



# COTTON AND ITS BY-PRODUCTS

## in the United Republic of Tanzania

BACKGROUND PAPER





# COTTON AND ITS BY-PRODUCTS IN THE UNITED REPUBLIC OF TANZANIA

*Background Paper*

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## *Table of contents*

1.	Introduction.....	5
2.	A brief overview of the status of the cotton subsector in Tanzania.....	5
3.	Utilization of Cotton By-Products.....	8
4.	Cottonseeds.....	9
5.	Cottonseed oil.....	10
6.	Meal or cottonseed cake.....	15
7.	Hulls (Husks).....	16
8.	Linters.....	17
9.	Cotton waste.....	17
10.	Cotton stalks.....	18
11.	Challenges facing cotton by-product development in Tanzania.....	20
12.	The future of cotton by-products in Tanzania.....	21
13.	Developing a Cotton By-product value Chain in Tanzania: Some key considerations.....	22
14.	Stakeholders: Roles and functions in the cotton by-products study.....	23
15.	Bibliography.....	24
16.	Map showing cotton producing regions in Tanzania.....	25

## *List of tables*

Table 1.	Trends in the production of raw cotton, cotton lint and cottonseeds in Tanzania for the period 1990 to 2010.....	9
Table 2.	Status of cotton oil mills in the WCGA.....	11
Table 3.	Brand names of cottonseed oils produced in Tanzania.....	12
Table 4.	Edible oil imports in Tanzania between 2006 and 2011 (tons).....	13
Table 5.	Production of the major oilseeds in Tanzania (tons), 2000/01 – 2009/10.....	13
Table 6.	Relative proportions of lint, seed and waste for the period 1990 - 2010 in Tanzania.....	18
Table 7.	Estimated cotton stalk production in Tanzania for the period 1999/00 to 2010/11.....	19

## *List of abbreviations*

BRN – Big Results Now

CA - Cellulose Acetate

CAB - Cellulose Acetate Butyrate

CAP - Cellulose Acetate

CFC - Common Fund for Commodities

CIRCOT – Central Institute for Research on Cotton Technology

CTI – Confederation of Trade and Industries

DFID – Department for International Development

EAC – East African Community

ECGA – Eastern Cotton Growing Area

ESA – Eastern and Southern Africa  
FAO – Food and Agricultural organization of the United Nations  
GCF – Gatsby Charitable Foundation  
GDP – Gross Domestic Product  
GHG – Green House Gases  
ICAC – International Cotton Advisory Committee  
ICAR – Indian Council for Agricultural Research  
IPM – Integrated Pest Management  
ITMF – International Textile Manufacturers Federation  
LDC – Least Developed Countries  
OECD – Organization for Economic Cooperation and Development  
PS – Primary Society  
RCU – Regional Cooperative Union  
R & D – Research and Development  
SADC – Southern African Development Community  
SSA – Sub Saharan Africa  
TBS – Tanzania Bureau of Standards  
TCA – Tanzania Cotton Association  
TACOGA – Tanzania Cotton Growers Association  
TCB – Tanzania Cotton Board  
TFDA – Tanzania Food and Drug Authority  
TIB – Tanzania Investment Bank  
TIC – Tanzania Investment Centre  
TLSMB – Tanzania Lint and Seed marketing Board  
TOSCI – Tanzania Official Seed Certification Institute  
TRA – Tanzania Revenue Authority  
USA – United States of America  
VAT – Value Added Tax  
VOIL – Vegetable Oil Industries Limited  
WCGA – Western Cotton Growing Area  
WCA – Western and Central Africa

## 1. Introduction

Tanzania's economic growth is agricultural-led. To date agriculture still employs up to 70% of the Tanzanian workforce and accounts for over 60% of total merchandise exports, 85% of which is derived from exports of five major cash crops namely; coffee, cotton, cashew, tobacco and tea in declining order of importance. Recently the contribution of agriculture to gross domestic product (GDP) declined to about 27% and the country attained a growth rate of 7% largely as a result of increased roles of other sectors such as mining, services and tourism. However, rural poverty still remains high at 33%. This implies that economic growth has not yet benefitted the poor the bulk of whom live in the rural areas because employment opportunities in sectors such as tourism and mining tend to be rather limited.

Under the Big Results Now (BRN) program Tanzania is striving to further accelerate economic development by improving productivity in designated key sectors such as agriculture with potential for maximum impact on poverty reduction. In agriculture the motto is on making a paradigm shift from "primary commodity production for export" to "production for domestic processing and value addition" coupled with boosting production, productivity and profitability within the commodity subsectors.

In 2006 the cotton industry attained a crop harvest of 126,229 metric tons of lint for the first time in over one hundred years of cotton's history. Since then the industry sought to increase output to 270,000 tons and the domestic processing of lint to 50% by 2015. However, cotton output has stagnated and up to 70% of the lint is still being exported outside the country. As a result the country has been unable to capitalize on its huge comparative advantage based on cotton *per se* and on the socioeconomic benefits associated with its Cotton-Textile-Apparel value chain if it was functioning optimally.

Partly as a result of challenges facing the production, processing and marketing of seed cotton as well as the Cotton Textile Apparel value chain, the other subsector of the cotton industry namely the Cotton By-products value chain has remained largely underdeveloped in Tanzania. As a result, cottonseeds and its by-products such as oil, cake, husks and linters do not yet feature prominently in the cotton economy. The same applies to cotton stalks that remain in cotton fields after harvest. In their totality these by-products have immense potential to contribute to job creation, income generation and hence poverty reduction. Globally, annual biomass production for cotton amounts to 75 million (Holt 2016). However, only 10 to 15 million tons tend to be used in the manufacture of value added products. The remainder or 80% of the biomass stays unutilized in cotton fields on annual basis.

## 2. A brief overview of the status of the cotton subsector in Tanzania

Cotton is Tanzania's second most important cash crop after coffee in terms of its contribution to foreign exchange earnings. Cotton is also by far the most widely cultivated cash crop when compared to coffee, tobacco, cashew, tea, sugar cane, sisal and pyrethrum. It is estimated that cotton and its related value chains supports directly or indirectly the livelihoods of up to 40% of Tanzania's population.

Cotton farming was started by the German colonial administration at the turn of the 20<sup>th</sup> century. However, production stayed marginal until after World War 2 when the British colonial administration took up promotion and expansion of cotton during the early 1940s and 1950s. Partly as a result of peasant resettlement programs, supply of improved seeds, increased delivery of extension services and good post war prices for lint production picked up significantly. These developments were greatly facilitated by the establishment of two cotton specific research and development (R & D) stations at Ukiriguru and Ilonga in 1932 and 1949 respectively. The two stations served to cater for cotton production needs for western and eastern cotton growing areas respectively (WCGA and ECGA).

Between the 1930s and early 1950s Asians of Indian origin were responsible for buying seed cotton from farmers and ginning it Uganda. However, due to deteriorating relations between the traders and farmers, the colonial administration opted to promote the agricultural marketing cooperatives. The latter had emerged as a result of private traders cheating on farmers during the weighing of seed cotton at buying posts. They eventually took over all functions relating to input supply, cotton buying and marketing. In 1956 the Tanzania Lint and Seed marketing Board (TLSMB) was established in order to deal with the export of lint

and seeds as well as oversee cotton quality control. Thus cotton marketing became organized through a three-tier system consisting of primary cooperative societies (PS), regional cooperative unions (RCUs) and the parastatal marketing board called TLSMB. PS purchased seed cotton from farmers on behalf of RCUs that had a legal monopoly in purchasing and ginning of seed cotton in the. The parastatal body was responsible for the sale of lint and seed on domestic and export markets as well as overseeing quality control.

Such single channel marketing system started facing problems starting from the mid - 1970s when cotton production began to decline. Some of the reasons for the decline included the compulsory villagisation program in early 1970s and dissolution of cooperatives as independent organizations in 1976 (Kabissa, 2014). A rapid build-up of disincentives among cotton producers ensued after these changes and these became exacerbated by the failure of the Tanzania Cotton Authority (TCA) that had been formed to replace TLSMB in 1976 to undertake the functions that were previously being handled by cooperatives and TLSMB. Organizing production, buying, grading and ginning of seed cotton, export of lint as well as carrying out regulatory functions became too difficult to handle by just one institution. As a result the government reinstated the agricultural marketing cooperatives in 1986 to undertake the overseeing of production, buying and ginning. Similarly, TCA was changed to Tanzania Cotton Marketing Board (TCMB) and became the statutory agent for marketing cooperatives with regard to the sale of lint both abroad and overseas.

In a nutshell, up until the early 1990s, the cotton subsector was characterized by frequent and widespread state regulation, intervention and control. TCMB and the cooperatives in their new format could not bring about a turn-round in the performance of the cotton industry as reflected by cotton output failing to rise above 54,000 tons of lint by 1990. Thus the single channel marketing system had in effect failed to deliver in spite of the monopoly positions of the cooperative unions and the parastatal bodies. In order to improve performance, the cotton subsector was liberalized in 1994. This broadly entailed abolition of fixed prices for seed cotton that were both pan-territorial and pan-seasonal; abolishing the monopolies of the parastatal body and RCUs by allowing the re-entry of the private sector in production, marketing and processing and redefining the roles and functions of the parastatal body.

Liberalization was introduced with the hope of stimulating competition and hence efficiency in the processes of buying, ginning and marketing cotton. By introducing competitive prices for seed cotton it was hoped that farmers would be motivated to increase production. By relaxing government controls on private investments and marketing, it was further hoped that members of the private sector would be attracted to participate fully in the production, processing and marketing of cotton. In the aftermath of liberalization, the country witnessed increased investments in ginning capacity in general. Because most ginners are also oil millers, investment in oil mills also increased in tandem with the number of ginneries.

However, rather than going up, cotton output went into decline after liberalization from 96,372 tons of lint during the 1992/93 marketing season to merely 35,514 tons of lint by the close of the century in 1999/00. The main reason for this was that the transition from a single channel to multi-channel marketing system was poorly handled and with no safeguards put in place. Rules and regulations regarding the operation of the private sector took more than two years to prepare. As a result most of the new comers lacked any experience in ginning and marketing of lint and were primarily motivated by prospects of easy money and thence were not interested in quality. Thus most new comers preferred to go into cotton buying rather than investing in production. Secondly, some of the macroeconomic reforms for example, the withdrawal of input subsidies and devaluation of the shilling resulted in the price of inputs increasing quite steeply and so in spite of agricultural prices for smallholders also increasing with devaluation, the margin of difference was not enough to compensate for the high costs of inputs.

Contamination of lint also increased after liberalization and by 2001 Tanzanian lint had become the 12<sup>th</sup> most contaminated out of 30 national origins (International Textile Manufacturers Federation's report 2001). Due to declining cotton output, buyers and ginners found it almost impossible to reject any cotton they were offered for sale. Under such circumstances farmers quickly realized that they did not have to put large amounts of labour into the maintaining of a quality crop. In a nutshell, it was the lack of a supply response to price incentives that precipitated a scramble for seed cotton amongst market participants.

Apart from contamination, the quality of lint also deteriorated in part due to the increased mixing of previously zoned cottonseed varieties particularly in the WCGA. The mixing of varieties that were previously being produced in distinct geographical zones resulted in significant increases in within bale

variability of many of the fibre characteristics such as staple, strength and micronaire among others. These and other developments were helped in part by the increasing inability of the Tanzania Cotton Board (TCB) to regulate the industry properly owing to its own structural, financial and legal predicaments at that point in time.

A recovery of cotton production occurred during the early 21<sup>st</sup> century when output reached 114,540; 126,229 and 123,080 tons of lint during the 2004/05, 2005/06, and 2008/09 marketing seasons respectively. Such revival in production owed in part to TCB's roles and functions within the industry becoming better defined following the passage of a new statute called the Cotton industry Act No. 2 of 2001. The latter empowered and enabled TCB to regulate, coordinate and promote the industry more appropriately than was the case in the early 1990s. Another factor behind the recovery in production was the institutionalization of a Cotton Development Fund through which funding for procurement and distribution of seasonal inputs up to village level, cotton R & D and ancillary services became possible. In 2009/10 the government introduced an input subsidy program via the voucher scheme. The latter did not work out as intended in part due to poor preparations and mismanagement.

Starting from the 2008/09 cropping season the Cotton and Textile Development Program under the Gatsby Charitable Foundation (GCF) and Department for International Development of the United Kingdom (DFID) in collaboration with the Tanzanian Government started piloting contract farming as a model for revamping low productivity and contamination related problems facing Tanzanian cotton. Ginners, farmers and district officials seemed to welcome the intervention in spite of a few teething problems relating to side selling and defaulting on contracts. During the 2009/10 cropping season, the testing of contract farming was repeated in Mara region, contract farming and further extended to more districts in Shinyanga and Mwanza regions during the 2010/11 cropping season. The release of an improved high yielding variety called UKM08 in 2008 was widely seen to as a timely boost to efforts geared at increasing cotton output in the country.

To date cotton is cultivated quite widely all over the country. Nevertheless, cotton growing is prohibited in the southern regions of Mtwara, Lindi, Katavi, Rukwa, Mbeya, Songwe, Njombe and Ruvuma. These regions have, ever since the colonial period, been designated a quarantine zone in order to prevent the entry into Tanzania and the east African region as a whole of a notorious insect pest of cotton called the red bollworm, *Diparopsis castanea*. The latter occurs in all cotton growing countries to the south and south west of Tanzania. In the islands of Zanzibar and Pemba as well as the three mainland regions of Arusha, Dodoma and Dar es Salaam cotton growing has proven less attractive relative to other crops (see map of Tanzania).

Up to 98% of the cotton crop is produced in the so-called western cotton growing area (WCGA) that covers the administrative regions of Shinyanga, Simiyu, Mwanza, Mara, Geita, Tabora, Kigoma and Singida. The remainder comes from the Eastern Cotton Growing Area (ECGA) that lies to the west of the Indian Ocean and comprises of the administrative regions of Manyara, Morogoro, Coast, Kilimanjaro, Tanga and Iringa. Up until the early 1990s the ECGA accounted for up to 10% of annual cotton output in the country.

Cotton farming in Tanzania is entirely smallholder based and wholly rain-fed. Areas under cotton tend to vary from as small as 0.4 ha to as large as 40 ha in some parts of the districts of Meatu, Bariadi, and Bukombe in the WCGA. There are an estimated 400,000 smallholders involved in cotton farming each year. The total area sown to cotton is in the order of 350,000 to 450,000 ha per annum and tends to fluctuate quite drastically between seasons. Cotton is normally sown between the 15<sup>th</sup> November and 15<sup>th</sup> December in case of the WCGA as well as some parts of the ECGA (notably Iringa, and Manyara regions). In the remaining areas of the ECGA sowing takes place between January and March.

Annual cotton output tends to fluctuate largely in tandem with rainfall patterns because of its rain-fed nature. And because farming is also smallholder-based, annual cotton output tends to be greatly influenced by the producer price for cotton in the previous season. If such price was considered reasonably high relative to other seasons then farmers will most likely increase the acreage under cotton and *vice versa*. The area planted to cotton has tended to be greatly influenced by prices for competing crops as well as policy and institutional changes that the government often makes from time to time.

Another feature of Tanzanian cotton is that average yields per ha have tended to be quite low by world standards. Tanzania's national average yield for cotton stands at 750 kg of seed cotton per ha or 220 kg of lint per ha. Data collated by the International Cotton Advisory Committee (ICAC) show that Tanzania's average yields are not only low but have also tended to stagnate over the years. Between 1945/46 and



2009/10 for example, Tanzanian average yields remained between 121 and 156 kg/ha of lint while the global average yield for cotton rose significantly from 210 to 738 kg/ha of lint during the same period.

In Australia, Brazil, China and the USA average yields increased 3 to 13 times. In South Africa, Cameroon and Burkina Faso average yields increased by 3 to 10 times. Low production and productivity of cotton in Tanzania is due to many factors. Seeds are of poor quality and largely recycled; correct spacing of plants is not adhered to as farmers prefer to broadcast seed during planting; uninformed intercropping of cotton with maize is quite common; farmers do not use inorganic fertilizers at all. Finally, use of pesticides to control pests is ad hoc and quite limited due to lack of input credit. Not surprisingly, average yields per ha are low and Tanzania's annual cotton output has tended to be considerably lower than in other Sub-Saharan Africa (SSA) countries such as Burkina Faso, Mali, Zimbabwe and Benin with similar acreages under cotton cultivation.

Finally, up to 70% of the raw cotton produced in Tanzania tends to be exported overseas on an annual basis. Because of the present downward trend in global prices for cotton due to supply being out of balance with demand and the cotton fibre losing its market share on the global fibre market, Tanzania and other commodity dependent countries must seek to promote the conversion of lint into textiles, garments and apparel domestically. Farmers and ginners in particular are likely to benefit even further from cotton farming and ginning respectively if the processing of two major by-products of farming and ginning namely cottonseeds and cotton stalks respectively into value added products is also seriously taken into account. The present report is an attempt to give a bird's eye view of the status of the cotton by-product status in the country.

### 3. Utilization of Cotton By-Products

All over the world cotton is grown primarily for the production of lint. The latter is globally valued for the manufacture of textiles, apparel and related products. Lint is obtained from seed cotton after a process called ginning during which lint and cottonseed are separated mechanically. Because the value of lint obtained from a ton of seed cotton is about 3 to 4 times the combined value of oil and cake derived from the processing of the seeds, it has tended to be prioritized in spite of cottonseeds accounting for up to 60% or more of the weight of each kg of seed cotton. For this reason, cottonseeds tend to be best looked at as a by-product of the ginning process.

However, due to prices of lint on the global market being on the declining trend, most SSA countries are lacking the incentives to increase lint output. On the other hand, there has been increasing demand for cotton by-products such as cottonseed, cotton cake, cotton oil, hulls and linters at the local level. Thus, there is potential for cotton by-products to contribute to increased income generating capacity within the cotton subsectors. In a recent study undertaken by the World Bank (see Tschirley *et al* 2009), it was found out that cottonseed by-products such as oil, cake and others typically represent up to 30% of the total value of seed cotton in most SSA countries. Thus they are potentially an important complementary source of revenue that has quite often tended to be overlooked by policy makers. Nevertheless, markets for cotton by-products are not well developed and hence there is some scope for their improvement.

The other reason for re-examining the economic importance of cotton by-products does stem from the fact that there is a tendency for lint prices and those of by-products namely cottonseed, oil, cake, linters, husks and waste to move in opposite directions. Thus an understanding of the status of the by-products would help in deciding how they can be streamlined in mechanisms used for setting producer prices. For example, in view of rising prices for cotton by-products such as cooking oil that is purchased by farmers, the latter have tended to query on whether the producer price for seed cotton is adequately accounted for by the value of by-products at the time of setting the seed cotton prices.

According to the TCB in 2015 one ton of crushed cottonseeds in Tanzania yielded 16% crude oil (12% after cleaning), seed cake 45-55%, husks 25-27%, linters 8-10% and wastes 4% on average. The relative proportions of these by-products depend on the ginning out-turn ratio, which for the period between 1990 and 2010 ranged between 28% and 35% of the weight of seed cotton, and the cotton oil extraction ratio which ranges between 10% and 16% of the weight of cottonseed depending on the method of crushing and extraction used.

**Table 1. Trends in the production of raw cotton, cotton lint and cottonseeds in Tanzania for the period 1990 to 2010**

Year	Lint (tons)	Seed (tons)	Seed cotton (tons)
1990	49,221	90,298	149,141
1991	90,717	170,852	268,730
1992	85,784	197,234	303,200
1993	50,142	92,952	144,700
1994	42,695	78,232	125,300
1995	84,782	160,143	248,200
1996	85,187	161,845	252,800
1997	69,636	133,000	206,600
1998	39,500	52,100	92,700
1999	35,470	66,654	105,600
2000	41,374	77,742	123,400
2001	81,450	153,090	243,000
2002	63,000	80,500	148,500
2003	50,000	112,096	180,800
2004	114,000	200,000	326,680
2005	126,228	225,000	357,260
2006	43,770	82,270	130,587
2007	70,773	125,000	200,662
2008	123,600	228,000	368,697
2009	83,700	170,000	267,004
2010	110,000	194,000	315,000

Source: FAOSTAT.

Apart from cottonseeds which are a *de facto* by-product of the ginning process, cotton stalks constitute yet another important albeit grossly under-utilized by-product of the cotton farming operation.

#### 4. Cottonseeds

Between June and September each year cotton farmers in Tanzania sell their seed cotton to as many as 40 registered buyers who compete for market share via their agents spread out all over the WCGA. These buyers, the majority of whom are ginners cum oil millers, have full ownership over both the lint and cottonseeds obtained after the ginning process. 80% to 90% of cottonseeds obtained after ginning are used for the extraction of cottonseed oil. The remainder is often reserved, after consultation with TCB, for the planting of the next season's crop. Because of the continued use of recycled fuzzy seed for planting, ginners are required by law to reserve and allocate 10% to 14% of their seeds for planting for the next cropping season.

Some of the seeds obtained after ginning is also traded between ginners themselves and between them and oil millers not owning ginneries. Cottonseeds are occasionally fed to livestock but this is not common practice because seeds are often in short supply and therefore tend to be reserved for oil milling only. In other countries such as Mali, up to 20% of the seeds are sold by ginners as livestock feed. In the USA where the livestock industry is quite well developed, over half of all seeds produced each year are fed to dairy and beef cattle as well as sheep and goats. There is potential in using cottonseeds a raw material for the

production of edible oil based bio-diesel as well but this is probably a non-starter in view of the prevailing need for edible oil self-sufficiency in Tanzania.

## 5. Cottonseed oil

During the 2015/16 marketing season 33 out of 42 cotton buyers registered by TCB to buy cotton from farmers were ginners cum oil millers. The need for ginners to also undertake oil milling in addition to ginning has persisted starting from the late 1950s. Ginners do this because in spite of the value of lint obtained from a ton of seed cotton being about 3 to 4 times the combined value of oil and cake derived from the processing of the seeds, oil milling has had a huge cross-subsidization potential in their business operations.

To date all operational cottonseed oil mills are based in the WCGA. In the 2015/16 marketing season out of the 33 millers, two participating companies called the Vegetable Oil Industries Ltd (popularly known as VOIL) and Dehong Oil Mill do not at all engage in cotton ginning and so must annually source for their seeds from ginners and particularly the ones not involved in milling. In the ECGA, oil production stopped in the late 1990s due to the shortage of raw material in the aftermath of continued decline of cotton production there. So although there are up to 79 registered ginneries in Tanzania, less than half of these tend to operate from time to time. Others remain un-operational either for fear of incurring high processing costs due to low ginning capacity utilization or because of other factors such as technological obsolescence.

Oil extraction from cottonseeds is either by the solvent or chemical extraction method or by the expeller–pressing method. The former entails treating the raw material, in this case cottonseeds minus hulls, with hexane and recovering the oil by distillation of the resulting solution of oil in hexane. The solvent extraction method takes advantage of the low boiling point of hexane (67 degrees Celsius or 152 degrees Fahrenheit) coupled with the high solubility of oils and fats in hexane. After oil has been obtained, the solvent is then removed from the oil by a process of evaporation and condensation from the distillation of the oil - hexane mixture.

The solvent extraction method is certainly the more efficient as it tends to recover up to 99% of the oil from the parent material. Nevertheless, traces of the solvent quite often remain in the final oil produced and attempts to rid the oil of all hexane or other chemical solvents used such as heptane, octane pentane e.g. by heating to very high temperatures, tends to result in most of the beneficial constituents naturally occurring with the oil getting destroyed.

In the expeller – pressing method cottonseeds are pressed, squeezed, and crushed under high pressure until oils begin to seep out from the parent material. This is the method by which oil has often been extracted for centuries worldwide. An expeller press is a screw type machine that presses oilseeds through a caged barrel like cavity. The machine uses friction and continuous pressure from the screw drives to move and compress the seed material. The oil seeps through small openings that do not allow seed fibre solids to pass through. Afterward, the pressed seeds are formed into a hardened cake that is removed from the machine. Expeller pressing tends to remove up to 70% of the oil within the raw material.

The main advantage of the expeller - pressing method is that it is relatively simple, can be used for any kind of oilseeds and it is not capital intensive. Furthermore, there are expellers available to cater for the processing needs starting from a few tons per day to several tons up. The expeller - pressing method produces edible oil that is completely free of solvent or chemical residues in addition to retaining most of the natural colours, flavours and nutritional qualities of cottonseed oil. However, the fact that the level of residual oil in the press-cake cannot be reduced below 3 to 5% even with the most powerful presses is considered a draw back for cottonseeds whose oil content is relatively lower when compared to other oilseeds.

Use of the expeller–pressing has tended to be preferred over the solvent extraction method in spite of the latter's efficiencies and modern outlook. Because consumers may not be willing to pay for the higher prices of the so-called double refined oil derived from solvent extraction, millers are afraid that shifting to the more advanced technology does not guarantee increased profitability because of the high installation and operational costs of the solvent extraction technology. Perhaps more importantly, millers are also afraid that

due the prevailing shortages of cottonseeds in the WCGA, they may not be able to run solvent extraction mills at full capacity.

As a result, most millers have tended to deploy low – cost Indian expeller–pressing technology and equipment as corroborated by the existence in the country of all kinds of models of expeller – pressing equipment. The occurrence of several models with varying seed crushing capacities further confirms that the expeller–pressing technology can also be more flexibly tailored to meet the rather specific crushing needs of individual millers. This fact tends to confer millers using the expeller–pressing oil extraction technology the flexibility to deal with fluctuating cottonseed production trends existing in Tanzania.

However, the preponderance of oil milling equipment using the expeller–pressing technology implies that the bulk of cottonseed oil produced in the WCGA is of relatively low ‘‘quality’’ and which may be having traces of the undesirable compound called gossypol. However, in the WCGA where most of the cottonseed oil is consumed, it tends to be preferred over palm oil for the frying of fish and doughnuts because it burns at a higher temperature. There may as well be other considerations such as taste (neutral or with flavours), health (with regard to ratios of good and bad fats) and performance (smoke point, fry life and shelf life). To date there are eight oil brand names of cottonseed oil produced in the WCGA (see Table No. 3)

**Table 2. Status of cotton oil mills in the WCGA**

Oil mill	Number of expellers	Crushing capacity per 8 hours (tons)	Oil capacity per 8 hours (tons)	Cake capacity per 8 hours (tons)	Husks (tons)
Nassa	5	15	1,800	6.75	4.05
Nyambiti	6	18	2,160	8.1	4.86
New Era	7	81	9,720	36.45	21.87
Buchosa	5	15	1,800	6.75	4.05
Ukerewe	5	15	1,800	6.75	4.05
Farai	3	9	1,080	4.05	2.43
Best Lint	4	12	1,440	5.4	3.24
Birchand	3	90	10,800	40.5	24.3
Dynamic	6	18	2,160	8.10	4.86
Bibiti Mwanza South	2	33	3,960	14.85	8.91
Bibiti – Igunga	1	3	360	1.35	0.81
Mara Oil	3	63	7,560	28.35	17.01
S & C	4	20	2,400	9.0	5.4
Mount Meru	22	66	7,920	29.7	17.82
Jambo	4	90	10,800	40.5	24.3
Gaki	3	90	10,800	40.5	24.3
Fresho	3	60	7,200	27.0	16.2
Brown Eagle	5	15	1,800	6.75	4.05
Soud	4	12	1,440	5.4	3.24
Luguru	5	15	1,800	6.75	4.05
Malampaka	10	30	3,600	13.5	8.1
Uzogore	5	15	1,800	6.75	4.05
Manonga	5	15	1,800	6.75	4.05

Oil mill	Number of expellers	Crushing capacity per 8 hours (tons)	Oil capacity per 8 hours (tons)	Cake capacity per 8 hours (tons)	Husks (tons)
Singida	5	15	1,800	6.75	4.05
Mhunze	3	60	7,200	27	16.2
Shinyanga	10	30	3,600	13.5	8.1
KCCL	3	15	1,800	6.75	4.05
Hassanali Walji	2	30	3,600	13.5	8.1
Nyakabindi	2	6	720	2.7	1.62
Kahama	3	90	10,800	40.5	24.5
Diamond	5	25	3,000	11.25	6.75
Mugango	5	30	3,600	13.5	8.1
Sangu	3	15	1,800	6.75	4.05
Vegetable Oil Industries Ltd (VOIL)	NA	NA	NA	NA	NA
Dehong Oil Mill	NA	NA	NA	NA	NA

Source: TCB; NA stands for 'Not Available'.

**Table 3. Brand names of cottonseed oils produced in Tanzania**

Name of oil miller	Ginner, miller or both	Brand name of product
VOIL	Miller	Okay oil
Dehong	Miller	Urafiki oil
Birchand	Ginner/miller	Ndiyo oil
Gaki	Ginner/miller	Sawa oil
Afrisian	Ginner/miller	Farasi oil
Mount Meru	Ginner/Miller	Mount Meru oil
Kahama	Ginner/miller	Kahama oil

Source: TCB.

Cottonseed oil production in Tanzania accounts for only 8% of total national edible oil consumption. The remaining 92% is accounted for by other sources of edible oil namely; groundnuts, sunflower, sesame, soya, palm oil, coconut oil and imported edible oil. It is currently estimated that Tanzania consumes between 200,000 and 300,000 tons of edible oil annually with demand growing at 5% to 6% per annum. These values tend to corroborate with estimates of 250,000 tons of edible oil per year based on FAO's recommendation of 5 kg per of edible oil per capita per annum for a population of 50 million people.

Because Tanzania produces only between 80,000 and 120,000 tons of edible oil domestically, there is a shortfall of between 120,000 and 180,000 tons of edible that has to be imported on annual basis. Such imports, which largely comprise of intermediate products comprising of crude and semi-processed edible oils tend to originate from South East Asian countries of Malaysia and Indonesia. Between 2006 and 2011 the major imports comprised of crude palm oil and soybean oils.

**Table 4. Edible oil imports in Tanzania between 2006 and 2011 (tons).**

Year	2006	2007	2008	2009	2010	2011
Crude soybean oil	639	17,302	12,002	7966	17,127	14,389
Crude palm oil	165,374	3,000	48,654	126,151	125,851	146,473
Crude sunflower seed/safflower	6,500	1,825	90	4,247	4,308	3,920
<b>Total</b>	<b>172,515</b>	<b>22,129</b>	<b>60,747</b>	<b>138,365</b>	<b>147,288</b>	<b>164,784</b>

Source: TRA

As a result of imports of edible oil constituting a rather sizeable share of the edible oil market in Tanzania, the refining of imported edible oils has become a major manufacturing industry. Such trend is being facilitated by the fact that most of the imported products only require simple refining and packaging before being distributed to marketing outlets.

The importation of edible oils in general and that of palm oil in particular has had negative implications on the prospects for growth not only of a Tanzanian palm oil industry but also on countrywide domestic edible oil manufacturing industry based on oilseeds such as cottonseed, sunflower, sesame and groundnuts. Because imports of edible oils tend to come into the country fraudulently or without paying the full amounts of tariffs and taxes, such imports tend to serve as a disincentive to local millers and producers of oilseeds to expand production on account of the unfair competition that ensues. On its part the government tends to lose considerable revenue because the legal-regulatory framework for the liberalized edible oil market has so far proved difficult to enforce.

In spite of cotton being second after groundnuts in terms of volumes of cottonseeds produced on an annual basis, its contribution to total national edible oil production remains quite low. This is in part due to oil content in cottonseeds being lower relative to other oilseeds. Cotton's oil content of only 15% is much lower compared to sunflower at 54%, groundnuts at 50% and soybean at 20%. Low oil content is largely due to cotton research and development stations prioritizing lint quantity and quality over oil content in cottonseeds. On account of rampant adulteration of seed cotton prior to ginning, cottonseeds being used for oil extraction tend to be of extremely poor quality. This fact coupled with the use of older models of the expeller–pressing technology probably adds up to this problem as well.

Finally, because data on production statistics for cotton tend to be generally under-reported by ginners cum millers, the situation for cottonseeds may in fact be worse because TCB does not routinely monitor cottonseed production as it does for lint bales. In practice data on the quantities of cottonseeds produced per ginnery tend to be computed based on quantities of seed cotton purchased and the approximate ginning out-turn ratio that is determined separately for each ginnery.

**Table 5. Production of the major oilseeds in Tanzania (tons), 2000/01 – 2009/10**

Season	Sunflower	Cotton **	Groundnuts	Sesame	Palm oil	Soya
2000/01	80,870	243,000	206,800	25,707	10,440	1,430
2001/02	104,400	148,500	289,500	55,100	10,620	1,270
2002/03	112,400	180,800	255,100	22,485	10,940	2,060
2003/04	106,312	326,680	163,360	49,163	11,788	1,070
2004/05	88,854	357,260	125,311	74,989	11,098	1,150
2005/06	373,391	130,587	783,775	221,421	14,989	5,000
2006/07	369,803	200,662	408,058	155,794	15,224	3,000
2007/08	418,317	368,697	396,769	46,767	17,787	3,500
2008/09	310,584	267,004	349,306	90,063	NA	NA
2009/10	328,533	315,000	475,918	146,919	NA	NA
<b>Average</b>	<b>229,346.4</b>	<b>253,819.0</b>	<b>345,389.7</b>	<b>88,840.8</b>	<b>12,860.8</b>	<b>2,310</b>

Source: Ministry of Agriculture

\*\* Figures quoted for cotton were extracted from FAOSTAT.

### *Challenges and constraints facing the cottonseed oil industry*

Cottonseeds and other oilseeds have the potential to meet Tanzania's overall requirements for edible oil. Experiences by VOIL which has been producing high quality double refined cottonseed oil for over fifty years show that there are factors that tend to make oil milling quite a daunting task (Hansen *et al* 2015). The first challenge is with regard to the business environment. This, they characterized as being very harsh due to unpredictable legal and regulatory systems. As a result of Tanzania having 3 licensing regimes for businesses, this creates the potential for overlap, duplication and multiplicity. The need for oil millers to deal with multiple statutory regulatory bodies on matters relating to taxation, fire safety, food safety and food standards tends to be confusing. Because fees and taxes are sources of revenue for government then perhaps one statutory body such as TRA should be left to do this. The other challenge facing oil millers and probably other businesses as well is of an institutional nature and relates to pervasive bureaucracy, corruption and unwarranted political interventions although the magnitude of these is rapidly changing for the better.

Other challenges facing oil milling and other manufacturing industries in general have been discussed by Wangwe *et al* (2014). First and perhaps foremost most industries tend to deploy technologies and equipment that are not state of the art as reflected by the oil milling industry being dominated by the expeller–pressing method. Such trend tends to limit upgrading and competitiveness. As a result consumption of cottonseed oil is largely confined to WCGA in spite of the widespread demand for good quality edible oil countrywide and the eastern and southern region of Africa as a whole. Tanzania competes with Zimbabwe to be the largest cotton subsector in the eastern and southern African region where other countries are not well positioned to substantially increase output of cotton by-products like Tanzania and Zimbabwe.

Secondly, the transmission and distribution of power needed for running manufacturing industries continues to be problematic in Tanzania largely due to much of the infrastructure being very old and dilapidated. Nevertheless, diversification from hydro to thermal generation using gas has vastly improved the availability of electric power in recent years.

Thirdly, most manufacturing firms face problems relating to the lack of skilled labour for many of their operations. As a result of low levels of educational attainment and vocational skills, firms are being compelled to bring in foreign experts. However, some immigration policies tend to make it very hard for firms to bring in foreign experts in spite of their requisite qualifications.

Fourthly, access to credit remains one of the greatest barriers to manufacturing firms. In spite of the multiplicity of banks and financial institutions, lending in Tanzania is fraught with uncertainties and risks relating to difficulties in identifying applicants due to lack of a national identification system, lack of credit information, poor systems of collateralization, ineffective enforcement systems and the propensity for most banks to prefer offering only short term loans for certain business oriented activities.

Finally, oil millers in the country tend to face stiff and unfair competition from imports of cheap and subsidized palm oil from the Far East. As indicated earlier, imports of palm oil constitute more than 50% of the edible oil market in Tanzania. The challenge here is that existing policies do not adequately state how the country should deal with such imports in the short and medium term basis while working on how to exploit and maximize its comparative advantage in the production and utilization of its oilseeds.

In the case of the cottonseed oil industry in particular, three major policy issues need to be addressed soon rather than later. First, seed quality has to be improved and maintained over time. This will entail overhauling the present seed system whereby farmers continue to use recycled fuzzy seeds for planting. Under the new system based on the recently released varieties such as UKMO8, seed for planting shall originate from designated seed multiplication farms that on a yearly basis receive 2<sup>nd</sup> generation seeds coming from research farms where breeder seed is multiplied each year. Seeds obtained after the ginning of a commercial crop (obtained from farmers) shall all be destined for crushing for oil extraction. Once a system for the provision of improved seeds for planting by farmers is in place and separated from one for the provision of seed for the oil millers, the country will stand a better chance of increasing not only cotton output but also the quantity and quality seed for oil milling as well.

Secondly, farmers are to be incentivized to comply with best farming practices. Sowing on time, observing spacing requirements, fertilizing the crop and managing weeds and pests properly are some of the basic requirements for optimizing average yields per ha. The current competitive model prevailing in Tanzania has

so far failed to tackle the issue of seasonal inputs and input credit and no doubt yields have stagnated. Institutionalization of some form of contract farming can help raise yields and the quality of cotton as a whole. Attempts to introduce contract farming have so yielded little success largely for lack political goodwill from government. Although contract farming is already being implemented on other crops such as sugar cane, tobacco and cut flowers to mention just a few crops, the reluctance to adopt contract farming for cotton is to a large extent due to vested interests on the part of some ginners (Kabissa, 2014). In view of the wide diversity of edible oils available in the country there is need for some kind of a social economic study to analyze the main drivers for the demand of some brands over the others.

When viewed from a much broader perspective of Tanzania's comparative advantage in edible oils, it would appear that the country must also address, in terms of improved policies, issues relating to the rather harsh business environment which the edible oil subsector faces from time to time. Because palm-oil imports from Malaysia and Indonesia contribute more than 50% of all edible oils consumed in the country, they are critical in driving market prices for edible oil in the country. Thus policy guidance is needed with regard to ensuring free and fair competition as well as providing a framework for the support and promotion of the production of oils originating domestically.

First and foremost, there is need by government to reconsider its current trade policies that favour the importation of crude oils over refined ones. Because imported oils recorded as crude are, in fact, fully refined oils in *sensu stricto*, the import duties to be charged on both of them should be uniform and kept relatively small in order to incentivize the importers to pay rather than evade the duties/taxes as is currently the case. Import duties are currently waived on imports and so locally produced oils tend to become more expensive and hence uncompetitive because of the produce cess and VAT being charged on them. Such an intervention would also help to curb corruption at clearing houses. To be effective this measure should be followed up instituting a standardized system for valuation of imported edible oils in order to prevent under-valuing of edible oil imports that has been quite rampant in recent years.

Secondly, in order to promote local processing and hence increase the competitiveness of domestically produced edible oils against imported ones the government should waive VAT for edible oil for processors using locally produced oilseeds. Provision of tax exemptions on machinery and packaging material imported for the production of edible oil would also greatly help to incentivize the domestic processing of oilseeds produced locally. Thirdly, efforts should be directed at enhancing investments in research, extension and development of infrastructure in order to increase production efficiencies for oilseed producers because seed cotton yields and oil content in the case of cottonseeds are currently quite low by world standards. Fourthly, because cottonseed oil competes with other edible oils, there is a need to set up standards relating to health requirements as well as the operation of the oil expelling technology in the country as a whole.

Finally in view of Tanzania's huge potential to lead the eastern and southern African region with regard to increased production not only of cotton but also the by-products of cottonseed, an understanding on the factors determining demand, supply and trade linkages with other sectors is needed given the relatively huge market prospects for edible from cottonseeds and other oil seeds within the EAC and SADC regions.

## 6. Meal or cottonseed cake

Cottonseed cake or meal is the by-product remaining after cotton is ginned and the seeds crushed and the oil extracted. Because cottonseed cake or meal is protein-rich it is quite often used as a common source of protein for livestock particularly dairy and beef cattle, goats and sheep. In the USA it is also used for the manufacture of organic fertilizers. Because the extraction of cottonseed oil by the expeller-pressed method tends to leave behind substantial amounts of oil in the cake, such cake is often subjected to further oil extraction in some countries before it is utilized for other purposes.

The presence of gossypol in the cottonseed meal derived from expeller-pressed technology may be unsuitable for consumption by non-ruminant animals (such as poultry and pigs) that somehow are unable to metabolize it like the ruminants. Nevertheless, technologies have been developed that are capable of removing the free gossypol content by 80% and bound gossypol by 60%. Such processes also serve to improve the protein content by 40% and lysine content by 25%. There are suggestions to the effect that the heat and pressure normally associated the expeller – pressed method tends to deactivate the gossypol.



In the WCGA where the bulk of the seed cake is produced (see Table No.2) the daily production capacity ranges between 2.7 and 40 tons per 8 hours shift. Amongst the millers, only 16 of them are capable of producing 10 or more tons of cake per 8 hours shift. Only six companies namely; Birchand, Jambo, Mount Meru, S & C, Gaki and Kahama oil mills are capable of producing 27 to 40 tons of cake per 8 hours shift. These companies are among the top ten leading seed cotton buyers in Tanzania.

Because of stagnating cotton production in the country, only companies with the financial and logistical capacity to compete for seed cotton during the buying season can hope to produce reasonable quantities of cake. Thus in spite of the bulk of oil millers using the expeller–pressing method for oil production, only a few companies such as Birchand, Gaki, and Kahama oil mills that tend to procure relatively large quantities of seed cotton have the capacity to produce relatively large quantities of cotton cake in the order of 40 tons of oil per 8 hours by using large capacity expeller – pressing models like the Umus brand.

Baffes (2010) contends that cottonseed cake is rarely traded internationally because of its low value – to - weight ratio. There is reason to believe though that reasonable amounts of Tanzanian cake are annually exported to some neighbouring countries, Kenya in particular. The bulk of the seed cake is derived from mills using the expeller–pressed method and so the oil remaining in the cake becomes a good incentive for further oil extraction. Similarly, the resulting cake tends to be readily marketed in view of Kenya’s dairy industry being better developed and the local cotton industry being far less capable of meeting the demand for feeds. There is also a big demand for cake in the entire eastern and southern African region. This partly explains why Mozambican and Malawian seeds are annually sent to South Africa for oil extraction. In Tanzania, some of the cake produced in the WCGA is used domestically as supplementary feed for peri-urban livestock keepers in large towns and cities where some of the country’s 0.7 million improved dairy cattle live.

### *Challenges to the increased use of cottonseed cake*

The major market for cottonseed cake is the livestock sector. According to the 2009/10 official statistics there were 19.2 million cattle, 13.7 million goats, 3.6 million sheep, 1.9 million pigs and 23 million improved chickens in Tanzania. There are less than 0.7 million improved cattle in the whole country. Unfortunately, there is a lack of linkages to and knowledge of the animal feed industry. Consequently, except for peri-urban livestock keepers in cities and big towns, the bulk of the livestock in Tanzania is assumed to be largely dependent on grazing in natural pastures. Secondly, because trading in cake is quite an informal business and millers and their vendors fail to register, incorporate and operate legally because of existing regulatory and administrative obstacles, government policy should seek to intervene and formalize markets for by–products. The need for this cannot be over-emphasized because cottonseed cake is just a part of several other agricultural feeds competing for market share within the livestock sector. Because trading in cottonseed cake is quite informal, data pertaining to production, consumption and exports is hard to find.

## **7. Hulls (Husks)**

A cottonseed hull is the outer husk of the seed. It is recovered as a by-product of the oil extraction process. In the WCGA where cotton farmers also keep livestock husks constitute a much cheaper alternative to cotton cake and quite easily available. Recently, husks have become an important livestock feed during the dry season when grass and crop residues are in short supply.

Husks have also become an important livestock feed during the transportation of cattle from WCGA to Dar es Salaam prior for slaughter. Prior to such shipments cattle tend to be routinely fed on cotton hulls for a couple of days before being loaded onto the trucks. This is a relatively recent development for Tanzania that tends to elevate the economic value of hulls. Other than animals destined for slaughter, the only other group that may benefit feeding on either husks or cake are the 0.7 million improved dairy cattle cited in the official statistics of 2009/10.

As discussed earlier, other animals within the livestock sector are currently thriving on natural pastures to be 1.4 million ha. Thus as the livestock sector further develops into a commercially oriented one, the demand for hulls and other by-products is likely to grow as well. Hulls are considerably cheaper than cottonseed cake and therefore more likely to be affordable to many livestock keepers. They are likely to be of great use

during the dry season when there is the feeding of cattle is very difficult owing to widespread shortage of grass and plant residues on which animals can feed.

In the USA, hulls are increasingly being used as mulch on agricultural fields and as a component of the medium used for the production of edible mushrooms. Tanzania has a relatively small mushroom industry that stands to benefit from cotton husks coming from oil mills within the country. However, major uses of hulls are in relation to the manufacture of cellulose based value added products in view of hulls being very rich in cellulose. Some such products include cellulose esters for example cellulose acetate (CA), cellulose acetate propionate (CAP) and cellulose acetate butyrate (CAB). CA is used commercially in plastics such as tool handles, face shields, eyeglass frames, tapes, textile fibres, photographic films and cigarette filters. CAP is used in printing inks, specialty coatings, tool handles, toothbrushes and ophthalmic frames. CAB is used in plastics such as brush and tool handles, automotive and furniture coatings, film and sheets. Thus there are prospects for industries based on these products to develop in Tanzania given the ready availability of hulls.

In the past hulls were either being disposed of by burning or used as fuel to run boilers. This was the case because pastures were plentiful and population densities were very low. To date hulks just like cottonseed cake are both in great demand as livestock supplementary feed. The major challenge with regard to husks is that they are in short supply and cannot satisfy the demands from businessmen transporting cattle to Dodoma and Dar es Salaam for slaughter let alone peri-urban livestock keepers let alone the livestock keepers capable of buying them. An even bigger problem is that once they have left the oil mill, trading in husks becomes entirely informal. As a result data on production, consumption and exports of husks is extremely limited. There is therefore need for TCB to also participate in the monitoring the production of husks as is the case for cotton lint. In view of the potential of husks to be used for the production of several value added products, there is need for some kind of feasibility study that will examine the potential of producing CA, CAP and CAB from husks in Tanzania.

## 8. Linters

Linters are defined as the residual fibres left on the seed after ginning. These remaining fibres are removed at the cottonseed oil mill and/or at the ginnery before processing the cottonseed for oil or to make the so-called black seeds for planting. The type of linters is determined by how many times the seed passes the delinting machines.

Because the ginners cum oil millers in Tanzania prefer using the expeller–pressing method for oil extraction over the solvent extraction one, it follows that the production of linters is quite minimal in Tanzania and currently confined to the three companies engaging in oil extraction by the solvent method. Because TCB does not monitor the production of cottonseeds, cottonseed oil, hulls and linters, data on these products tends to be quite limited.

In other countries including the USA linters are mainly used for the production of four categories of products; stuffing materials for pads, cushions, comforters, mattresses, upholstery and automobiles; absorbent cotton for surgical dressings, lined underwear, felt and paper stock; low - grade yarns for carpets, twine, rope and lamp and candlewicks and finally, cellulose based products such as writing paper and chemical cellulose products such as rayon, plastics among others. In a nutshell, linters are essential for the manufacture of pharmaceuticals, paper and chemicals.

## 9. Cotton waste

Up until the early 1980s Tanzanian cotton was famous for its high quality because it was hand-picked and largely roller ginned. After liberalization the grading of cotton prior to sale stopped and seed cotton became subject to adulteration by both farmers and cotton buying agents. Similarly the number of saw gins increased. By 2009, 26 out of the 79 registered gins were of the saw type while 53 gins were fitted with rollers. Because most of the roller gins owned by cooperatives are no longer operational due to technological obsolescence and liquidity problems, it is clear that saw ginning has become a significant influence on cotton waste management.

Due to increased use of saw gins and a concomitant rise in the levels of trash in Tanzanian cotton, the need for the pre-cleaning of seed cotton prior to ginning and of lint prior to baling cannot be over emphasized. As

a result of these measures considerable amounts of trash or waste have tended to accumulate at most ginneries. In Tanzania such trash or just simply waste has tended to be gotten rid of by either burning or using it as fuel for boilers.

In the OECD countries such waste is being utilized as valuable feed for livestock mainly as a source of roughage; for making compost; making bedding for dairy cattle and as a soil amendment by applying it back to the field to add humus to the soil.

**Table 6. Relative proportions of lint, seed and waste for the period 1990 - 2010 in Tanzania.**

Year	Lint %	Seed %	Waste %
1990	33	64	3
1991	34	64	2
1992	28	66	6
1993	35	64	1
1994	34	62	4
1995	34	65	1
1996	34	64	2
1997	34	64	2
1998	43	56	1
1999	34	63	3
2000	34	63	3
2001	34	63	3
2002	42	54	4
2003	28	62	10
2004	35	61	4
2005	35	63	2
2006	34	63	3
2007	35	62	3
2008	34	62	4
2009	31	64	5
2010	35	62	3

Source: FAOSTAT

It can be seen that the by-product subsector has immense potential to equal or even surpass lint with regard to the overall financial contribution to the cotton industry vide their use in the manufacture of value added products. However, such potential remains largely untapped because levels of their production continue to be low for the same reasons that largely constrain seed cotton production, ginning and lint marketing.

## 10. Cotton stalks

Cotton stalks constitute the major by-product of the cotton farming process that is routinely produced each season. Until recently cotton stalks have tended to be disposed of by burning. The latter also served as a valuable and reliable method for suppressing populations of some cotton pests and diseases by way of destroying the habitat on which they survive during the non-cropping season.

In Egypt, Sudan and Greece cotton stalks have been tried at experimental level to determine if they can be used to provide a better source of energy for domestic use by converting them into briquettes. In advanced economies such as the USA, Australia and Brazil, farmers routinely undertake end of season stalk destruction by cutting them at ground level, shredding and incorporating them into the soil. Thereafter other measures are taken to ensure that the stubs remaining at ground level do not regenerate into a new crop on whose fruiting points boll weevils and the pink bollworms would overwinter and become a thence perpetuate their damage on cotton in subsequent seasons.

In India, work undertaken by the Indian Council of Agricultural Research (ICAR) in collaboration with the Central Institute for Research on Cotton Technology (CIRCOT) with financing from the Common Fund for Commodities (CFC) demonstrated that in terms of chemical composition cotton stalks are comparable to most species of hardwood as they too contain holocellulose (69%), lignin (27%) and ash (7% ash). Thus they can be used as an alternative raw material for the manufacture of several value added products such as particle boards, pulp and paper, hard boards, corrugated boards and boxes, microcrystalline cellulose, cellulose derivatives and various substrates for the production of edible mushrooms.

The use of cotton stalks to produce such products tends to open up opportunities for the launch of manufacturing industries that are less dependent on natural forests of hardwood for wood. Perhaps more importantly, by selling their cotton stalks as raw material for wood based industries, cotton farmers have the potential to significantly increase their incomes over and above the income that is derived from cotton farming alone. On an annual basis between 350,000 and 450,000 ha of land are sown to cotton in Tanzania from which between 455,000 and 585,000 tons of cotton stalks biomass is produced.

**Table 7. Estimated cotton stalk production in Tanzania for the period 1999/00 to 2010/11**

Cropping Season	Area sown to cotton (ha)	Estimated tonnage of stalks*
1999/00	250,000	325,000
2000/01	182,000	236,000
2001/02	420,000	546,000
2002/03	387,000	503,100
2003/04	295,000	383,500
2004/05	561,000	729,300
2005/06	245,000	318,000
2006/07	410,000	533,000
2007/08	450,000	585,000
2008/09	406,000	527,800
2009/10	348,000	452,000
2010/11	469,000	609,700
<b>Average</b>	<b>368,583</b>	<b>479,025</b>

Source: TCB

\* To compute the tonnage of cotton stalks produced per season an assumption was made based on work done in India where 1 ha of rain-fed *Gossypium hirsutum* cotton gives 1.3 tons of clean cotton stalk chips.

After harvest the entire bulk of the cotton stalks in cotton fields is either cut and used as a source of firewood in cotton farmers' homesteads or just disposed of by burning in areas where there are better alternate sources of firewood exist. Under existing Cotton Growing Regulations, cotton farmers in the WCGA and ECGA are obliged to uproot and burn all cotton remains after harvest within designated dates as part of an area-wide program designed to suppress *Pectinophora gossypiella* or the pink bollworm. After those dates, cotton farmers are also required to observe a three months' period during which absolutely no cotton crop is to be grown or seen on any field in both the WCGA and ECGA.

The basic premise for such measure is quite simply to deprive the inspect pest species of any plant material on which its populations would survive after harvest as it is strictly restricted to feeding on cotton and it is not known to diapause in the tropics. As a result of such measures, the pest would no longer become a significant threat to the next crop because its population levels will have been reduced too low to be of any consequence. Such cultural control tactic worked quite well prior to liberalization and especially during the colonial period because all farmers tended to comply with the law and because it was implemented on an area-wide basis. Defaulting on this requirement was also punishable under the law.

However, the compulsion to uproot and burn cotton stalks after harvest as well as observe the three months' closed season after harvest waned after liberalization and to date enforcement of the regulation is no longer there. One of the major reasons for such trend is that due to increasing population pressure and declining stocks of firewood brought about by deforestation, most farmers in the WCGA are increasingly resorting to the use of cotton stalks as firewood. And so rather than uprooting and burning the cotton stalks after harvest, farmers do instead take the cotton stalks to their homes for use as firewood on a need basis.

The reluctance by farmers to uproot and burn cotton stalks after harvest is also being partly fueled by another recent trend called ratooning. The latter is quite simply a practice whereby rather than uprooting and destroying the plant remains of a previous cotton crop, the same plants are allowed to re-grow and produce a second cotton crop. Although the cotton species is generally capable of doing this, this is discouraged in practice because the yields from ratoon cotton obtained tend to be uneconomic. Moreover, from an entomological viewpoint such ratoon cotton serves to exacerbate the pest status of the pink bollworm and other late season pests on cotton where they occur.

The advent of alternative ways of using cotton stalks that have potential to generate additional income to farmers would in theory be a highly welcome initiative. The period between July and mid – November is characterized by lack of income generating activities in much of the WCGA and so the launching of activities relating to the collection, transport and sale of cotton stalks would create new employment opportunities. The conversion of cotton stalks into briquettes will be of great interest because they give more energy and are more convenient to use and store than stalks. In general stalks are likely to be viewed more positively than in the past in view of their potential to boost rural employment by getting farmers and non-farmers alike involved in the collection, transportation and processing of cotton stalks.

From an environmental safety perspective, the use of cotton stalks to produce value added items is likely to help minimize the emission of greenhouse gases (GHG) by reducing or even terminating the regular end of season burning of huge amounts of cotton stalks. Similarly, deforestation in the cotton growing areas will tend to be minimized as farmers increasingly adopt the use of briquettes derived from cotton stalks. Finally, due to a more regularized end of season removal of cotton stalks for the manufacture of value added products, the pest status of the pink bollworm and other late season pests on cotton is likely to be reduced quite considerably and thereby scaling down pesticide use on cotton.

Each cropping season cotton farmers in Tanzania produce vast quantities of cotton stalks that either end up being used as a fuel resource or just disposed of by burning in compliance with existing good farming practices. In light of recent developments that perceive cotton stalks as a valuable resource for the production of value added products with considerable economic value, Tanzania needs to ponder on how a paradigm shift on how stalks are used can be made both smoothly and successfully.

## **11. Challenges facing cotton by-product development in Tanzania**

In Tanzania the demand for some of cotton by-products for example cake and hulls by the livestock sector is quite high all year round. In the case of cottonseed oil its demand in the WCGA is apparently greater than for most other edible oils. In general cotton by-products have the potential to develop and become significant sources of income just like lint. However, the realization of such potential is currently being undermined by a multiplicity of challenges and constraints some of which are discussed below.

1. In the case of cottonseed oil the number one challenge would seem to be the competition for market share that it gets not only from cheaper imported palm oils but also from other edible oils particularly sunflower oil that is produced locally;
2. Due to a widespread dependency on the expeller-press method for oil extraction, both the volumes and quality of cottonseed oil produced in Tanzania tend to limit the potential for expansion of the cottonseed oil market to the EAC and SADC regions where there exists a potentially large market for edible oil;
3. Cottonseed oil is by and large consumed in the WCGA where all oil millers are based. Its supply to other parts of the country tends to be limited by the quantities of oil available annually due to frequent shortages of cotton seeds occasioned by stagnating cotton production in the WCGA;

4. Tanzania lacks a clear national policy guidance on the development of the edible oil industry as reflected by the current position on taxes on imported oils that seems to favour imports at the expense of local oil industry development;
5. Volumes of cotton cake and hulls produced in the country are currently not enough to meet the demands of the dairy livestock estimated at less than 0.7 million as well as a growing chicken industry. This is largely due cotton production in Tanzania stagnating in recent years;
6. Linkages between the cotton by-products subsector and the livestock sector tend to be very weak partly because trading in cake, hulls and linters is strictly informal. As a result coordination between oil millers, traders, consumers, policy makers and other potential stakeholders remains extremely limited;
7. Just as volumes and quality of cottonseed oil tend to be limited by a dependence on expeller-pressing technology, the production of linters tends to be similarly limited because this method tends to circumvent the need for carrying out two or more cuts on the cottonseeds prior to oil extraction as is the case in solvent extraction;
8. In the case of cotton stalks the major challenge will be with regard to convincing farmers to switch from their traditional use of stalks as firewood to alternative and newer sources of energy. The other challenge is likely to be in relation to attracting investors into a new venture involving the manufacturing of particleboards and other products. Such investors will need to be assured on whether or not cotton farmers can be organized to produce quality stalks on annual basis in order to guarantee a profitable business.

## 12. The future of cotton by-products in Tanzania

Among the major by-products discussed thus far the following namely; cottonseeds, cottonseed oil, cottonseed cake and cotton stalks would seem to merit more attention in the future on the basis of the following consideration:

1. **Cottonseeds:** One of the major reasons for low cotton yields in Tanzania is that seeds currently in use are of lower yield potential and deteriorated genetically. In the ESA as a whole there is a huge countrywide demand for certified seed for planting. Except perhaps for Zimbabwe, Zambia and South Africa systems for the production of certified seed for planting do not exist (case of Tanzania) or largely under-developed (case of Kenya and Uganda). As a result annual cotton output remains too low to meet the demand for cottonseeds and its by-products. Efforts are therefore needed to introduce certified seed production and processing systems. If this cannot be done, then perhaps cottonseeds should be produced elsewhere in the region and then imported into Tanzania as is presently the case for other seeds notably maize.
2. **Cottonseed oil.** None of the countries in either the EAC or eastern and southern African region (ESA) as a whole is self-sufficient in edible oil production. Tanzania which competes with Zimbabwe on becoming the largest cotton subsector in ESA has the potential to meet not only its domestic demand for edible oil but also to export some to regional markets if present constraints can be addressed.
3. **Cottonseed cake.** Livestock sectors in Tanzania and the ESA region as a whole stand to benefit immensely from increased cottonseed cake availability in Tanzania. To date cottonseed cake is often in short supply relative to the demand by the existing dairy and/or beef cattle in Tanzania. Demand is expected to rise further as livestock keeping shifts from a dependence on grazing on natural pastures to a more advanced system where cattle tend to be confined to paddocks where supplementary feeding becomes a norm.
4. **Cotton stalks.** In view of the huge area devoted to cotton farming each year, Tanzania has the unique potential to produce several value added products from cotton stalks for the entire ESA region. In the WCGA where Miombo woodlands were cleared in order to give way to cotton production, the residents there are now hard pressed to buy furniture that is derived from very expensive timber moved from other distant parts of the country or use imported furniture. However, before cotton stalks can be used for the intended purposes, the timber industry will need to be

convinced on the utility of stalks to produce quality products. Cotton farmers on their part will need to be informed on the trade-offs associated with giving up stalks for other products.

### **13. Developing a Cotton By-product value Chain in Tanzania: Some key considerations**

Cotton by-products have the potential to compete head on with lint as sources of income to numerous stakeholders. Nevertheless, there are several questions to be asked as to how better they should be handled if they are to significantly contribute to the overall cotton subsector profitability and contribution to income generation, employment and poverty reduction. Some of the questions relate to the following issues:

1. In relation to raw material availability, the major issue is how quickly can seed cotton output in the country be increased to requisite levels given the existing constraints and challenges? To date buyers cum ginners face capacity utilization and processing costs because their facilities operate at less than 50% of the installed capacity for lack of enough seed cotton.
2. With regard to cottonseed availability, the key question is that even if seed cotton quantities were to be raised substantially, most of the gineries would fail to operate at full capacity in part due issues relating to old age, technological obsolescence and financial liquidity.
3. Most ginners are not finding trading in lint as profitable as it should be because of price discounts and loss of premiums as a result of the reputation of Tanzanian cotton becoming tainted due to increased contamination and quality related issues. Efforts seeking to raise cotton output must therefore go hand in hand with those for raising quality.
4. Trading in by-products is currently quite informal. As a result coordination and regulation within the subsector is problematic because the major stakeholders are largely unknown officially. So while there is a ginner's association as well as a farmer's association, issues relating to cotton by-products are never discussed.
5. Because of increasing market demand for oils with designated quality standards, cottonseed oil millers will need to adopt business and labour practices that to a large extent ensure that oil (and cake) produced in Tanzania conforms to such standards and safety. This is hardly the case at present.
6. Cottonseed oil and cake tend to compete for market share with other locally produced oils and cake. Unfortunately, the promotion and branding of cottonseed oil remains extremely limited because retailers are unregistered and hence tend to trade in these products rather informally.
7. The existing tax regime is not conducive for the promotion of increased production of edible oils such as cottonseed oil and other oils. The current tax system exempts imported palm oil from payment of import tax and produce cess. Because cottonseed oil and other locally produced edible oils tend to be charged VAT and produce cess, they tend to be more expensive than imported palm oil.
8. As a result of trade in cake countrywide being largely informal, there is an extreme paucity of data on major competing feeds with regard to their production levels, prices and markets. Consequently, sector level links to the animal feed industry are woefully missing.
9. In view of the importance of the edible oil countrywide and the relatively underdeveloped nature of the sector, one may ask if it would constitute a valid case for 'infant industry' and thence warrant the two ministries currently supporting it (the agricultural and industry ministries) to consider granting it a full sector status?
10. Given the multiplicity of stakeholders, products and market scenario for cotton by-products, would it not make sense to empower TCB to assume full regulatory oversight for the by-product subsector?

## 14. Stakeholders: Roles and functions in the cotton by-products study

When cotton farmers and ginners meet under the umbrellas of their respective associations, their discussions tend to focus on issues relating to either seasonal inputs or buying and selling of seed cotton. They hardly discuss issues on cottonseed by-products because the production as well as marketing of cotton by-products is unregulated and tends to be largely informal. Potential stakeholders for the by-products value chain include the dairy, poultry and pig keeping businesses. This group would make a useful addition because unlike the cotton-farmers cum livestock keepers who tend to be largely dependent on natural pastures for the feeding needs of their local breeds, dairy, poultry and pig keepers tend to be quite dependent on agricultural by-products for the supplementary feeding of their animals.

Stakeholder category	Roles and functions
Cotton farmers	They grow cotton annually and tend to keep livestock as well. Their major concerns relate to increasing the profitability of cotton as well as keeping their livestock well fed and healthy all year round. Cotton farmers are currently organized under the Tanzania Cotton Growers Association (TACOGA)
Ginners cum oil millers	They buy seed cotton from farmers and gin it into lint and seeds. They own cottonseeds from which they extract oil and other by-products. Under present market arrangements they also supply seeds and pesticides to farmers on behalf of the Cotton Development Trust Fund. All ginners are members of the Tanzania Cotton Association (TCA)
TCB	Licenses legal entities to buy, gin and market cotton. It coordinates stakeholders and advises government on cotton development related matters. It monitors buying, ginning and export of cotton as well as the quality of seed cotton and lint.
Local Government Authorities	They are responsible for provision of agricultural extension services to farmers of all crops including cotton. They collaborate with TCB during the licensing of cotton buyers. On behalf of the central government they oversee the enforcement of all laws and regulations relating to rural development as a whole.
Financial institutions	They provide the credit needed by ginners cum oil millers to run their businesses. Some of these include CRDB, NBC, KCB, TIB and EXIM banks.
TOSCI	Oversees rules and regulations regarding the production, multiplication, certification and use of seeds in the country.
Ministry of Agriculture, Livestock and Fisheries	It provides policy guidance for the development of the agricultural, livestock and fisheries sectors.
Tanzania Food and Drug Authority	It is responsible for controlling the quality, safety and effectiveness of food, drugs, herbal drugs, cosmetics and medical services imported into Tanzania.
Tanzania Investment Centre	It is the single platform for accessing information relevant to investment promotion and facilitation into Tanzania.

### Notes:

*Cotton stakeholders do meet on annual or biannual basis. These meetings, dubbed ‘‘cotton stakeholders’ meetings’’, are as a rule organized by TCB and tend to be attended by these and some other selected stakeholders such as cotton R & D staff as well as members of parliament from designated cotton growing districts in the WCGA. The agenda tends to be drawn up by a secretariat comprising of TCB and representatives of major stakeholder groups. Over the years such stakeholder meetings have tended to focus on issues relating to production, processing and marketing of cotton. As stated in the narrative, issues relating to cotton by-products are never discussed at all.*

*Although cotton farmers have TACOGA as their association, there is some debate on whether this association or some other organization such as the regional cooperative unions should be regarded as being a more legitimate forum for*



*their representation. To date none of these organizations can rightly claim to represent all the cotton farmers in the country.*

*The group labeled ginners cum oil millers comprises of private companies as well as the Regional Cooperative Unions such as Nyanza and Shirecu and a few smaller cooperative organizations. In spite of their market share having dwindled over time, they still own a substantial share of ginneries and oil mills in the WCGA the bulk of which tends to be leased to some private companies.*

*Stakeholder meetings have tended to be quite useful in galvanizing opinions and strategies for resolving certain industry-felt constraints facing the industry. However, they have also tended to become politicized and subject to manipulation by some powerful personalities with vested interests.*

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## 16. Map showing cotton producing regions in Tanzania

