



COTTON AND ITS BY-PRODUCTS

in Uganda

ANALYSIS OF COTTON BY-PRODUCTS SURVEY



Acknowledgments

UNCTAD commissioned this survey as part of United Nations Development Account Project 1617K: "Improving the value added of cotton by-products in Eastern and Southern Africa (ESA)". The survey will inform later activities in the project, including a national workshop. For more information, please visit the project site at: www.unctad.org/commodities.

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While due care was taken in compiling this report, any errors and omissions remain the author's responsibility.

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List of Acronyms and Abbreviations

BUBU	Buy Uganda Build Uganda
CCB	Cotton Control Board
CDO	Cotton Development Organisation
COMESA	Common Market for Eastern and Southern Africa
CPSP	Cotton Production Support Programme
EPRC	Economic Policy Research Centre
FAOstat	Food and Agricultural Organization Statistics
GOT	Ginning Out-Turn
HVI	High Volume Instrument
ITC	International Trade Centre
JMS.....	Joint Medical Store
LMB	Lint Marketing Board
MAAIF.....	Ministry of Agriculture, Animal Industry and Fisheries
MDAs	Ministries, Departments and Agencies
MT.....	Metric Tonnes
NARO	National Agricultural Research Organization
NaSARRI	National Semi-Arid Resources Research Institute
NMS	National Medical Store
TEMAU	Textile Manufacturers Association Uganda
TEXDA.....	Textile Development Agency
UBoS.....	Uganda Bureau of Statistics
UOSPA	Uganda Oil Seed Producers and Processors Association
UGCEA.....	Uganda Ginners & Cotton Exporters' Association
UGX.....	Ugandan Shillings
UIA	Uganda Investment Authority
UIRI	Uganda Industrial Research Institute
UNCTAD.....	United Nations Conference on Trade and Development
UNECA	United Nations Economic Commission for Africa

Executive Summary

Cotton is an important crop in Uganda, ranked as the country's third largest export crop after coffee and tea, according to the Cotton Development Organisation (CDO). The cotton value chain employs several actors including: farmers, traders and ginners. Their primary products and by-products are inputs into various industries namely: cottonseed millers (husks, cake and soap makers), cotton wool manufacturers and textile manufacturers. In general, the lint value chain is more developed than that for by-products.

Several impediments undermine production and productivity along these value chains. To address these bottlenecks, the United Nations Conference on Trade and Development (UNCTAD) and its regional partners, the United Nations Economic Commission for Africa (UNECA) and the Common Market for Eastern and Southern Africa (COMESA) have designed a project "Promoting Cotton By-Products in Eastern and Southern Africa". It is upon this project that a research on promoting the development of cotton by-products in Uganda was undertaken. The overall objective of the study is to examine the development of cotton by-products in Uganda.

The research applies two methods to collect and analyse data, i.e. desk review and field interviews. The study team interviewed farmers, ginneries, oil millers, surgical cotton producers, animal feeds producers, mushroom producers, soap manufacturers and Government Ministries, Departments and Agencies (MDAs). The research team worked closely with CDO throughout the entire research process. Fieldwork was conducted in the West Nile, Northern, Western Uganda and the Eastern regions.

Results show that most parts of Uganda have the potential to produce cotton, that different varieties are produced in the country, but that farmers are not entirely aware of what variety they grow. Production and productivity is low due to input and credit constraints, competition from other crops and inadequate extension knowledge, among other factors. Addressing these would increase the volumes of cotton grown and thus the availability of raw materials for the cotton by-products value chains.

Several issues are associated with low productive capacity along the cotton by-products value chain. These include: inadequate technical capacity; lack of spare parts in the local market; load shedding and erratic power supply, which slows down operations; old equipment; an absence of technologies to exploit some by-products like cotton stalks; and an unfavourable business environment. For example, in milling and oil extraction, cottonseed oil is favoured by bakeries, but it faces numerous impediments like: limited supply of raw material; lack of capital; poor technology and limited technical capacity to purify cottonseed oil; high operating costs due to poor infrastructure; and competition from other edible oils like palm oil.

The potential demand for some by-products, like animal feeds, is revealed by the growing demand for imports. Likewise, the potential demand for some by-products like cotton wool and sanitary towels is enormous, but lacking significant investments to manufacture the products locally. There is potential in the regional market to further increase investments in by-products, with the potential of improving Uganda's trade balance.

To develop the cotton by-products industry in Uganda, the study recommends:

1. Increasing cotton production at the farm level through improved delivery of quality extension services and inputs;
2. Increasing both public and private investments in the development of cotton by-products, especially in value addition technologies;

3. Supporting the development of local textile industry to increase the demand for seed cotton;
4. Ensuring quality and adherence to standards during production, transportation and processing;
5. Reviewing government policies on taxation that increase the unit cost of production at both farm and ginnery levels;
6. Ensuring local content in domestic consumption;
7. Ensuring a consistent and affordable supply of electric power;
8. Ensuring that cotton prices are stable and attractive to encourage farmers to grow cotton;
9. Enable value chain stakeholders to access credit for working and development capital;
10. Conduct further studies on the feasibility of exploiting the identified by-products; and
11. Design training programmes are designed to build the capacity of the technical workforce in their respective manufacturing and processing plants to effectively manage the equipment and undertake repairs and maintenance work, through coordination among ginners, CDO and training institutions.

1. Introduction

Cotton remains an important crop in Uganda, ranked as at the country's third largest export crop after coffee and tea, according to the Cotton Development Organisation (CDO). It is the main source of income for some 250,000 households, who cultivate cotton under rain-fed conditions and with minimal use of inputs such as fertilisers and chemicals.¹ The sector generates export revenue, which increased from US\$ 20.8 million in 2015 to US\$ 31.6 million in 2016 (UBoS, 2017). In addition, it offers employment opportunities and incomes to families, particularly in rural areas.

Although cotton is primarily used for lint, several by-products can be derived to increase value added. In terms of development of cotton by-products, Arnell (2016) observes that African firms, and Uganda in this case, are usually stuck at the bottom of the value chain and have an unfavourable trade balance, since they export primarily raw materials and import finished goods. This is more pronounced in the textiles industry, where Uganda exports cotton lint and imports manufactured cloths, both new and second-hand clothing. Much as the main cotton value chain activity is ginning, many other actors are involved in the cotton by-products value chain in Uganda. These include, for example: cottonseed dealers, oil millers, animal cake and soap makers, surgical cotton wool manufacturers, as well as textile industries.

To address the bottlenecks to developing the cotton by-products, the United Nations Conference on Trade and Development (UNCTAD) and its regional partners, the United Nations Economic Commission for Africa (UNECA) and the Common Market for Eastern and Southern Africa (COMESA) designed a project "*Promoting Cotton By-Products in Eastern and Southern Africa*", funded by the United Nations Development Account to address key challenges in the cotton by-products industries, particularly by filling the data and policy gaps that restrain its development in the region. The overall objective of the project is to strengthen the capacity of selected countries in Eastern and Southern Africa to assess the economic viability of the development of cotton by-

¹ Cotton Development Organisation, available at <http://www.cdouga.org/>

products and formulate evidence-based policies that promote their value addition. The project key objectives are:

1. To improve the capacity of cotton value chain stakeholders to assess the market opportunities for cotton by-products; and,
2. To improve the capacity of policymakers in the beneficiary countries to: (a) formulate evidence-based policies that help to develop cotton by-products industries; and (b) devise investment profiles to attract investors to these industries.

This report presents the findings from a survey on cotton by-products in Uganda, examining the different dynamics, from production to marketing, along the value chain, as well as a policy analysis of the sector.

1.1. Objectives

The overall objective of the study is to examine and enhance the development of cotton by-products in Uganda. The specific objectives are:

1. To examine the production and marketing dynamics of cotton by-products in Uganda;
2. To identify the main impediments to the development of cotton by-products in Uganda;
3. To assess the infrastructure and technology capabilities and challenges at the different nodes of the cotton value chain;
4. Identify possible opportunities for developing the cotton by-products value chain; and
5. To identify strategies and incentives that can motivate cotton by-products actors to invest in the various nodes of the value chain.

1.2. Methodology

The study used two approaches to collect and analyse data, namely: desk review and field interviews. Under desk review, we reviewed background materials for the project and secondary literature to gain an understanding of the project and of the cotton and cotton by-products sub-sector in Uganda. In addition, we reviewed other literature on cotton by-products in Uganda, advocacy documents for value chain actors, government reports and strategies. Secondly, we conducted field interviews with actors along the cotton by-products value chain to understand issues of production and marketing as well as impediments to their development.

In undertaking field interviews, we sampled 25 ginneries, of which we visited 23, the two other ginneries being inoperative. With regard to farmers, we sampled 80 farmers for interviews and managed to collect data from 116 of them (Eastern, Northern Uganda and Kasese district). For cotton wool producers, out of the six sampled, four were interviewed as two were inoperative. For animal feeds manufacturers, we sampled five and managed to visit all of them. Out of the nine oil millers sampled, we collected data from six, given that two were inoperative and the last one milled sunflower exclusively.

1.2.1. Selection of study areas and research scope

The research team met with the CDO and gathered information on the 10 cotton production zones in Uganda, as illustrated in Figure 1. CDO also provided the team with contacts of its regional coordinators, who were instrumental in setting appointments with the sampled value chain actors.

Out of the 10 zones, EPRC sampled value chain actors in the West Nile region, Northern region, Western Uganda region and the Eastern region.

The survey activities were conducted in three stages, i.e. pre-test, main survey and survey in Central region. The pre-test was conducted in Jinja and Iganga, while during the second stage, the team split into two groups. The first group conducted the survey in the Eastern parts of Uganda covering the districts of Jinja, Luuka, Iganga, Kamuli, Busia, Butaleja, Tororo, Mbale, Manafwa, Pallisa, Kibuku, Kumi and Bukedea. The second team conducted the survey in the West Nile, North and Western regions, covering the districts of Arua, Nebbi, Pakwach, Gulu, Oyam, Lira, Apac and Kasese. The first two stages covered mainly the farmers, ginners, oil/seed millers and surgical cotton manufacturers. The third stage in Central region covered the capital city Kampala, where most MDAs are situated, and the districts of Mukono, Mityana and Masaka targeting cotton by-products value chain actors including, oil millers, surgical cotton manufacturers, cake, soap and animal feeds producers, mushroom producers and textile producers. The survey was conducted from 19 November to 8 December 2017. However, more stakeholder consultations were conducted until February 2018 to complete the report.

2. Overview of the cotton sector in Uganda

2.1. Evolution of the Cotton Sector

Cotton production was introduced in Uganda by the British in 1903, initially in the Central Region, with production later spreading to the rest of the country. The policy framework governing cotton production and marketing was embedded in the revised Cotton Act (1964) and the Lint Marketing Board (LMB) Act (1959, amended 1976). The Board monopolized cotton lint and cottonseed trade at domestic and international levels, while ginning and marketing functions were assigned to cooperative unions. The country then witnessed a continuous increase in the production of cotton until the 1970s. Much of the success was attributed to the fact that, before independence, cotton was grown under forced-labour conditions, through the enforcement of a poll tax (Baffes, 2009a). Households were mandated by the colonial government to allocate at least 0.5 hectare (ha) to cotton production and failure to grow cotton could result into a prison sentence (Lugojja, 2017). Other factors that contributed to the success include the introduction of ginneries, textiles mills and other processes across the country both by government and the private sector.

Heavy government involvement in the sector also contributed significantly to its post-independence success, largely in the form of protecting farmers from price volatility. Such efforts included the establishment of the Cotton Control Board (CCB) in the 1930s, the passage of the Cotton Zone Ordinance, which established fourteen production zones, each allotted with a ginnery (Lugojja, 2017). However, after the 1970s, political instability and poor policies in the 1970s led to the sector's demise. Attempts to revive the sector during the Economic Recovery Programme of the World Bank in the 1990s set the pace for policy reforms. These reforms, combined with a lending operation and the high cotton prices of the 1990s, led to a revival of the sector (Baffes, 2009b).

In 1994 the Ugandan government liberalized the ginning and marketing of cotton. Liberalization of the sector was effected by passing of the Cotton Development Act of 1994, hence the creation of the CDO, a semi-autonomous agency under the Ministry of Agriculture, Animal Industry and Fisheries. The Act opened cotton ginning and marketing to private sector participation, while at the same time mandating CDO to carry out monitoring, promotion, processing, marketing and regulation of the cotton sub-sector on behalf of the Government. Its mandate includes: to enhance the quality of lint and cotton products, both for export and domestic consumption; to promote the distribution of high quality planting seed; and generally to facilitate the development of the cotton industry. For instance, during baling of cotton in the ginneries, samples are automatically taken from each bale and a total of 4 per cent of the samples are subjected to analysis through either manual classing or High Volume Instrument (HVI) classing by CDO. However, most of the cotton produced in Uganda is exported as lint, with only 5–10 per cent of production used domestically (Masiga & Ruhweza, 2007).

The National Agricultural Research Organisation (NARO) is charged with undertaking research to enhance the development of production technology. This is done through the National Semi-Arid Resources Research Institute (NaSARRI), which generates, packages and disseminates appropriate agricultural production technologies and information for improved and sustained integrated crop and natural resource management. Research on production technology is aimed at developing new cotton varieties, yields, yield components, fibre quality, initial seed multiplication, improving existing varieties, controlling pests and diseases, and improving current farming practices.

The Uganda Investment Authority (UIA), a semi-autonomous government agency that drives national economic growth and development, in partnership with the private sector, has identified a number of investment opportunities in the cotton sector. These investment opportunities are directly linked to value addition, thereby providing for opportunities to developing cotton by-

products in the country. The key areas for investment include: cotton ginning, cottonseed oil, animal feed, absorbent cotton wool and cotton yarn.² According to UIA, investments in the cotton sector can be located near the cotton growing areas and where large tracts of land can also be leased to investors for them to grow their own seed cotton. Moreover, UIA can also allocate the investor industrial land to construct new facilities in planned industrial parks in the North and West Nile regions. The details of the cotton by-products value chain that offers investment opportunities are summarized in Figure 2.

The Textile Development Agency (TEXDA) promotes the growth of entrepreneurs in textile businesses through technical, managerial and entrepreneurial skills upgrading. TEXDA strengthens the capabilities of Micro Small and Medium Enterprises (MSMEs) in the textile sector, through mentoring, provision of inputs and machinery, and facilitating the manufacturing of innovative quality products that are competitive on both local and export markets.³ Products range from crafted table cloths, hand designed beddings, curtains, fashionable women and men's attire to children's wear.

In the recent past Uganda has developed two policies that are important for developing cotton products and by-products in Uganda. First, the Buy Uganda Build Uganda (BUBU) policy was initiated in 2014, based on existing Government policies to support and encourage the consumption of locally produced goods and services. The BUBU policy vision is to develop a vibrant dynamic and competitive private sector that transforms local products through the value chain to meet the required standards. This is to be realized by its mission statement, which is to support the production, purchase, supply, and consumption of local goods and services (Government of Uganda, 2014). Secondly, the National Textile Policy of 2009 was designed to enhance the performance of agro-based industries in the country, so as to increase value addition on locally produced raw materials and export of manufactured goods (Government of Uganda, 2009b). The policy vision is to create a strong and vibrant textile and clothing industry, with sustainable capacity utilization and enhanced investment, throughout the cotton-to-clothing value chain.

2.2. Performance of the cotton sector

Most areas of Uganda have the potential to produce cotton. Currently, the main production areas include the North, East and South East of Lake Kyoga, and in the Kasese area in the West, as shown in Figure 1. Different varieties are produced in the country, which yield finer fibre of medium to long staple length, with excellent characteristics, being silky and well suited for spinning.⁴

The total area under cotton cultivation in Uganda has fluctuated over the years due to various factors, including weather conditions, price expectations and the provision of farm inputs (Ahmed & Ojangole, 2012). For instance, from 2008 to 2009, total area under cultivation reduced from 101,215 ha to 68,000 ha, before increasing to 80,000 ha in 2010 (MAAIF, 2011). The area has since increased to 109,312 ha by 2017 according to preliminary estimates by CDO. It is also important to note that cotton production has not reached its historic peak of the late 1960s. In fact, production is still far below the estimated potential of 1,000,000 bales at full employment level (Government of Uganda, 2009a). In addition, the observed growth has varied over time. There are annual fluctuations in production largely due to price movements and changing weather patterns due to climate change (Lugojja, 2017). The main driver to this fluctuation is the volatility in cotton

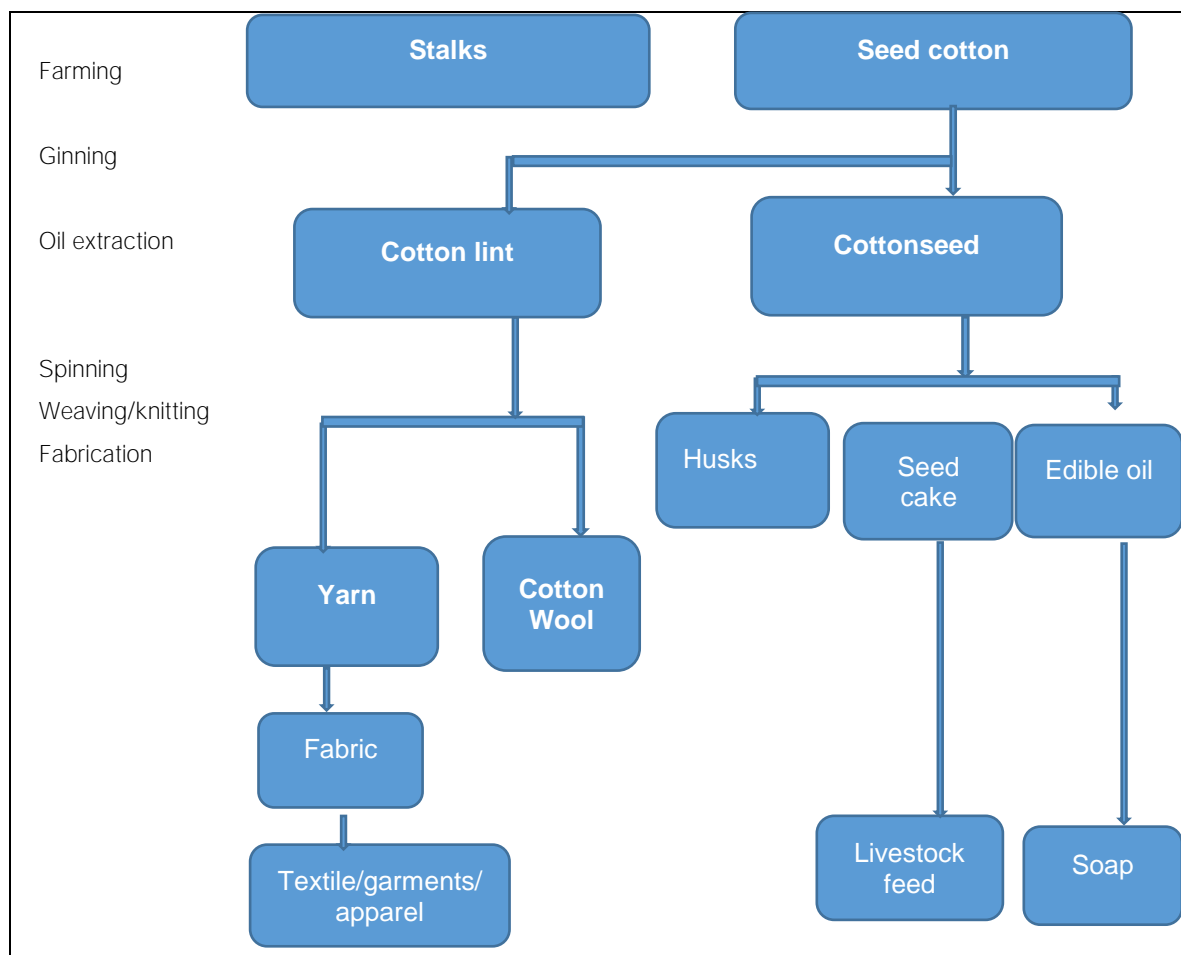
² Uganda Investment Authority (UIA), Cotton Sector Profile, available at http://www.ugandainvest.go.ug/uia/images/Download_Center/SECTOR_PROFILE/Cotton_Sector_Profile.pdf

³ The Textile Development Agency (TEXDA), available at <http://www.texdauganda.net/about.html>

⁴ Cotton in Uganda, an International Trade Centre (ITC) brochure, available at http://www.coton-acp.org/sites/default/files/documents/downloads/final_uganda_brochure_october_2011.pdf

prices as well as drought, which acts as a disincentive to farmers, forcing some to move into the production of other crops.

Figure 2: A summarized cotton value chain in Uganda



Source: Lugoja, (2017)

According to CDO, cotton yields between 2013 and 2017 varied between 700 and 850 kg/ha of seed cotton. Despite a long tradition of growing cotton in Uganda, productivity is low, with an average yield of about 780 kg/ha compared to the international average of 900 kg/ha (Horna, Kyotalimye, & Falck-Zepeda, 2009). This average yield is far below that of the main cotton producing countries, such as China with 1,270 kg/ha, Israel with 1,700 kg/ha as computed by the Index Mundi, 2017. This low productivity for Uganda is largely due to weak adoption of agronomic farm practices (Government of Uganda, 2009a), including the over reliance on rain-fed production. Cotton production in Uganda is largely carried out by smallholder producers, many of whom lack appropriate farming skills (Government of Uganda, 2009a). Climatic changes manifested in the form of unpredictable rainfall patterns and volumes, have also adversely affected the timing and duration of the planting, leading to poor harvests (Lugoja, 2017).

Low usage of inputs like pesticides and fertilizers, coupled with declining soil fertility are other factors affecting productivity (Government of Uganda, 2009a). Most of the production inputs are imported and are relatively costly to an average farmer (Lugoja, 2017). Although efforts by the government to improve productivity have yielded some positive results, the desired yield remains out of reach. According (Lugoja, 2017) this is partly attributed to limited funding for research and technology development. This has slowed down development of new varieties and production technologies, hampering the sector's ability to adapt to changing farmer needs and emerging

constraints, in particular climate change (Lugojja, 2017). Other factors include constrained extension services, limited or lack of credit for purchasing inputs.

Furthermore, cotton in Uganda is mostly grown on small, family farms with an average area of 0.5 ha (Government of Uganda, 2016). These farmers are rarely dedicated, professional cotton growers. Rather, they decide how to allocate their land and labour among, for example: other cash crops, subsistence food crops, as well as other non-farming activities. The allocation of smallholder resources to cotton thus depends on the comparative returns from cotton compared with the returns from competing crops (Olupot, 2003). Indeed, a profitability analysis carried out by Baffes (2009a) revealed that cotton has low profitability when compared with food crops like beans, maize, bananas (*matooke*) and sorghum. His findings show that, during the period 1989/90-2003/4, nominal cotton prices received by farmers increased by an annual average of 3.1 per cent, while the corresponding price increases of the four food crops were much higher: 5.3 per cent for beans, 6.1 per cent for maize, 5.3 per cent for *matooke* and 7.8 per cent for sorghum. This, he noted, is because food commodities respond to domestic demand conditions, which are primarily driven by increases in Uganda's per capita income, while cotton responds to international market conditions (Baffes, 2009a).

The cotton produced in Uganda is mostly exported to Bangladesh, China, Switzerland, United Arab Emirates, Singapore, the United Kingdom of United Kingdom of Great Britain and Northern Ireland and Hong Kong (China).⁵ Cotton has the potential to improve the welfare of about 250,000 low income farming households (Gordon and Goodland 2000; Baffes 2009a). As shown in Figure 3, Uganda has a positive trade balance in cotton. From 2007 to 2010, exports averaged US\$ 21 million, while imports averaged US\$ 8 million. In 2011, exports drastically increased to US\$ 86 million, while imports fell slightly to US\$ 4.7 million, yielding a positive trade balance of US\$ 82 million. However, exports have fallen since then, with a slight recovery witnessed in 2015 and 2016. Similarly, production has also fluctuated with a tendency to recover and increase.

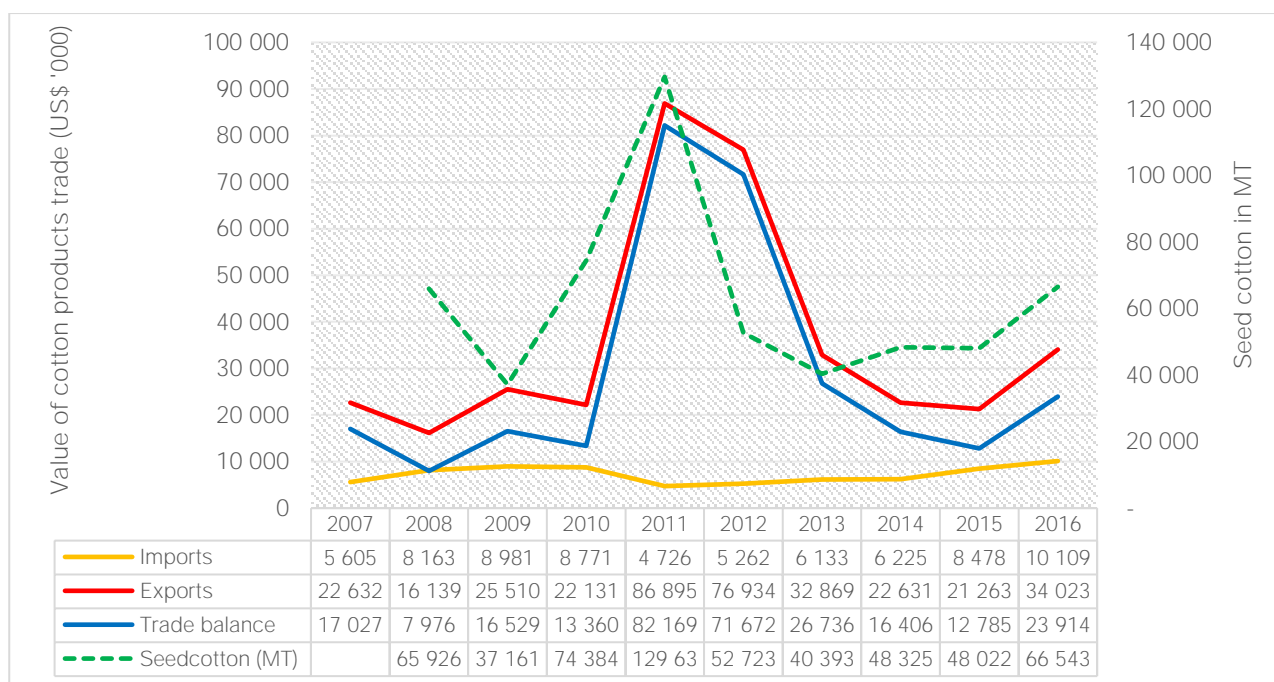
CDO has encouraged the formation of associations to support the development of cotton by-products in Uganda. The three key associations are: the Uganda Ginners & Cotton Exporters' Association (UGCEA), formed in 1997, Uganda Oilseed Producers and Processors' Association (UOSPA), formed in 2007 and Textile Manufacturers Association of Uganda (TEMAU).

The UGCEA is an umbrella body that brings together all the cotton ginners and exporters in Uganda. The Association seeks to: promote, protect and coordinate the interest of ginners, farmers and exporters in Uganda; initiate discussions and exchange of information amongst members on cotton issues; advise government on key policies affecting cotton sub-sector; provide a united forum for people interested in cotton ginning, export and generally the improvement of the cotton industry.⁶ According to the Government of Uganda (2016), UGCEA adopted the Cotton Production Support Programme (CPSP) and initiated a Cotton Development Fund (CDF) to finance the CPSP. Through these interventions, the association works with CDO to provide production inputs – such as planting seed, pesticides, spray pumps, fertilizers and herbicides – to mobilize and sensitize farmers, as well as provide them extension services. UOSPA, on the other hand, is an umbrella organization of cottonseed processors. They procure cottonseed from ginneries for milling into cottonseed cake and oil. Cotton seed oil is used primarily as cooking oil by bakeries and confectionaries, while the cake is used in compounding livestock feeds (Lugojja, 2017).

⁵ According to the UN COMTRADE Database

⁶ Uganda Ginners and Cotton Exporters Association profile, available at http://actif africa.com/documents/members/1000024_member_2014-09-30-17-14-14.pdf

Figure 3: Seed cotton production and trade in cotton products, Uganda, 2007-2016



Source: International Trade Centre (ITC) calculations based on United Nations COMTRADE, ITC statistics⁷ and production data from CDO

3. Analysis of issues and impediments along the value chain

3.1. Issues at cotton production level

3.1.1. Input supply

Farmers mentioned the following cotton varieties grown in Uganda: BPA 2002, BPA 2015A, BPA 2015B, SZ 9314, QM 301, QM 301 and MS2. When asked to name the varieties of cotton grown in their areas, surprisingly, 40 per cent were unable to do so. Worse still, 51 per cent of the farmers did not know the varieties they themselves grew. The main challenge at this point is developing the appropriate seed for planting in the different cotton zones. According to National Semi Arid Resources Research Institute (NaSARRI) at Serere, planting seed is developed for a period of about 10 years, after which the foundation seed is given to CDO to multiply for distribution to farmers. This process has been implemented well with the exception of few isolated challenging incidences. In such cases seeds are imported from Zimbabwe given the similar varieties grown and cultivation conditions in the two countries. Although a variety once developed is envisaged to last up to 10 years, sometimes this goes beyond impacting on the yields as such seed is susceptible to diseases and pests having outlived its time.

Unlike other crops, cotton planting seed is regulated by one agency – CDO. However, a major challenge has been the inability of CDO to control mixing of planting seed. Ginners are the main source of planting seed – after separating the lint, they reserve a small proportion of cottonseed, around 10 per cent, for planting seed. But because ginners buy seed cotton from different parts of

⁷ We used the ITC Trade Map database due to data limitations at national level

the country, seed varieties from different zones are often mixed during ginning, making it difficult to isolate planting varieties adapted to the different zones. CDO has put in place a plan to overcome this problem by identifying specific areas to grow cotton for planting seed in the different cotton zone. This has been strengthened by procuring delinting equipment to prepare the seed for planting.

There is limited application of some necessary inputs at farm level, with only 38 per cent of farmers applying fertilizers and 39 per cent using herbicides. Almost all farmers use pesticides (98 per cent) and spray pumps (94 per cent). The main reasons given for limited application of fertilizers and herbicides include high prices (38 per cent), a belief that they are ineffective (33 per cent), a lack of access (28 per cent) and adulteration by suppliers. Given the poor application of some of the inputs, especially fertilizers, the study sought to establish the main sources of inputs, including planting seed, fertilizers, herbicides, pesticides and spray pumps. Results suggest that the main supplier is CDO through the area and site coordinators (41 per cent), followed by ginners (29 per cent), the open market (17 per cent), middlemen or ginners' agents (10 per cent), and finally other farmers (10 per cent). This implies that cotton inputs are largely supplied by CDO and the ginners. Farmers do minimally rely on the open market for inputs. The distance to source of inputs is not a problem, given that on average, they are collected within a distance of 8 to 9 km. Any policy actions to strengthen the inputs system will have to work with the dual, CDO-ginner model, and therefore a more critical examination of their operations should be made.

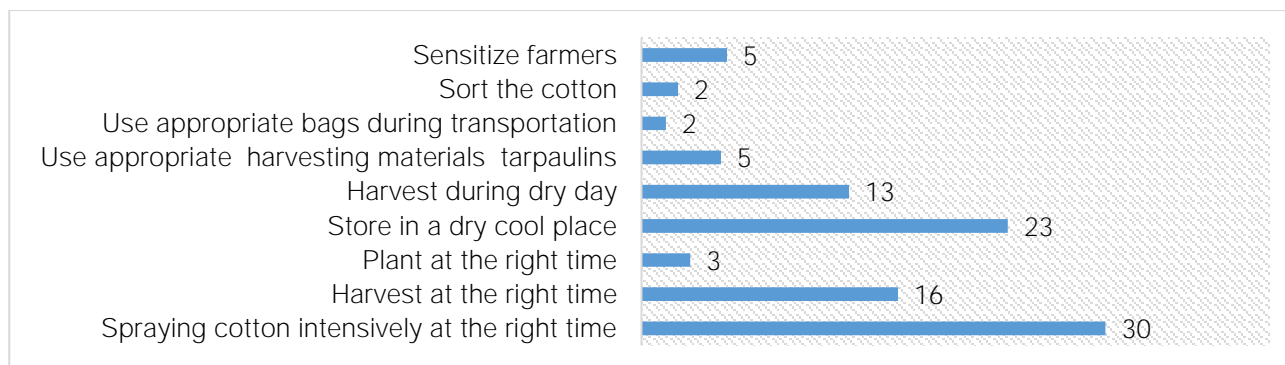
3.1.2. Extension services

The majority (95 per cent) of the farmers had received extension services of some sort, of which the Government – CDO (48 per cent) was the main provider, followed by ginners (36 per cent) and non-governmental organizations (14 per cent). This implies that the target institutions to provide extension services are the CDO and ginners. These results are supported by the current extension systems that CDO and ginners have put in place. However, there was a view that the mainstream extension system through the district production office include little information on cotton growing. The few farmers who did not receive extension services cited the long distance to the training venues and the shortage of extension workers. Most farmers (93 per cent) identified agronomic practices as the main subject of extension services, followed by storage and marketing, each with 3 per cent. Although there was general satisfaction with the extension services provided, respondents voiced two major issues: a small ratio of extension workers to farmers, which limits their interaction; and insufficient and inadequate training on spraying and managing cotton pests. Given that new cotton varieties come with new agronomic practices to get maximum yields, this gap should be addressed.

3.1.3. Cotton contamination

One of the challenges that respondents at all levels of the value chain mentioned regarding maintaining standards of seed cotton was contamination, which was largely attributed to bad practices when picking cotton and the use of poor storage and transport facilities. Figure 4 lists suggestions and proposals to handle this problem. Respondents think that spraying cotton as recommended reduces the effect of pests in staining the cotton. They propose good storage facilities, harvesting at the right time, use of appropriate materials for harvesting, storage and transportation.

Figure 4: Proposal to deal with cotton contamination



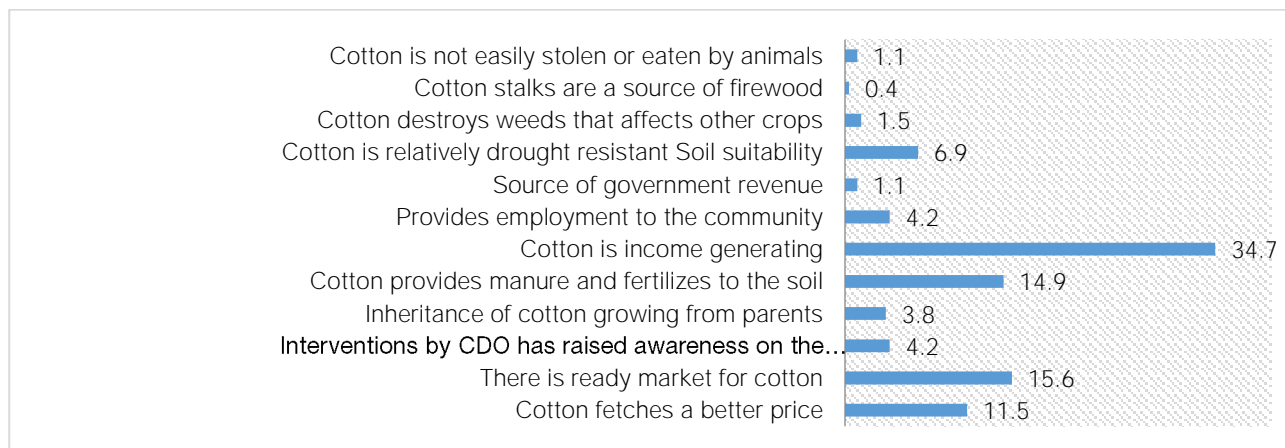
Source: Survey data

The other problem of contamination was adulteration of seed cotton by farmers and traders who add foreign bodies and water to increase the weight of cotton. This lowers the quality of lint produced. This is a regulatory problem which is not fully addressed by the relevant stakeholders. Whereas CDO is too thin on the ground to enforce standards, the ginners interaction is characterized by competition among members for seed cotton in the open market, to the extent that they close their eyes to some of these bad practices to buy larger quantities. Within the institutional framework for managing cotton, this is a glaring gap that should be addressed.

3.1.4. Why farmers grow cotton

According to respondents, the main factor influencing cotton growing in Uganda is income generation, which is related to the ready market and fairly good prices paid to farmers (see Figure 5). CDO always announces the indicative price for seed cotton early in the season, following consultation with internal and external institutions as well as stakeholders. The indicative price has in the recent past remained as a reliable minimum price throughout the season, which attracts farmers into cotton growing. The fact that farmers are guaranteed the market further explains why those who grow cotton continue to do so. The perceived role of cotton as a crop in maintaining soil fertility, sensitization by CDO and other are critical factors as well. However, for sustainability of cotton growing in Uganda, the income element, the price and ready market play the most significant role in influencing households to grow cotton.

Figure 5: Factors that influence farmers to grow cotton

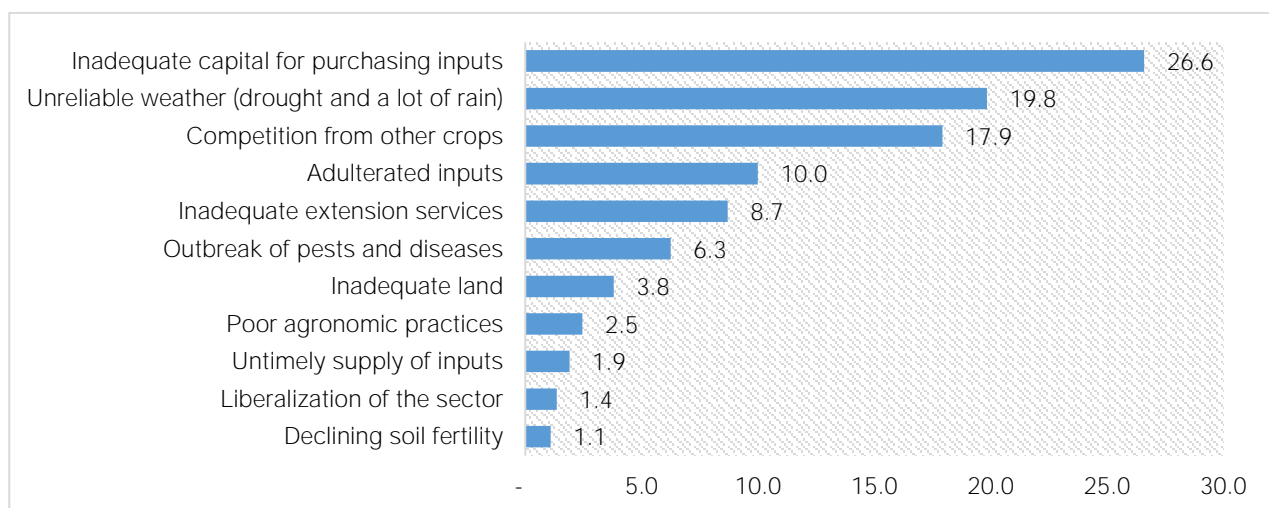


Source: Survey data

3.1.5. Impediments at farm level

The farmers mentioned a number of factors that act as impediments to growing and expanding cotton farming (see Figure 6). The main impediment is inadequate capital to purchase inputs, which limits productivity at the end of the season. This is reflected in the results on farmers' sources of capital, with 65 per cent raised from personal savings and 23 per cent from Village Savings and Loan Associations.

Figure 6: Impediments at farm level



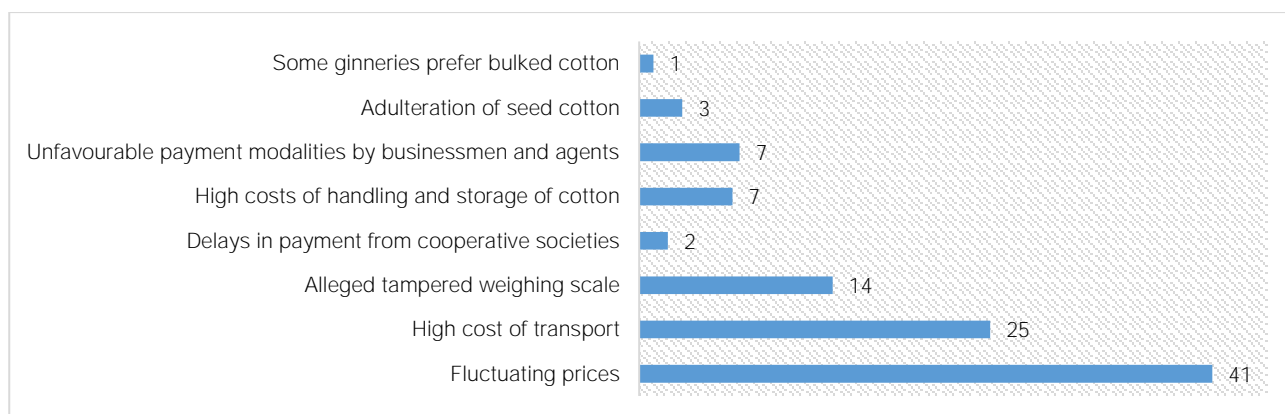
Source: Survey data

The credit problems are compounded by high interest rates, lack of collateral security, short grace periods and limited loan amounts. Unreliable weather, characterized by drought and erratic rains, also pose a threat to cotton growing. The crop has also suffered from competition with other crops. Such crops include sugar canes and maize in the Busoga sub-region, sunflower, rice and sesame in northern Uganda, among others. Sometimes these crops fetch more income and are not as capital and labour intensive as cotton. Due to weaknesses in enforcement of regulations in the inputs market, there is a lot of adulteration, especially so with inputs acquired from the open market. The farmers raised the challenge of inadequate extension outreach to them which sometimes leads to outbreak of diseases and pests when poorly controlled. Although not pronounced, some farmers complained of late distribution of inputs, which leads to poor timing of cotton growing seasons. The other factors include: inadequate land for allocation to cotton production, given that the estimated cotton acreage at household level is only 0.5 ha; declining soil fertility; and weak agronomic practices.

3.1.6. Marketing of and demand for seed cotton

The majority of farmers (87 per cent) pointed to a ready market for seed cotton, with only one per cent citing moderate demand and 12 per cent low demand (see Figure 7). However, a few farmers who are in extremely remote areas, isolated from ginners, find it difficult to market their cotton. Out of all the respondents interviewed, 56 per cent sold their cotton to ginners' agents, 32 per cent sold directly to ginneries, 10 per cent to independent intermediaries and only 2.5 per cent sold through cooperatives. With over 87 per cent of the seed cotton being sold to ginners and their intermediaries, it implies that they wield a lot of power, which they can use to their advantage. In some few and isolated incidences, independent intermediaries offered prices below the indicative price to farmers, citing transport costs to reach ginneries. Figure 7 gives the challenges in marketing cotton, as perceived and experienced by farmers.

Figure 7: Challenges in marketing cotton



Source: Survey data

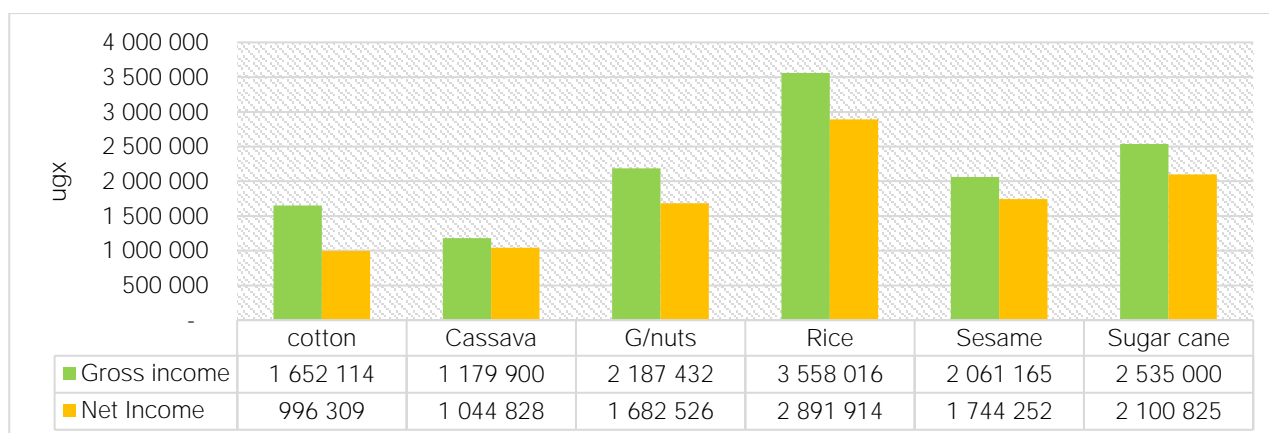
Overall, fluctuating prices is the main disincentive. This is followed by high transport costs to deliver seed cotton to buyers. Respondents also cited cheating arising from tampering with weighing scales. There is sometimes a marginal difference between their estimated cotton weight and what is given to them by all these buyers. Farmers perceive this problem is worse when independent intermediaries are involved. There are incidences when independent intermediaries do not pay on time, which denies households quick income from seed cotton. Whereas farmers who still operate under the cooperatives umbrella complained of delays in payment, the rest never complained of delayed payment. Because cotton is grown mainly by smallholders, bulking is a challenge to them as some ginners only accept bulked cotton. Actually, 70 per cent did not bulk their cotton before marketing. It is noted that any bulk marketing should be done through arrangements of ginners, who have got a strong system under which farmers can be organized. Farmers groups would work best along these lines and have potential to organize farmers.

Farmers in the last season were offered UGX 1,555 per kg of seed cotton and yet their preference was UGX 2,423. They claimed and argued that their preferred price is commensurate to the high cost of production and the cost of living. In some isolated cases, the price farmers receive is different and lower than the indicative price, especially for farmers who live far away from ginners.

3.1.7. Profitability analysis for cotton and competing enterprises

The trends in cotton growing in Uganda show that cotton acreage declined significantly during the last three decades. This is partly attributed to competition from other crops. Although the crops in Figure 8 have different growing seasons, with the exception of sugar cane and cassava, the others yield two crops per year. A profitability analysis of crops competing with cotton reveals that a farmer is likely to earn more money from them per acre than cotton. Direct cost margins, i.e. direct production costs as a proportion of revenue, are 40 per cent for cotton, compared to 11 to 24 per cent for competing crops. In addition to the relatively high cotton production costs, the price is volatile, which is a disincentive. Whereas the prices for competing crops are largely determined domestically and are typically less volatile, the producer prices that ginners pay to farmers are linked to volatile international lint prices, often making cotton the riskier crop. Details are in the annex Table A1.

Figure 8: Profitability analysis for cotton and main competing crop enterprises (UGX per acre)



Source: Survey data

3.2. By-products at seed cotton production

Lint is typically the primary product derived from the cotton plant. But other parts of the plant can be recovered at different nodes of the value chain and processed into by-products. At the farm level, these include cotton stalks, which are typically destroyed after harvesting seed cotton. At the subsequent processing nodes, along with lint, ginners produce cottonseed, which millers process into linters, hulls, cottonseed oil and cake. The latter two are further processed into cooking oil and animal feed, respectively. In Uganda, the lint and cottonseed value chains are more developed, with limited emphasis on the other cotton by-products. However, it is increasingly understood that cotton by-products can have a significant impact on the economic benefits of cotton as a crop enterprise. Cotton by-products are relatively undeveloped in many cotton-producing countries, with the exceptions of countries like China, India and the United States of America.

3.2.1. Farm level (cotton stalks)

Cotton stalks have many potential economic uses. In contrast to other agricultural crop residues, cotton stalks are comparable to the most common species of hardwood in respect of fibrous structure and hence it can be used for the manufacture of particle boards, preparation of pulp and paper, hard boards, corrugated boards and boxes, microcrystalline cellulose, cellulose derivatives and as substrate for growing edible mushrooms. This study estimates that about 330,000 metric tonnes (MT) of cotton stalks are generated in Uganda every year. However, most of the stalk produced is treated as waste. The bulk of the stalks are disposed of by burning in the field, as they can harbour several insects and pests, which can be harmful for the future crop.

There is technology for making particle boards from cotton stalk (Pandey and Mehta, 1980; Gurjar, 1994). The process involves the following: chipping of stalks to 1.5 - 2.0 cm size; re-chipping to particles of 20 mesh size and 8 mesh size; mixing of chips with synthetic binder such as urea formaldehyde or phenol formaldehyde; preparation of a three-layered mat comprising coarser particles for the core layer and finer ones for the top and bottom layers; and pressing the mat between heated platens of a hydraulic press for specific time and pressure. After this the board is cooled to attain dimensional stability and then cut to the desired size. The boards are thereafter enhanced by adding different chemicals and additives to make them water proof, fire proof and termite resistant. The cost advantage with this process is the expected low cost of raw material (cotton stalks) and reduced power required for its conversion into finished product. This implies

that the cost of particle board made from cotton stalk would be much lower than that of boards made from wood.

The economic uses of the particle boards are wide ranging including the following: door panel inserts, partitions, wall panels, pelmets, furniture items, floor and ceiling tiles among others. These are suitable for use in residential houses, commercial buildings, schools, hotels, theatres to mention a few. This can ease the pressure on wood needs like commercial plywood. This is because they are substitute materials for timber, commercial plywood, marine plywood and block board in general for ceilings. Promoting such a venture would greatly contribute to addressing deforestation hence being an environmentally friendly initiative in itself.

3.2.2. Estimated potential of cotton stalks in Uganda

We determine the potential by estimating the amount of cotton stalks that Uganda is likely to produce in a year, and thereafter proceed to examine the import and export values and volumes of particle boards that can be substituted by cotton stalk boards. Anap (2014) estimates that one hectare of rain-fed cotton, which is the practice in Uganda, can produce about 3 MT of cotton stalks and this can yield about 2 MT of particle boards. According to CDO statistics, Uganda has been cultivating an average 80,000 ha of cotton over the last five years and this is expected to reach 110,000 ha in 2018. This suggests that Uganda has the potential to produce 330,000 MT of cotton stalk chips for value addition and therefore 220,000 MT of particle boards. Trade statistics suggests that Uganda is a net exporter of particle board made from ordinary hard wood, although a significant proportion of this is likely to be re-exports (Table 1). An investment into particle boards made from cotton stalks would increase the supply available for export.

Table 1: Imports and exports of board, oriented strand board and similar board

Code 4410	2012	2013	2014	2015
Exports in Quantities (MT)	5,274	6,088	4,152	3,778
Imports in Quantities (MT)	1,239	598	644	852
Value of exports (US\$ '000)	2,185	2,612	1,738	1,700
Value of imports (US\$ '000)	1,054	310	457	433

Source: ITC calculations based on United Nations COMTRADE and ITC statistics

However, there are hurdles that should be addressed before this can be achieved. Uganda Industrial Research Institute (UIRI), which was incubating technologies to make paper and boards, was of the view that the use of cotton stalks to make paper and board, was not feasible at the moment, due to a number of factors, key of which is that the equipment required to process cotton stalks into boards is very bulky and expensive. Cotton has one harvest per year in Uganda, which implies that cotton stalks would be available for limited period of time in a year, with a need for storage to ensure adequate raw material supplies to board manufacturers for the entire year's production. Cotton stalks are bushy in nature and have very low bulk density that would make collection and transportation very expensive. Cotton growers are scattered all over the country, posing serious logistical challenges. Furthermore, during storage in stick form, cotton stalks can be degraded by insect attack. This suggests that any efforts to use cotton stalks as an industrial raw material, would require an elaborate, sustainable supply chain to deliver them to industrial users, which is currently a major limitation. The critical factors to consider include: logistics of economic collection of cotton stalks, chipping and transportation from field to industry, and its proper storage in different forms at various centres that are likely to determine the economic viability of this raw material. Possible models for cotton stalk collection might entail:

1. Transportation of cotton stalks directly from the field to the factory for chipping in the factory. This would have challenges especially the location of factories throughout the country.
2. Chipping of cotton stalks by farmers and transportation to the factory. The challenges of technology for farmers to chip the stalks would arise.
3. Collection and transportation of cotton stalks by farmers from the field to chipping centres, chipping and subsequent transportation to the factory.

The arguments made so far assume that only particle boards can be produced from cotton stalks, however other products can be made as well. According to UIRI, there is a high potential for Uganda to use cotton stalks to make briquettes for fuel. There are two forms that can be made, namely: carbonized briquettes or non-carbonized, pressed pellets. Trials are being done on all sources of biomass, including cotton stalks, which has demonstrated great potential using the carbonization approach, which can produce 33kg of charcoal from 100kg of cotton stalks. For the pellets, the process starts with the collection and drying of the cotton stalks to the desired temperature. They are then compacted by a press after considering the moisture content, pressing temperature and compacting pressure to achieve high quality stalk pellets.

3.3. Ginning Level

Cotton ginning is the process of separating seeds, and other foreign particles from the cotton fibre, or lint. It is the main activity driving Uganda's cotton sector, being at the centre of production and marketing of cotton by-products. Cotton ginning in Uganda was first attempted in 1904 when the then colonial government sold 62 hand gins to African chiefs, but later withdrew them because of the chiefs' lack of training to effectively operate the gins (Nayenga, 1981). With the failure of hand gins, ginning continued to be carried out in Kenya and the lint was then exported to Liverpool to service the British Textile Mills (Sabune, 2005). In 1906, the first ginnery in Uganda was constructed followed by another one in 1907 (Nayenga, 1981). With time, many more ginneries were established across the country, mainly by private individuals of Indian origin (Sabune, 2005). Following the liberalization phase in the early 1990s, the Government, through CDO and other partners, enabled the private sector to embark on rehabilitating the ginneries.

According to CDO, there are currently 39 ginneries in Uganda, with an installed ginning capacity of close to one million bales per annum an equivalent of 185,000 MT. It is noted that all the ginneries operate at an average of only 10 per cent of the established capacity. This is partly explained by the fact that some of them are not operational. This means that 90 per cent of the operational capacity is unutilized. The average ginning out-turn (GOT) in 2015/16 was 42.75 per cent lint, 53.3 per cent seed and 3.95 per cent process waste, which is usually the case every ginning season. The main cotton by-product at the ginning level is cottonseed, which is further processed into other products. In terms of ownership, 33 ginneries are private and six are owned by cooperatives.

3.3.1. Cottonseed

During the last four years Uganda produced an estimated 25,000 to 45,000 MT of cottonseed annually, most of which was consumed locally by emerging animal feeds and vegetable oil demand. The cottonseed is processed into oil and cake, which are further processed into stock feed and cooking oil. Some amount of the cottonseed produced is exported, mainly to Kenya, to be used in the processing of animal feeds. This is a major market destination to the extent that the local market now competes with the external market. Table 2 demonstrates that although Uganda imports some cottonseed, exports outstrip imports. This is reflected in the value of exports and imports which although fluctuating illustrates increasing exports and declining imports. The export of cottonseed is counterproductive to the development of cotton by-products because it denies raw materials for

other actors in the value chain, especially milling, which brings additional by-products in the form of animal feeds, soap and husks as a substrate for mushroom growing.

Table 2: Import and export trade of cottonseed

	2007	2008	2009	2010	2011	2012	2013
Export (US\$ '000)	213	8	11	28	230	652	1,992
Import (US\$ '000)	0	648	1,146	309	398	7	3
Export MT	2,558	234	88	1,064	1,698	4,147	14,896
Import MT	-	2,034	10,169	330	2,181	6	66

Source: FAOStat

The majority of ginners interviewed were of the view that there are sufficient markets (83 per cent) for their cottonseed by-products. In particular, some ginners belong to vertically integrated firms that produce oil and animal feed from their ginned cottonseed, making marketing very easy for them. Meanwhile, marketing was problematic for fewer than 15 per cent of respondents, typically those ginners located in remote rural areas where poor transport negatively impacts on their marketing opportunities. Owing to this structure of marketing, occasional scarcities exist in the supply of cottonseed. This was echoed by 65 per cent of the ginners, who pointed out that supply of cottonseed is inadequate on the market and fairly seasonal, leaving them with no supply during a significant portion of the year. Overall, significant amounts of cottonseed can be consumed by the local market. Any further investments in the growing of cotton will therefore have a ready market for cottonseed.

3.3.2. Impediments

According to the ginners, in a typical season, they operate below their established capacity. Evidence from CDO corroborates this finding, especially when inoperative firms are considered. Nevertheless, there are factors responsible for low capacity utilization, including: inadequate supply of seed cotton; inadequate working capital; load shedding and power shortages for several days; breakdown of machines, which are expensive to repair; and lack of technical capacity among local technicians, as illustrated in Table 3. The impediments are ranked, with 1 representing the most pressing impediments and 5 the least. The institutional issues voiced emanate from the inability of the respondents to reconcile CDO's mandate with that of the divested Lint Marketing Board (LMB). The perception is that CDO: a) does not provide adequate extension staff; b) is responsible for delays in the delivery of inputs to farmers; c) does not work with other government structures to support cotton growing; and d) does not adequately control cotton quality standards. It should be noted that the new cotton governance structure under CDO is of a liberal nature with operationally different mandates from those of the former LMB. On the side of taxation, ginners expressed the problem of "many taxes" paid. The deductions UGX 200 per kilogram, a contribution to the CDF, CESS, the 2 per cent export tax on lint cotton, and corporate tax among others raised many concerns.

Table 3: Key impediment for Ginners

Rank	Institutional issues (%)	Taxation (%)	Inadequate Infrastructure (%)	Lack of productive capacity (%)	Business environment (%)
1	28	26	30	14	14
2	22	26	26	10	14
3	11	9	30	18	33
4	17	26	13	27	10
5	22	13	-	30	29
Total	100	100	100	100	100

Source: Survey data

Ginners mentioned inadequate technical capacity among local technicians to man the ginning facilities as a key business constraint, resulting in Indian facility owners importing technicians from India, at considerable cost. However, an interaction with Busitema University has a different view on this. They argue that the University has trained enough technicians to run all the ginneries in the country.⁸ However, the compensation for their graduates is the problem. When they are recruited to work for ginners, they are given a non-commensurate and non-attractive pay which makes them look for alternative jobs. This is made worse by the fact that ginning takes place in approximately 4 months a year followed by redundancy on the side of the equipment. Although this issue remains contentious, what is true is that the university has a full ginnery and has designed courses to train students to run and repair them. The second problem is the lack of spare parts in the local market. In the event of a breakdown during the peak ginning period, chances are that it will take a while before the equipment is replaced, leading to losses due to lack of operation. Most of the ginners had workshops to service and repair equipment, however the majority of them are in poor state and lack basic maintenance equipment.

Regarding electricity, the main problem is load shedding and erratic power supply, which interrupts operations. Most of the ginners had procured fuel generators to overcome this problem, although this is costly. According to Umeme, the electricity distributor, Uganda has enough electric power, however, much of the distribution infrastructure needs replacement as it is old and often breaks down, cutting off power.

The ginners voiced a number of issues with regard to the business environment. The biggest challenge is the lack of affordable credit for operations and expansion. The commercial interest rates in banks are extremely high which deters long-term investments. Although the bank rate has been significantly reduced by the Central Bank in the last three years, from 19 to 10 per cent, the interest rates remain high between 19 and 23 per cent. Buying seed cotton requires a lot of capital, let alone procuring expensive equipment and spare parts.

3.4. Milling level and oil extraction

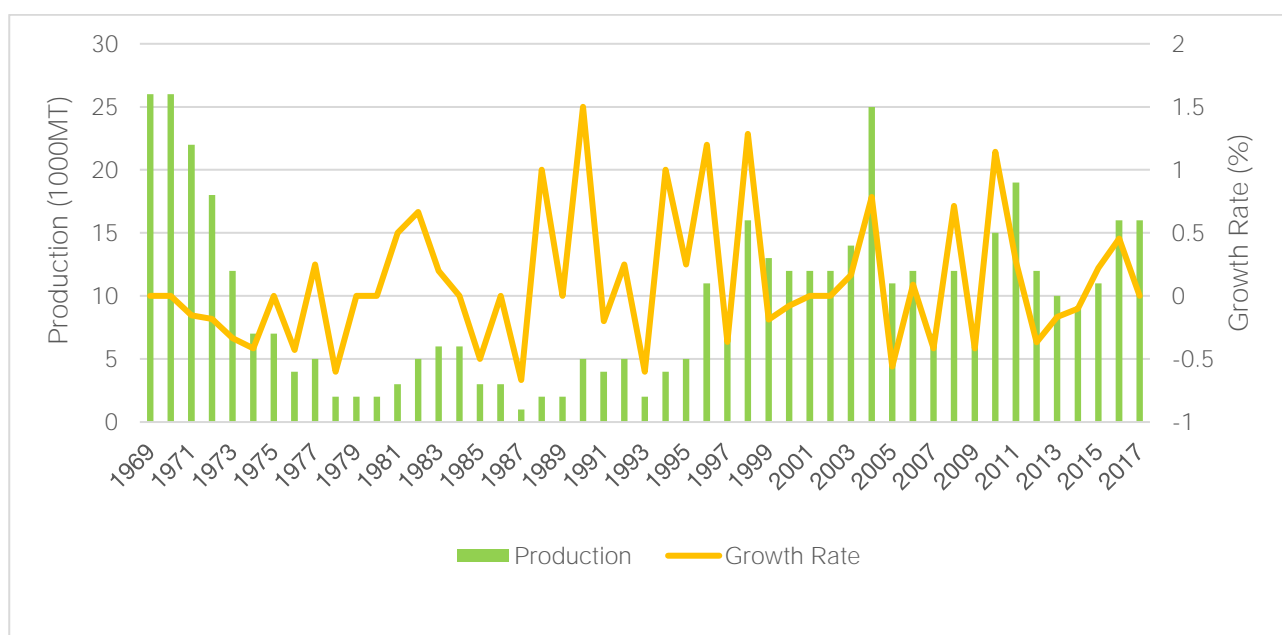
The ginning process separates the seed cotton into lint (42 per cent) and fuzzy cottonseed (53 per cent). Oil millers then process the fuzzy seed into two main products: cottonseed oil and cake. Cottonseed oil has an unpleasant smell, compared to other oilseeds, like sunflower or palm oil. Besides, it has a dark colour and, if not bleached, would need pre-heating to moderate the colour. As such, cottonseed millers undertake refining, bleaching and deodorizing, before it can be sold to

⁸ The University offers a BSc. in Polymer, Textile Engineering and Industrial Engineering and a Diploma in Ginning Engineering

the food industry in bulk or as a finished consumer good. This is also common practice for the commercial production of any other vegetable cooking oils, like palm and sunflower oil (BSPACE, 2014). Currently there are about nine privately owned cottonseed crushing and oil extraction facilities, located in various parts of the country,⁹ operating at an average capacity utilization rate of 33 per cent. As demonstrated in Figure 9, cottonseed oil production and its growth rate have fluctuated over the years, even during the 1970s, when cotton production fell. Much as production of cottonseed oil has never reached the 1969 peak of 26,000 MT, it increased from 2,000 MT in 1987 to 16,000 MT in 2010.

There is high demand for edible oil in Uganda, standing at 120,000 MT against a production capacity of 40,000 MT, leaving a deficit of 80,000 MT annually. Figure 10 shows Uganda’s trade deficit in edible oil from 2001 to 2016. The trends suggest that cottonseed oil has a potential market in the country and can contribute to narrowing or eliminating the trade deficit in edible oils. The World Health Organization (WHO) recommends per capita consumption of edible oil of 19.21 kg per person per annum, whereas consumption in Uganda was at about 3.2 kg per person in 2016, or 16 per cent of the recommendation. Uganda’s high and rising edible oil trade deficits are a strong indicator of unmet demand in the domestic market, representing an opportunity for investment

Figure 9: Cottonseed oil production in Uganda

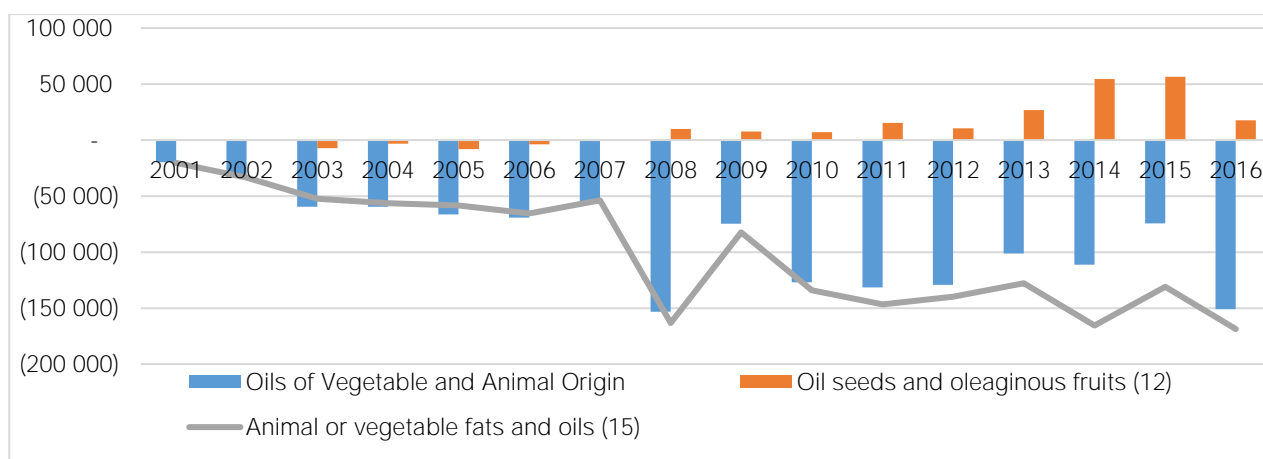


Source: United States Department of Agriculture

The demand for cottonseed oil is high partly due to its limited supply, related to low production volume of seed cotton and, thus, cottonseed. Nevertheless, cottonseed oil is relatively cheaper than other edible oils like sunflower and palm oil. Figure 10 illustrate the export and import trends, which underline that almost all cottonseed oil produced in Uganda is consumed domestically and that demand for edible oils, in general, far outstrips domestic production (Baffes, 2010). Oil millers buy cottonseed from the ginneries, while some ginneries also operate their own oil milling plant. Cottonseed oil is mainly consumed by bakeries and confectionaries, because its thickness is suitable for baking.

⁹ Cotton in Uganda, an International Trade Centre (ITC) brochure, available at http://www.coton-acp.org/sites/default/files/documents/downloads/final_uganda_brochure_october_2011.pdf

Figure 10: Uganda's edible oil trade balance (US\$ '000)



Source: ITC calculations based on United Nations COMTRADE and ITC statistics

3.4.1. Impediments

Although there is high demand for cottonseed oil, increasing production faces many constraints. These include:

1. Limited supply of the raw material, as described earlier.
2. High interest rates and prohibitive terms for credit, as described earlier.
3. **Poor technology and limited technical capacity:** oil millers mainly use the old expeller pressing technology, rather than the more efficient, but much more costly solvent-based technology for extracting oil. In addition, there is a lack of skills both to run and repair the machinery. This is coupled with the fact that most of the expelling machinery, as with Uganda's ginning equipment, is imported from Indian manufacturers (Baffes, 2010), meaning that breakdowns are costly and take a long time to fix, since parts have to be imported from India and China.
4. **High operating costs due to poor infrastructure:** This comes in form of high cost of power, power outages and poor roads. Unstable power supply forces some millers to operate with generators, which further increases their operating costs.
5. **Competition from other edible oils:** Firms engaged in the production of cottonseed oil do not have established brand names, unlike large edible oil producers such as Mukwano Industries and BIDCO, which produce cooking oil from other oilseeds, mainly sunflower and palm. Moreover, the quality of cottonseed oil is still low compared to other edible oils on the market. This renders cottonseed oil less competitive and therefore relegated to being used mostly by bakeries.

4. Analysis of selected cotton by-products

4.1. Cottonseed cake

Cottonseed cake is the other main product after oil expressers extract oil from cottonseed. With only an estimated 25,000 – 45,000 MT of cottonseed produced annually between 2015 to 2017, it implies that there is limited internal production of the by-product to feed animals. It is estimated that if 50 per cent of the total number of livestock in Uganda are fed on formula feeds, the demand

would exceed 7,000,000 MT (note that cottonseed cake is just one of the many ingredients). Owing to data limitations and the proliferated nature of cottonseed cake production in Uganda,¹⁰ it is difficult to estimate the quantities produced. Animal feeds are in high demand, but there is insufficient local production. In addition, owing to weak and in some instances non-existent standards enforcement, poor quality cake products are common.

The main producers of animal feeds in Uganda include Ugachick, Biyinzika, Nuvita and Kagodo. They produce feeds for the poultry, dairy, piggery and rodents segments, as well as fish feeds categorized as mash, pellets and floating feeds. Each company has feed factories with full production capacity of over 5,000 MT per month. However, Biyizika was not using cottonseed cake in its animal feeds mixture, preferring sunflower instead. This implies that sunflower and cotton are the main sources for making animal feeds. Whereas the United Republic of Tanzania is the main source of animal feeds imported into Uganda, the leading destination for Uganda's animal feeds is Kenya, followed by Rwanda and South Sudan.

Table 4 illustrates that export value of animal feeds increased from less than US\$ 0.5 million in 2007 to US\$ 3.6 million in 2017. At the same time, imports grew at a much lower rate, underpinning the fact that Uganda is net exporter of animal feeds. Uganda leverages its heavy cultivation of maize, a major ingredient in animal feeds. Overall, the value of exports is higher and has grown faster than imports. In terms of volume, Uganda is increasing its imports at a very high rate, signalling opportunities for more investment to supply the local market.

Table 4: Export and imports of animal feeds

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Exports (US\$)	313	222	438	1,019	2,520	5,060	4,325	2,096	3,608	1,716
Imports (US\$)	595	205	228	402	525	513	1,358	1,214	620	812
Exports MT	5,349	2,620	8,805	3,516	5,820	18,900	22,507	6,110	12,025	4,633
Imports MT	4,856	7,094	7,388	12,595	16,874	15,564	19,698	14,880	7,478	8,963

Source: ITC calculations based on United Nations COMTRADE and ITC statistics

Currently, Uganda has an estimated population of 37 million (UBoS, 2017) people, growing at an annual rate of 3.2 per cent. The country is increasing its demand for animal feeds because of the increased demand for animal and poultry products, e.g. milk, meat, chicken and eggs. This is reflected in the country's growing population of livestock. As demonstrated in Table 5, in 2016 the total livestock population was estimated at 14.3 million cattle, 46.2 million chickens and, 15.7 million goats, excluding pigs and sheep. Among these populations, the share of exotic species remains small, but is growing steadily. This represents an opportunity for animal feed producers, as exotic species are predominantly pen-fed.

¹⁰ There is a very large number of producers with extremely small output capacities spread in urban and peri-urban centres.

Table 5: Estimated Cattle and Poultry Population ('000s), by breed, 2012 - 2016

	<u>Cattle</u>		<u>Poultry</u>		<u>Goats</u>	
	Indigenous	Exotic	Indigenous	Exotic	Indigenous	Exotic
2008	10,679	730	32,835	1,536	12,288	162
2012	11,979	861	36,955	5,176	13,830	182
2013	12,339	887	38,064	5,332	14,245	188
2014	12,709	914	39,206	5,492	13,829	182
2015	13,090	941	40,382	5,657	15,113	199
2016	13,377	991	40,597	5,694	15,521	204

Source: UBoS 2017 Statistical Abstract

On average about 33 per cent of dairy farmers use compounded dairy concentrate feeds, while nearly 56 per cent of households, use feed ingredients such as maize bran and rice bran as straights (EADD, 2010). The annual production of compounded feeds by the commercial feed millers is estimated at about 75,000 MT,¹¹ with small scale mixers producing 40,000 MT (Graffham et al. 2003). Liberalization of the feed market has enabled many small processors to penetrate the market to supply livestock farmers. However, this has also raised the challenge of controlling standards, given that there is no enforcement of regulations. Nonetheless, the potential in this industry is immense, to the extent that even tripling the investment in animal feeds may not match the current feed consumption of the livestock population.

4.2. Hulls or husks

Cottonseed hulls are the outer coverings of the seed that can be put to several economic uses. They are a by-product of the de-hulling, a necessary procedure before oil extraction. Specifically, after removing linters from the fuzzy cottonseed, the hulls are separated from the kernel by screening. Cottonseed hulls have high fibre content and are primarily used to feed ruminants. In Central Uganda, Ekiryia Atabala General Merchandise, a stockfeed manufacturer was using hulls in the processing of animal stockfeed to boost the fibre content. They are mixed with cottonseed cake with the intention to create a higher density product that is easier to transport and handle. According to the stockfeed manufacturers interviewed, hulls are roughage used to add bulk to diets rich in protein and energy, to reduce digestive upsets in ruminants. Due to an absence of data, it was impossible to establish the volume of hulls that are used within the country to make stockfeed.

Another economic use of cottonseed hulls is as substrate for mushroom cultivation, after which the used substrate can be fed to livestock. Mushrooms are a rich source of protein, minerals and vitamins and they are increasingly being grown in urban areas. Hotels and restaurants require steady supplies of quality mushrooms. A kilogram of fresh mushrooms can fetch between UGX 2,500 to 3,500, while a kilogram of dried mushrooms costs about UGX 3,000. Makerere University has a mushroom training centre, funded by Agricultural Technology Transfer program together with other partners. The mushroom training facility trains students and groups of farmers on mushroom cultivation. The facility is a laboratory for carrying out trials on substrates that can be used for mushroom growing. The facility experimented wood shavings as a substrate, but this failed

¹¹ The constituents include the other ingredients like bran and not just the cottonseed raw materials

because they compacted over time, leading to poor mushroom yields. The recommended substrate is cotton husks because farmers can harvest for over a period of three to five months.

Challenges of using cotton husks as a substrate include: low availability of cotton husks because many industries use them as fuel for boilers; poor quality of husks due to de-husking techniques, leading to rotting and lack of standards in the production of spawn. To address some of these challenges, existing standards should be enforced to ensure quality seeds are produced during ginning. Furthermore, the number of training centres for mushroom growing should be increased to promote mushroom growing in Uganda, hence increasing the demand for cotton husks. Although respondents alluded to other industrial uses of cotton hulls, like plastic manufacture, oil drilling (as a mud additive) and furfural production (as a solvent in plastic and synthetic rubber production and in petroleum refining), none of these was found in Uganda. But their use can be explored.

There are no compiled statistics on the volume of cottonseed hulls produced in Uganda. However, using Trade Map international statistics, it is suggested that Uganda has on average increased the amounts exported. The value of exports increased from just US\$ 111,000 in 2007 to US\$ 2.3 million in 2014 (see Table 6).

Table 6: Exports of Cottonseed hulls in value and quantities

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Value (US\$ '000)	111	224	120	301	358	750	736	2,345	309	2,173
Quantities (MT)	2,114	2,819	612	5,138	1,415	2,331	2,968	13,758	1,269	5,665

Source: ITC calculations based on United Nations COMTRADE and ITC statistics

Although they declined in 2015, exports picked up in the following year, suggesting a general trend of growth. Similarly, the volume of exports grew from 2,114 MT in 2007 to 5,665 MT in 2016. The results suggest that there is potential to export more cottonseed hulls. The main export destinations include Kenya, Rwanda, India, South Africa, United Arab Emirates, the United Republic of Tanzania and Oman.

4.3. Linters

Cotton linters are fine, very short fibres that remain on the cottonseed after ginning. They are curly fibres typically less than 3 mm long and are removed before pressing the seeds to extract oil. There is a range of products produced from linters which include: security paper; currency paper; and as a raw material in the manufacture of cellulose plastics, commonly used for medical supplies such as bandages, cotton buds, cotton balls and x-rays (Graffham et al, 2003). CDO installed a handful of delinting machines to perform this function but due to technology limitations, the quality remains poor and cannot compete in the export market. Besides, it is unlikely that there are sufficient volumes of linters to achieve economies of scale, given the low quantities of seed cotton produced. This by-product potential should be explored further owing to its high economic value especially addressing the technology challenges.

4.4. Surgical cotton wool

Although absorbent cotton/surgical cotton may not be classified as a cotton by-product, field experience revealed that actually it is partly a by-product. The two main buyers of absorbent cotton are National Medical Store (NMS) and Joint Medical Store (JMS) and the rest is supplied to clinics, pharmaceutical shops and beauty parlours. Note that NMS and JMS, together, also import over

124 MT of absorbent cotton per year. Uganda is a net importer of cotton wool and related products, although domestic production is growing due to the increase in the number of cotton wool processing plants. Beyond being used in health care facilities like hospitals, cotton wool is increasingly being used in cosmetic care as ear cleaners, nail cleaners and face cleaners, as well as for baby care. The processing of cotton wool and related products in Uganda has great potential given the high demand. The value chain is yet to expand to more sophisticated products like sanitary pads and diapers, among others. The management of Mutuma Commercial Agencies, a surgical cotton producer, was at the time of data collection exploring possibilities of accessing credit to expand their activities to produce sanitary pads and diapers.

Despite the increase in the number of cotton wool processing plants, the sector faces several challenges. Most of the processors interviewed during the survey were operating far below their installed capacities, at an average of about 33 per cent. Despite the general challenges faced by the entire manufacturing sector in Uganda, operating below installed capacity is to a large extent due to the unique characteristics of the cotton sector in Uganda. Cotton being a seasonal crop, implies that processors have a relatively short period of approximately four months to purchase all the material needed for the entire year's production. This arrangement poses several limitations on the processors. First, they require sufficient capital to purchase all the lint needed for the entire production cycle, based only on the hope that demand for the finished product will transpire. Unfortunately, most processors lack the funds to buy enough raw material to run the entire year. Second, buying in bulk imposes extra storage costs on the processors. Given that cotton is susceptible to catching fire, many processors tend to fear taking the risk.

In addition to the sector specific constraints, cotton wool production faces stiff competition from imported cotton products, which are, in some cases, of superior quality. Despite differences in quality, growth of this node of the value chain is further hampered by tax policies, as imported cotton wool enjoys duty exemptions.

4.5. Cotton oil soap stock and other products

Crude cottonseed oil is refined to produce edible oil and fatty matter, the latter used to make soap stock for production of soap, bakery fat for production of bread, and margarine. Soap making in Uganda largely uses other soft oils, rather than cotton soap stock. This is because cotton soap stock needs to be blended with other oils in order to gain instead of yielding a soft consistency, moreover its unpleasant smell is difficult to remove. According to soap producers, overcoming these limitations increases the unit cost of producing soap using cotton soap stock. Instead they opt for the use of cost effective oils, like palm. There was no effort to invest in improving technologies to benefit from cotton soap stock by soap producers partly also because the small quantities of available cotton soap stock do not warrant the investment. Mukwano Industries, the main producer of soap, produces sunflower oil, from which it derives soap stock, as does Nile Agro Industries. Small-scale soap producers rely mainly on imported ingredients, given that they do not have the technology to overcome the limitations of cotton soap stock. The biotechnology laboratory at UIRI trains interested individuals on soap manufacturing to start businesses in soap making in their backyards on a small scale. They train individuals on the use of cottonseed cake to make soap but do not use it during their practical lessons. The people that are trained also do not use it in soap making because cottonseed soap stock is scarce on the market as a raw material.

4.6. Manure

During the production of oil, there are impurities mixed in water that are discharged as effluents. Nile Agro Industries has an innovative way of dealing with these effluents, by generating manure that is used as fertilizers by an affiliated sugar company. During the purification, the waste water is

treated through a multi-grade filter chamber and finally through the activated carbon filter, before discharge to the national sewer line. During these various processes, water floats on top and sludge remains at the bottom. Water is drained off and is subjected to chemicals and bacteria in the plant to remove the remaining organic materials, yielding clean water. Clean water is then directed to the National Water and Sewage Corporation for distribution to consumers. Sludge is dried in beds and then used as a fertilizer and can also be used for power generation.

5. Strengths, weaknesses, opportunities and threats (SWOT) analysis

In the SWOT analysis of cotton by-products industry in Uganda, we examine the production and marketing dynamics of the sector. As presented in Table 7, the major strengths of the sector are the ready market for seed cotton and the many by-products produced locally. The major weaknesses range from: competition among ginners which undermines quality enforcement, irregular supply of seeds, seed cotton contamination, inadequate trained personnel to transportation challenges, among others. The main opportunities include value addition, availability of markets both domestically and externally, presidential directive to the Prisons Department to grow cotton and the elimination of export subsidies which is expected to translate into better prices for farmers. Finally, the main threats for the cotton by-products value chain development include: competition from other crops; high energy costs which threatens processors profitability hence undermining prices; importation of palm oil which outcompetes the local edible oil price vitality; and the perceived numerous taxes, among others.

Table 7: SWOT analysis for the market of the cottonseed shows that there is potential

Strengths	Opportunities
<ul style="list-style-type: none"> • Several by-products are produced locally, increasing the income of value chain actors. • The price for cotton has improved over the last few years motivating farmers to continue production and increase their acreages. • Farmers are now organized, motivated and mobilized to supply seed cotton by the UCGEA, together with CDO. • The CDF, agreed to by ginners and supported by CDO has enabled farmers to acquire subsidized inputs and extension support easily. • The existence and preparedness of Busitema University who train technicians to man the equipment for the different by-products actors. • The existence of necessary research infrastructure (NARO & NaSSARI) and scientists to develop the needed cotton varieties. • Under the leadership of CDO, the sector has associations of value chain actors supporting growth and development. 	<ul style="list-style-type: none"> • Many opportunities to add value on the by-products, including: cotton stalks, linters, husks, surgical cotton, extraction of gossypol and substrates for mushroom growing. • Availability of both domestic and export markets. Whereas domestic and regional markets are attractive for the by-products, the export market is particularly attractive for lint. • Presidential directive to Uganda Prisons Service to grow cotton on prison land will increase seed cotton, and thus raw material for developing the cotton by-products value chain. • The 2011 decision at the tenth WTO ministerial conference in Nairobi, eliminated export subsidies on cotton and provided for technical assistance, which is expected to increase global cotton prices. • There is unutilized capacity at different by-products actors' levels. This implies that there is sufficient capacity to absorb any increase in seed cotton production. • Potential for the expansion of acreage under cotton in zones that have ideal cotton growing conditions, e.g. Northern Uganda.
Weaknesses	Threats

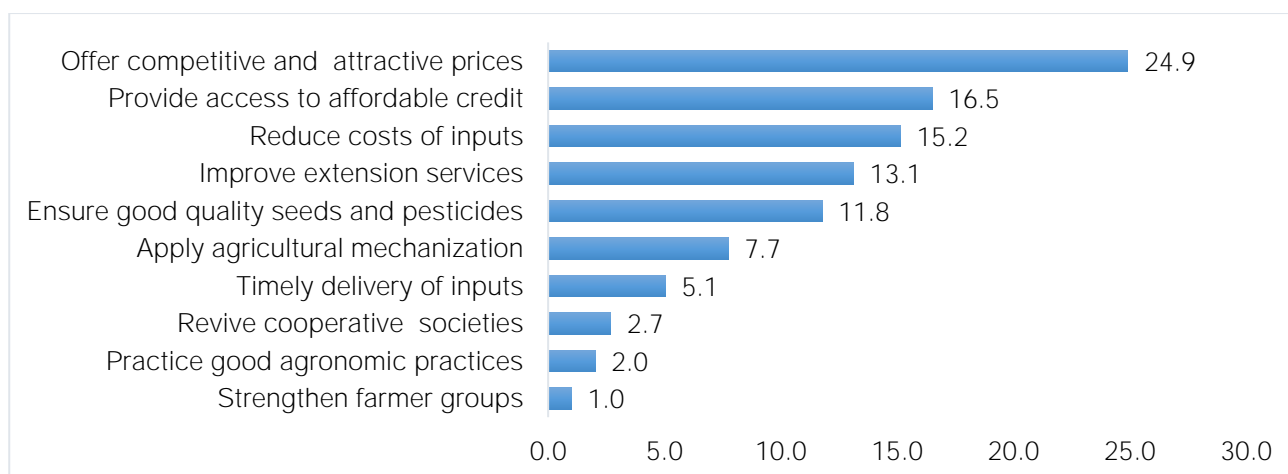
<ul style="list-style-type: none"> • Competition among ginners sometimes leads to compromise of standards of seed cotton. This undermines quality enforcement along the entire value chain. • Irregular supply of seed cotton which deprives processors of the required raw materials. • Contamination and poor handling of seed cotton. • Inadequate local trained technicians to run facilities, which delays and increases the cost of production when technicians must be sourced from either the capital or even abroad to fix the machines in case of a breakdown. • Inadequate transport system and facilities to collect seed cotton. This exposes the seed cotton to contamination, while also affecting the prices received by farmers. • Poor storage facilities which undermines bulking and therefore bargaining for better prices by farmers. • Inadequate technology to exploit by-product (e.g. stalks, oil and linters). • The inability of existing extension workers to reach all the farmers on a frequent basis. Some farmers also fail to uptake the knowledge imparted to them during extension. 	<ul style="list-style-type: none"> • Competition from other more lucrative crops like rice, maize, and sugar cane, among others, discourages farmers from production as well as increasing on their acreage. • Irregular and erratic power supply, which increases the costs of production, since ginners and processors resort to generators. Erratic power supply also exposes the machines to breakdowns. High energy costs contribute to lower prices paid to farmers. • Palm oil importation that outcompetes local edible oils threatens growth of the cotton by-products value chain. • Uganda being a smaller player is a price taker and so does not have much policy space to ensure better prices for the farmers.
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Source: Literature review and fieldwork

6. Respondents' suggested improvements

Various interventions by value chain actors have been suggested for improving cotton production and productivity in Uganda. This would boost the entire sector, allowing for full capacity utilization of ginneries and surgical cotton manufacturers, oil mills and animal feeds manufacturers, among others. According to the survey results, 25 per cent of the farmers think offering competitive and attractive prices to producers is the single biggest factor that can motivate farmers to increase their cotton production and productivity (see Figure 11). Seventeen per cent of farmers were of the view that provision of and access to affordable credit would help them increase their production and productivity, while 15 per cent suggested a reduction in the costs of inputs would help. Some 13.1 per cent of farmers suggested improving extension services to boost production and productivity. Other suggestions included: ensuring good quality seeds and pesticides; application of agricultural mechanization; timely delivery of inputs; revival of cooperatives; practice of good agronomic practices; and strengthening of farmer groups to increase production and productivity.

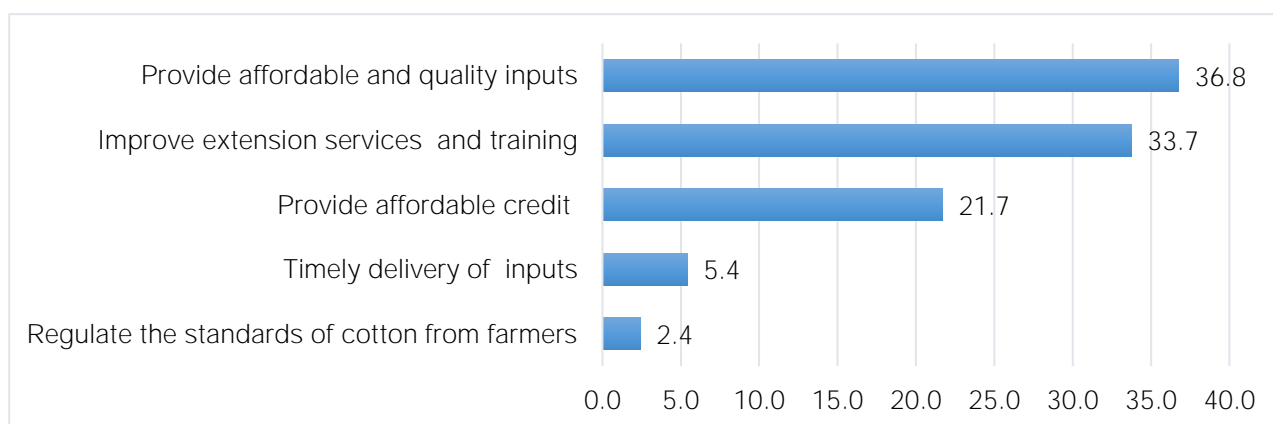
Figure 11: Respondent farmers' suggestions for improving cotton production and productivity



Source: Survey data

Improving the quality of seed cotton produced is instrumental in developing the cotton by-products industry. This is because the level of quality at the farm level impacts the quality of all derived products and by-products. As illustrated in Figure 12, many farmers (37 per cent) suggest that the provision of affordable and good quality inputs would help them improve the quality of cotton.

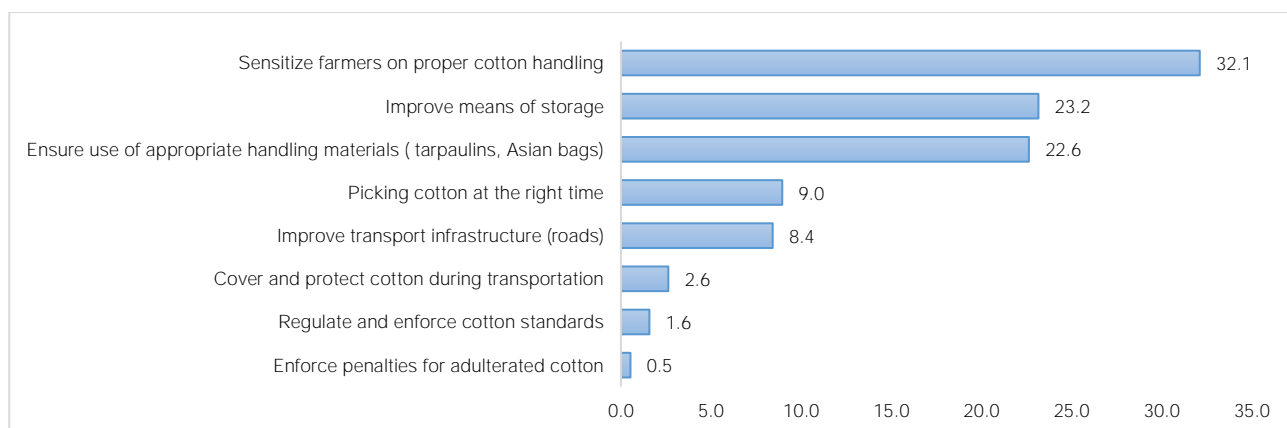
Figure 12: Farmers' suggestions to improve the quality of cotton



Source: Survey data

This should be accompanied by a well facilitated and improved extension services system (34 per cent). Given that the quality of cotton is affected by agronomic practices that require working capital, 22 per cent identified provision of affordable credit as the most important incentive. The farmers also recommended the timely delivery of inputs and enforcement of cotton standards. Contamination of cotton has been identified as one of the major issues undermining the development of cotton products and by-products in Uganda. All the value chain actors believe addressing contamination should start at the farm level, where most contamination occurs. Farmers were interviewed on what should be done to reduce or eliminate contamination of cotton and, as illustrated in Figure 13, the most common suggestion (32 per cent) was to sensitize farmers on proper cotton handling. Improvement of storage comes next, with 23.2 per cent, followed by appropriate handling materials, with 22.6 per cent.

Figure 13: Farmers' suggestions to reduce or eliminate contamination of cotton

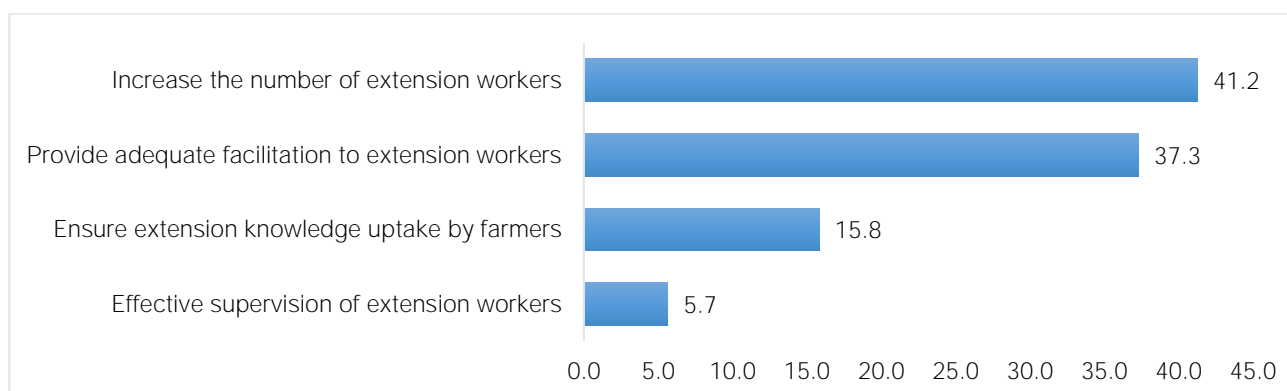


Source: Survey data

At the transportation stage, 8.4 per cent of farmers said there is need to improve transportation and road infrastructure, while 2.6 per cent identified covering and protecting cotton during transportation to both collection points and ginneries. The need to regulate and enforce cotton standards as well as enforce penalties for adulteration of cotton was also identified by farmers. Competition among the ginneries has led to limited focus on the quality of cotton purchased, as what is rejected in a particular ginnery can easily be bought by a rival ginnery, especially if they are nearby. This requires the cooperation of and compliance by ginneries themselves, as already pointed out.

Improving extension services is also an important factor in increasing cotton production and productivity. Figure 14 shows the suggestions made by farmers on how to improve extension services. While 41 per cent want increase in the number of extension workers, 37 per cent want provision of adequate facilitation to extension workers. A lesser proportion of 16 per cent identified the need to ensure extension knowledge uptake by farmers and 6 per cent called for effective supervision of extension workers. The issue of extension services is very important for developing the cotton sector because it is key to increasing production and productivity at farm level, which has a ripple effect on production and productivity throughout the entire value chain. CDO therefore must do more in terms of recruiting more extension workers, as well as facilitating and supervising them to increase coverage. However, farmers also must play their role in terms of uptake of extension services.

Figure 14: Farmers' suggestions to improve the extension system



Source: Survey data

At the processing and manufacturing node of the value chain, the actors called for training of workforce in their respective manufacturing and processing plants, not only for operational roles,

but also for repair and maintenance work. The skills gap hinders productivity in cases of machine breakdown, which slows down production as some ginneries and oil mills must wait for technicians from either Kampala or even abroad to undertake repairs. To further improve skills, experts from abroad, especially India, should be sourced to train private industries on how to increase productivity. The training institutions like Busitema University should also be integrated in the cotton ginning system to overcome some of these challenges. In this case, Busitema University should integrate ginners to coordinate their training programmes with a view of them making use of the training facilities there, in addition to on-the-job training.

Introduction of energy-saving and efficient technologies was identified by value chain actors as instrumental for developing cotton by-products industry. This would facilitate the cotton by-products industry, not only through reducing the costs of production, but also to enable the industries to be more effective. A number of ginneries use old equipment which is susceptible to numerous breakdowns. Oil millers, on the other hand, need efficient technologies for refining and bleaching, which are not readily available. Introducing such technologies would make cottonseed cooking oil competitive with its substitutes like sunflower and palm oil.

Effective implementation of the Buy Uganda Build Uganda (BUBU) policy was highlighted by the cotton by-products value chain actors as critical for increasing domestic demand for cotton by-products. The policy, which seeks to promote public and private consumption of locally produced goods and services, would increase demand for products like uniforms for public workers and schools, which creates more demand for seed cotton – indirectly supporting greater economies of scale in cotton by-products industries – as well as direct demand for by-products such as cottonseed oil.

Uganda needs to take advantage of the regional markets to develop its cotton by-products industries. Processors and manufacturers see numerous market opportunities in the region, including for cooking oil, animal feeds and soap. For example, Kenya has benefited by exporting such products in the region. Uganda's strategic location would make the country more competitive to supply targeted products to countries like South Sudan, Rwanda and the Democratic Republic of Congo. The increased demand would translate into better prices received by farmers, who would in turn be motivated to produce more cotton.

Tax incentives to domestic industries would promote domestic producers to favourably compete with imported products. The cotton sector is perceived by value chain actors, especially ginners and processors, as having burdensome taxes. This reduces their profit margins, affecting the prices they offer to farmers and undermining needed investments in upgrading their capital equipment. A major complaint is that capital-rich foreign investors are often given tax incentives, while infant domestic industries are subject to taxation, putting them at a major competitive disadvantage. Tax incentives would also support the establishment of new factories to process the different cotton by-products.

Government needs to provide concessional loans and ensure competitive lending interest rates to encourage industries to borrow the needed capital. Investment in the cotton industry is capital-intensive and since most processing and refining machinery is not fabricated in Uganda, ginners, oil millers and refiners must import it at high cost. To develop the sector, cheaper financing mechanisms with longer repayment terms are needed for industries to import machinery and remain profitable.

There is need to improve packaging materials for the cotton by-products in Uganda to attract more consumers. In particular, cottonseed cooking oil is poorly packaged compared to competing products, like sunflower and palm oil from established companies Mukwano and BIDCO. Companies invest a lot in packaging because consumer tastes and preferences respond to a product's visual appeal. Cottonseed oil from companies interviewed is poorly packaged, which

renders them unattractive to consumers, even though they may be of similar quality to competing edible oils.

Government needs to support the development of local textile industry by checking the importation of second-hand clothes and inexpensive Chinese textile products. Uganda's textile industry collapsed under competition from cheap imports and this has hindered the development of the cotton sector, to the extent that almost all the lint produced by the ginneries is exported. A developed textile industry would increase demand for lint and seed cotton, indirectly contributing to more raw material being available to cotton by-products industries.

There is need to harmonise and enforce standards by the Uganda National Bureau of Standards (UNBS), so that people trust the quality of cotton by-products and demand more of them. Locally produced by-products like cottonseed oil are perceived to be of low quality, so are demanded mostly by bakers, but not retail consumers. UNBS needs to be brought on board to ensure quality assurance, as CDO is not mandated to undertake this role.

7. Conclusion and recommendations

This report attempts to build a deeper understanding of the development of cotton by-products in Uganda. It examines the production and marketing dynamics of cotton by-products, identifies the main impediments to the development of cotton by-products, and assesses the infrastructure and technology capabilities and challenges at the different nodes of the cotton value chain. It identifies the possible opportunities for developing the cotton by-products value chain, as well as strategies and incentives that can motivate cotton by-products actors to invest in the various nodes of the value chain.

Although farmers are responding to the call to increase cotton cultivation, especially with better prices as an incentive, seed cotton production is still far below the thresholds required to service the current ginning capacity. The ginneries are underutilized due to low production at farm level and they export almost all the lint they produce due to low demand in the domestic market.

Although CDO works closely with ginneries to provide extension services and inputs to farmers, which has produced near optimal outcomes, there is still room for improvement. It is particularly important to increase the supply and reach of extension services towards farmers and to continue to improve the cotton-specific technical expertise of extension officers.

As the sector regulator, CDO is mandated to ensure and enforce standards. While it sets best-practice standards, there is a weak point when it comes to enforcement. Owing to the limited CDO staff on the ground, due to insufficient funding, as well as the liberal environment among ginners, sometimes standards are compromised.

Given that some ginners complained of the current taxes and levies at the ginning level, claiming that these have the potential to impede the development of the cotton by-products, the stakeholders may have to revisit especially the CDF, with the view to raising awareness of the usefulness of this fund to the sector. The CDF is overseen by CDO, but is run and paid for by the ginners, who agree on, and adhere to, its mechanisms and funding. It has proven an effective model in Uganda's liberalized environment, removing damaging competition among ginners on input provision, thereby ensuring that farmers reliably receive the inputs they require to guarantee production. Any efforts to remove the CDF are likely to negatively impact the sector. Among ginners and other stakeholders, it is therefore necessary to promote the benefits for the CDF and distinguish its levies from a tax. Nevertheless, taxes on by-products may be reviewed to encourage and attract investments.

There is limited development of the cotton by-products value chain and yet a number of opportunities exist, for instance high domestic demand for vegetable oil, fuel for cooking (briquettes), particle boards, animal feeds, surgical cotton, and substrate for mushroom growing, among others. The value chains for the by-products are not well developed and are operating at suboptimal levels, characterized by poor and obsolete technology, weak institutional support, poor standards, weak regulation and a lack of competitiveness. Mention is made of the limitations of the existing technology to: refine cotton seed oil to a competitive level, extract and remove gossypol from the cotton cake, among others. The UIA's emphasis in the cotton subsector has been on lint, textile and apparel – the cotton-to-clothing value chain – but not on by-products. Without deliberate government support to develop some of the cotton by-products, their potential may not be realized. The role of UIA and UIRI becomes relevant and imperative given the small-scale nature of investments by SMEs in the country.

To develop the cotton by-products industry in Uganda, we recommend:

1. Increase cotton production at the farm level through improving and facilitating extension services, provision of quality inputs and affordable credit to farmers by the relevant stakeholders;
2. Increase in both public and private investments in the development of cotton by-products to harness their potential. Whereas public investment may take the form of building required infrastructure, institutional frameworks, research and development, the private sector will invest in the required plants, technology, and distribution networks;
3. Government to support the development of the local textile industry to increase the demand for seed cotton, which will in turn avail additional raw material for cotton by-products. The missing link in the chain is making of yarn, which will attract fabric manufacturing;
4. Ensure quality and adherence to standards from production through to transportation and processing of seed cotton. This requires greater cooperation amongst the ginneries, who are the critical link between farmers and other cotton by-products value chain players;
5. Review government taxes that have high chances of increasing the unit cost of production at both farm and ginnery level, as well as for other processors and manufacturers. This may entail tax holidays for prospective investors in cotton by-products. Moreover, create a level playing field for locally produced products, in relation to imported substitutes that enjoy duty exemptions;
6. Incentivize the investment and adoption of technologies to harness the opportunities in adding value to cotton by-products. These can be tax incentives or local content measures like BUBU;
7. Ensure the availability and affordability of electric power to reduce the unit cost of production;
8. Increase access to credit for working and investment capital among value chain stakeholders;
9. Conduct further studies on the feasibility of exploiting the identified by-products. This may entail working with stakeholders to establish the availability of raw materials and technology, lessons from elsewhere and the market for the by-products; and
10. Design training programmes to build the capacity of the technical workforce in their respective manufacturing and processing plants to effectively manage the equipment and undertake repairs and maintenance work, through coordination among ginners, CDO and training institutions.

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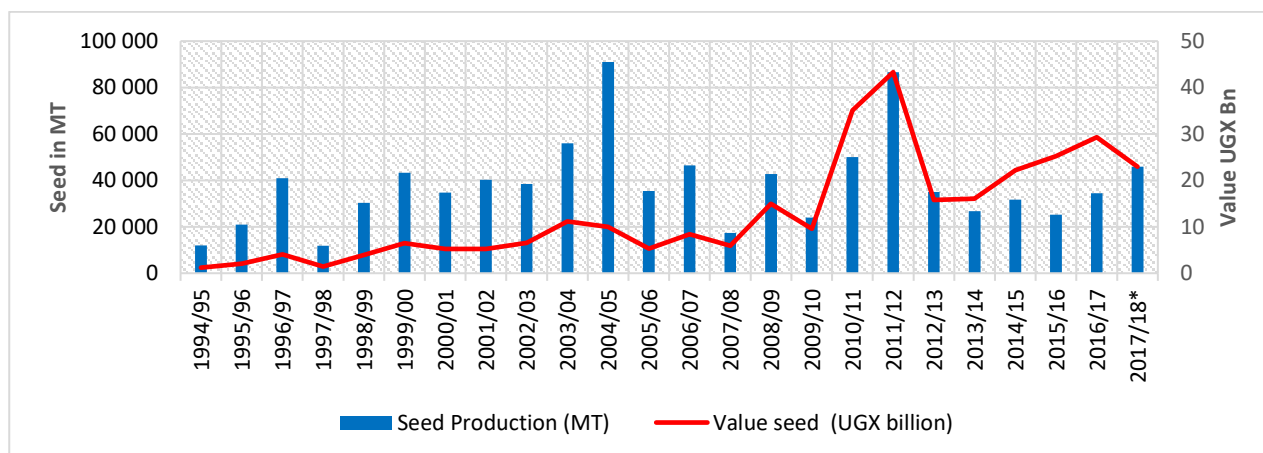
Annexes

Table A1: Profitability Analysis for cotton and main Competing crop enterprises (UGX)

Item	Cotton	Cassava	Groundnuts	Rice	Sesame	Sugar cane
Fertilizers	91,917	-	22,850	27,000	30,000	120,000
Pesticides	55,681	-	46,583	13,500	6,000	6,000
Herbicides	30,143	-	-	12,500	15,000	45,000
Spray pump	49,742	-	58,000	50,000	84,166	-
Physical inputs	49,618	21,000	-	8,000	50,388	-
Labour hired	221,201	76,140	208,000	384,333	63,888	152,500
Labour family	84,685	15,000	114,966	85,000	35,714	90,000
Transport	41,590	16,500	30,464	54,050	16,666	-
Total Cost	655,805	135,072	504,906	666,102	316,913	434,175
Yield in kgs	1,047	950	738	1,672	1,003	76
Farm gate price	1,578	1,242	2,964	2,128	2,055	1,500,350
Gross Income	1,652,114	1,179,900	2,187,432	3,558,016	2,061,165	2,535,000
Net Income	996,309	1,044,828	1,682,526	2,891,914	1,744,252	2,100,825

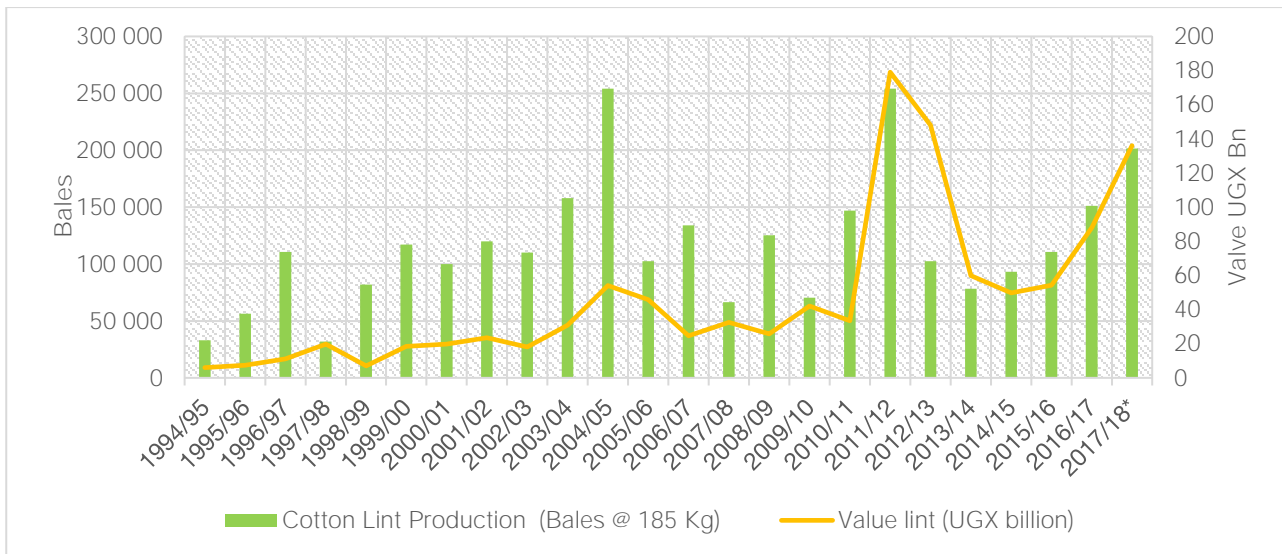
Source: Survey data

Figure A1: Trends in seed production and value



Source: CDO

Figure A2: Trends in lint production and value



Source: CDO