha (460 kg/ac). Most of farmers are ploughing their fields and some are using the Magoye ripper, although it would have to be combined with herbicides.

Organic cotton. 1877 farmers are registered as organic farmers, with a target of 5000. They obtain the same level of yield as the others. The main difference with conventional is in the crop protection: instead of synthetic chemicals,

Neem oil, Solanum (against aphids), Lantana, Cow urine. They are paid a 5% premium, when the market gives 2 cts/lb incentive (less than 3%). They also

receive free inputs.

- Organisation: **Birchand**
- Date of the interview: **17/10**
- Place: **Mwanza**
- Persons interviewed: Mr. Arshad **JETHA** (Birchand Public Relation Officer)

Activity. Birchand is a company that owns 4 ginneries (including KCCL) and deals also with seed crushing. It gins about 20% of the seed cotton produced in Tanzania, after it used to be up to 30%. Roller ginning is preferred as it preserves better the quality of the fibre. At present, ginneries are working at less than 25% of their full capacity which is about 750 tons/day or 20,000 tons/month (total of the 4). The seed crushing plant is



Figure 9. Sow ginning plant.

producing edible oil for the local market. The extraction system is due to be upgraded with the installation of an expeller/hexane unit.

Variety. Likes UKM08 because of its high GOT (Ginning out-turn) as compared with the previous UK91, although the performance be partly altered by the cohabitation in the field with UK91, and possible mixing up.

Seed production system. The coordination body (TCB) is going to limit the competition between private actors, for the better. It places the AMCOS in the Cooperatives as key players. TCB is distributing the roles and zones to be covered by each of the 4/5 Ginning Companies allowed to enter the FW free zone and produce seeds. Locally, the AMCOS is organizing the contractualization between the relevant company and the farmers groups. The company will pre-finance and put in place the cotton production packs (seed, rope and insecticides), and buy, through the AMCOS. The input costs will be deducted from the seed cotton revenues produced by the farmers under contract.

Cotton Development Trust Fund (CDTF) is replenished by a levy, which used to be at 30 TSh and has been raised, from 2018, at 100 TSh (50 from the Ginners, 50 from the farmers) for each kg of SC sold. This amount (5.2 Mo€) subsidizes the cotton pack, and supports TCB as well as Research operational costs.

- Organisation: **Biosustain**
- Date of the interview: **21/10**
- Place: **Siginda**
- Persons interviewed: Dr. Riyaz **HAIDER** (Director, haider@biosustain.de), Mr. Leonard **MTAMA** (Agronomist)

Activity. Biosustain has been founded as a ginning company specialized in organic or sustainable cotton, like Alliance does. It has also been qualified as seed dealer, registered to produce Certified and now Basic seeds in the free FW zone (Meatu, Singida and the Eastern zone). It is in contract with 8000 out-growers in the region of Singida. The new variety seed of UKM08 to be produced in the entire district of Ikungi and in Meatu districts. Control the seed system

(ginning roller, 13000 tons). Same role as Alliance / CMIA as a standard, but also some organic.

Collaborations. Biosustain works with CHA.

Sustainable and organic cotton. CMIA criteria are used as a standard for sustainability: improving the quality of manure by composting, good working conditions for staff, for example at the ginneries, but no 'fair trade' criteria. Organic cotton consists mainly of scouting the pests and avoiding synthetic chemicals: molasses traps that eliminate 65% of the moths by trapping at night, and can reduce by 30% the application of insecticides, *Solanum incarnum* as dried powder (50 tons are under processing), Neem oil, cow urine *etc.* Farmers obtain yields of 400 kg/ha to 1000 kg/ha.



Figure 10. Centre, from left to right: Mr. L. Mtama (Biosustain), Dr. E. Lukonge (TARI) and Dr. R. Haider (Biosustain).



Figure 11. Fruits of *Solanum incarnum* drying at the plant.

→ *Comment 9. There is a need of research to be conducted by entomologists. What is the actual efficiency of the products used in Organic cotton, often on an empiric basis? What are their cost of production, effect on labour productivity and acceptability by farmers? May the application methods be improved eg going ULV? What about the boosting effect of cow urine?*

All East Africa affected by the poor control of insect pests.

→ *Comment 10. Tipping could be tested as a way of controlling excessive vegetative growth when too much rain, for improved pest control.*

→ *Comment 11. It is suggested to test the products used in organic and improve the processing (market possible?). CHA could perhaps support such research (bibliography and experiments).*

Seed system. Seeds will all be delinted next year. Farmers don't like delinted seed (cost of delinting at TSh 1200, and price of delinted seed at TSh 2500 or 3000/kg instead of 650 for fuzzy seeds). Seed provided to Biosustain farmers will not be delinted this year (too costly).

Processing capacity. Want to go for oil (traditional extraction by heat and pressure). Cakes at 450 \$/ton in Germany (250 for soyabean?). Ginning: 28 roller gin with a capacity of 100 ton/day or 2500 tons/month (1 person to feed 2 gins).

Seed multiplication. 7 ginners have been approved by TOSCI and are monitored by TCB as seed multipliers, *ie* allowed to buy seed cotton in the FW free area (Meatu and Igunga districts), through paying \$ 180,000 for each ward. This amount covers the cost of the extension services and other services to the commodity chain. Biosustain has paid for 2 wards out of 32 or 34 for this area in total (to be confirmed). Olam (international company) itself has paid for 2/3



Figure 12. Manual feeding of the roller gins at BIOSUSTAIN.

of this area. Note that the number of districts involved with cotton are about 46, which represent around 150 wards. All the other ginners have to get their seed from the approved ginners.

Table 2. Performance of some of the most important ginning companies in Tanzania (TCB, 2017).

Ginnery	District	Seed Cotton Ginned		Bales nb	Fiber	
		Weight tons	Share %		Estimated GOT %	Control GOT % (nb)
FRESHO	Shinyanga	13,530	10.3	24,208	32.6	34.1 (5)
OLAM	Mara	12,800	9.8	19,828	28.2	34.9 (3)
AFRISIAN	Shinyanga	11,750	8.9	20,909	32.4	36.3 (3)
ICK	Mwanza	7,200	5.5	10,300	26.0	34.3 (2)
ALLIANCE	Simiyu	4,600	3.5	7,946	31.4	35.4 (3)
BIOSUSTAIN	Singida	3,770	2.9	7,260	35.1	37.2 (2)
MeTL	Mara	690	0.5	1,400	36.8	
BCU - CHATO	Geita	240	0.2	462	35.0	

Approx weight of a bale: 182 kg

Comment 12. From the figures collected by TCB in 2017 (table 2), and considering a uniform bale weight of 182 kg (national average), the average GOT (Ginning out-turn or percentage of fibre) across all ginning

plants could be estimated at 31%. It varied between 26% and 37% depending on the plant/company. For example FRESHO and AFRISIAN were estimated at 32%, while GAKI and OLAM at only 28%. Compared to the tests conducted by TCB (Table 2, last column), there was a significant difference between the actual GOT estimated from the figures reported by the companies (31.0%) and the controls by TCB (35.4%). Among the six companies mentioned in Table 2, the largest difference was for ICK (8.3) and OLAM (6.7), and the smallest for FRESHO (1.5) and BIOSUSTAIN (2.1). Such differences could be explained by variable bales weights (to be confirmed). They also could be attributed to local growing or harvesting conditions, stones, dust or water added to the seed-cotton at harvest, or ginning machine wear and adjustment.

Comment 13. The results also show that the full potential of UKM08 variety (42%) is far from being achieved in real conditions. The change of variety (from UK91 to UKM08) does not seem to have yet affected the global GOT countrywide (see table 1 of the Questionnaire, Annex 2). The results of the tests conducted by TCB indicate that more progress is expected with the full dissemination of UKM08 as the average GOT obtained in these tests was 37.0 with UKM08 against 34.6 with UK91 (+2.4).

Seed delinting

- Organisation: **Quton company**
- Date of the interview: **17 and 19/10**
- Place: **Mwanza and Bariadi**
- Persons interviewed: Mr. Prady **CHAUHAN** (Country Head), Shailendra **BAGRAO** (to be confirmed as Country Head), Raymond **NDAROWA** (Acting Manager of the delinting plant), Gracious **GARAMUKAMOA** (Technician), Mrs. Pendo **MATULANYA** (Quality control)

Role. Quton is a Zimbabwean seed company, part of SeedCo, bought by Mahyco Seeds (India). It was called by the government in 2009 to restore the cottonseed chain in Tanzania. All seeds were then produced by Quton, in contract with ginners and farmers. Ginners provided the fuzzy seeds to be delinted in the plant settled at Bariadi. The TOSCI (Tanzanian Official Seed Certification Institute) would certify the seeds. In 2014, ginners would not deliver the seeds to the delinting plant because of poor results in the field observed in 2012-13 (see Comment 14). They lost confidence and recycled their own fuzzy seeds. Quton could not operate in 2014-15 and 2015-16. It was then decided that Quton's role would be limited to delinting the seeds on demand of the TCB. Then in 2017-18, the production of delinted seeds started again with 3100 tons, and for the next season 6000 tons were expected.



Figure 13. Germination tests on real soil at the Quton delinting plant.



Figure 14. A 4kg bag of delinted seed for one acre.

Comment 14. *Quton did well at the beginning but there were a lot of complaints about seed germination in 2012-2013 with delinted seeds. Hypothesis vary from poor quality of the seeds to misuse by the farmers which planted the seeds too deep in the soil, forgetting that they lost emergence capacity with only 2 delinted seeds per hole instead of 6-10 fuzzy seeds before.*

Hybrid seeds. Under Mahyco², Quton introduced 6 hybrid seeds which were tested against UKM08 by TARI.

Quality control. In the absence of seed cotton grading, the quality of the fibre and seeds cannot be anticipated. Hence, prior to the delivery of fuzzy seeds for delinting, a primary sample is taken at the ginnery (350 g fuzzy seeds) for testing. Physical examination and germination tests on 2 x 100 seeds (incubator at 25-30°C). Germination must be superior to 70%, mechanical damages less than 10%, immature seeds less than 15% (confirmed by floaters) and linter less than 10%. Germination is conducted on wet paper enclosed by 4 in plastic bags, estimated after 5 days. Germination of delinted seed is expected to be above 75% (even though, ISTA does not make a difference between fuzzy and delinted, minimum being at 70%). Germination is also performed on a 'normal' soil substrate and in open air, to confirm the results obtained in the incubator. Fast testing provides indication after 48 Hrs in water.

Delinting process. The delinting plant uses about 25 kg of acid per ton of fuzzy seeds processed (1/4 as compared with manual delinting). The full capacity of the plant is 12,000 tons of delinted seed, based on 8 months operating period (April to November). This implies that some carryover from the previous season may be stored at the plant. At the day of our visit (18/10), 4000 tons had already been delinted and Quton was expecting more orders from TCB. Operating target is 18% of rejected seed (in weight)



Figure 15. The seed is mixed with 10% diluted acid in a worm screw.

Production

- Organisation: **Mwabusalu Farmers Business Group**
- Date of the interview: **20/10**
- Place: **Mwabusalu, Meatu district**
- Persons interviewed: Ruben **IDAYA** (Farmer), Mugoma **MLISHA** (Progressive farmer), Bundala **MIHAWA** (Progressive farmer), Mwandu **LUKATA** (Progressive Farmer), Nhungo **SALUM** (Farmer), Charles X (AMCOS)

Cropping recommendations. Ploughing, planting between 15/11 and 15/12, at a spacing 0.9 x 0.4 m, with 4 to 8 fuzzy seeds per hole, thinning at two plants. No ridge, 3 to 5 weedings per season, no fertilizer, only manure, 4 sprays with bi-compound (pyrethroid + organophosphate).

Land usage. The farmers manage between 6 to 25 acres of cotton (2,4 ha to 10 ha, median at 4 ha), out of 10 to 35 acres of arable land (4 to 14 ha) + 3 to 8 acres (1.2 to 3.2 ha) for cattle grazing as they all have



Figure 16. The consultant with farmers of Mwabusalu cooperative and local staff of the Ministry of Agriculture.

² Mahyco is a private breeding company operating in India (Maharashtra state). It was the first company to produce and sale hybrid seeds at a large scale. It is under contract with Monsanto/Bayer to access to the GMO technology, and try to improve Nitrogen or Water use efficiency, Insect resistance, or Tolerance to salinity and herbicides

a small herd of 6 to 22 cattle mainly used for land preparation. They can keep the same land if they want.

Soil fertility practices. Cotton covers 43% to 70% of the total cropping land (median at 60%), fallow (arable land grazed by cattle) is possible on 0 to 23% of the total arable land of their farms (average 12%). Soils are said still “alive” and soil fertility is maintained by manure applications on the patches where fertility looks declining, as all have oxen. Before applying manure, the first measure is to crop on ridges for 2-3 years, in order to bring more soil to the cotton plant. No fertilizer is used due to its cost.

→ *Comment 15. One can only suppose that the response to mineral fertilizer would not cover its cost.*

Extension. The Ministry officers have identified ‘Progressive farmers’, who are considered as good farmers and used as relays to train other farmers, mainly on cotton production.

Productivity. After heavy hail storms and excessive rainfall during the season, the yields were, by far, not as high as expected. They ranged from 250 kg/ha to 550 kg/ha with 5 to 10 insecticide sprays. Some of them lost hope because the pests remained mostly uncontrolled.

Table 3. Results obtained by the Mwabusalu farmers.

	Farmer	SC Yield kg/ha	Expected yield	Cotton planted (ac)	Nb of sprays	1st planting date	Last planting date
1	Progressive	290		6	6	16-nov	15-déc
2	Normal	247		10	7	10-nov	15-déc
3	Progressive	555	1700	10	5	15-nov	05-janv
4	Progressive	549		18	8	24-nov	10-janv
5	Normal	247	1650	6	10	16-nov	25-nov
	<i>Average</i>	<i>378</i>		<i>10</i>	<i>7,2</i>	<i>16-nov</i>	<i>20-déc</i>

Pest control. It seems that the sprays of insecticide used (Dudu All which includes Cypermethrin and Chlorpyrifos) did not work out properly. As a consequence, all insecticides were finally given free to the farmers. Several explanations may be proposed:

- the pest pressure was exceptionally high: it seems that this problem has affected the whole of Eastern Africa,
- insecticides were systematically washed by water: possible as heavy rains were unusually frequent this season,
- insecticides were not provided on time: ?
- there was a lack of active ingredient due to bad formulation: this was noticed by TPRI and some products were withdrawn
- farmers diluted excessively the active ingredient: this is said to be of common practice,
- a change in pest profile affected the efficiency of the insecticides: this explanation is proposed by F. MROSSO, entomologist at TARI, as the new pest *Spodoptera frugiperda* seems to have arrived with some degree of resistance to pyrethroids.

→ *Comment 16. TPRI is in charge of surveying the appearance and level of resistance to insecticides. How this is done?*

AMCOS. Its role is seen as benefiting to the community. He checks that there is no difference between the amount of cotton weighed on the market and the one weighed at the ginnery. AMCOS also make sure that farmers remain serious with reimbursing loans.

Regulatory bodies

Coordination

- Organisation: **Tanzanian Cotton Board**
- Date of the interview: **17 and 18/10**
- Place: **Mwanza**
- Persons interviewed: Dr. Marco **MTUNGA** (Director General), Prosper **KULAYA** (Planning Officer, Prosper.kulaya@tcb.go.tz)

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Origin. Since the liberalization / deregulation (year 93-94), the cotton sector collapsed. TCB was then created by the Cotton Industry Act (Parliament).

Governance. It is governed by a Board of Directors composed of 6 members, and a Chairman appointed by the President of the Republic. Five members represent the Farmers (G. MPANDUJA, Bariadi), Ginners (G. GACHOUA, SNC), Local Government (LGAs) (A. NGOROMIA, Meatu district), Cooperative Unions (J. MIHANGWA), Textile industries (S. KAZI, A to Z), the sixth being a knowledgeable person to the cotton sector. For each representative position, three names are provided by the stakeholders associations, and the final decision is made by the Ministry of Agriculture.

Staff. TCB employs 64 people, including the 4 Gin inspectors (control and maintenance of plants), 27 cotton inspectors / district, 4 classers, 3 sample classers. All are paid by the government but receive some incentive by the commodity chain.

Role in cotton production. TCB licenses the seed cotton buyers (from 45 to about 25 now), which deposit the value of the crop they will buy from the villages. The AMCOS (Agricultural Marketing Cooperative Societies) are in charge of buying the seed cotton in the villages, deducting the cost of the cotton packs, supervising the loading of the seed cotton (by the Ginners which have pre financed the campaign) and escorting it to the ginnery. TCB has also cotton inspectors in each district. Gin inspectors (4 inspectors for 26 ginneries) control ginneries 6 to 10 times and complete 3 GOT tests per season. Other inspectors are supervising AMCOS in the control of seed cotton quality on the markets. More than 80% of the fibre is exported, average GOT (price for fiber and price for seed)



Figure 17. TCB is in charge of defining and maintaining the commercial cotton standards (top for roller gin; bottom for sow gin).

Seed cotton price. TCB calculates a floor price by considering the international price for fiber (provided by CotLook, 76 cts for 2018-19 season and 72 for 2017-18) + national price for seed (450 TSh/kg³ in 2018-19 and 500 TSh/kg in 2017-18) – operation costs (buying expenses, transport cost for money, gin expenses, profit

³³ 1 \$ = 2300 TSh

margin for ginners) → farm gate price of 1200 TSH for the SC crop bought in 2018 (72% of the international market price) and 1100 TSh in 2019 (67%).

Cottonseed multiplication. TCB authorizes a small number of ginners (4-5) to pass contracts with the farmers for seed production, *ie* in FW free, area. These ginners may contract with the farmers through AMCOS to buy and transport. Total need of seed is 15000 to 20000 tons of fuzzy seed or 6000 to 8000 tons of acid delinted seed. Seed production follows several stages including: Breeder's seed produced at TARI Ukiriguru research station, Pre-Basic seed at Kanziga in Misungwi district under TARI Ukiriguru; Basic seed in 4 villages of the Meatu district and Certified seed in Igunga district (17 wards). Farmers are getting a premium price of 10% for the production of Basic seed, but not for Certified. The seed committee is planning each year for the seed production and requirement. As delinting is concerned, there is only one company to guide for establishing the cost.

Seeds. The presently grown variety UKM08 seems to express a moderate susceptibility to Jassids because of few leaf hairs and FW. In case of seed importation, phytosanitary certificates are needed as well as authorization by TCB and Ministry of Agriculture though is not a priority for cotton seeds except for germplasm exchange.

Ginning capacity. Seed cotton is both roller ginned (60%) and saw ginned (40%). Total capacity is about 600,000 tons. Ginners were about 45 in previous years, but some 20 of them went out of cotton, mainly because they could not recover the loans conceived for inputs.

Textile sector. The commodity chain includes 21 companies involved in cotton spinning, weaving or knitting. Mostly with obsolete equipment. Local transformation could be 20% (to be confirmed). There is a wish to support it with governmental orders (hospitals, police, army *etc.*).

Seed control

- Organisation: **Tanzanian Official Seed Certification Institute (TOSCI)**
- Date of the interview: **18/10**
- Place: **Ukiriguru**
- Persons interviewed: Gregory Jeremiah **MWANISHI**, Albert **MANG'WATA** (Seed inspectors)

Role. TOSCI headquarter is located at Morogoro (more than 20 seed inspectors, for cotton and other crops). Ukiriguru office covers Mwanza, Shinyanga, Mara, Kigoma, Simiyu, Tabora and Kagera with 6 seed inspectors. Their role is to train seed farmers and verify that their fields are suited for seed multiplication. They also supervise the transport of SC from the field to the ginnery, and test the different categories of seeds for germination. The headquarter

of TOSCI is also in charge of inspecting the sanitary status of the introduced varieties and registering them officially, as well as those produced locally.



Figure 18. Center: MMr. G. Mwanishi and A. Mang'wata (TOSCI).

Specific seed requirements. Isolation distance for Prebasic (200 m), Certified (100 m). Farmers must be registered as seed growers (Name of the Farmer Business Group A, Name of the people, and Field number located with GPS). Fields are also registered (same site by Groups). Field inspection consists of:

- looking that off types do not exceed 2% of the plants from several criteria established with the breeder: color of the leaves (pinkish on the sides for UKM08), color of the stem (red vs green for UK91), color of the pollen (creamy vs yellowish), allocation of stigmas, plant shape (cone vs box);
- looking at cropping standards: restricted weeds / no *Striga*, no FW (if 1 plant you uproot, otherwise discard the field), no ratoon plants.

Inspections. Two inspections per season are required, first at the vegetative stage and then at maturity (sharp bolls vs brand/ smooth, boll opening earlier), although there cannot be rejection anymore.

Seed testing. Norms are adapted from International Seed Testing Association (ISTA). Around 200 samples are processed in Mwanza. Each 25 tons of seed produced, a 1kg sample is collected. The working sample is 350 g (approximately 2500 seeds). It is then analyzed for broken seeds and sand content (99% in weight for delinted seeds). Germination test is conducted on 100 seeds (%) for 12 days at room temperature, and the minimum is 75%.



Figure 19. Taking a sample in a delinted seedcotton bag.



Figure 20. Seed germination tests in process at Ukiriguru (TOSCI).

→ **Comment 17.** *The reduction of seed amounts delivered to the farmers to 4 kh/ac or 10 kg/ha increases the chances for the farmer to get a poorer stand. With a seed index of 9 and a planting density of 0.8*0.2m the 4 kg bag allows to use about 1,4 seed per station, and no spare seeds for re-sowing. Table 4 shows that planting with 6 seeds per hole limits the risk of getting empty stations in a field when compared to 2 seeds per hole, and the difference would even be higher with only 1 seed per station. Besides, one knows that groups of seedlings may break more easily the surface crust of a soil than a single seedling. The distribution of limited quantities of delinted seeds must then be based on much higher germination standards than with fuzzy seeds, and also go along with recommendations on more superficial planting. The table shows that to get almost full stand, a germination percentage of 85-90% is needed.*

Table 4. Chance to get a full stand with 6 seeds or 2 seeds per station (62500 holes per ha i.e. 0.8 m x 0.2 m).

Germination (%)	Percentage of empty station (%)		Final stand (stations/ha)	
	6 seeds/hole	2 seeds/hole	6 seeds/hole	2 seeds/hole
50	1.6	25.0	61,523	46,875
60	0.4	16.0	62,244	52,500
70	0.1	9.0	62,454	56,875
75	0.1	6.3	62,485	58,594
80	0.00	4.0	62,496	60,000
90	0.00	1.0	62,500	61,875
100	0.00	0.0	62,500	62,500

Fiber classification

- Organisation: **Tanzanian Cotton Board**
- Date of the interview: **22/10**
- Place: **Shinyanga**
- Persons interviewed: Sharifa **SALUM**, Frugens **IRUNGA** (Cotton classifiers)

Staff. TCB employs 9 classifiers who complete about 300,000 manual tests per year, and around 30,000 HVI analysis.

HVI laboratory. It takes part to the Bremen round test for HVI, and follows USA standards for classification. Results are good. Not much sharing of experience with Zambia (2) and Zimbabwe (1 in 2014).



Figure 21. Mrs S. Salum and Mr. F. Irunga in the HVI lab (TCB).

Variety. Small weakness in strength. But there is no comparison done with the other countries.

→ *Comment 18. The HVI laboratory (USTER purchased in 2014) looks very well settled, with proper isolation and air conditioning. It produces all the analysis asked by TARI's breeding program, which at present are limited to advanced strains (about 1000 analysis). This number could be increased to 2000 to include single plants selected at earlier stages.*

→ *Comment 19. For the varieties included in the multi-location trials, samples could be submitted to the classers, classified manually to confirm the results obtained with HVI.*

SWOT analysis (more details at Annex 5)

<ul style="list-style-type: none"> • Organization / legislation / research in place including for quality control (seed and fiber) • Coordination body in place (TCB) where the main actors are represented • Political support for cotton production • PPA including some ginning companies deploying development programmes • Experience with seed delinting • Large use of ox draught • HVI equipment managed by TCB • Enough land for seed multiplication 	<ul style="list-style-type: none"> • Low yields and low productivity at the field (rainfed) or plant level (GOT) • Scattered cotton growing area with regards to the production • High number of small ginners • Ginning capacity under-utilized • Under representation of farmers in the Coordination body • Risk of confusion between private and public stakes • Impartial assessment of seed delinting not yet done • Low dissemination speed of released varieties • Good agricultural practices limited • Limited funding of public service providers including research and extension • Little regional coordination in research
<ul style="list-style-type: none"> • Popular crop with experienced farmers • Commodity identified as a priority in the ASDP • Main African exporter of organic cotton • Significant local consumption by the national textile industry • Ginning equipment ready to absorb a much bigger production 	<ul style="list-style-type: none"> • Low genetic exchange to increase diversity • Fusarium wilt • Pest control: efficiency seems to have been declining over the past seasons • Soil fertility: its decline is especially noted in the older part of the CGA, the Lake zone • Climate change

Main documentation

Chirimi, S., P. Kibinza, E.L. Kaboni, J. A. Ngura and F.S. Mabagala, 2016. Cotton *Fusarium wilt* disease status in Itilima District Council, Simiyu Region, Tanzania and district suitability for Cotton seed multiplication. Final survey report, June 2016. LZARDI, 22 p. + Appendices

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ANNEX 1. Detailed programme

Itinerary for Cotton Expert House Africa Consultant 16-24/10/2018

Date	Location	Activity	Time
15/10/2018	Montpellier	Departure of consultant	05.30
16/10/2018	Mwanza	Arrival of consultant	11.00
		Travel to cotton research station for courtesy and discussion with Center Director, and scientists (TARI)	12.00
	Ukiriguru	Lunch (TARI)	13.00
	Ukiriguru	Visit of the breeding program and ginneries (TARI)	14.00
17/10/2018	Mwanza	Visit Quton Company	10.00
	Mwanza	Visit Tanzania Cotton Board (TCB)	11.00
	Mwanza	Visit Birchand / ICK Company	13.00
18/10/2018	Ukiriguru	Visit Tanzania Official Seed Certification Institute (TOSCI) Discussion with Phytopathologists and Agronomist (TARI)	
19/10/2018		Travel from Mwanza to Bariadi, (4 Hrs)	08.30
	Bariadi	Visit Alliance Company	14.00
	Bariadi	Visit Quton Company	15.00
20/10/2018		Travel to Mwabusalu Meatu (2 Hrs)	07.30
	Mwabusalu	Meeting with a group of farmers at the center of the seed multiplication area	10.00
		Travel to Singida (5 Hrs)	13.00
21/10/2018	Singida	Meet with Dr Everina Lukonge (TARI)	07.00
	Singida	Visit Bio-sustain company	08.30
22/10/2018		Travel from Singida to Mwanza (10 Hrs)	08.30
	Shinyanga	Visit the Classification unit (TCB)	15.30
23/10/2018	Ukiriguru	Work with Dr Lukonge (TARI)	08.30
24/10/2018	Mwanza	Departure of the consultant	10.00
25/10/2018	Montpellier	Arrival of the consultant	18.00

ANNEX 2. Acronyms

AMCOS	Agricultural Marketing Cooperative Societies
ARCAD	Agropolis Resource Centre for Crop Conservation, Adaptation and Diversity
ASA	Agricultural Seed Agency
ASDP2	Tanzanian Agricultural Sector Development Programme II
BB	Bacterial Blight due to <i>Xm</i> (<i>Xanthomonas axonopodis</i> pv <i>malvacearum</i>)
BMZ	The Federal Ministry for Economic Cooperation and Development (Germany)
BMGF	Bill and Melinda Gates Foundation
CA	Conservation Agriculture
CDTF	Cotton Development Trust Fund
CGA	Cotton Growing Area
CHA	Cotton expert House for Africa
Cirad	Centre de Coopération Internationale en Recherche Agronomique pour le Développement
CMIA	Cotton Made in Africa
CSP	Corporate Strategic Plan
DUS	Distinctness Uniformity and Stability (UPOV)
ECGA	Eastern Cotton Growing Area
EMBRAPA	Brasilian Agricultural Research Corporation
FBG	Farmers Business Groups
FW	Fusarium Wilt due to <i>Fov</i> (<i>Fusarium oxysporum</i> vasinfectum)
GDP	Gross Domestic Product
GIS	Geographic Information System
GMO	Genetically Modified Organism
GOT	Ginning – Out – Turn
GPS	Global Positioning System
GxE	Genotype x Environment interaction
HVI	High Volume Instrument (Fiber testing)
IER	Institut d'Economie Rurale (Mali)
ISTA	International Seed Testing Association
LZARDI	Lake Zone Agricultural Research Development Institute
NARS	National Agricultural Research System
NPT	National Performance Trials
QDS	Quality Declared Seeds
SCP III	Strategic Corporate Plan III (TCB)
SOS	Set of Specification
TACOGA	Tanzania Cotton Growers Association
TAGEA	Tanzania Ginners and Exporters Association
TARI	Tanzania Agricultural Research Institute
TARZI	Tanzania Agricultural Research Institute
TASTA	Tanzania Seed Traders Association
TCB	Tanzania Cotton Board
TOSCI	Tanzania Official Seed Certification Institute
TPRI	Tropical Pesticides Research Institute
ULV	Ultra Low Volume (for pest control)
UPOV	International Union for the Protection of New Varieties of Plants
WCGA	Western Cotton Growing Area

ANNEX 3.

Questionnaire

Data Collection Form for Cotton Seed Sector Study in TANZANIA

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1. Framework Conditions

1.1. Description of cotton production

1.1.1 Main production areas, cotton statistics, number of cotton farmers, main cotton stakeholders, and basic production details (desk study with main contribution from the research counterpart)

Western Cotton Growing Areas (WCGA's) around Lake Victoria, covering Simiyu, Mwanza, Geita, Shinyanga, Mara, Tabora, Kigoma, Kagera and Singida regions. The rest (less than 1%) is grown in the Eastern Cotton Growing Areas (ECGA's), which comprised of Iringa, Kilimanjaro, Morogoro, Tanga, Manyara and Coast region. Either cotton have introduced to more regions including Katavi last year and this year Dodoma.

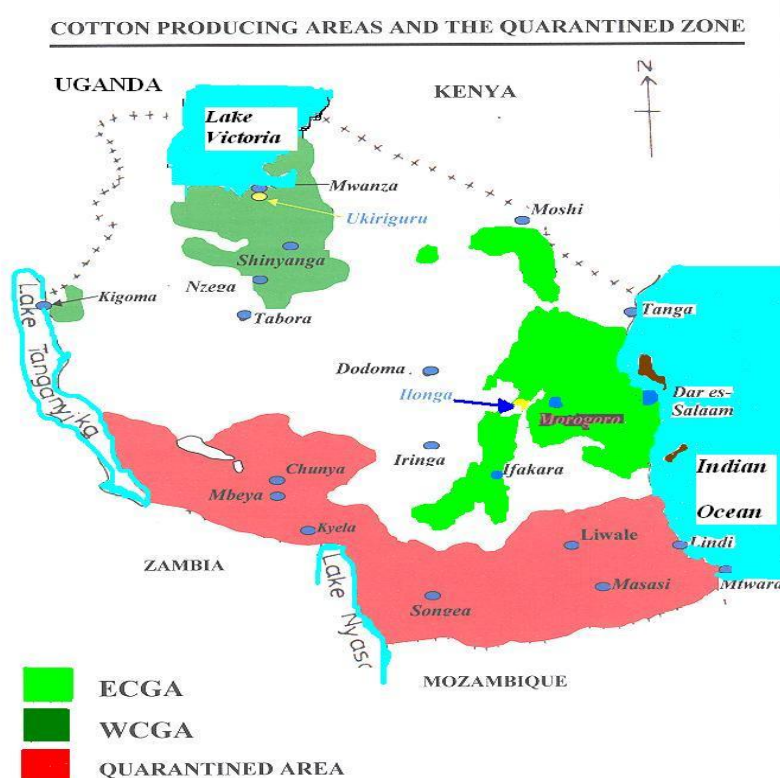


Figure 1. Map of the cotton growing areas in Tanzania (© TCB, 2011).

Although ECGA's produces less than 1 percent of the entire crop, it has a greater potential for increase in cotton production and productivity because of its fertile soil.

Table 1. Cotton Production and Yield 2005/06-2014/15 Period

	Acreage (Ha)	Fiber Yield Kg/ Ha	Lint Prod'n (Th MT)	GOT %F	SC Prod'n (Th MT)	Value (Th\$)
2005/06	471	214	128	34.0	377	116
2006/07	450	215	44	33.5	131	25
2007/08	459	163	68	33.8	201	47
2008/09	410	256	125	33.9	369	63

2009/10	485	306	89	33.3	267	59
2010/11	348	140	55	33.5	164	56
2011/12	469	200	76	33.6	226	55
2012/13	450	317	126	35.3	357	87
2013/14	450	218	82	33.3	246	56
2014/15	450	180	67	33.2	202	49

Source TCB, 2016

About 40% of Tanzanian population depend on cotton directly or indirectly and it is estimated that about 400,000 – 500,000 farmers grow cotton each year.

The major stakeholders for cotton in Tanzania are farmers, ginners, spinners, textiles, Local Government, Government Organizations and Non Governmental Organizations, Research Institutions, Universities, Private Companies and the Government in totality.

1.2. Specific Legal Provisions regarding cotton

1.2.1 Brief description of the main legal provisions on cotton germplasm:

- Cotton germplasm collection and conservation
- GMO cotton
- Cotton variety registration, evaluation, release, protection, national listing, licensing and royalty collection

a) Cotton germplasm is managed by the breeder, at research institution. The collection of germplasm mainly is through exchange and importation of seeds from research institutions in other countries. There is a gene bank managed by TPRI (Tropical Protection Research Institute, Arusha), but with very few cotton varieties. Many varieties are then kept at research institutions (Ukiguru and Ilonga) and rejuvenated every after 2 seasons because there is no cold room to store them.

b) GMO is allowed for experimentation (confined field trial and laboratory) but not for commercial purposes. There is a discussion going on at the Ministry level at least to do confined trials.

c) Cotton variety registration goes through NPT (National Performance Trial) handled by TOSCI (Tanzanian Official Seed certification) at least on 4 locations in three years, to conduct DUS (Distinct, Uniformity and Stability) testing, and also for other merits including yield, adaptability, insect/disease resistance and fiber characteristics. Considering the results of the tests, a variety release committee decides if it must be registered for growing in Tanzania. The VRC (Ministry of agriculture), TARI, Sokoine or Dar es Salaam universities representatives, TOSCI, Tanzanian Seed Traders Association (TASTA), Ministry representative from seed unit and Principle secretary meet once a year unless there is special request. Royalties of 2% on all the cotton seeds produced have been agreed orally with TCB to support research activities. TARI took the initiative of protecting both varieties released in 2008 (UKM 08 and UK 08): they are listed in the national Gazette and licensed by the Plant Breeders Right (PBR). The two new released varieties (UK 171 and UK 173) are also in the process of registration. Research produces Breeders seeds and Pre-basic seeds and sell them at the same price as Basic or Certified (2500 TSh ~ 1 €/kg for delinted seed and 650 TSh for undelinted seed).

1.2.2 Brief description of the main legal provisions on cottonseed multiplication/certification:

- Who may multiply cottonseed?
 - Cottonseed certification (OECD, US, national system)
 - Quality declared cottonseed
 - Farmers' privilege
- State the legal documents where these provisions are stipulated.

a) Whoever is approved by the TCB (Tanzanian Cotton Board). Now mostly are ginners by contracting farmers and research institutions

- b) Varieties are certified by TOSCI (Tanzanian Official Seed Certification Institute), following UPOV rules (DUS, and performance)
- c) QDS is not applied in Tanzania
- d) This is not applied because the issue of seeds is centralized in the mean time because TCB only is responsible with seed distribution through ginneries.

From Cotton Industry Act and Seed Act

1.2.3 Brief description of the main legal provisions on seed processing:

- a) Cottonseed processing (cleaning, drying, grading, treating, packaging, labelling)
- b) Cottonseed storage
- c) Quality control (for certified and quality declared cottonseed)

State the legal documents where these provisions are stipulated.

- a) Cottonseed processing services is done by a private company Quton (Zimbabwe) under the control of TOSCI (Tanzanian Official Seed Certification Institute) and supervised by TCB
- b) After delinting, the seeds are collected by ginners for distribution to the villages where the cooperatives store them before dissemination. Alternatively, seeds may be stored at ginneries waiting for dissemination.
- c) Quality is controlled (i) by Quton at the ginnery (on fuzzy seed, germination must be superior to 70%), then after delinting, adjusting to target of about 15% rejection in weight), (ii) by TOSCI on the final product.

From Cotton Industry Act and Seed Act

1.2.4 Brief description of the main legal provisions on cottonseed marketing:

- a) Who may market, distribute cottonseed, legal conditions and requirements
- b) Cottonseed import regulations

State the legal documents where these provisions are stipulated.

- a) A limited number of ginning companies must be approved by TCB to contractualize with farmers of the free Fusarium Wilt Zones (Meatu, Igunga, Nzega, Siginda) for the production of cottonseed. These ginners are responsible with marketing and distributing the cotton seeds. Also on moving the seeds, TOSCI has to provide them with the moving order.
- b) Seed import are subject to authorization by the Ministry of Agriculture through TOSCI by applying for the import permit and the original country has to provide the phytosanitary Certificate.
- The Legal documents are the Seed Act and the Cotton Industry Act.

1.2.5 Do farmers have a choice of the cotton variety they sow?

If yes, do legal texts secure the right of choice of cottonseeds for farmers? If no, what does the legal text say?

No. Farmers have no choice of cotton variety instead the variety (ies) to be grown is (are) authorized by the Ministry of Agriculture among the ones registered in Tanzania.

In the Cotton Industry Act it is well elaborated that cotton seed varieties are controlled by the Government under the TCB supervision.

1.2.6 Do legal texts protect specifically disadvantaged groups such as remote smallholder farmers, females, and young farmers?

Yes, because most of cotton farmers are from remote areas and smallholder farmers seeds are free from this season. Although it is not segregating females and youth.

1.3. National Development Plan
<i>1.3.1 Is cottonseed specifically addressed in the document (yes/no)? Provide full document name and publication date. What are the major objectives mentioned (example: improved qualities, access, information...)?</i>
<p>Yes cottonseed is addressed in the strategic plans for the country. In the Tanzania Agricultural Sector Development Programme (ASDP II) launched in June 2018, cotton is mentioned as a strategic cash crop. The major objective is to transform from a low productivity agricultural economy to a semi-industrialized country.</p>
1.4. Agricultural Development Strategy and Plan
<i>1.4.1 Is cottonseed specifically addressed in the document (yes/no)? Provide full document name and publication date. What are the major statements regarding plant breeding, seed multiplication, seed processing and storage, seed market and distribution, seed quality control)?</i>
<p>Although cotton is seen as one of the major crops to promote industrialization (textile industry, ginneries, oil mills) in the country, cottonseed per se is not really mentioned.</p> <p>However, it is said that “low productivity levels and growth trends are due to poor and or inadequate of sustainable access to key inputs (especially fertilizers and seeds, livestock genetic improvement, fingerlings, acaricides, vaccines and veterinary drugs). ASPD II wishes to promote the “value-chain approach” and a “new paradigm (called) ‘sustainable crop production intensification through strengthening the national seed systems involving TARI, the Agricultural Seed Agency (ASA), the Tanzania Official Seed Certification Institute (TOSCI), private seed producers and agro dealers.</p> <p>From Agricultural Sector Development Plan II (ASDP II)</p>
1.5. Environmental and Biodiversity Policy
<i>1.5.1 Is biodiversity a national objective related to the cottonseed sector mentioned in any relevant document? Provide full document name and publication date.</i>
<p>Generally biodiversity is one of national objective but it is focusing on environment and not directly to the cotton or cottonseed sector</p>
1.6. Market Interventions Affecting the Seed Market
<i>1.6.1 Which tariff and non-tariff barriers are in place related to the seed market for cotton?</i>
<p>No specific tariff barriers, but the importation of seeds is restricted to be approved by TCB and the Ministry of Agriculture.</p>
<i>1.6.2 Which taxes apply to cottonseed production, processing and trade? Are there any tax incentives or privileges in place?</i>
<p>3 to 5% taxes on cotton activities go to the government.</p> <p>Moreover, the Cotton Development Trust Fund (CDTF) is replenished by a levy, which used to be at 30 TSh (about € 1ct) and has been raised, since 2018, at 100 TSh or € 4 cts equally shared by the Ginners and the farmers, for each kg of SC sold. The amount collected (5,2 Mo€) subsidizes the cotton packs, inputs (insecticides and seed) and funds operational costs of TCB or Research.</p>
<i>1.6.3 Which subsidies are in place affecting production, imports, distribution, transport, local market prices of cotton, including seed aid?</i>

<p>The Tanzanian state is only playing a facilitation and coordination role in supporting TCB and Research. There are no subsidies to the production of cottonseed (either, this season the Government has provided seeds free to farmers).</p> <p>The price of seed cotton is derived from an anticipation of the World market price (CotLook) + Price for seed, weighted by the average GOT, from which are deducted estimated operational costs (buying expenses, transport, cost for money, gin expenses, profit margin for ginners for ginning).</p>
<p><i>1.6.4 Are there any other macro-economic interventions in force relevant to the seed market like e.g. foreign exchange control?</i></p>
<p>None</p>
<p><i>1.6.5 What are the main challenges regarding the legal and policy framework for cotton?</i></p>
<p>No major challenge identified</p>
<p>1.7. Major Constraints</p>
<p><i>1.7.1 Related to areas above, identification of key constraints facing the cottonseed system. Analysis of underlying reasons for constraints, incl. legal framework (be specific), government policies, natural resource endowment, technical know-how etc.</i></p>
<p>Few challenges are there but not major especially on the seed systems from multiplication, handling and distribution although the Government is trying to put the formal seed system. Resources for producing quality seed is still a challenge because just smallholder farmers are contracted for seed multiplication. Also technical knowhow for most of extension staff on seed production is still a challenge. On the research side financing for multiplication of Breeder and pre basic seed is a big challenge especially on resources (finance and equipment).</p>
<p>1.8. Proposed Interventions</p>
<p><i>1.8.1 Suggestions for project interventions differentiated between short-term, medium-term and long-term actions. (In case no direct project intervention is foreseen in the legal framework, recommendations shall be given for important field of actions)</i></p>
<p>For the short term: Capacity building to cotton seed growers and extension staff. Midterm: Need to establish a clear road map for seed systems and capacity building. Long term: Big investments in seed systems from production to processing and distribution. Advices to the Government on seed support (infrastructure, research, capacity building).</p>

2. Plant Breeding

2.1. Germplasm Collection and Conservation

2.1.1 What are the cotton germplasm sources for plant breeder? Where are suppliers located?

The main source is the germplasm that was constituted and maintained in previous years, with obsolete varieties although those germplasm presenting interesting traits are used as parental material to be crossed with local varieties for new varieties development.

Most recent introductions were provided in the years 2000 (varieties including US resistant to FW from the CIRAD genebank), in 2013 (varieties bred by EMBRAPA, Brazil), in 2016 (NTA varieties bred by IER, Mali). Note that the commercial UKM08 has been developed from a cross with a NTA variety.

2.1.2 Do gene banks for cotton exist in [country]? What are their objectives?

There is one gene bank managed by TPRI (Tropical Protection Research Institute) in Arusha but not much for cotton varieties. The objective is to maintain a seed nucleus in order to serve as a source for that commodity in case of a disaster.

2.1.3 What is the present cotton varietal national situation ("variety catalogue") – variety/ies name, - origin (local/imported), - areas and stages (under commercial cultivation, under advanced seed increase stage)?"

Two varieties are grown at the moment in the Western cotton growing area:

- UK91, released in 1991, is a local variety, under commercial cultivation still grown (40%)
- UKM08 released in 2008, is a cross between local variety and imported one, under commercial cultivation (60%), passed through all processes managed by TOSCI
- UK 171 and UK173, released in 2017 (registered in the national gazette), still at the Breeder seeds stage may take the place of UKM08 in years to come

Two varieties are grown at the moment in the Eastern cotton growing area:

- MKOMBOZI, released at Ilonga Research Station under TARI, had to be withdrawn after its purity had been lost
- UKM08, now is planted in the ECGA

Note that NTA93-21 is indicated in the TCB Corporate Strategic Plan III (2016) as the new variety for ECGA.

2.1.4 How did the diversity of the cotton varieties develop in the last 10 years? How will it presumably develop in the future?

Until 2006, three varieties were grown in West, Central and East cotton growing regions. However, due to poor seed management, it was then decided to reduce the number to two varieties: one (UK91) for the WCGAs and one for ECGAs (Mkombozi). When the purity of Mkombozi was lost, it was decided to grow only one variety in the whole country ie UKM08.

More diversity is expected, provided continuous support is available to develop in several parallel breeding programs and also seed systems and seed handling assumed to be okay.

2.1.5 What are the main challenges regarding cotton germplasm collection and conservation?

Two main challenges:

- Maintaining sustainably the germplasm because there is no cold room therefore rejuvenation is done every after 2 years
- Renewing and enlarging the genetic basis through increased seed exchange with other breeding programs or gene banks

2.2. Plant breeding objectives and activities for cotton

2.2.1 Is plant breeding for cotton dominated by public, private or civil society organizations? Who is involved? Role of cotton companies etc.

Cotton is dominated by public institution (TARI), so breeding for cotton is done by breeders from the public organization.

However, this program is discussed with TCB, where all stakeholders are involved, including the cotton companies and farmer organizations. Through contributions from farmers and cotton companies breeding is getting funds to run the activities.

2.2.2 What are the cotton breeding objectives?(differentiate public / private)

Cotton research is serving 3 major stakeholders (farmers, ginners, spinners and textile)

- Breeding for resistance to disease/insects, adaptability to environment and high yielding is favouring farmers
- Breeding for high ginning percentages is favouring ginners
- Breeding for good fibre quality is favouring spinners and textiles

Therefore, breeding aims at balancing all traits.

2.2.3 Is any cotton breeding done using GMO techniques (or other techniques)?

None

2.2.4 According to which criteria do breeders decide to breed and to maintain a certain cotton variety? Do they get information on variety characteristics demanded by farmers, agro-processors, consumers, exporters? How and by whom? Are farmers involved (participatory breeding)? (differentiate public, private)

Breeding for a certain variety criterion depends on the stakeholders request and need during the meetings.

Breeders are aware on the meetings conducted with farmers and also through evaluation made before variety release where the advanced lines are evaluated at farmers' fields by themselves in collaboration with extension and research from planting to harvesting so they select according to their preferences and needs. So breeder can know exactly the variety preferred by the farmers because it is a participatory breeding.

For the criterion preferred by other stakeholders, breeders are breeding for the traits depending to the global market because in the meantime only 20% of Tanzania cotton is consumed in country and the rest is exported. Therefore the exported fiber has to abide with International standards.

2.2.5 Which other stakeholders are involved in the decision, which cotton varieties to breed and to maintain besides the breeders?

Farmers, TCB, Ginners, Global market
2.2.6 What are the cotton germplasm sources for plant breeder? Where are suppliers located?
Already answered
2.2.7 What are the main challenges / constraints regarding cotton plant breeding?
<ol style="list-style-type: none"> 1. Few germplasm (low genetic diversity in cotton population) 2. Climate change 3. Lack/poor infrastructure (screen house, irrigation facilities, seed lab) 4. Technical know-how for young scientists on breeding and seed technologies
2.2.8 If breeders are involved in the multiplication scheme, at which stages: conservation and multiplication of breeder seeds, visit of the multiplication fields, elimination of off-types plants in the multiplication fields, ginning of seed cotton in the multiplication fields, support for the ginning of seed cotton in the multiplication fields by public or private cotton companies, etc?
<p>Breeders are responsible for breeder's seeds and prebasic seeds including ginning of seed cotton. They are involved in conservation and multiplication of breeder seeds as the mandate for public research institution. Other stages are managed by ginners with TCB and TOSCI.</p> <p>Breeders usually visit the fields that produce breeder's and prebasic seeds, but they can visit other levels (basic and Certified seed farms) on request.</p> <p>Breeders get involved at elimination of off-types plants in the multiplication fields established by other seed producers on request.</p>
2.3. Partnerships and linkages
2.3.1 Is there any (formalised?) collaboration between national research centres, CGIAR centres, other research institutes, sub-regional research organisations, universities, private breeders, donor projects, other VC actors, incl. farmer participation, cotton companies or other stakeholders?
<p>Considering seeds and breeding</p> <p>National RC: TPRI</p> <p>CGIAR: no</p> <p>Other Research institutes: IER, Embrapa (Brasil) but not recently, KALRO (Kenya)</p> <p>Universities: University of Dares salaam and Sokoine</p> <p>Private breeders: Quton (Zimbabwe and India)</p> <p>Donor projects: GATSBY (evaluation of material on farm)</p> <p>Other VC actors: government, TCB, TOSCI, Ginners (service provider)</p> <p>Farmers: on farm participatory breeding trials, management</p> <p>Local governments: demonstration establishment and on farm supervision</p>
2.3.2 What is the nature of such collaborations?
Have agreements but other are through table discussions
2.3.3 What are the main challenges regarding partnerships and linkages?
<p>Short term collaborations, donor-oriented: depend on donors requests</p> <p>Long term collaborations not financed</p> <p>Variety development not taken into consideration</p>

2.4. Major Constraints

2.4.1 Related to areas above, identification of key constraints facing the cotton breeding system. Analysis of underlying reasons for constraints, incl. legal framework (be specific), government policies, natural resource endowment, technical know-how etc.

The major reason for the challenge is limited funding from the Government and sometimes technical knowhow. Depending on donor funding for full breeding process is difficult to take such a long time.

2.5. Proposed Interventions

Possibility of developing a joint conventional-biotechnology program on disease resistance especially Fusarium wilt (FW) disease, fibre Length, fibre strength, and Hairiness or Jassid resistance.

Mechanism for facilitating seed exchange (Cirad genebank could play a role at African level) and evaluation of germplasm.

Developing an international breeding program for Bio-cotton.

Population genotyping and gene transfer to fasten variety release.

3. Seed Multiplication

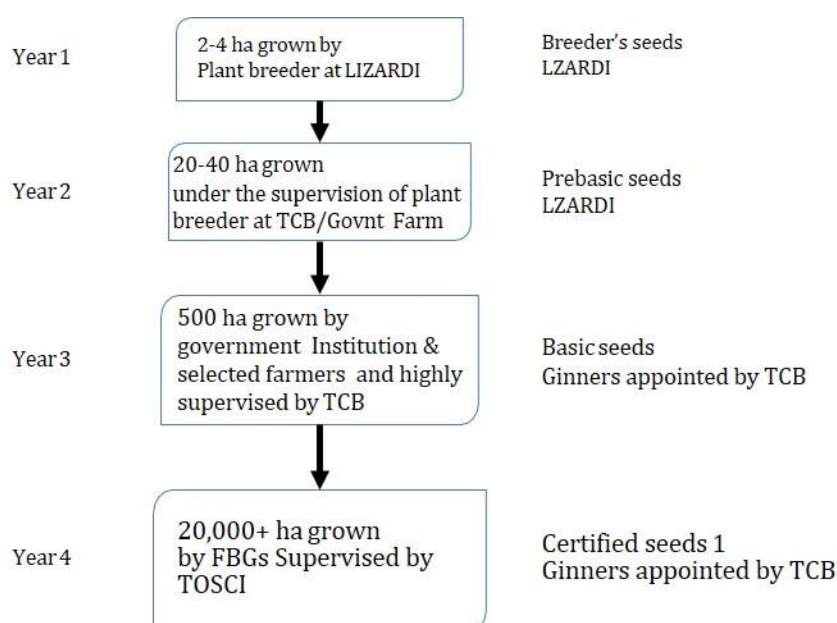
3.1. Formal Seed Sector

3.1.1 Is there a national cottonseed multiplication scheme in place; if yes provide description

The seed multiplication scheme involves many actors of the cotton sector.

It follows a chronology which is common to most multiplication schemes (see Figure below), with research playing a major role in the first two years of the process (multiplication of breeders' seeds and prebasic seeds).

From the seeds provided by research, authorized ginners, selected by TCB, are contracting the multiplication of basic and certified seeds with contract farmers / cooperatives.

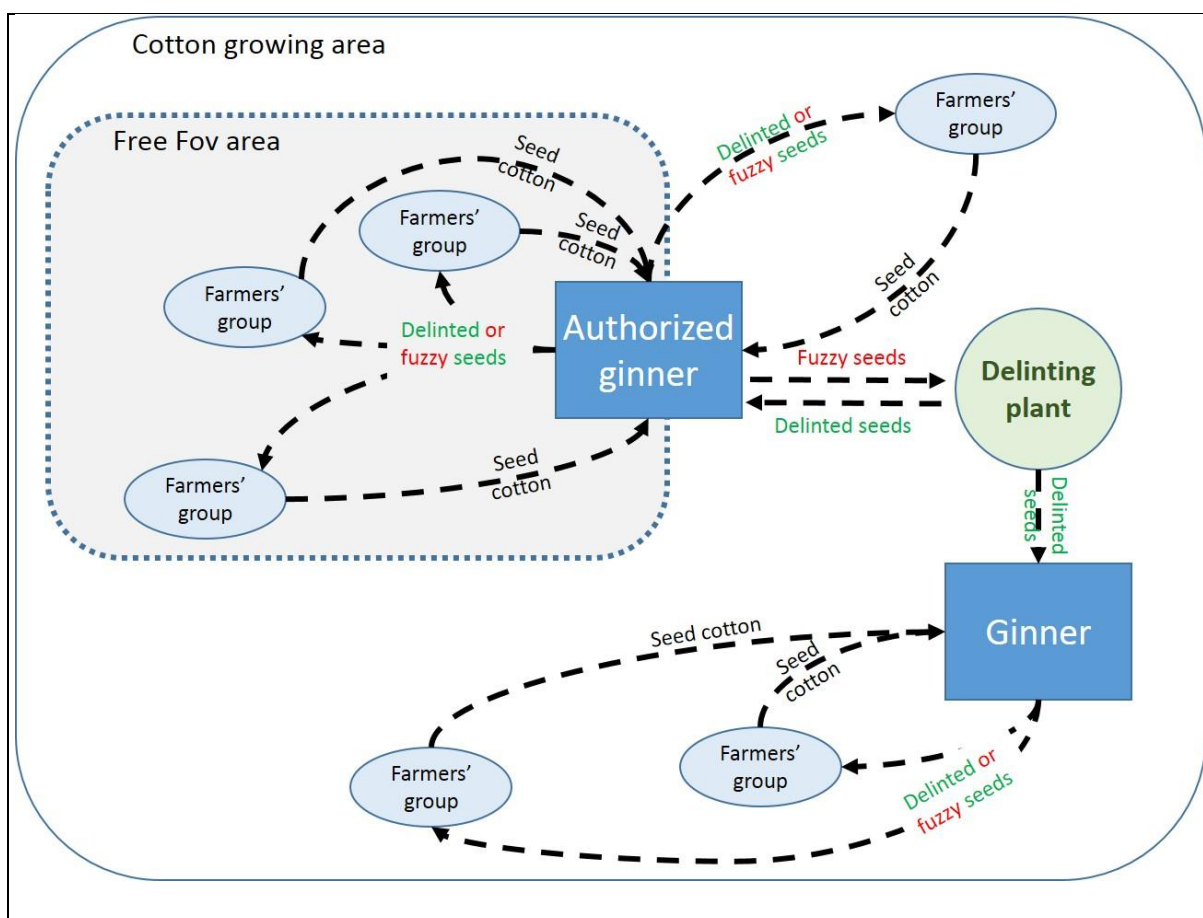


TCB plays a major coordinating role. It determines the seed producing area, select the companies (ginners) authorized to sign a contract with the entities (farmers' cooperatives and research) then allowed to grow seed.

The authorized companies buy seedcotton from farmers and provide support to the cooperatives under contract, transport and gin the seed cotton crop. Cooperatives' AMCOS is representing locally the farmers in liaison with TCB. Either after ginning, the authorized companies deliver the fuzzy seed from the free FW area to Quton plant in Bariadi for delinting. In return, they get back the delinted seed which will be distributed to their farmers.

Other ginners operating outside of the free FW zone will get delinted seeds from the Quton plant or recycle their own fuzzy seeds if delinted seeds are not sufficient.

The circulation of seed has been schematised below.



3.1.2 Is cottonseed multiplication dominated by public, private, cooperative or civil society organisations? Overview of the structure

After a period characterized by the absence of coordination, TCB is now playing a major role in coordinating the seed multiplication system. TCB is governed by a Board of Directors composed of six members, and a Chairman appointed by the President of the Republic. Five members represent the Farmers (G. MPANDUJA, Bariadi), Ginners (G. GACHOUA, SNC), Local Governments (A. NGOROMIA, Myatu district), Cooperative Unions (J. MIHANGWA), Textile industries (S. KAZI, AtoZ), the sixth being a knowledgeable person to the cotton sector. For each representative position, three names are provided by the stakeholders associations, and the final decision is made by the Ministry of Agriculture.

Although composed with representatives of the main stakeholders, TCB is placed under the control of the government.

3.1.3 Is cottonseed multiplication dominated by a few large companies or rather diverse and decentralised? Overview of the structure.

A few specialized companies (not very large though) are major actors of the seed sector, such as Quton for delinting Seed producers (OLAM, Biosustain, KCCL, GAKI) who are managing about 2/3 of the farmers' located in the cotton seed producing area.

3.1.4 Is there an established guide of good practices related to cottonseed production in place and used?

To be completed with TOSCI

<i>3.1.5 Are cotton out-grower schemes (subcontracted farmers) and contract arrangements a common practice?</i>
Contract farming between cooperatives and ginners is the usual procedure, under the close supervision of TCB.
<i>3.1.6 What are the conditions to work as a cottonseed producer?</i>
7 ginners (out of about 25) have been approved by TCB as seed multipliers, allowed to buy seed cotton in the FW free area (Meatu, Nzega, and Igunga districts). They must pay the Board \$ 180,000 for each ward in order to cover the cost of extension and other services to the commodity chain. Bio sustain has paid for 2 wards out of 32 or 34 for this area in total. Note that the number of districts involved with cotton are about 46, which represent around 150 wards. All the other ginners have to get their seed from the approved ginners.
<i>3.1.7 According to which criteria do formal cottonseed producers decide to multiply a certain variety?</i>
The cotton seed producer only multiplies the seed that have been officially released, under TCB instructions.
<i>3.1.8 Where do formal seed producers obtain their cottonseed material from (e.g. nat., reg., int. breeder, import, farm saved, consumer markets)?</i>
TARI (Ukiriguru and Ilonga) institution (Public/National institutions)
<i>3.1.9 What is the percentage of different types of cottonseed (certified, non-certified etc.) produced by the formal seed sector?</i>
Each type of cottonseed is produced under TCB and considered as part of the formal seed sector.
<i>3.1.10 How and who do formal seed producers market to?</i>
After delinting and packing done by Quton, Seeds are distributed to the farmers at the beginning of the growing season by the ginners under the instruction of TCB. Fuzzy seeds are sold to farmers at TSh 650 per kg and delinted seeds at 2500 per kg.
<i>3.1.11 Is technical knowledge, market information (e.g. demand in terms of preferred varieties, qualities, quantities, package sizes, timeliness etc.) and any other support being provided to formal seed multipliers ? What, how and by whom?</i>
The demand in terms of preferred varieties, qualities, quantities, package sizes, timeliness and any other support being provided to formal seed multipliers are done mostly by TCB in collaboration by extension staff to understand the variety, and quantity requirement. Then the seed quality is done TOSCI in collaboration with the TCB and seed producers, while the package size is done by stakeholders with technical understanding on the seed rate or requirement per acre and the plant population.

3.1.12 What are the main challenges regarding seed multiplication by the formal sector?
<ul style="list-style-type: none"> 1- Management of FW (includes the localisation of the delinting plant) 2- Slow rates of multiplication 3- Real advantage of delinted seeds
3.2. Informal Seed Sector
3.2.1 Is there an informal seed sector in your country? <i>If no, skip to 3.3, If yes, who is predominantly involved in cottonseed multiplication (smallholder farmers, cooperatives, small commercial farmers, ginners)?</i>
Not anymore. In previous years, ginners were recycling the commercial fuzzy seeds ginned in their plant as planting material for their contract farmers.
3.2.2 According to which criteria do informal seed producers decide to multiply a certain variety?
NA
3.2.3 Where do informal cottonseed producers obtain their seed material from (e.g. breeder, farm saved, consumer markets)?
NA
3.3. Major Constraints
3.3.1 Related to areas above, identification of key constraints facing the cottonseed multiplication system. Analysis of underlying reasons for constraints, incl. legal framework (be specific), government policies, natural resource endowment, technical know-how etc.
<ul style="list-style-type: none"> 1. Legal framework: Seed production levels – TARI just identified for only breeder seed and pre basic seed 2. No formal seed system 3. Irrigation facilities 4. Capacity building
3.4. Proposed Interventions
Funding and capacity building for resources (human and equipment).

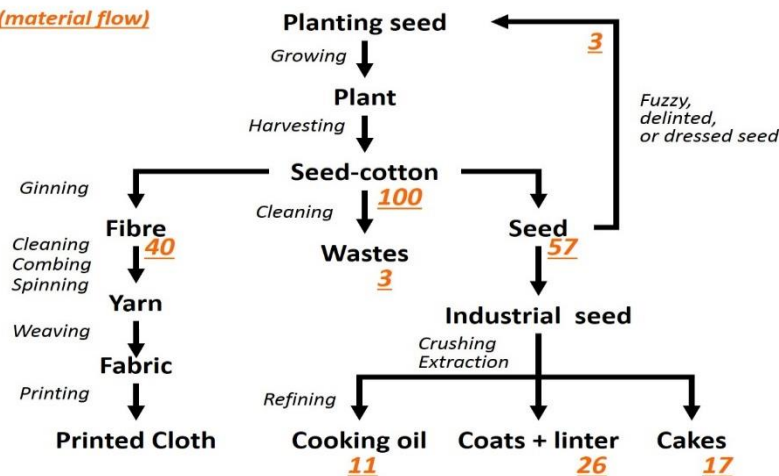
4. Seed-Cotton Processing, Seed Processing and Storage

4.1. Seed-Cotton Processing

4.1.1 Is seed-cotton processing and storage dominated by public, private, cooperative or civil society organisations?
Overview of the structure.

The commodity chain

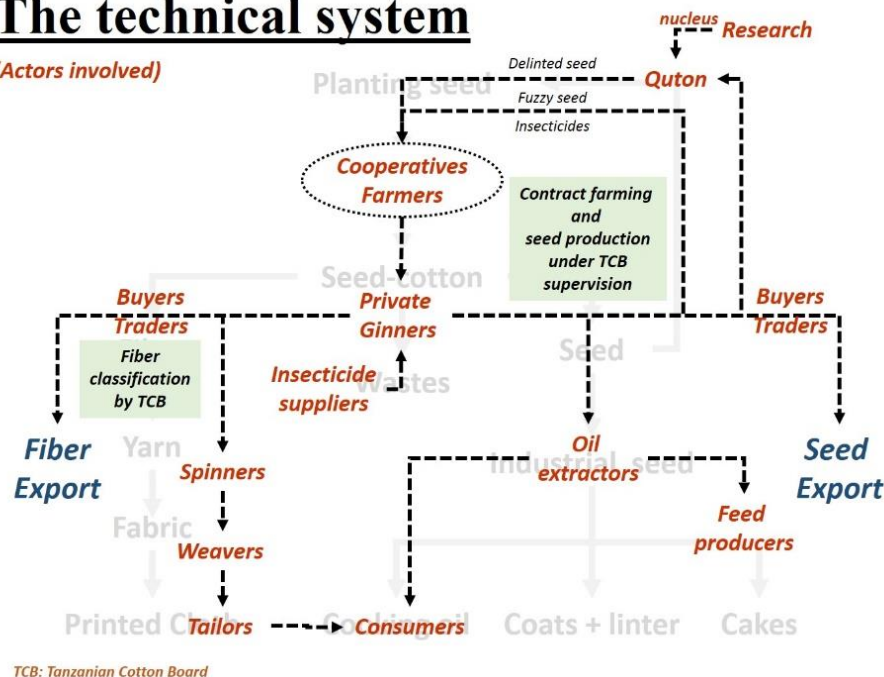
(material flow)



Considering a commodity chain which starts with planting seed and ends with the final products (Fig. above), the seed-cotton processing system involves both private actors (mainly ginners, growers, input suppliers and traders), as well as cooperatives, under close supervision of the Tanzanian Cotton Board, which is mixing representatives of the private sector and the administration (Fig. below).

The technical system

(Actors involved)



4.1.2 Is seed-cotton processing and storage dominated by a few large companies or rather divers and decentralised? Overview of the structure.

Seed-cotton processing is managed by a rather high number of private companies (approx. 25 active ginners in 2018), but potentially there are more than 40 ginners, private companies or cooperatives. However, some of them, such as Olam, are bigger players and can afford to control 2/3 of the seed multiplication area.

From TCB SCP III (2016), the local industry is able

- to transform between 100,000 and 400,000 bales of fiber (60,000 to 200,000 tons), which could represent an average of 50% of the total fiber produced in the country, and for a specific season from 1/3 to 3/4 of the product.
- to extract oil from about 80,000 tons of seed cotton.

There is no significantly bigger player.

During the 2016/17 season, GAKI ginned the biggest volume of seed cotton (11.5% of the 130,000 tons produced in total) followed by FRESHO (10.3%), OLAM (9.8%) and AFRISIAN (9%).

From the figures collected by TCB in 2017, the average GOT (Ginning out-turn or percentage of fibre) obtained across all ginning plants was 31%. It varied between 26% and 37% depending on the plant/company. For example GAKI and OLAM reported a 28% GOT, while FRESHO and AFRISIAN reported 32%. This shows that the full potential of UKM08 variety (42%) is far from being achieved in real conditions. Differences may be due to local growing or harvesting conditions, stones, dust or water added to the seed-cotton at harvest, or ginning machine wear and adjustment. The results and analysis of the tests run by TCB controllers should help understand the factors affecting such a low performance.

4.1.3 Which seed-cotton processing steps (cleaning, drying, ginning, grading, treating, packaging, labelling), are commonly practiced, and differentiated by informal and formal sector?

All the cotton processing operations (see figure above) are practised by the formal sector.

4.1.4 How many ginning plants are operating and with what type of ginning do they operate (saw-gin or roller-gin)?

The full ginning capacity is probably over about 1,000,000 tons of seed cotton. It is scattered among 77 plants, 47 equipped with roller gins and 30 with saw gins, with equal capacity for each kind of gin. In 2018, only 25 companies out of more than 40 are operating their plants at 10 to 20% of their full capacity, and it is believed that 60% of the seed-cotton has been roller ginned.

4.1.5 Is technical knowledge, market information (e.g. demand in terms of preferred quality characteristics, package size and any other support being provided to cottonseed processors)? What, how and by whom?

Genetic content: the users represented in the Board of TCB are making the decision to choose the variety to be grown, processed and marketed in the country. In the Board, there are representatives of private ginners or textile industries as well as growers who can say their word about the national or international market or field requirements.

Quality of seeds: norms are provided to Quton and TOSCI. However, the requirements for fuzzy seeds are less strict.

4.2. Seed Processing and Storage (addresses quality of seed)

4.2.1 Which storage technologies and practices are commonly used for various types of seed, differentiated by informal and formal sector?

If one considers that the informal sector deals only with the seeds that are recycled by the farmers themselves, there is no informal cottonseed sector in Tanzania. The formal sector is entirely managed by TCB, with two kinds of seeds:

- delinted and dressed seeds, which are due to become generalized;
- fuzzy seeds, which are directly produced by the ginneries, sampled and controlled by TOSCI, and distributed to the farmers.

4.2.2 What are the typical quality reasons for seed processing (differentiate between cleaning, drying, grading, treating, packaging, labelling) and storage?

Processing of delinted seeds:

- **Cleaning:** lots of seeds which show a germination percentage below 70%, or more than 10% mechanical damage (poor ginning), or more than 15% immature seeds, or more than 10% linter are discarded. The other lots are acid delinted in the Quton plant. Removing the fuzz from the seeds makes grading easier. In the field, the delinted seeds absorb the water more easily and germinate faster.
- **Drying:** seeds are dried at 8-9% during the delinting process.
- **Grading:** the smaller and lightest seeds (densimetric tables) are eliminated, the target being to reject a maximum of 18% at the end of the process. At the end, the germination percentage should not be less than 85%.
- **Treating:** delinted seeds are first dressed with lime to neutralize the acid in excess and then dressed with Cuprous oxide and Bronopol against diseases such as FW
- **Packaging:** seeds are packed in 4 kg bags, designed to plant an acre of cotton (Fig. on the right)
- **Labelling:** basic information is mentioned on the bag, such as the name of the crop (Pamba) and the variety (UKM08), the season (2018/2019), the quantity of seeds (4kg), the lot identification (difficult to guess from this picture), the producing company (Quton), the supervision by TCB
- **Storage:** seeds are stored by the ginners before delivering to the cooperatives and farmers



No normative process with the fuzzy seeds.

4.2.3 Whether the seeds are delinted, how and what proportion delinted / non delinted?

In 2018/19, the production of delinted seeds had reached 4000 tons at the end of October and it was supposed to finally reach 6000 tons. This should be enough to plant 400,000 to 600,000 ha, and depending on farmers' decisions, to cover about 50 to 60% of the whole area.

However, the objective is to provide delinted seeds to each and every farmer.

4.2.4 Whether the seeds are chemically treated with fungicides/insecticides, which molecules, and dosage?

Seeds are dressed with Cuproxyde and Bronopol (against fungi and bacterial), both showing a low level of toxicity and some tolerance with organic agriculture.

4.2.5 What are the main challenges regarding seed processing and storage?

Make sure that all cotton growers are provided with very high germination seeds (75% for fuzzy seeds but more than 90% for delinted seeds as these are planted at much lower rates per station).

Also the challenge of seed storage infrastructures

No price competition for delinting this makes seed prices to be higher.

4.3. Major Constraints

4.3.1 Related to areas above, identification of key constraints facing the cottonseed storage and processing system.

Combined with the low level of yield, the low GOT contributes to the poor performance (productivity, value added) of the cotton chain. Moreover, the low GOT level could hide factors, such as ginning machine defects and setting, which may also affect the seeds (seed damage).

The second main constraint is that the delinting plant is located in the middle of a *FW* infected area. This requires that seed and lorry move between infected and non-infected zones, with the risk to disseminating further *FW*.

4.4. Proposed Interventions

4.4.1 Suggestions for project interventions differentiated between short-term, medium-term and long-term actions.

If not done yet, the large variations in GOT could be studied and appropriate measures identified.

The possibility of having the delinting plant transferred to the *FW* free area could be envisaged in a global plan to eradicate or control the disease.

5. Seed Marketing

5.1. Preliminary information on cotton seed marketing
<p>5.1.1 Cottonseed price (per kg)? Recommended amount(s) of cottonseed (kg) per hectare? Actual average amount(s) of cottonseed (kg) sown per hectare? Which phytosanitary seed treatment(s) are applied?</p> <p>Fuzzy seed: at TSh/kg 650 (~ 0.25 €) and TSh/ha 13,000 (~ 5 € or 20 kg of cotton seed) Delinted seed: at TSh/kg 2500 (~ 1 €) and TSh/ha 25,000 (~ 10 € or 12 kg of cotton seed), treated with Cuprous oxide and Bronopol</p>
5.2. Seed Market (addresses access to demanded seed)
<p>5.2.1 Is any financing / credit available for cottonseed buyers, particularly smallholder farmers? Details on financial institutions, loan conditions etc.</p> <p>Cotton packs are provided on credit by the ginners to their contract farmers. They include the basic inputs to grow 1 acre of cotton: seeds (fuzzy or delinted) and insecticide for 4 treatments, sometimes a rope. The cost of the cotton pack is deducted from the harvest on the market place.</p>
<p>5.2.2 What are the main challenges regarding seed supply?</p> <p>Although there is good system to make sure that delinted seeds are distributed to the farmers with good quality (they are submitted to multiple controls), some farmers do not manage/store them well, thus get poor results.</p>
<p>5.2.3 Are there any specific difficulties faced by disadvantaged groups (women and youth) in accessing cottonseed?</p> <p>NA</p>
<p>5.2.4 What are the main distribution channels including the major stakeholders (from seed producer to final seed buyer), differentiated between informal and formal sector.</p> <p>Main distribution channels include identified ginners/buyers to collect the seed cotton then after ginning the seeds are sent to the delinting plant under Quton. After delinting the seeds are collected and distributed to farmers through the Cooperatives.</p>
<p>5.2.5 What are the main challenges regarding cottonseed distribution and access to cottonseed?</p> <p>Cotton seeds are distributed to the farmers by the ginners through cooperatives. Because of the high number of private companies involved, it has not been possible to survey the diversity of situations and track possible failures. Sometimes, the seeds distributed might not reach all cotton farmers because there is no enough data on seed requirement per village.</p>
5.3. Seed Market Information
<p>5.3.1 Who provides information to market actors on new or better cotton varieties and their properties, sources of seed supply, market prices and technical know-how on proper seed handling? (e.g extension services, agro-vet dealers, seed producers, cooperatives etc.</p>

TCB in collaboration with cotton actors because some information are provided by responsible people to TCB then TCB carries the responsible for all information regarding market actors on new varieties, properties, market prices etc. However, if TCB is not clear on something has to ask the responsible person on a certain field.

5.3.2 What are the main challenges regarding seed market information for producers and traders?

NA

5.4. Major Constraints

5.4.1 Related to areas above, identification of key constraints facing the cottonseed marketing system. Analysis of underlying reasons for constraints, incl. legal framework (be specific), government policies, natural resource endowment, technical know-how etc.

Seed production remains a service to the commodity chain as long as the market remains unprofitable. The low level of yields obtained in the fields and at the ginneries, linked with uncertainty, does not allow intensification and added value that could be invested in the services to agriculture, including improved and more productive seeds.

5.5. Proposed Interventions

5.5.1 Suggestions for project interventions differentiated between short-term, medium-term and long-term actions.

To study the agronomic potential and economic constraints to letting the farmers access to a range of varieties instead of a single one.

6. Seed Use by Cotton farmers (non-seed producers)

6.1. Knowledge and Information on Seed

6.1.1 Who provides information to farmers on new or better cotton varieties and their properties, sources of seed supply, market prices, and technical know-how on proper seed handling and use? Organisations could include extension services, agro-vet dealers, seed producers, cooperatives etc.

Farmers have no choice, they don't know what they plant, and often even when a new variety has been released.

TCB in collaboration with cotton actors because some information are provided by responsible people to TCB then TCB carries the responsible for all information regarding market actors on new varieties, properties, market prices etc. However, if TCB is not clear on something has to ask the responsible person on a certain field.

6.1.2 What kind of knowledge and information (new or better varieties and their properties, sources of seed supply, market prices, and technical know-how on proper seed handling and use etc) is commonly being provided?

Seeds are supplied to the farmers by the ginner or the Cooperatives, under the supervision of TCB. Information on new varieties is gathered by TARI and first shared with TCB, which takes the decision for the whole cotton chain and also for each actor involved in it. As there is no possibility of choice, farmers may not be fully informed about the characteristics of a newly released variety.

Sometimes the level of communication which goes along with a technology is not enough and misuses of delinted seeds were massively observed when first disseminated. At that time (2012), farmers planted delinted seeds without modifying what they used to do with fuzzy seeds *ie* planting in stick-made holes and in groups of 5 to 10 seeds per station. As a consequence, failures were often experienced, either because of seed shortage or poor emergence (too deep planting). Now, it seems that farmers are more accustomed to delinted seeds, and this difficulty has been overcome.

6.1.3 How is such information mainly being communicated (means, tools, channels like verbal communication, village meetings, farm demonstrations, radio broadcasts, leaflets etc.)? How effective is this?

The farmers are receiving information on the variety they grow or on all subject related to cotton growing through the personnel in charge of extension (attached to the Cooperatives or Business groups / AMCOS, to the Ministry of Agriculture, to a project or to a ginning company). With the exception of specific development projects often supported by an aid program, the number of extension staff is too low to reach directly a high number of farmers and progressive farmers are playing their role in amplifying the information.

Sometimes, farm demonstration are set in the villages and there are radio programmes as well as leaflets provided by researchers.

6.1.4 How do farmers feel informed?

Accepting the change or preferences to use the variety

*6.1.5 Do cotton farmers provide feedback on seed quality, varieties, technical experiences on use of seeds etc.? If yes, to whom and how
If no, why not?*

Yes, to other stakeholders

They may provide feedback on new varieties during the testing phase run by research (On farm trials).

Again, informal information may also be collected by extension staff and ginners which are contracting the farmers. Such information has a good chance to be captured by the Administration, the Associations such as TACOGA (Cotton growers), or TAGEA (Cotton Ginners) and reported to the Board and stakeholders meetings.

6.1.6 Are there any specific difficulties faced by disadvantaged groups (women and youth) in accessing this information?

Contrary to some of the food crops, cotton is not widely grown by disadvantaged groups as it requires an access to significant size of land and resources.

Some projects – more often in organic cotton – target women but there is no difference in the way they are informed.

6.1.7 How are cotton seeds planted: mode of sowing (manual, animal draught, mechanical)

Most of it is hand planted, even though many farms have access to draught ox power. However, under research planting is done mechanically.

6.2. Farmer Uptake

6.2.1 Which are the main cotton varieties used by smallholder farmers, by intermediate farmers, and by commercial farmers? What are the reasons?

Smallholder farmers are defined as those farmers owning small-based plots of land (<2 ha) on which they grow subsistence crops and one or two cash crops relying almost exclusively on family labour.

Intermediate farmers are those who cultivate plots of land of several ha (between 2 and 10 ha), and are partly mechanized

Commercial farmers are those who predominantly produce market crops for profit on larger plots of land (>10 ha), applying more advanced technological means and external workers.

Cotton is mostly grown by smallholder and intermediate farmers, more rarely by farms with more than 10 ha of cotton.

All grow the same variety.

6.2.2 What are typical quality issues related to cottonseed in the formal and informal sector?

NA

6.3. Major Constraints

6.3.1 Related to areas above, identification of key constraints facing the cottonseed system.. Analysis of underlying reasons for constraints, incl. legal framework (be specific), government policies, natural resource endowment, technical know-how etc.

The first constraint faced by the cottonseed system is biological, linked with the FW epidemic conditions which result through seed circulation.

The second constraint encountered by the farmers is the lack of genetic diversity and choice of genetic material. Only one variety is proposed, for every location and planting time. This of course can be justified: (i) the cost of creating and managing diversity cannot be supported by the cotton chain, (ii) GxE interactions are mainly affecting the growers and not significantly the other users

which are represented in the Board, (iii) some GxE interactions are already tested in the on-farm trials conducted by research (with or without inputs).

Finally there is no dedicated observatory of the cottonseed system where various actors could provide and get information to build a global, objective and clear view of the whole system.

6.4. Proposed Interventions

6.4.1 Suggestions for project interventions differentiated between short-term, medium-term and long-term actions.

After identifying the diversity of cropping systems, to study the opportunity:

- for research, to estimate the productivity increase from GxE valorisation (breeders, agronomists, economists etc),
- for the breeders to develop a range of specialized varieties instead of a single one
- for TCB (and Quton) to design and support a multiplication scheme which could handle several varieties

Also, a more formal communication system between Users (growers, ginners and spinners) – TOSCI/administration – and TARI could be organized under TCB umbrella to monitor more closely the needs and constraints (qualitative and quantitative), as well as the performance of the planting material.

Finally, considering the stakes represented by the production sector as compared with the other segments of the commodity chain, the weight and interests of the farmers in the decision making body could be strengthened, for example by increasing the number and diversity of their representatives in the TCB.

7. Regulatory procedures

7.1. Variety Registration, Evaluation, Release and National Listing
<i>7.1.1 Brief description of the processes and conditions involved by different state authorities.</i>
See section 1.2 of the questionnaire.
7.2. Breeder and Seed Producer Registration
<i>7.2.1 Brief description of the processes and conditions involved by different state authorities.</i>
See section 1.2 of the questionnaire.
7.3. Licensing and Royalty Collection
<i>7.3.1 Brief description of the processes and conditions involved by different state authorities.</i>
See section 1.6 of the questionnaire. Research is already supported by the CDTF (Cotton Development Trust Fund). There is a possibility of licensing varieties and get royalties in other countries, but there is more savings and benefits to expect from regional collaboration and little to gain from competition.
7.4. Seed Certification
<i>7.4.1 Brief description of the processes and conditions involved by different state authorities.</i>
See section 1.2 of the questionnaire
7.5. Quality Control
<i>7.5.1 Brief description of the processes and conditions involved by different state authorities. This includes certified and quality declared seed, processing and storage, application of ISTA and OECD certification regulations</i>
ISTA standards are used by TOSCI for seed testing Standards for delinted seeds are at the same level as they are for fuzzy seeds. They should be drastically raised to take into account the differences in the way they are utilized by farmers.
7.6. Major Constraints
<i>7.6.1 Related to areas above, identification of key constraints facing the cottonseed system. Analysis of underlying reasons for constraints, incl. legal framework (be specific), government policies, natural resource endowment, technical know-how etc.</i>
The regulatory system in place looks sufficient for the cottonseed multiplication to work smoothly.
7.7. Proposed Interventions
<i>7.7.1 Suggestions for project interventions differentiated between short-term, medium-term and long-term actions.</i>

It is proposed to modify the Cotton Industry Act in order to give a bigger place in TCB to the farmers as they represent several hundred thousands of farmers affected by the decision taken by the Board.

8. Additional information

Additional comments, remarks and proposals about the whole questionnaire

Considering that the diversity of actors and interrelated activities of the cotton chain make a system, it is better not to isolate the seed multiplication process and to consider specific improvements in the system as a whole. The low level of productivity observed at all stages of the chain has consequences on the global added value, its distribution and the level of services which can be provided to the actors. And conversely, lack or insufficient levels or quality of inputs, machines or services affect the productivity.

The seeds of course play their role:

- with limited funding, research cannot fully address GxE in creating sufficient genetic diversity,
- the genetic potential of the released varieties is not fully exploited both at the field (Yield) and industry (GOT) levels,
- the quality control might be different with the delinted seeds processed by Quton and the fuzzy seeds distributed directly by the ginners
- the concept of seed quality (and the norms applied) has not been adapted to the use made of it by farmers (hand or machine sowing in particular).

While looking for more ambitious and holistic solutions to boost the productivity of the whole sector, short term solutions can be mobilized such as:

- developing participatory breeding programmes with farmers organisations,
- leading regional initiatives to mutualize breeding efforts and share experience on seed multiplication,
- studying the productivity gaps along the value chain and prioritizing the interventions with an economic approach taking also the risks into account,
- adjusting the norms and controls applied to seed testing to the needs and constraints of farmers.

**ANNEX 4. Legal guide
for strengthening the
Seed system in
Tanzania (AGRA, 2016)**

*Extract of the report.***RECOMMENDATIONS TO ENCOURAGE MARKET DEVELOPMENT**

- (1) Establish Seed Stakeholder Platform
- (2) Develop DNA Fingerprinting System to Characterize and Track Public Germplasm
- (3) Study Institutional Arrangements for Early Generation Seed of Selected Crops
- (4) Apply Best Practices in Authorization of Public Varieties
- (5) Support Regional Implementation
- (6) Facilitate Trade of Seeds, Fertilizers, and Agrochemicals

RECOMMENDATIONS TO STREAMLINE REGULATORY RULES AND PROCESSES

- (1) Streamline Regulatory Processes Across Value Chain Functions
- (2) Develop Capacity Within the Tanzania Official Seed Certification Institute (TOSCI)
- (3) Streamline and Rationalize Functions of Regulatory Institutions Within Ministry of Agriculture, Food Security, and Cooperatives (MAFC)
- (4) Clarify Plant Breeders' Rights Language Related to Farmers' Rights and Increase Awareness
- (5) Provide Guidelines to Local Government Authorities (LGAs) on Implementation of Seed and Agriculture Regulations

RECOMMENDATIONS TO DEVELOP LEGAL TRAINING AND APPROACHES

- (1) Increase Awareness of Laws and Regulations and Improved Legal Training in Seeds and Inputs (Training and Legal Clinics and Model Legal Education Curriculum)
- (2) Address Legal Aspects of Access to Financing
- (3) Assess Legal Models for Equitable Contract Farming Arrangements

ANNEX 5.

Complementary SWOT

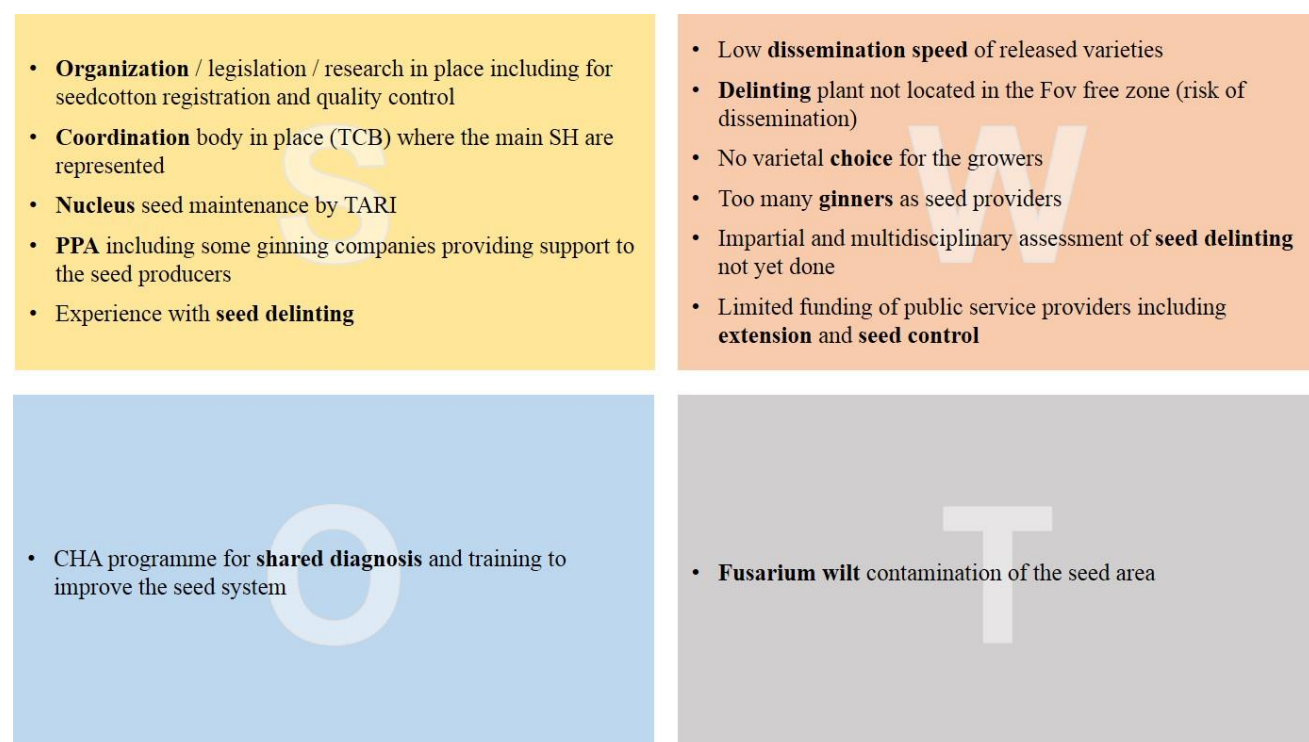


Figure 23. SWOT analysis for the Seedcotton system.

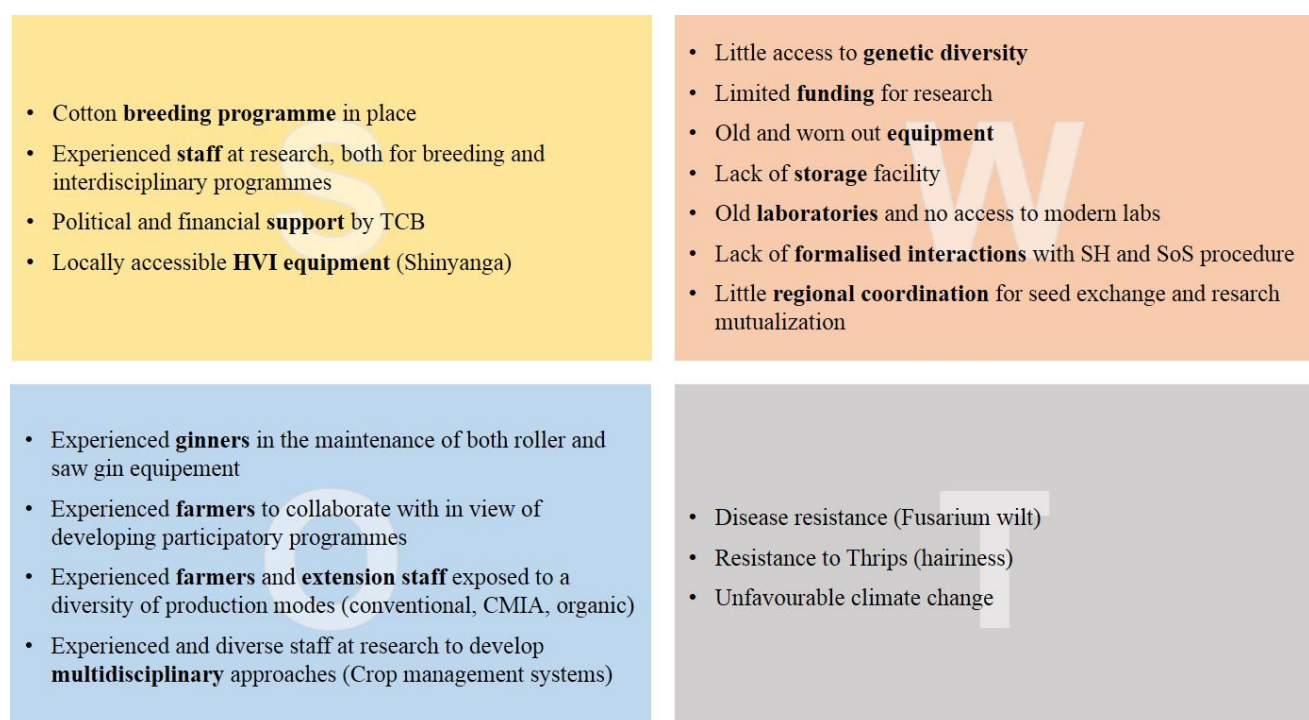


Figure 22. SWOT analysis for the Cotton breeding programme.

ANNEX 6. Programme presentation



COTTON SEED IMPROVEMENT PROGRAM

CONTEXT	<p>In Sub-Saharan Africa, cotton is typically produced by smallholder farmers. More than two million rural households rely on cotton production to earn their living. Overall, 37 out of 55 African countries produce cotton, and for some of them, it is a critical crop, accounting for a significant proportion of GDP or total exports. Although Africa has huge production potential, cotton yields are among the lowest in the world. The cotton sector faces a myriad of challenges such as inaccessibility to input financing for smallholder farmers, fluctuating cotton prices, poor/lack of extension services, low seed quality and seed-cotton productivity, or high rate of lint contamination.</p> <p>Pure varieties with high yield and fibre quality potential are basic factors to increase cotton productivity and value. However, the cotton seed supplied in many African countries cannot reach international quality standard. Insufficient research support led to weakened breeding programs, lack of variety maintenance, and poor supervision of seed production. The situation might have even be worsened by the introduction and dissemination of exotic seed by the cotton ginneries in an effort to maintain the productivity. Considering the trend over the last three decades, the contribution of genetics to cotton productivity has barely increased. It might even have declined.</p>
AIM OF THE PROGRAM	<p>The Cotton expert House Africa (CHA, Germany) will assist the Cotton Research and Cotton Development Companies of four African countries in evaluating and improving their seed multiplication schemes, up-grading their breeding program and recovering the integrity of the grown cotton varieties.</p>
IMPLEMENTATION OF THE PROGRAM	<ul style="list-style-type: none"> • Phase 1: Implementing a Cottonseed Sector Study in four countries: Zambia, Tanzania, Côte d'Ivoire and Burkina Faso • Phase 2: Sharing results of Phase 1 with the local stakeholders in the four countries and elaborate a work plan <p>The Centre for International Cooperation in Agronomic Research for Development (CIRAD, France) will lead the work. In each country, the CIRAD expert is working in pair with a national expert.</p>
EXPECTED RESULTS	<p>For each of the four involved countries:</p> <ul style="list-style-type: none"> → Data collection by using the template "Data collection form" → SWOT analysis of the cotton seed sector, including cotton seed breeding, maintenance and multiplication program → A workshop report (incl. participants list) → A Cotton Seed Multiplication Program with detailed work plan and training plan as well as the description on the set-up and maintenance of cotton seed multiplication plots within the time frame until December 2020
DURATION	6 months (October 2018 – March 2019)
FUNDING	BMZ (Federal Ministry for Economic Cooperation and Development, Germany) through GIZ (Agency for International Cooperation, Germany)
PARTIES INVOLVED	Stakeholders of the national cotton seed sectors (Ministry of Agriculture, sectoral cotton organization, certification body, cotton research, producers, extension services, cotton companies from the public and private sectors...)
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