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COTTON AND ITS BY-PRODUCTS

in Zimbabwe

ANALYSIS OF COTTON BY-PRODUCTS SURVEY

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ANALYSIS OF COTTON BY-PRODUCTS SURVEY IN ZIMBABWE

by

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The survey was conducted, and this report written, by a national consultant, Dr. Gibson Chigumira, Executive Director of Zimbabwe Economic Policy Analysis & Research Unit (ZEPARU), Zimbabwe. The ZEPARU team assisted in carrying out the survey. The work was supervised by Ms. Yanchun Zhang, Chief, Commodity Policy Implementation and Outreach Section (CPIOS) with the contributions of Mr. Kris Terauds, Economic Affairs Officer, Special Unit on Commodities. UNECA and COMESA provided detailed reviews of the report.

The team is grateful to the different respondents, including farmers, who participated in the interviews.

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

AMA	Agricultural Marketing Authority
CGA	Cotton Ginners Association
COMESA	Common Market for Eastern and Southern Africa
COTTCO	Cotton Company of Zimbabwe
CMB	Cotton Marketing Board
GMOs	Genetically Modified Organisms
GAIN	Global Agricultural Information Network
SMA	Stockfeed Manufacturers Association
UNCTAD	United Nations Conference on Trade and Development
ZEPARU	Zimbabwe Economic Policy Analysis and Research Unit
ZFU	Zimbabwe Farmers' Union
ZFNU	Zimbabwe National Farmers' Union (ZNFU)
ZIMASSET	Zimbabwe Agenda for Sustainable Social Economic Transformation

EXECUTIVE SUMMARY

The executive summary focuses on some of the key issues emerging from this survey, details of which are provided in the text. In general, all stakeholders identified limited seed cotton production as the main constraint in the development of downstream activities in the cotton by-product value chain. Investment opportunities exist, for example in the processing of cotton stalks to produce kraft paper, for use in the manufacture of corrugated boxes. Local production of the kraft paper would reduce Zimbabwe's import bill for kraft paper, which averaged USD 2.2 million per year between 2012 and 2016. Thus, adding value to cotton stalks has the potential to generate comparable revenues for investors.

There are four main products that are being produced from cottonseed; cooking oil, cottonseed meal, linters, and hulls. In terms of the cottonseed value, one of the oil expressers in Zimbabwe estimates that the cottonseed meal would constitute the bulk, at approximately 44% of the total value of the seed, followed by cooking oil at about 18%, hulls (9%) and linters (7%). Low availability of cottonseed has generally resulted in preference to use alternatives such as soya beans, canola and sunflower by oil expressing companies. Furthermore, inadequate supply of cottonseed is adversely affecting the stockfeed industry, which has been experiencing shortages in the market as their demand for cottonseed cake at times goes unmet by the oil expressers. In this regard, the supply of cottonseeds in Zimbabwe currently falls short of demand, which would inevitably affect the viability of new investments in cotton by-products activities.

Cotton by-products are currently not suitable as an input into the manufacture of stockfeed for non-ruminants. The demand for cotton by-products by the stockfeed manufacturers is therefore limited by the dominance of poultry and other non-ruminants, which rely on soya by-products. Limited local demand for stockfeed for ruminants, at a time when export capacity is limited due to high production costs, is also induced by limited demand for beef and dairy products, as well as an abundance of pastures. An increase in regional demand for stockfeeds can foster growth in the local stockfeed industry and consequently the growth of the feedstocks. Cotton by-products are, however, significant determinants of the costs for the ruminant feed industry, even though they are not the main inputs.[2] Stockfeed manufacturers also noted that, while the focus could be on cottonseed cake/meal, the availability of vitamins, minerals and other additives, which are mainly imported, is the most critical issue that impedes cotton by-product value addition into stockfeed.

There is also potential in investing in cost-cutting technologies to enhance intake of cottonseed oil into the margarine production process, especially if there is a surplus supply of oil, after satisfying household and industrial demand. The possibility of using cotton by-products to produce soap is appreciated by the oil expressing firms. However, high purification costs have been identified as the main inhibitor to cost-effective production of soaps and detergents from cotton by-products. Thus, diversifying the portfolio of cotton by-products requires consideration of cost effectiveness; marketability and competition with substitutes.

They have been recent investments in upgrading cooking oil manufacturing plants with state-of-the-art equipment. There are thus no outstanding technological concerns for cooking oil expressing. The only key challenge is the adequate supply of feedstock. Some oil expressers are considering contract farming to guarantee supply, but side marketing is a deterring factor. Details on perceptions of the different stakeholders based on the key informant interviews and survey of a sample of farmers in all cotton growing areas are provided in the report.

[2]Maize and soya bean products are the main inputs

1. INTRODUCTION

1.1 Background

While the cotton-to-clothing value chain has been studied in detail, cotton by-products are often ignored, despite their potential to increase value for farmers, traders and processors are often left out. These cotton by-product value chains have thus largely remained underdeveloped, pointing at the need for an assessment of the opportunities and challenges of these value chains in Zimbabwe. The United Nations Conference on Trade and Development (UNCTAD), in partnership with the United Nations Economic Commission for Africa (ECA) and the Common Market for Eastern and Southern Africa (COMESA) are currently implementing a project that is intended to address challenges that are currently inhibiting the development of cotton by-products value chains in the COMESA region. The project, which is being implemented in four countries: Tanzania, Uganda, Zambia and Zimbabwe, is aimed at increasing the value added on cotton by-products with two specific objectives:

i) improve the capacity of cotton value chain stakeholders - including government officials, the private sector and farmers' associations to assess the market opportunities for cotton by-products;
ii) improve the capacity of policymakers in the 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 of the findings of the survey on the cotton by-products value chain for Zimbabwe was prepared in this context.

1.2 Objectives

The main objective of the survey was to interview a cross-section of actors in the cotton and cotton by-products value chain, to inform a value-chain analysis. Other specific objectives of the study include the following:

- To identify the main impediments to the development of cotton by-products;
- To understand the infrastructure, including technologies, available at each activity step of the value chain;
- To understand producers' demographic and income profiles, margins and cost drivers from cotton and cotton by-product activities;
- To understand the perceptions, mind-sets and views of each value chain actor about the development of cotton by-products.
- To understand the main motivation of the value chain actors' decision to invest or not in cotton by-products;
- To identify the incentives that would motivate farmers, ginners, spinners and other actors to develop cotton by-products.

1.3 Methodology

The survey was complemented by secondary data analysis, which included a review of background materials for the project and various reports on studies that have been done in Zimbabwe on the cotton industry as well as other country experiences. The background project documents provided an overview of the cotton and cotton by-product markets in the four countries as well as the COMESA Regional Strategy for Cotton-to-Clothing Value Chain.

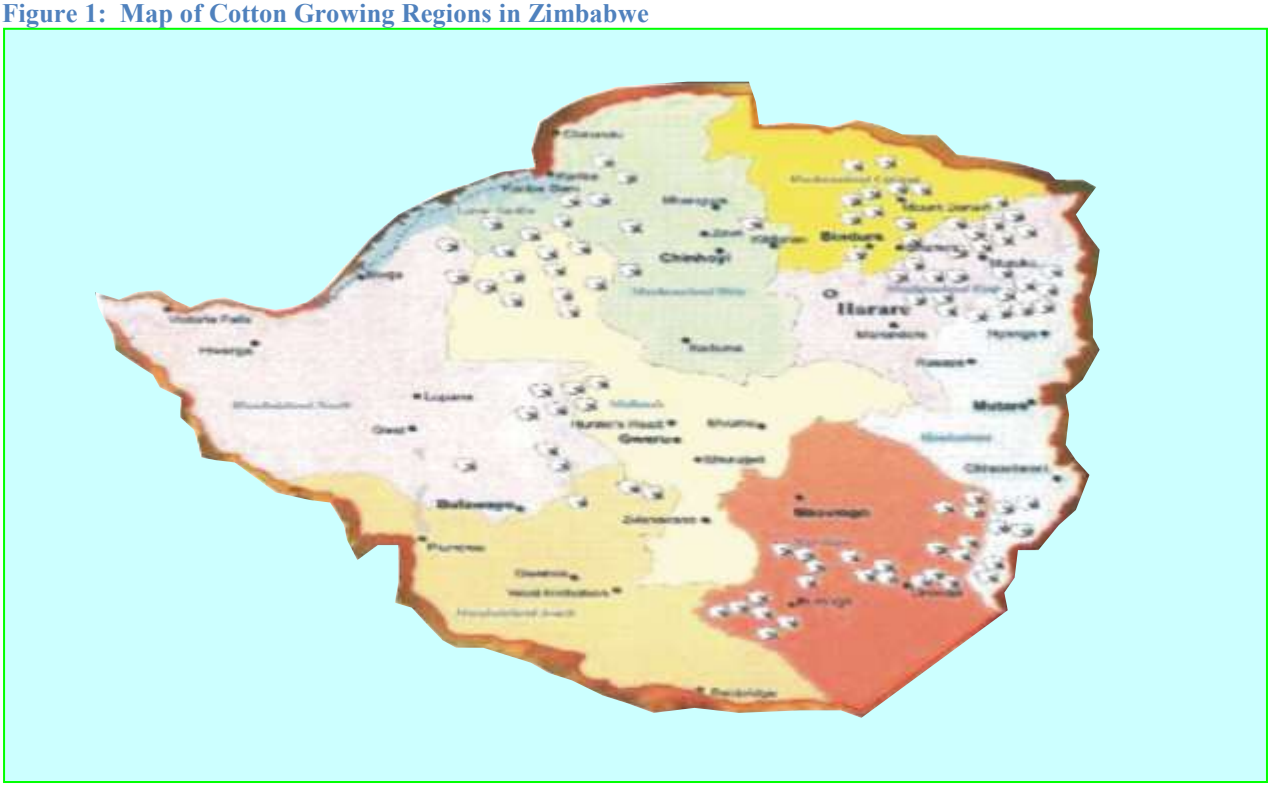
Primary data was collected through key informant interviews with the current and potential players in the cotton by-products value chain. Key informants who were interviewed to get their perspectives on cotton and cotton by-products included farmer associations: Zimbabwe Farmers' Union (ZFU) and the Zimbabwe National Farmers' Union (ZNFU); oil expressers and feedstock manufacturers. Farmers were also interviewed, as they are critical in the provision of seed cotton, as well as cotton stalks, an as-yet unutilised by-product.

Attempts were made to draw a sample of farmers large enough to allow for some level of national representation of cotton farmers. In the 2015/16 season, it is estimated that about 125,000 farmers produced cotton in Zimbabwe (Global Agriculture Information Network (GAIN), 2016). Based on a 95% confidence level and a confidence interval of 6, a representative sample was determined to be about 266 cotton farmers.[3]

The cotton growing areas in Zimbabwe can also be classified into three as follows (see Figure 1):

- The central and north-western parts of the country in Midlands, Mashonaland West and parts of Mashonaland Central provinces covering areas around Kadoma, Chegutu, Hurungwe, Gokwe North, Gokwe South, Sanyati, Patchway and Guruve;
- The northern parts of the country in the Mashonaland Central province covering areas around Muzarabani, Mahuwe, Mushumbi and Binga in the Zambezi Valley, Mt. Darwin and Centenary; and
- The south-eastern part of the country in the lowveld of the Manicaland and Masvingo provinces covering areas around Checheche, Triangle, Zaka, Mwenezi and Chiredzi.

Figure 1: Map of Cotton Growing Regions in Zimbabwe

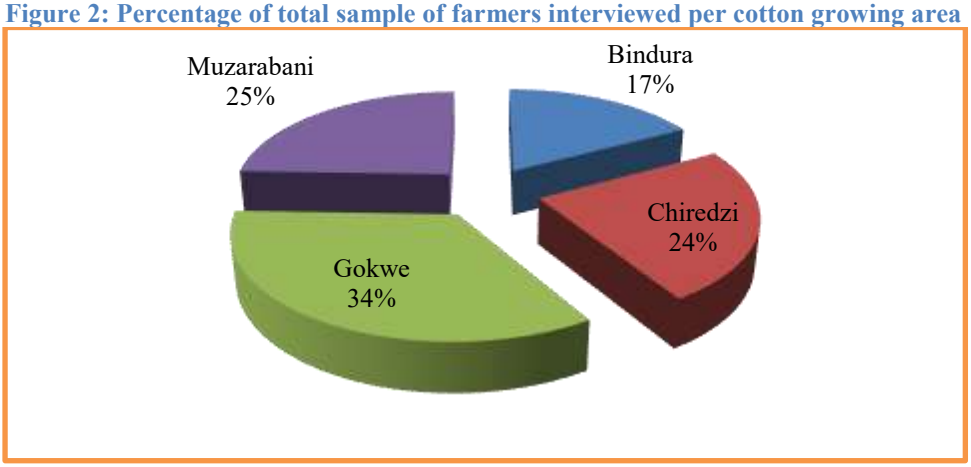


Source: ZEPARU, 2014

[3]Using a simple random sampling method determined using an inbuilt calculator by Creative Research Systems at website https://www.surveysystem.com/sscalc.htm#oneaccessed 17 July 2017

Although it is generally estimated that the Midland and Mashonaland West Provinces produce about 70% of the cotton in Zimbabwe (Buka, 2016), for the purpose of sampling, farmers across the three cotton growing areas were considered in order to capture some area specific issues. Gokwe (Midlands Province) was identified as the area where cotton growing activities are mostly centred. In addition, Muzarabani (Mashonaland Central) was also identified as an important district for sampling. Given that in Mashonaland Central province, the cotton growing areas are widely dispersed, Bindura, was also added to capture any different dynamics. In the south-eastern part of the country in the lowveld, Chiredzi area was identified. A total of 233 farmers were interviewed (about 88% of targeted respondents) with Gokwe contributing the bulk of the farmers, at about 34% of the total interviewees (see Figure 2).

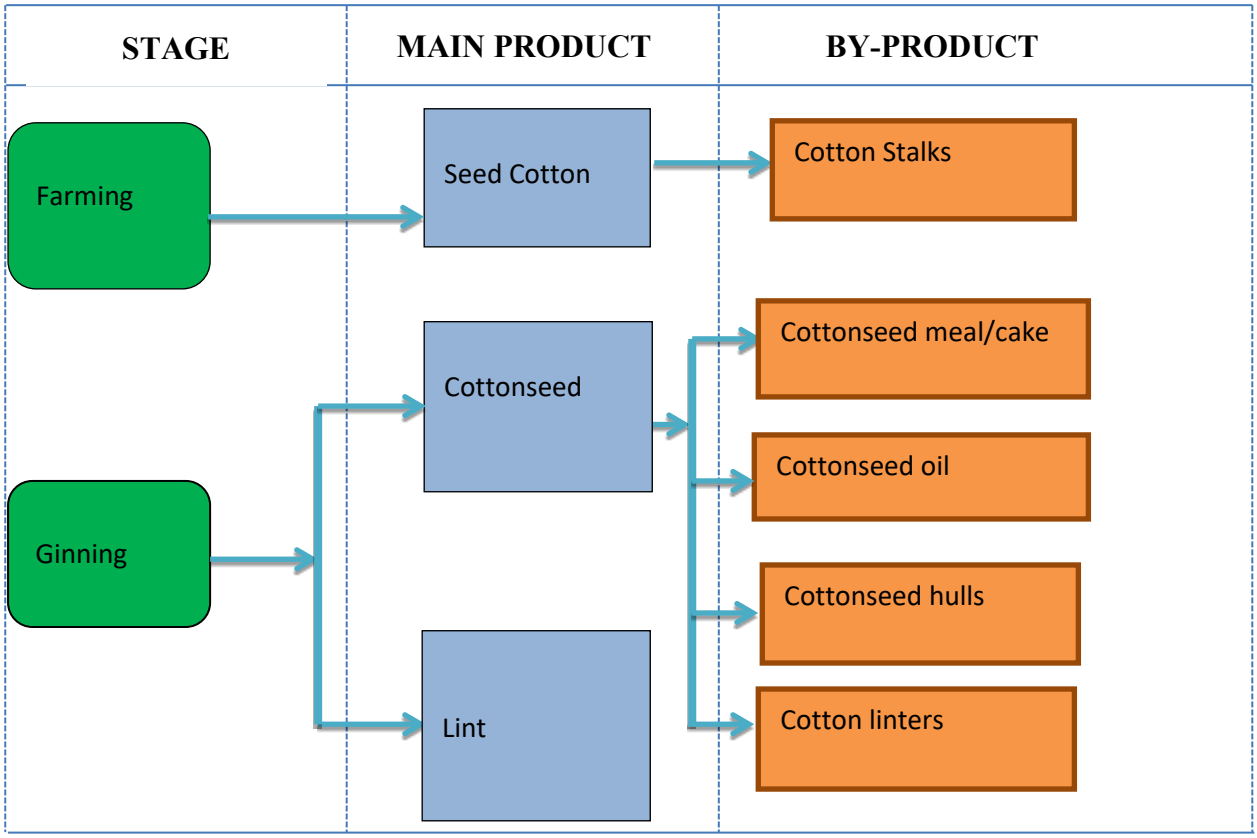
Figure 2: Percentage of total sample of farmers interviewed per cotton growing area



1.4. Scope of the study

The study considered cotton lint as the main product in the cotton value chain. The processing of lint after ginning was also considered to result in cotton by-products that are not of significant potential in terms of value added. As a result, stakeholders from industries such as the textile and clothing industries were not considered for the study. Thus, the cotton by-products considered for the study only focused on those coming out of processes up to the ginning stage as well as other secondary products that can be produced using the by-products (see Figure 3).

Figure 3: Typical stages where the cotton by-products are produced



2. OVERVIEW OF THE ZIMBABWE COTTON INDUSTRY

2.1 Historical overview

The production of cotton in Zimbabwe was enhanced following the establishment of the Cotton Marketing Board (CMB) in 1969, a monopoly responsible for the buying of all cotton produced. Cotton production supports the livelihoods of over 200,000 families and is principally grown in marginal low rainfall areas of Natural Region 4.[4] The communities in the bulk of the cotton growing areas have very limited choices in terms of crop production. As a cash crop, cotton has contributed to economic growth and improved livelihoods among cotton farmers. Distortions in the product producer price have had negative effects on the farmers and their communities at large, while favourable producer prices enhance development and sustainability (Rukuni et al, 2006).

Some of the services provided by CMB included provision of market information: when to sell, where to sell, when to be paid, how to be paid and how much to be paid as well as input support. Farmers were assured of adequate inputs and fair seed cotton prices, which was not ideal given the absence of competition. The high yields attained from the good inputs packages brought viability to farmers, who, in turn, delivered their entire crops and paid off their loans. Farmers also had three option prices: the seasonal pool, the spot price and the forward contract price.

[4]Zimbabwe is divided into five agro-ecological regions (natural regions), based on rainfall patterns, soil quality and vegetation. Region 1 has the most rainfall and most favourable weather conditions for farming while region 5 is the least favourable.

With the seasonal pool farmers received an average price that would be adjusted at the end of a season when price adjustments used to be paid through bonuses.

The liberalisation of the cotton industry through the Economic Structural Adjustment Programme (1991-1995) saw the establishment of a wholly owned government private company, The Cotton Company of Zimbabwe (Private) Limited (Cottco). The liberalisation era also saw the entry into the industry of Cargill, which participated in the buying during the 1995/96 season. The two players competed, each one providing inputs and developing its pool of farmers. The liberalisation also saw the introduction of mobile buying and the payment of cash at farm gate level.

New players entered the market after 2000, including: Grafax, Parrogate, Alliance, Insing and FSI Agricom. The resulting increase in competition created new challenges in the provision of inputs and credit, as well as the marketing of cotton. By 2008, the industry had 30 players supporting cotton production and rampant side marketing emerged as a key challenge in the sector.

Industry players formed the Cotton Ginners Association in 2006. Among its objectives, the Association aimed to promote the production of cotton and its value added products in Zimbabwe. Statutory Instrument 142 of 2009was put in place to establish orderliness in the ginning and marketing of seed cotton. The SI mandated all ginners to finance cotton production and buy from their contracted farmers.

Sustainable financing of cotton production by the ginners has however been undermined by the perennial challenge of side marketing. While SI 142 of 2009 also regulates side marketing, the implementation of the provisions has been poor, amidst concerns that the regulator lacks the capacity to prevent ginners from buying cotton financed by other ginners. Unable the recover their investments in cotton production, ginners have incurred losses. With the loss recording a high of 50% in the 2013/14 marketing season (see Table 1), cotton production has also fallen as ginners reduced their investment.

Table 1: Ginners losses per marketing season

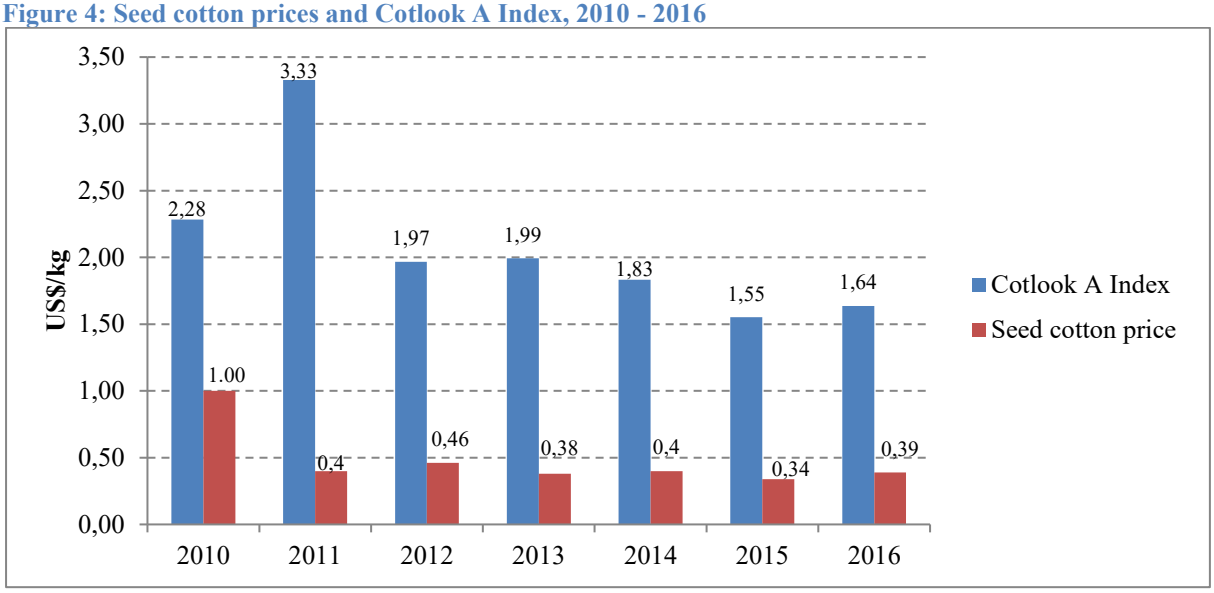
	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Investment value (USD million)	17	25	30	36	42	22	32
Recovery loss (USD million)	2	7	9	4	18.5	10.8	16
Loss on recovery	12%	28%	30%	11%	44%	49%	50%

Source: Cotton Ginners Association

2.2 Production trends, margins and cost drivers

Following phenomenal world lint price increase in the 2010/2011 season, farmers were well rewarded with seed cotton prices of USD 1.00/kg, which then declined and have remained below USD 0.50 since 2010 (see Figure 4).

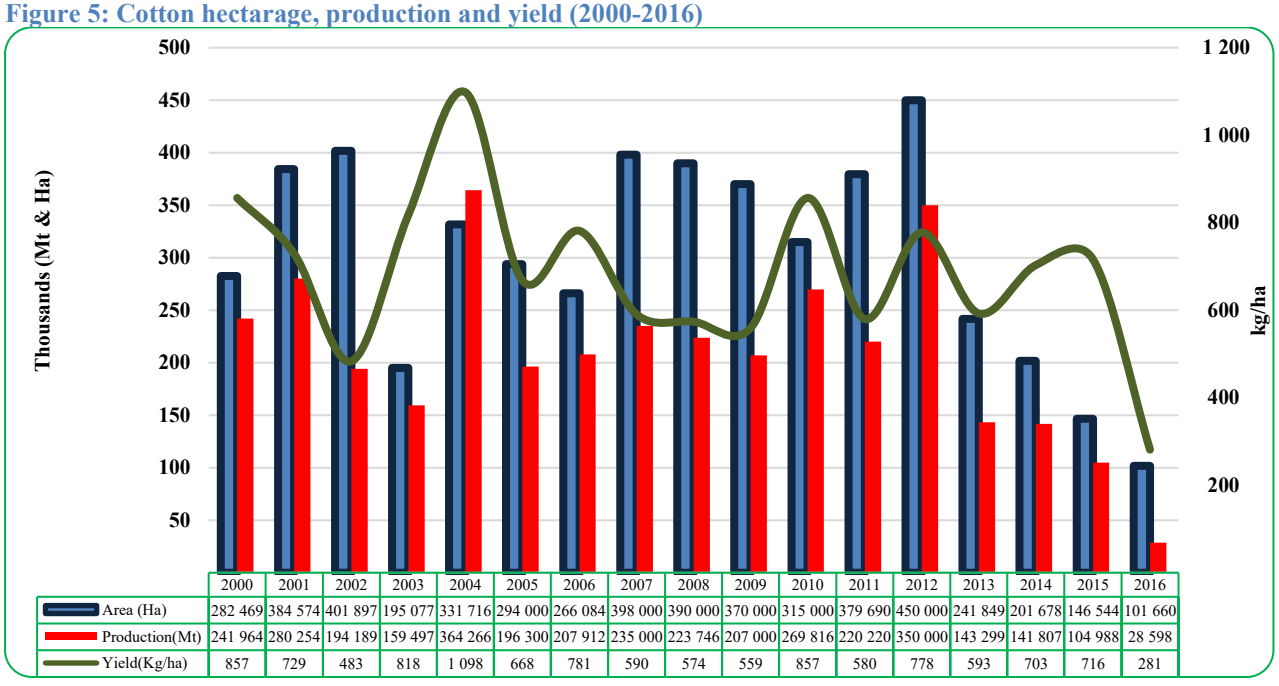
Figure 4: Seed cotton prices and Cotlook A Index, 2010 - 2016



Source: AMA End of Year Cotton Reports and World Bank Pink Sheet

In the following season, 2011/12, production increased to 353,000 tonnes. In 2012/13, prices fell to an average of USD 0.46 per kg, contributing to a corresponding fall in production, to 145,000 tonnes. In the following seasons, production continued to decline, to a record low of about 30,000 tonnes in the 2015/2016 season (see Figure 5). Following the provision of inputs by the Government through Cottco, production was expected to rebound to 70,000 tonnes in the 2016/17 marketing season.

Figure 5: Cotton hectarage, production and yield (2000-2016)



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Area (Ha)	282 469	384 574	401 897	195 077	331 716	294 000	266 084	398 000	390 000	370 000	315 000	379 690	450 000	241 849	201 678	146 544	101 660
Production(Mt)	241 964	280 254	194 189	159 497	364 266	196 300	207 912	235 000	223 746	207 000	269 816	220 220	350 000	143 299	141 807	104 988	28 598
Yield(Kg/ha)	857	729	483	818	1 098	668	781	590	574	559	857	580	778	593	703	716	281

Source: Agricultural Marketing Authority (AMA)

Zimbabwe seed cotton production has also been characterised by low yields. The highest yield since 2000 was recorded in 2004, at about 1,098 kg/ha. In addition to having a record low production level, the year 2016 was also characterised by a record low yield, at only 281 kg/ha.

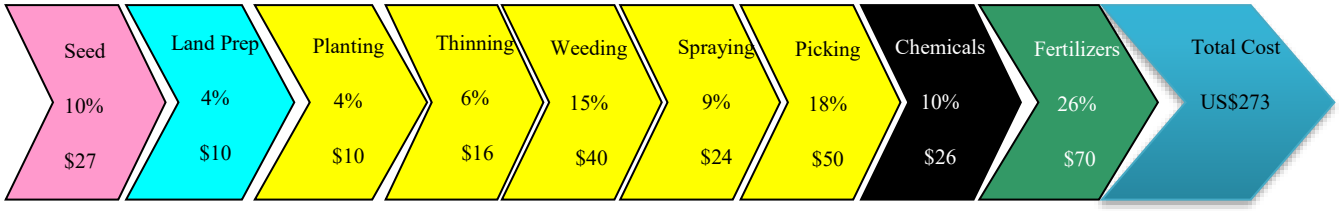
The low yields are attributed to poor agronomic practices, such as sub-optimal plant population, limited fertilizer application, mono-cropping and non-adoption of efficient technologies.

Farmers generally regard cotton production as a venture with a poor risk-to-reward proposition, especially if they grow the cotton under contract farming arrangements with ginners. For example, we estimate that a farmer would produce about 500kg of seed cotton per hectare, for which he would earn about USD 0.50/kg, or a total of about USD 250.

Meanwhile, we estimate that the total cost incurred by the farmer in producing one hectare of cotton is about USD 273 (see Figure 6). Labour items (excluding land preparations) are the main costs, constituting about 51% of all the costs, followed by fertilizers (26%). Fortunately, farmers rely on family labour, hence the implied 51% costs are often regarded as free labour and are not often factored in the viability decision making by the farmers. Taking into account the cost of land preparation, planting, weeding and harvesting, the farmer would therefore incur a loss (ZEPARU, 2014).

Assuming an average ginning outturn of lint at 41% reported in the AMA End of Year Cotton Report for 2016, out of 500kg of seed cotton there would be 205kg of lint sold at USD 1.64/kg (Cotlook A annual price index for 2016). Therefore the ginner would get total revenue of USD 336.50 from selling the lint. Assuming average ginning costs of USD 0.13/kg, total costs to the ginner would be USD 0.63/kg (i.e. USD 0.50/kg paid to the farmer plus USD 0.13/kg for ginning). Therefore the total cost to the ginner would be USD 315 (i.e. USD 0.63/kg * 500kg) against total revenue of USD 336.50. Thus ginners would make a profit while farmers make a loss.

Figure 6: Cotton value chain cost drivers per hectare



Source: *Author estimates, adapted from ZEPARU (2014)*

3. COTTON BY-PRODUCTS PRODUCTION AND USE IN ZIMBABWE

Lint is generally considered the primary product of seed cotton and therefore represents the focus of cotton cultivation. As a result, investment in cotton production is seen as the responsibility of ginners, rather than by-product producers, such as oil expressers or stockfeed producers.[5] Nevertheless, cotton by-products have a recognised economic value in Zimbabwe, with a few established value added activities and the potential for further commercial development. At different stages of the cotton value chain, the use of cotton by-products in Zimbabwe can be described as follows:

[5]This is different from soya beans in South Africa, for example, where the primary determinant for investment into producing soya beans is to supply the feed industry.

3.1 By-products at seed cotton production

3.1.1 Cotton Stalk

The only cotton by-products that can be utilised to add value at the cultivation stage are the stalks. These can be used as a source of fuel, especially for households, as well as commercial purposes, such as tobacco curing. In addition, the cotton stalk can be pulped for use in the production of corrugated boxes, which can be used for packaging. First, the cotton plant stalk chips of about 1.5 cm to 2 cm in size are digested in a rotary digester with kraft liquor at high temperature. After washing, the material is converted into pulp. Using a paper-making machine, the pulp is then made into kraft paper, which is then corrugated to produce boxes of various dimensions, suitable for packaging (Shaikh *et al*, 2003).

Cotton stalks in Zimbabwe also have suitable properties for other value added applications. For example, in a scientific study based on cotton stalks from Umguza District of Zimbabwe, Nkomo *et al* (2016) established that the cotton stalk fibres had properties that made them suitable for use in fibreboard manufacture with resins such as urea formaldehyde and phenol formaldehyde, for use in partition boards and furniture.

Currently, there are no commercial uses for cotton stalks in Zimbabwe. Cotton stalks left in the fields after harvest are a breeding ground for pink bollworm (pectinophoragossypiella), boll weevil and other pests (Nkomo et al, 2016). As a result, farmers are ordered to destroy the stalks, to prevent the build-up of these pests. The farmers cut and dry the cotton stalks before burning them. This is a requirement under the Pests and Diseases Act [Chapter 19:08], for which failure to comply results in the farmer being fined or imprisoned. However, nothing in the legislation scan prevents the farmer from selling the stalks instead of burning them, if the demand exists. Therefore, the absence of demand for the stalks for value added purposes explains the lack of any value added, rather than the legislative requirements. The stalks are being used as fuel in areas where firewood is scarce.[6] Farmers also use them as cattle feed and to make manure by throwing them in cattle pens. There are also indications that some farmers use stalks as soda for cooking – they burn the stalks, mix the ashes with water and distil the mixture, which is then used for cooking.

Discussions were held with Hunyani, a corrugated box manufacturer to understand whether there is any possibility to pulp cotton stalks for use in the corrugated box business. Hunyani had already closed its corrugated box manufacturing plant in Norton, due to viability challenges. The closed plant has been decommissioned, the materials sold off as scrap and the land sold. The main problem was lack of demand, given that throughout Southern Africa, firms were producing at excess capacity. Import competition was too intense and Hunyani could not compete. Hunyani now imports the materials and adds only finishing touches in Zimbabwe to produce its boxes.

At the time the firm was operating, it was not using cotton stalks as raw material. The technology to do so had not yet been explored at the time. However, the use of cotton stalks could be viable for a producer of corrugated boxes, although currently there is none in the country. The cotton stalks would need to be crushed and mixed with pulp from wood as the cotton stalks on their own might call for a different level of technology that is currently not in use. This therefore means that the use of cotton by-products in corrugated box manufacturing is unlikely to be adopted in the near future.

[6]Development partners are also promoting the use of a wood efficient stove, *tsotso* stove, which uses less firewood. The cotton stalks have potential to be used as fuel in such stoves instead of just being destroyed.

However, there are still a lot of raw materials available, which could interest investors. Kabissa (2016) estimates that one hectare of rain-fed cotton gives about 1.3 tonnes of clean cotton stalk chips. Between 2010 and 2015, seed cotton production hectarage averaged about 295,000 ha per year. This would imply that about 383,500 tonnes of cotton stalk chips would be available each year for value addition if the industries were to develop in Zimbabwe.
The local production of kraft paper would also go a long way in saving the country of the much needed foreign currency, especially at this time when the current account deficit is associated with liquidity challenges in Zimbabwe. The average value of kraft paper[7] imports in Zimbabwe between 2012 and 2016 was USD 2.2 million per year. Adding value to cotton stalks thus has the potential to generate comparable revenues for investors.

3.2 By-products at ginning

3.2.1 Cottonseed

Cottonseed is arguably the most valuable by-product from cotton ginning. Cottonseed constitutes about 56% of the seed cotton volume, compared to only 41% for lint.[8] Cottonseed is therefore a ginnery's main product, in terms of weight. For illustration, the FAO[9] estimates that Zimbabwe will produce about 125,000 tonnes of seed cotton in the 2016/17 season, representing 70,000 tonnes of cottonseed.

Statistics from the Stockfeed Manufacturers Association show that its members also purchase cottonseed for use in the feed business. For example, about 595 tonnes of cottonseed were purchased by the industry in 2016, which is almost double what was purchased in 2015. This shows that there is competition for cottonseed supply among oil expressers and feed manufacturers. However, cottonseed only constituted about 1% of the total raw materials used in stockfeed production, hence is not the main raw material.

There are four main products that can be produced from cottonseed; cooking oil, cottonseed meal, linters, and hulls. In terms of the cottonseed value, one of the oil expressers in Zimbabwe estimated that cottonseed meal constitutes about 44% of the total seed value, followed by cooking oil at about 18%, hulls (9%) and linters (7%). Unrecovered waste products represent the remaining 22% of total cottonseed value, even if some portion of these products could be recovered and used. For example, oil processing produces gums that could be used to produce lecithin, an ingredient in margarine. But the produced quantity of these gums is insufficient to constitute a market, so they are discarded as waste.

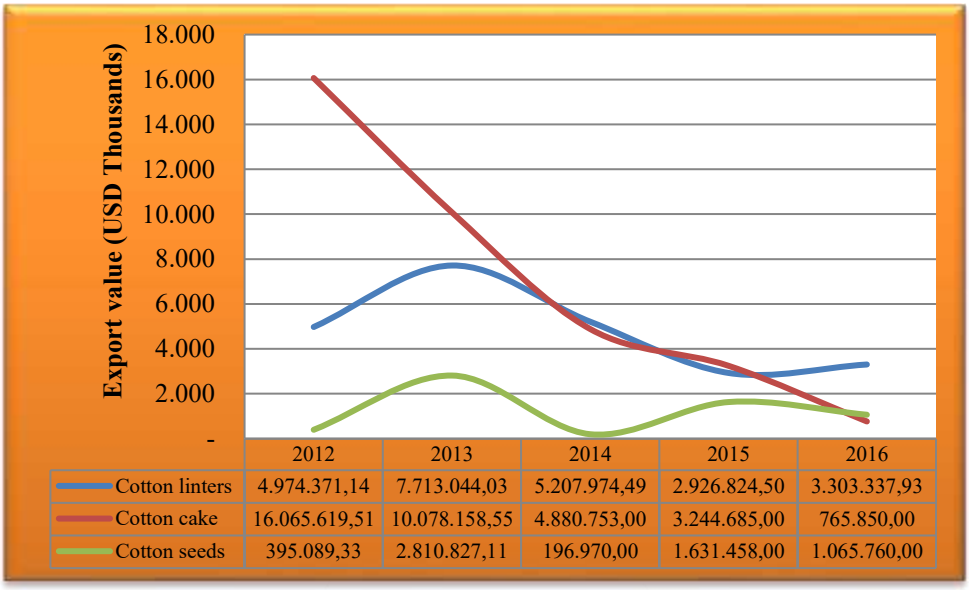
The Stockfeed Manufacturers Association estimated 2017 cottonseed prices at around USD 280 per tonne, with cottonseed meal prices at around USD 330-340 per tonne.[10] In terms of volume, it is also estimated that one tonne of cottonseed in Zimbabwe would produce 200kg

[7]Excluding the kraft liners and the fluting paper which is also used in corrugated box manufacturing. Thus this refers to HS codes 48042100 to 48045900
[8]Authors' estimates based on interviews with players. The remaining 3% would constitute losses in production as well as waste and by-products (e.g. cotton linters)
[9]FAO Country Brief at website http://www.fao.org/giews/countrybrief/country.jsp?code=ZWE accessed July 10 2017
[10] 'Raw Materials Supply: March 2017', Stockfeed Manufactures Association at website http://www.livestockzimbabwe.com/images/raw%20materials%20supply%20march%202017.pdf accessed July 10 2017

of oil, 500kg of cottonseed meal and 300kg of hulls (Buka, 2016). This underlines that the stockfeed industry is the main potential user of cottonseed by-products.

In addition to their use in the local industry, cottonseeds are also exported. The export of cottonseed is however lower compared to other cotton by-products, such as cotton linters and cotton cake, with only about USD 1 million worth of cottonseeds exported in 2016, down from a peak of about USD 2.8 million in 2013 (see Figure 7).

Figure 7: Cotton by-products export revenue (USD), 2012-2016



	2012	2013	2014	2015	2016
Cotton linters	4.974.371,14	7.713.044,03	5.207.974,49	2.926.824,50	3.303.337,93
Cotton cake	16.065.619,51	10.078.158,55	4.880.753,00	3.244.685,00	765.850,00
Cotton seeds	395.089,33	2.810.827,11	196.970,00	1.631.458,00	1.065.760,00

Source: ZIMSTAT

3.2.2 Linters

Linters generally refer to the short fibres that would still be clinging to the cottonseed after ginning. The installation of a de-linting machine after the ginning process will remove more linters from the seed. Both ginners and downstream users of the seed, such as oil expressers, invest in de-linting machines to ensure that the linters that survive the ginning process are removed. Thus, linters can also be identified as an oil expression by-product. Although largely underutilised in many countries, linters can be used for a number of products, such as the manufacture of cellulose products like cellulose acetate, carboxymethyl cellulose, viscose rayon, microcrystalline cellulose, cellulose nitrate and the preparation of specialty-grade paper (Balasubramanya and Shaikh, 2007).

In Zimbabwe, linters are generally exported, due to the absence of local value added industries. In the past, Cottco used linters to produce receipt books and security paper, including currency paper for the Government. But the Kadoma ginnery that produced the linters was unprofitable, leading Cottco to close it. After that, producers could only export their linters. The oil expresser firm Surface Wilmar, for example, exports its linters to China and Japan, due to a lack of local demand. In other words, although linters represent approximately 7% of the total cottonseed value, quantities are too low to attract new investment in value added activities.

Statistics show that the export of cotton linters has decreased significantly between 2012 and 2016, from a peak of USD 7.7 million in 2013 to about USD 3.3 million in 2016 (see Figure 6). Thus, efforts to promote the competitiveness and markets for value added linters within the

local and regional markets can attract new capital into ginneries and oil expressers to add value to linters.

3.2.3 Motes

The ginning process also results in a cotton by-product known as motes, which are immature seeds with fibres attached to them. Motes can also be used to produce some of the same non-woven products that are produced using linters. In Zimbabwe, motes are mostly treated as waste products. Ginners currently recover some value from the motes by selling them to furniture making firms, in particular small-scale ones, which use them in cushions for sofas and chairs.

3.3 By-products at oil extraction

3.3.1 Cooking oil

Cooking oil is currently the main cotton by-product in Zimbabwe. The process of cottonseed oil expressing involves the following steps: seed cleaning, seed cracking, seed flaking, cooking, expelling and refining. Cleaning generally involves getting rid of organic impurity (e.g. stems and leaves), inorganic impurity (e.g. dust, silt, pebbles and metals) and the hull. The result is a de-hulled cottonseed that is ready for the next step. Cracking involves reducing the cottonseed kernel into pieces, which flaking then reduces further into uniform smaller flakes. The cooking process involves steaming and then drying the flaked kernel. At the expelling step, oil expelling press machines squeeze out the oil, usually through a solvent extraction method, to produce crude oil. Refining is the final step, by which residue and solid powder are removed from the crude oil.[11]

Most of the cooking oil expressers in Zimbabwe have invested in both soya bean and cottonseed processes, to enhance flexibility. Only Grafax has an oil expression business that is based wholly on cottonseed, as the oil business was established to achieve vertical integration with Grafax's ginning operations. Alliance Ginneries, where about 80% of the oil derives from cottonseed, also relies on seed cotton production.

Apart from these exceptions, the overall reliance on substitute oilseeds, such as soya bean, has limited the demand for cottonseed. This helps explain why investment in cotton production is generally considered as the responsibility of ginners. The importation of crude oil further suggests that oil expressers can still produce edible oil, including cottonseed oil, even if there is no cotton production in the country.

Due to the scarcity of cottonseed in sufficient quantities, oil expressers have generally preferred to use substitutes, such as soya beans, canola and sunflower. For example, Surface Wilmar has the capacity to process 150,000 tonnes of cottonseed into 30 million litres of oil per year. This capacity is greater than the country's average annual production of cottonseed in recent years and greater than the projected production in 2016/17. Surface Wilmar is an investor in Olivine, which it jointly owns with the Government of Zimbabwe. Surface Wilmar is therefore likely to buy the majority of the ginned cotton seed from the state-owned ginner Cottco, which is currently the country's biggest buyer of seed cotton from farmers.

[11] Henan Kingman Mechanical and Engineering Complete Plant Co., Ltd, http://www.oilmillmachinery.net/cottonseed-oil-processing.html, accessed 07 July 2017

Estimates show that about 70,000 tonnes of cotton seed are expected for the 2016/17 season. Given that one tonne of cottonseed in Zimbabwe is estimated to produce 200kg of oil (Buka, 2016), then about 14,000 tonnes of cooking oil could be derived from the 2016/17 crop. This would be well below the production capacity of the firms, hence oil expressers must fill the deficit with imports of seeds and crude oil.

This situation demonstrates the fact that the utilization of cottonseeds in edible oil expression is currently below potential, which, in turn, affects the availability of by-products from the oil expression process, such as: cottonseed hulls and meal, margarine, soaps and candles. We review these by-products in the following subsections.

3.3.2 Cottonseed Hulls

Hulls are the outer covering of the cottonseed and are a direct by-product of the de-hulling process to expose the kernel. The stockfeed industry uses hulls to produce feed for ruminants. Cottonseed hulls are sometimes mixed with cottonseed meal to create a higher density product that is easier to transport and handle (Blasi and Drouillard, 2002). However, the hulls are also difficult for ruminants to digest, hence the need for further refinements in their processing (Balasubramanya and. Shaikh, 2007). Hulls are at times blended with the meal to provide roughage (Buka, 2016). The demand for hulls would thus tend to be lower than that for the cottonseed cake, due to low protein content in the hulls.

In Zimbabwe, cottonseed hulls are fully utilised by the stockfeed industry. One oil expresser estimates that hulls account for about 9% of the cottonseed value and are an important source of revenue for oil expressers. In 2016, stockfeed manufacturers used about 323 tonnes of cottonseed hulls as a raw material. This consumption represented a 52% drop from the volumes of hulls that were used in 2015, mainly due to scarcity resulting from poor seed cotton production. In terms of value, the cottonseed hulls used in 2017 were worth about USD 57,800, a drop of about 35% from 2015.

3.3.3 Cottonseed meal

After the oil is extracted from the crushed kernels, cottonseed meal or cake remains. Balasubramanya and Shaikh (2007) make a distinction between cottonseed meal and cake. When the whole seed is crushed and oil is extracted, they term this remaining substance as cottonseed cake, which has lower protein content at about 40% of the total nutrient content. However, if the kernels are crushed and the oil is extracted, then cottonseed meal remains, which has a higher protein content, at about 50% of total content. In this study, however, cottonseed meal will be used to refer to cottonseed cake as well.

Cottonseed meal is mainly sold to the stockfeed industry, as it is an important source of protein. The oil expressing firms actually earn more profit from cottonseed meal than from oil, with one of the oil expressers, Alliance, indicating that the meal and hulls constitute the bulk of their total cotton business, while oil generates only about 13% of total sales. Surface Wilmar estimates that the cottonseed meal constitutes about 44% of their total cotton product sales and is hence more valuable than oil, which constitutes about 18%. Therefore, cake is considered a joint product, as opposed to a by-product, of the oil extraction process.

Statistics from the Stockfeed Manufacturers Association show that about 532 tonnes of cottonseed meal were used in the stockfeed industry in 2016, a decrease of about 15% from the volumes used in 2015. Between 2014 and 2016, cottonseed meal input constituted only

between 1% and 2% of the total volume of raw materials used in the stockfeed industry. In terms of monetary value, cottonseed meal worth about USD 179,000 was used by the stockfeed industry in 2016, a decrease of about 14% from 2015.[12]

However, cottonseed meal is only suitable for feeding adult ruminants, and is generally unsuitable for non-ruminants. While cottonseed is a source of high protein for feed, it is unsuitable for poultry, as it contains a compound called gossypol, which inhibits the digestion of some important nutritional enzymes in non-ruminants. As a result, feed containing cottonseed cannot be used for poultry or pigs, even though it is used for cattle feed. While processes exist to remove gossypol, their costs would not be justified when compared with gossypol-free substitutes, such as soya. This also limits demand for cottonseed meal, as poultry together with piggery constitute the bulk of the stockfeed industry. For example, National Foods estimates that, of the 150,000 tonnes of feed that the company produces per year, about 53% is for poultry, 40% for beef and dairy, with the remainder for other feeds. At Agrifoods and Profeeds, feed for ruminants only constitutes about 30% and 20%, respectively, of the total feed production, with the bias being towards non-ruminants, especially poultry. This stockfeed demand pattern is also due to the demand preferences for final products, especially beef and poultry. The problem of gossypol thus limits the consumption of cottonseed meal by the feed industry.

Thus, while cottonseed meal constitutes only about 1% of total inputs in the feed industry, it constitutes a higher share of the ruminant feed segment. For example, in 2015, beef and dairy stockfeed worth about USD 2.4 million was produced. Cottonseed meal worth about USD 208,400 was used as an input into the production of this feed.[13] This implies that the cost of the cottonseed cake would be worth about 8.6% of the total cost of beef and dairy feed production.

Due to limited cottonseed availability, the stockfeed industry has encountered shortages in the market, with their demand at times going unmet by the oil expressers. The Stockfeed Manufacturers Association estimates that the firms are currently operating at an average of 60% capacity utilisation. In the 2016/17 marketing season, no such shortages are anticipated. The Stockfeed Manufacturers Association estimated that about 70,000 tonnes of cottonseed will be available in the 2016/17 marketing season. Given further estimates that one tonne would produce about 500kg of cottonseed meal (Buka, 2016), then about 35,000 tonnes of cottonseed meal would be expected. This would be enough to meet the demand of all stockfeed producers, especially given that they used only 532 tonnes in 2016.The Stockfeed Manufacturers Association confirmed this by projecting an adequate supply of cottonseed meal in 2017.[14]

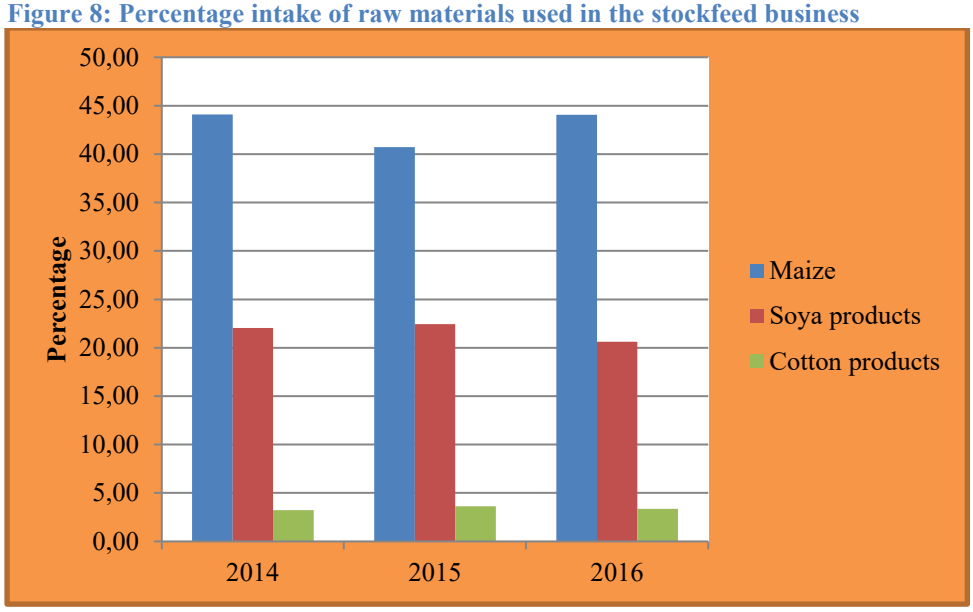
Cottonseed meal is also exported from Zimbabwe by oil expressing firms, as they also seek access to foreign markets. Statistics show that the exports of cottonseed meal declined from a peak of about USD 16 million in 2012, to only about USD 766,000 in 2016 (see Figure 6). The declining trend in exports is attributed to the increase in capacity utilisation in the stockfeed industry, especially following recent import control measures to protect the industry.

[12] 'Raw Materials Usage and Feed Production Returns: December 2016', Stockfeed Manufacturers Association
[13] 'Raw Materials Usage and Feed Production Returns: December 2016', Stockfeed Manufacturers Association
[14] 'Raw Materials Supply: June 2017', Stockfeed Manufacturers Association at website http://www.livestockzimbabwe.com/images/raw%20materials%20supply%20june%202017.pdf accessed 10 July 2017

Cottonseed meal can also be used as a natural fertiliser. It is generally a natural acidifier, making it a preferred fertiliser for azaleas, camellias, blueberries and other acid-loving plants.[15] However, given the demand for cottonseed meal by the stockfeed industry, none of the interviewed oil expressers indicated having sold cottonseed cake to farmers or fertiliser manufacturing firms.

Statistics from the Stockfeed Manufacturers Association can be used to show the importance of the cottonseed in the stockfeed business. In terms of volumes, stockfeed manufacturers' main raw material is maize, of which they consume approximately 19,000 tonnes per year, or 44% of total feedstock consumption. Soya meal is the next most important raw material, at around 9,000 tonnes consumed per year, or 20-22% of the total. Meanwhile, cottonseed cake represents only 1-2% of the total raw materials consumed, with cottonseed hulls representing a further 1%. Cotton by-products therefore represent a total of approximately 3% of the total raw materials consumed by the stockfeed sector (see Figure 8).

Figure 8: Percentage intake of raw materials used in the stockfeed business



Source: Computed from Stockfeed Manufacturers Association statistics (2016)

The use of cotton by-products by the stockfeed industry is limited, as poultry and other non-ruminants are the dominant livestock segments in Zimbabwe. For example, in 2015, only 19% of the total volume of feed produced was for beef and dairy animals, up from 18% in 2014. In terms of value, the cost of cotton by-products (e.g. cottonseed meal and hulls) constituted between 12% and 13% of the total costs of the dairy and beef feed produced in 2014 and 2015. Cotton by-products are therefore significant inputs in the ruminant feed segment, even though they are not the main inputs.

3.3.4 Margarine

Some oil expressers also produce margarine. However, while margarine can be made from cottonseed oil, it can also be made from cheaper substitutes. One oil expresser, Olivine is already making margarine. Another oil expresser advised that they expect to start producing margarine in September 2017. Both companies, however, indicated that they do (will) not use cottonseed oil to make their margarine. Pureoil prefers canola seed oil, while Olivine did not

[15] http://www.natureswayresources.com/nl/66OrganicFertilizer8.pdf accessed 10 July 2017

indicate their feedstock oilseed, to protect their formulation. Generally, oil expressing firms do not consider margarine as a by-product, but rather a joint product, as they must choose whether to use semi-refined oil for margarine or cooking oil. The production of margarine from cottonseed oil is not considered cost-effective due to the processing requirements. Therefore, there is still potential to explore cost-cutting efficiencies in processing to make cottonseed oil a more attractive input for margarine production, especially if more cottonseed oil production increases to the point that it exceeds household and industry demand.

3.3.5 Soaps and detergents

Cottonseed oil, just like other so-called "soft oils"– such as groundnut, castor and olive oil – has soap making properties. It cannot be used to produce hard soap when used alone, but is usually blended with nut oils. Soaps containing cottonseed oil have superior detergent properties and lather freely. Nevertheless, although soaps containing cottonseed oil saponify easily, if they are not blended with other oils, the soap is difficult to grain and yields a soft consistency and has an unpleasant odour (Donkor, 1986).

The possibility of using cotton by-products to produce soap is appreciated by the oil expressing firms. One firm, Grafax, already has a soap product containing cottonseed oil. However, there are challenges that prevent them from scaling up the production. Soap derived from cottonseed oil is typically dark and foul-smelling. To remove the smell is difficult, as it requires additives that reduce profitability. Prohibitive costs to clean and purify the soap currently dissuade investments in cottonseed oil-based soaps. Producers have invested in processes based on more cost-effective substitutes, such as palm oil. The oil expressers are still exploring new processes to make cottonseed oil-based soap more cost-effective and appealing to consumers, but the current business case for this product is a non-starter for oil expressers' profitability.

Other firms, for example Pure Oil, produce soaps and detergents from palm oil. Palm oil is pure and white, so does not require further costly purification. Imported palm oil is also cheaper than domestically produced cottonseed oil and is therefore the cost-effective choice. Stakeholders also pointed out that the cottonseed oil has some fatty acids that need to be removed to improve its appearance. Thus, viability is the main challenge for using cottonseed oil to produce soaps and detergents. As a result, while some oil expressers appreciate that there could be some value from the inner cottonseed husks to produce soap, the husks are currently disposed of as waste or sold as scrap to customers who use it as fuel.

Olivine currently produces soap, but this does not come from cottonseed oil. In addition to the costs, Olivine also believes that the available volumes of the by-product are insufficient, as compared to palm oil.

3.3.6 Candles

Through a process called hydrogenation, which is the turning of liquid cottonseed oil into a thick, solid fat,[16] cottonseed oil can be crystallised into wax to manufacture candles. Discussions with oil expressers, however, show that while there are some who are making candles, they do not consider cottonseed oil as a viable raw material for candle making. This is because the wax content in cottonseed oil is considered so small that, with the limited quantities of oil currently produced, a firm cannot take advantage of economies of scale. Olivine produces candles using imported candle wax and considers the technology needed to process cottonseed oil into candles to be quite costly. Alliance considers candle manufacturing

[16] http://www.huffingtonpost.ca/meghan-telpner/what-is-crisco-made-of_b_3745634.html accessed 13 July 2017

from cottonseed oil to be uneconomical as it would require coagulant chemicals that increase the cost of production and make the business unviable.

4. THE MAIN IMPEDIMENTS TO THE DEVELOPMENT OF COTTON BY-PRODUCTS

4.1 At cotton production

There is potential for cotton stalk value added in Zimbabwe, given that these exist in sufficient volumes for value added. Manufacturing of corrugated boxes, as well as other pulp and paper products, appears to be the low-hanging fruit, given the current heavy reliance on imports of these products. Cotton cultivation is also clustered in specific geographical areas, making it more feasible to harvest the stalks and transport them to a centralised value added plant.

The main impediment, however, is lack of knowledge among farmers and existing value chain actors about the potential value that could be harnessed from the cotton stalks. The necessary technologies to add value to cotton stalks does not exist. In addition, the existence of cheaper imported products, including kraft paper, makes the decision to invest in local production risky. This suggests that value added activities for cotton stalks are unlikely to develop in the near future without deliberate policies that improve the business case for these activities. These policies could include discouraging the importation of competing raw materials, as well as policy incentives to attract investment in cotton stalk value addition.

4.2 At ginning

Ginners in Zimbabwe already produce and commercialise the main cotton by-products derived from the ginning activity, including cottonseed, motes and linters. While cottonseed is in high demand, motes and linters are not produced in sufficient quantities to achieve economies of scale. This makes it important to increase cotton production, which would lead to increased ginning activity and increased production of seeds, motes and linters. The responsibility for enhancing cotton production is mostly placed in the hand of ginners, as they fund cotton production.

Side marketing and poor yields are the main impediments to increased cotton production. To reduce side marketing, the Government needs to enforce existing legislation and regulations, which are adequate to quell the problem. Side marketing deprives ginners of seed cotton they have already partially paid for, in the form of inputs provided to the farmer on credit. Controlling side marketing would increase ginners' confidence in the contracts they sign with farmers and assure them of a more predictable supply, conditions that would make them more willing to invest in the cotton production.

Poor yields also undermine value addition activities, as they contribute to low production volumes. Investment into higher yield seed varieties is called for, which could also warrant some policy action. In addition, the number of cotton farmers is currently low, as many farmers migrated to competing cash crops due to low returns from cotton over the previous years. This is another impediment to ginners and other value added processors to benefit from economies of scale. Currently the ginneries are operating at below capacity, given that the expected 125,000 tonnes of seed cotton would constitute only about 28% of the total available ginning capacity.[17]

[17]Buka (2016) indicates that the total available ginning capacity from eight ginneries is 440,600 tonnes

4.3 At oil extraction

Currently a number of cotton by-products such as cottonseed meal, hulls and oil are produced in commercial quantities at the oil extraction stage. To achieve greater economies of scale, seed cotton production must increase. In addition, investment is needed for the adoption of cost-effective processing technologies to extract gossypol from cottonseed meal and, thus, make it suitable for use in producing feed for non-ruminant animals.

There are a number of cotton by-products at the oil extraction stage that could be further processed. For example, the production of margarine is currently hindered by costs, given that cottonseed oil is not currently produced in sufficient quantities. Cotton production could create the economies of scale necessary to produce margarine from cottonseed oil. As for soap production, innovation is needed to reduce purification costs, bolstered by marketing and advertising programs to encourage consumers to use brown soap.

The other potential also lies in candles, where the main impediment is the low volumes of cottonseed oil, as the wax from the cottonseed oil would need huge volumes to become economically viable. Significant increase in seed cotton production will also increase prospects for processors to revisit the use of cottonseed oil to produce candles.

A number of possible uses for cotton by-products are yet to develop and in this regard their potential could not be determined in this study. These include using cotton by-products in, for example: salad dressings, emulsifiers, cosmetics, pharmaceuticals, rubber and oil paints. Current producers of these products have either not yet tried to embrace cotton by-products or could not be reached during the course of this study.

5. INFRASTRUCTURE, INCLUDING TECHNOLOGIES AT THE COTTON VALUE CHAIN

Infrastructure to add value to cotton and its by-products is generally available, even though further investments are required. For example, at the seed development stage, a challenge remains as to how to breed a higher-yield cotton plant. Initially, the Cotton Research Institute, in partnership with the private breeder Quton Seeds Ltd, were expected to have the sufficient technology for seed breeding, agronomy, entomology and pathology to breed a high-yield variety in Zimbabwe. Currently three ginners, Cottco, Alliance and Olam are involved in seed multiplication using the varieties from the Government and Quton.

Yields remain constrained due to the use of poor agronomic practices involving late plantings, low plant populations, poor weeding, incorrect application of chemicals and improper harvesting. Only about 45% of the country's smallholder cotton farmers use fertilizers in producing the crop (ZEPARU 2014).[18] In addition, the level of mechanisation at the cotton production stage is very low, with family labour used for land preparation, tillage, planting, thinning, weeding, spraying and harvesting. Increased use of cost-effective and time-saving technologies is needed to improve productivity in cotton farming. These may include use of tractor-drawn implements that are compatible with the land sizes in the cotton growing areas. Factors behind the yields demonstrate the need for concerted efforts by the government and

[18]This was before the free Presidential Input scheme, where all farmers interested were given free inputs including fertiliser. In the current 2016/17 season, this rate is expected to have gone up.

private sector involvement to build the knowledge of smallholders to employ fertilizers, improved seeds and new technologies.

At the ginning stage, all the ginners generally have state-of-the-art ginneries, including both rollers and saw gins, which are present in the major cotton growing areas of the country. The combined installed capacity of the ginneries is well above seed cotton supply; for example Zimbabwe has an annual ginning capacity of 440,600 tonnes, with the leading ginner, Cottco's six ginneries having a total capacity of 175,000 tonnes per year. The state of infrastructure at ginning level is considered by players in the sector as satisfactory.

Similarly, many cooking oil manufacturers have recently invested in state-of-the-art equipment, so there are few concerns about production technology in this sector. Indeed, Surface Wilmar is considered to have cutting-edge technology that allows the firm to compete regionally.

Nevertheless, there are still opportunities for cooking oil manufacturers to invest in innovations that would unlock product lines based on cotton by-products. For example, investing in a technology to remove gossypol from the cottonseed meal would go a long way to adapting the meal for use in the main poultry segment of the stockfeed industry. In addition, there is no industry player who is currently de-waxing cottonseed oil to produce candle wax, which could also increase demand for cottonseed oil.

There has also been a lot of investment recently in the feed industry, with modern plants in place. Infrastructure cannot be considered an impediment to increased production. For example, Agrifoods has cutting-edge equipment, with the potential to produce 4,000 tonnes of feed per day. However, this is largely underutilized due to a lack of demand for feed and a limited supply of raw materials.

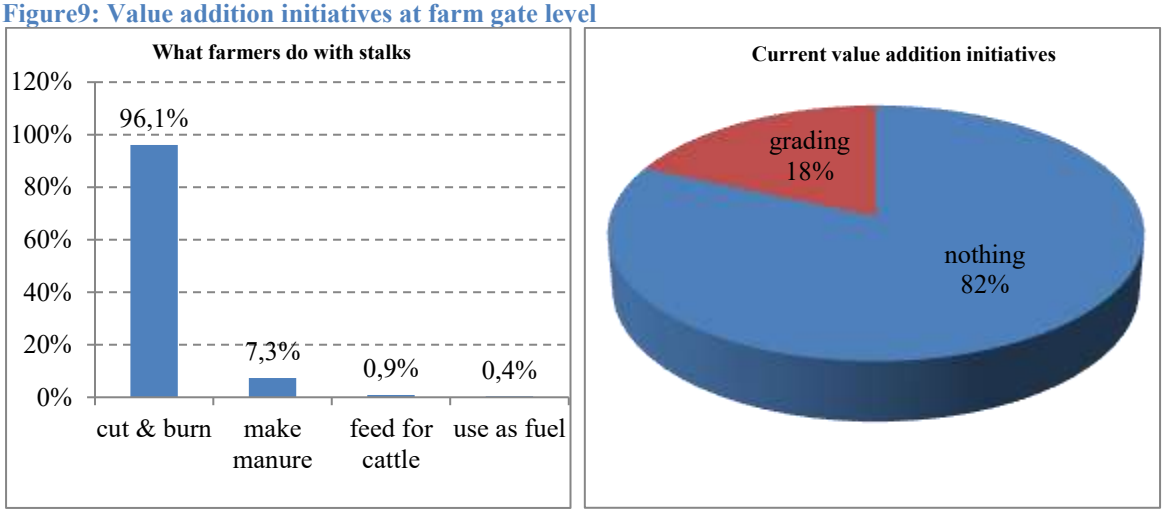
6. PERCEPTIONS OF VALUE CHAIN ACTORS ABOUT DEVELOPMENT OF COTTON BY-PRODUCTS AND INVESTMENT DECISIONS

6.1 Perceptions of famers

6.1.1 Farmers' perceptions on value addition

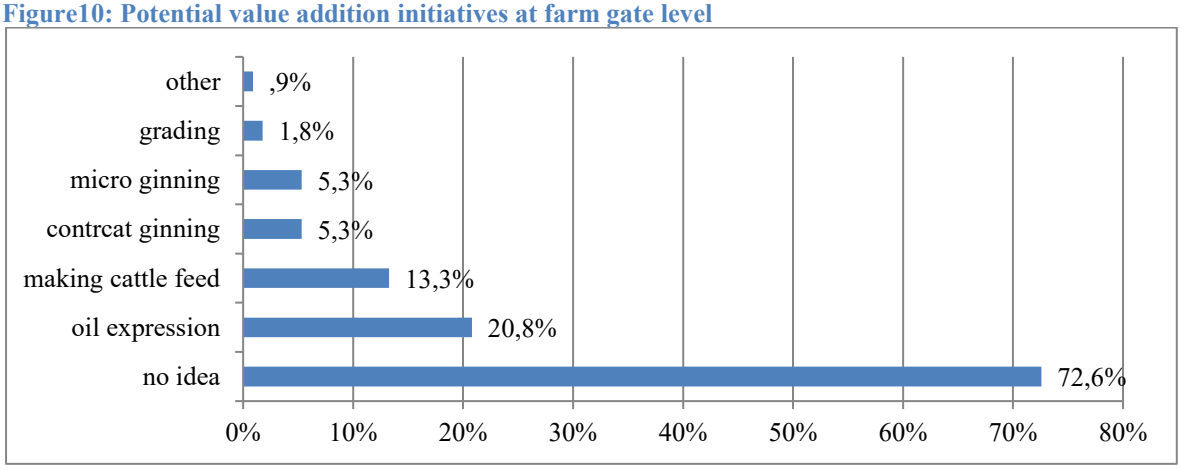
There is minimal cotton by-product value addition taking place at the farm level. Most farmers (96.1%) indicated that they cut and burn their stalks after harvesting to prevent the spread of pests (see Figure 8). About 7.3% of the farmers make manure from cotton stalks by throwing the stalks into cattle kraals and mixing it with dung to produce manure, which they use as substitute for basal fertilisers. Very few farmers (0.9%) make feed for cattle using cotton stalks, by allowing the stalks to slightly decompose during the rainy season, then sprinkling salts on the stalks before feeding them to cattle. Some farmers in areas where firewood is a challenge use the stalks as fuel.

Figure9: Value addition initiatives at farm gate level



Most farmers are not aware of the potential value addition activities that can be done at farm level. About 72.6% of the farmers indicated that they do not have any idea about what value addition activities they can undertake (see Figure 10). However, a few farmers identified oil expression (20.8%), cattle feed manufacturing (13.3%), micro and contract ginning (5.3%), and cotton grading (1.8%) as potential value added activities.

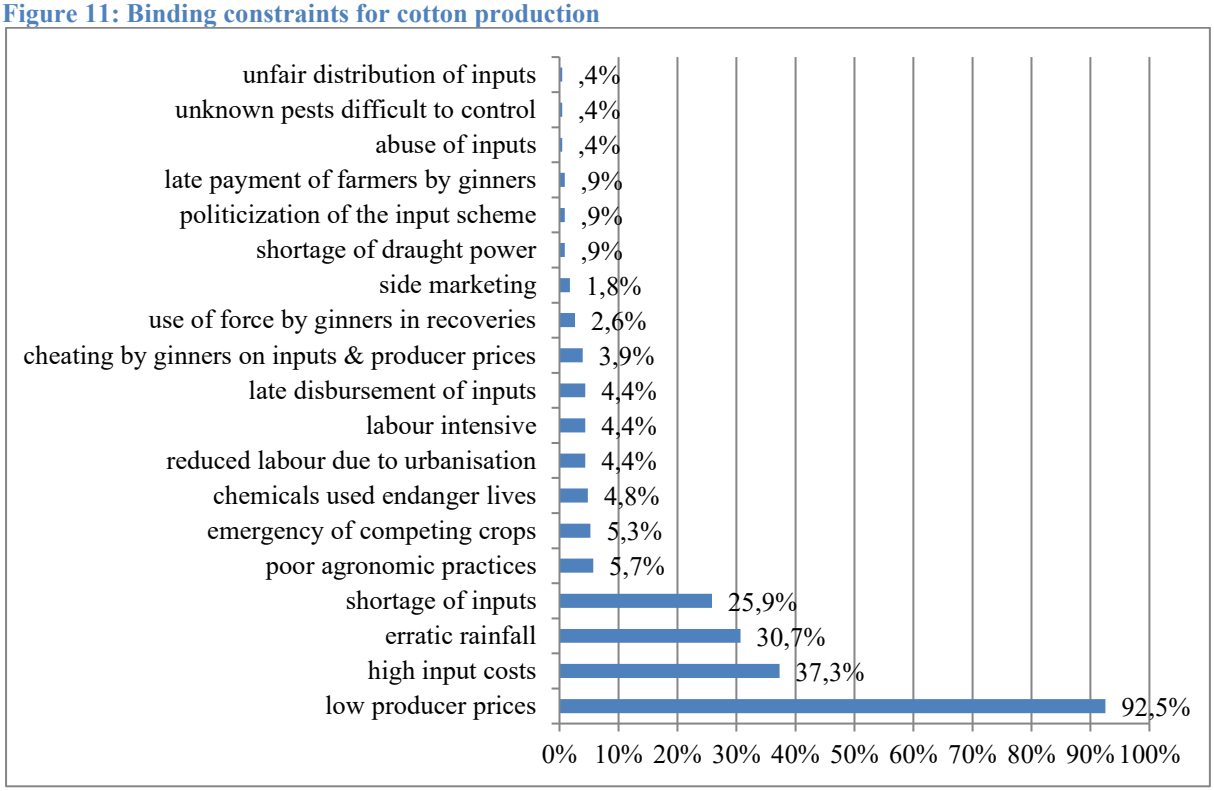
Figure10: Potential value addition initiatives at farm gate level



6.1.2 Farmers' perceptions on factors affecting cotton production

Farmers were asked to identify factors that adversely affect cotton production in Zimbabwe. Most farmers (92.5%) identified low cotton producer prices as one of the important reasons why production of cotton has fallen in the country (see Figure 11). Farmers indicated that the real income they earn from cotton has declined significantly over the years. As an illustration, farmers recounted that they could buy a cow from one bale of cotton many years ago, but now they require several bales to afford a cow.

Figure 11: Binding constraints for cotton production



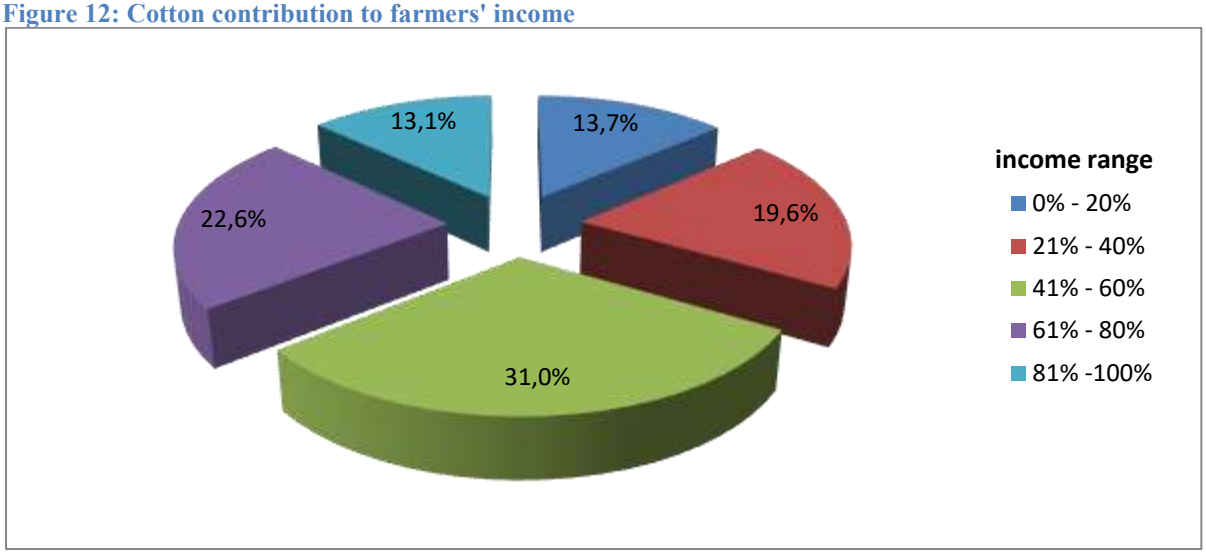
Farmers believe that the inputs provided to them by the ginners are more expensive than retail prices and, thus, ginners profit from the provision of inputs. The farmers also believe that the inputs given by the ginners are inadequate, at a time when seed is not readily available in retail shops for farmers to grow cotton outside of contract farming arrangements. Ginners are also accused of late disbursement of inputs, contributing to low cotton production.

6.1.3 Cotton farmers' perceptions on incentives for cotton production

Most farmers (66%) indicated that growing cotton had more incentives compared to other crops. Some farmers prefer to grow cotton because it is a cash crop for which they have considerable knowledge and experience compared to other cash crops, while it is mostly suitable for their agro-ecological zone. The availability of input schemes, especially the recent free Presidential Input Scheme, is one of the incentives that motivate cotton production.

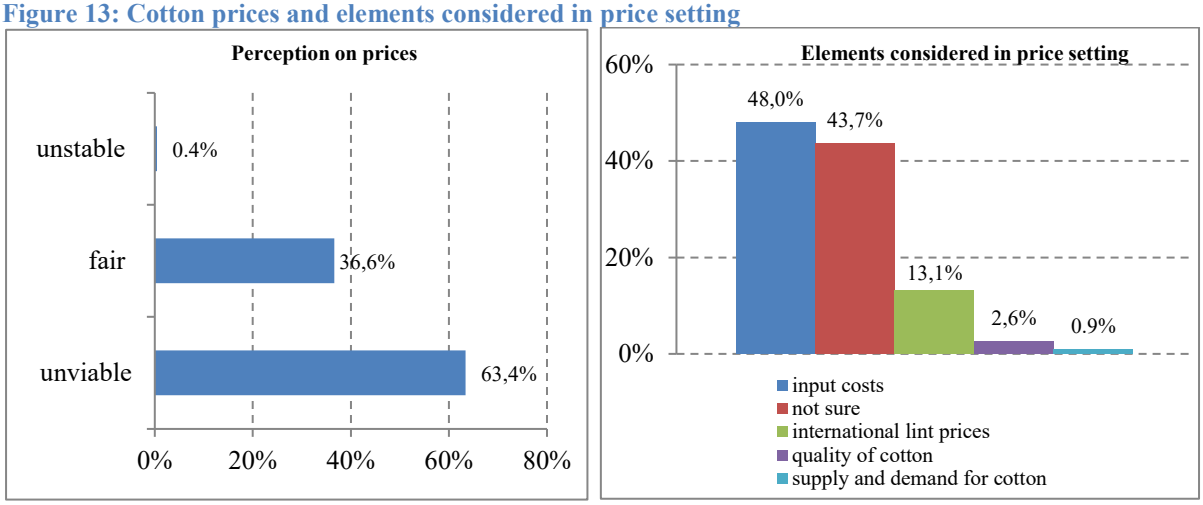
Farmers in drier agro-ecological zones also prefer cotton because of its contribution to their income and livelihood when compared to other non-drought resistant crops. Cotton contributes more than 40% of income to about 66.7% of the cotton farmers (see Figure 12).

Figure 12: Cotton contribution to farmers' income



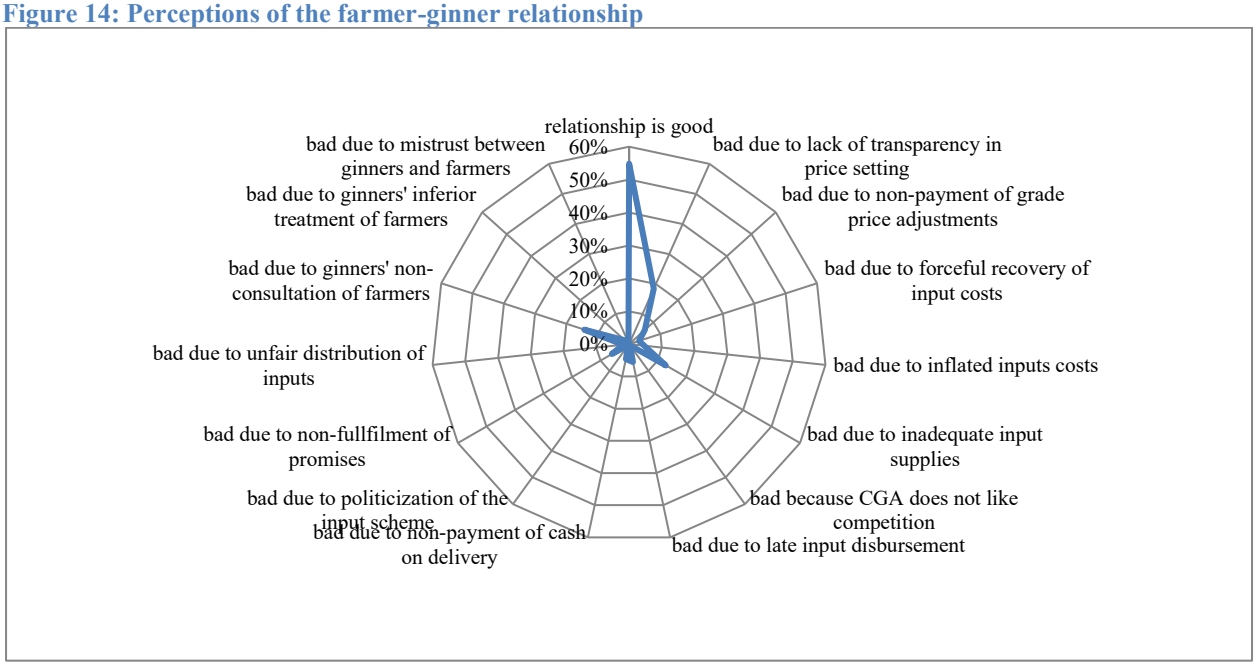
About 63.4% of the farmers interviewed indicated that the price paid for cotton is too low (see Figure 13) when their labour is included in cost calculations. About 43.7% of them are unsure what components make up the cotton producer price, although about 48% of the farmers were able to identify inputs costs such as seed, fertilizer, chemicals and labour as components of the cotton producer price. Only 13.1% of farmers identified international lint price as a component of the producer price. Meanwhile, ginners cite the international price as the main component of the price they pay to farmers, underlining information asymmetry gap between the two groups.

Figure 13: Cotton prices and elements considered in price setting



More than half of the farmers (54.8%) characterized their relationship with the ginners as good, but noted room for improvement. The rest of the farmers had some complaints, which included: non-transparent price setting system; differences between the indicative price announced at the beginning of the season and the price paid at sale; non-payment and lack of transparency in grade price adjustments (see Figure 14).

Figure 14: Perceptions of the farmer-ginner relationship



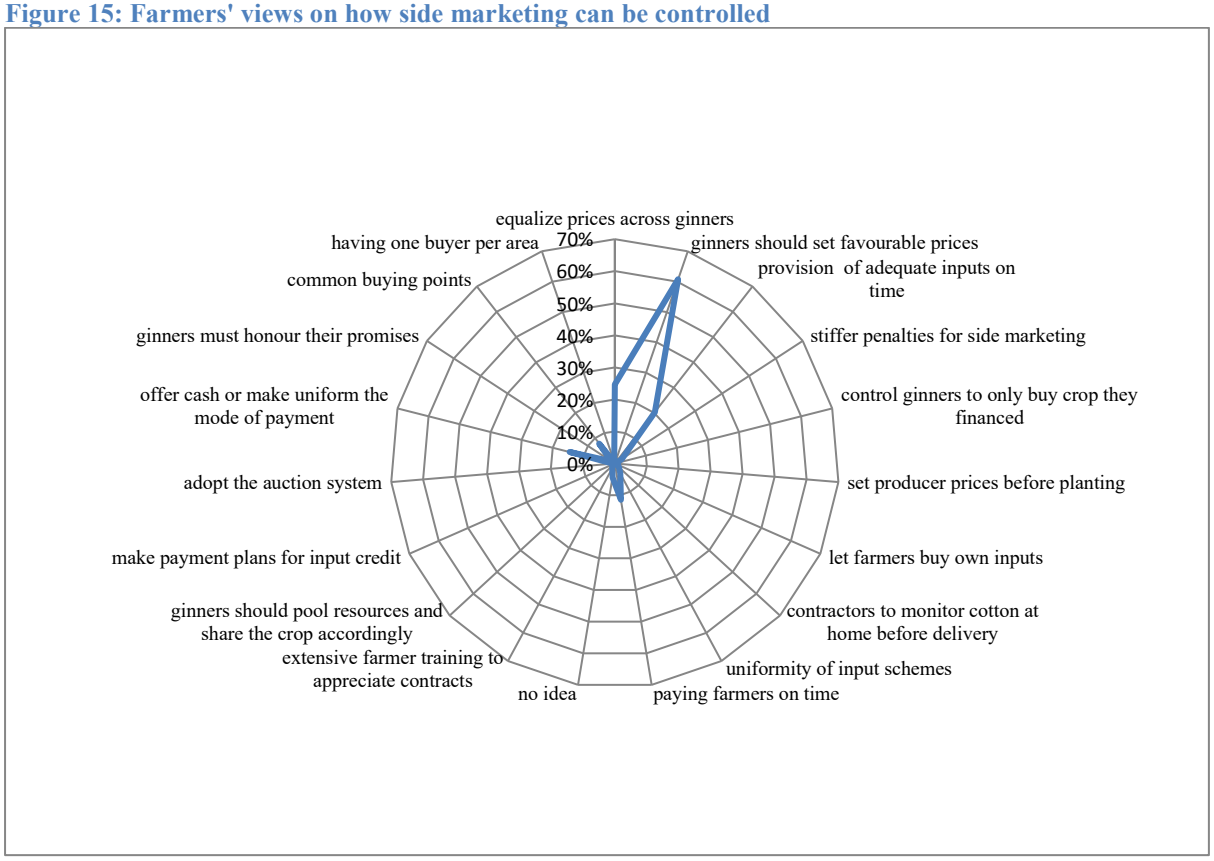
6.1.4 Farmers' perceptions on input package schemes and side marketing

About 69% of the farmers highlighted that the input package that they received was inadequate. The input package that they receive includes fertilizer, seed and chemicals. However, they are not given tillage loans and, as a result, some farmers without draught animals exchange a portion of the inputs they receive to pay for tillage. About 8.7% of the farmers interviewed indicated that they exchange some inputs for tillage or sell them to pay for household expenses. Some indicated that they use the inputs received for cotton on other crops, for example to control the outbreak of army worm on maize. Some farmers indicated that they deliberately overstate the hectarage they want to plant so that they are given more inputs, which they then use on half the hectarage. They do this as a way of ensuring that the inputs they get are adequate for the area they want to plant since ginners provide inadequate inputs. While this may contribute to ginners receiving less seed cotton than they pay for, and increase the risk of default by the farmer, it may also increase productivity, since more inputs are used per hectare than what the ginner would normally provide (i.e. ginners provide a partial input package per hectare). The moral hazard problem arising from the provision of inputs to farmer by ginners may call for the need for adequate monitoring by the ginners' technical staff to ensure that the inputs provided are utilised on the targeted hectarage.

Farmers were asked on how side marketing can be controlled. Most of the farmers (60.8%) were of the opinion that ginners should set favourable producer prices to control side marketing (see Figure 15). Favourable prices would create no incentive for selling to a ginner who has not provided inputs. However, ginners that finance inputs cannot compete with prices offered by ginners who do not finance inputs, since the former must deduct the input credit from the sale price.

Other farmers (24.7%) thought that side marketing can be dealt with through equalizing the cotton price across all the ginners, thus eliminating incentives for ginners to compete for harvests contracted to competitors.

Figure 15: Farmers' views on how side marketing can be controlled



Some farmers (20.3%) were of the opinion that ginners should provide adequate inputs, on time, to avoid side marketing. They felt that side marketing is partly caused by inadequate inputs provision, which results in farmers having to supplement the inputs by striking contracts with multiple ginners.

About 14.5% of the farmers indicated that side marketing could be controlled if all ginners used a similar mode of payment to farmers. For illustration, in the 2016/17 season, some ginners paid cash, some paid with mobile money, while others paid with a combination of both. However, farmers prefer cash over mobile transfers and they are therefore tempted to side market to cash buyers. Farmers dislike mobile money because of higher perceived transaction charges.

Some farmers (3.5%) highlighted that standardizing the input schemes across ginners would help reduce side marketing (see section 8 on the Ugandan common-pool model). Their thinking is that ginners offer different prices on the basis of the input package they will have provided to the farmers. Therefore those ginners who provide a less comprehensive input package will offer a higher price compared to those who offer a more comprehensive input package. As a result, there are incentives for side marketing, whereby a farmer who receives a more comprehensive input package from one ginner, before selling to a ginner offering a higher price but fewer inputs.

Establishing common cotton buying points was also raised by 7.9% of farmers as a way of dealing with side marketing. Farmers were of the view that when all ginners buy from a single point, chances of farmers selling to a ginner who did not finance the crop production will be limited. Respondents suggested that this could help restrict ginners to buying only the crop they have financed.

Some farmers indicated that having one buyer per area would reduce the incidence of side marketing. However, having one buyer per area is akin to creating a monopoly, which could limit competition and result in lower prices and high inefficiencies.

Some farmers suggested that farmers should be left alone to finance cotton production so that they can freely decide to whom they sell their crop, thus eliminating side marketing. However, it is unlikely that most farmers are able to finance production on their own.

Other farmers were of the view that the cotton industry should adopt the auction system that is used in the tobacco industry. Some suggested that ginners should pool resources together that will be used to finance cotton production and each contributing ginner is allowed to buy a portion of the total crop equivalent to their contribution to the common input fund.

Farmers also highlighted that ginners should make payment plans for input credit. They noted that side marketing is partly prompted by fear of losing everything to the ginners after input cost recovery. Thus, there should be an input credit payment plan that is considerate to the farmer's situation, since some of the factors that affect production are beyond the farmer's control.

Some farmers suggested that there would be need for extensive farmer training to appreciate and observe contract arrangements. There is need for behaviour change not only among the farmers, but also among the ginners, since both are involved in side marketing.

6.2 Ginners' perceptions

Ginners generally agree that there is scope for more cotton by-product value addition in the country. Some ginners regarded oil expression as a viable business in Zimbabwe, since the country consumes a lot of imported oil. Thus, oil expression would be good import substitution strategy for the country. Other ginners noted that there is a lot of potential in seed multiplication for the export market, since cotton production in Zimbabwe is done without irrigation and uses less pesticides and fertilizer, thereby producing seeds that are more natural than in markets where GMO seeds predominate.

Ginners perceive that one of the biggest inhibitors to increasing cotton by-product value addition is insufficient volumes of seed cotton production, which precludes economies of scale. However, some ginners argue that the biggest setback in the development of cotton by-product value chain is the limited market for finished by-products. While it can also be argued that the supply of seed cotton from farmers must increase first, there is no guarantee that industries can develop unless domestic and regional markets for the product are developed. As such, some ginners have no plans to add any more cotton by-products into the production chain unless there is an assured market for them. Currently, the economy is characterized by a lack of and high cost of capital, which also constrains investment prospects for cotton by-products value addition.

Lack of demand and the low-value nature of some by-products, such as linters, prevent their development. Germany and China were the main markets for linters, but the economic benefits of exporting are limited due to low volumes and low value. In addition, stiff competition from in expensive imports also displaces local production and makes cotton by-products activities unviable. However, there is need to explore opportunities in nearby regional markets.

6.3 Oil expressers' perception

Oil expressers generally acknowledge that the cotton by-product value chain is underdeveloped. Their decision to invest in cotton by-products value addition is mainly predicated on the availability of cottonseed as a raw material in sufficient quantities for economies of scale.

They note that the biggest impediment in producing cooking oil from cottonseed is the limited availability of cottonseed. Also, cottonseed oil is dark and would need a new purifying technology to lighten it. Any costly investments in purifying technology would further push oil expressers to use soya over cottonseed as their preferred oilseed. The oil expressers however conceded that a big positive for cottonseed oil is that it is generally thick and is the preferred oil for baker's fats and chips because it has a high smoke point, which enables it to withstand a higher temperature than many other edible oils before burning or dissipating.

6.4 Stockfeed perceptions

The stockfeed manufacturers noted that one of the impediments to cotton by-product value addition into stockfeed is the limited local demand for beef and dairy feed products, due to the abundance of pastures. The need for foreign currency was also raised as an impediment to increasing the use of cotton by-products in stockfeed, since some oil expressers prefer to export cottonseed meal to earn foreign currency, despite an unsatisfied local demand for cottonseed meal.

The stockfeed manufacturers also noted that while the focus could be on cottonseed meal, the availability of vitamins, minerals and other additives, which are imported, is the most critical issue that impedes cotton by-product value addition into stockfeed. There are about 10-15 vitamins, 10 minerals and six amino acids that are needed in the feed business and all have to be imported.

The other impediment is the low volume of cotton production. Stockfeed manufacturers note that although the market potential for cotton by-products for stockfeed production is high in Zimbabwe, the supply of cottonseed cake is low due to low production of cotton.

6.5 Perceptions of Stockfeed Manufacturers Association

The Stockfeed Manufacturers Association (SMA) perceives that the availability of the raw material has been the limiting factor in using cotton by-products in stockfeed in the past. SMA also observed that this season only one ginner, Cottco, is buying almost all the seed cotton and this could result in overpricing of the cottonseed cake to stockfeed manufacturers.

Generally SMA is optimistic of bright prospects for using cotton by-products in stockfeed, given a huge interest in raising goats, with Asian markets demanding over 1,000 goats a day. This could create a major demand for stockfeed produced from cottonseed meal. The Government's free input support scheme was also noted as a boost to cotton production and by-product value addition, although it is not a sustainable way to scale up seed cotton production.

6.6. Perceptions of farmers' unions

Zimbabwe Farmers Union

According to the Zimbabwe Farmers Union (ZFU), the main constraint in cotton by-product value addition is the limited scale of seed cotton production, which constricts the development of downstream value addition activities. ZFU notes that with current scale of production, value addition would require the technology to be small-scale or rely on cooperatives to assemble the required critical mass of raw materials.

ZFU notes that there are a number of factors that have led to the decline in production of cotton. It notes that Zimbabwe is a price taker hence it is affected by international price volatility, which often results in unfavourable cotton prices that de-incentivize production. Poor agronomic practices, such as sub-optimal plant population, limited fertilizer application resulting in the mining of soil nutrients and weakening the soil, mono-cropping, and non-adoption of efficient technologies (e.g. biotechnology cotton, which can withstand pests and have higher yields) are some of the challenges hampering production. In addition, yields are currently low, at between 450 and 500 kg/ha. ZFU highlighted the need to consider the adoption of GMO cotton for export and the generation of foreign currency.

Zimbabwe National Farmers Union

The Zimbabwe National Farmers Union (ZNFU) indicated that the underdevelopment of cotton by-products value chain is due, in part, to farmers' lack of knowledge on the potential value addition activities that can be undertaken at farm gate level. ZNFU also noted that cotton production is fragmented, thus limiting the number of value addition activities that are possible.

ZNFU also highlighted that the cotton contracting system in the country is currently tilted in favour of the buyers and against the farmers who produce the cotton, hence lowering production. The inputs that are provided by the buyers or ginners are also inadequate. Poor agronomic practices by farmers have also reduced productivity, which is currently about 500 kg/ha on average. Input costs are also high compared to other countries in the region, which negatively affects production and profitability. Prices of cotton are also very low, due to competition with synthetic fibres and this is de-incentivizing farmers to grow the crop.

There are also stringent regulations for cotton farmers that discourage some farmers from growing the crop. For example, as required by the SI142 of 2009, a farmer must register with multiple organisations, such as CGA, AMA and Quton, to receive inputs. Furthermore, the institutions responsible for registering farmers are centralized, hence not easily accessible to most of the farmers. Thus, the good intentions of the regulations maybe distorted by technicalities that increase compliance costs. Cotton inputs are also not readily available in retail shops, unlike those for other crops, such as maize.

6.7. Perceptions of Agricultural Marketing Authority

The Agricultural Marketing Authority (AMA) perceives that the decline in seed cotton production is mainly underpinned by the decline in productivity. According to AMA's End of Year Cotton Report for 2016, over the period 2000 to 2016, cotton productivity peaked at 1,098 kg/ha in 2004 and fell by 65.3% to 381 kg/ha in 2016. Factors contributing to low yields include inadequate inputs and their late disbursement. The lower price of lint due to heavy subsidies by major world producers was also noted as one of the main factors reducing seed cotton production in Zimbabwe, as they depress producer prices offered to farmers. The AMA End of Year Cotton Report for 2016 shows that the hectarage under cotton production peaked

at 432,901 ha in 2012 and declined by 82.7% to 75,000 ha in 2016, the lowest ever recorded hectarage over the period 2000 to 2016.

To promote seed cotton production, AMA and the Government undertook several initiatives. AMA indicated that it had put in place a regulatory framework in the form of statutory instruments (SI) 148 of 2009 and 63 of 2011 to ensure fairness and transparency in the funding, production and marketing of seed cotton. This encourages investors to fund seed cotton production and farmers to cultivate cotton. Regarding the claims by some farmers' unions that contract farming contractual agreements are biased in favour of ginners, AMA indicated that contractual agreements between farmers and ginners are negotiated by the farmers' unions and the ginners, in line with the regulatory framework set by the statutory instruments based on fairness and transparency. However, AMA noted that some leaders of farmers' unions are double agents, working for both the farmers' unions and the ginners. As a result, they may not negotiate in good faith on behalf of the farmers.

Among other issues, the regulatory framework covers the sanctity of contracts, transparency in the distribution of inputs, and setting up of common buying points, which help to reduce side marketing. The framework also covers the quota system, whereby ginners buy seed cotton from farmers according to the proportion of input financing contributed to the farmer. The quota system is intended to deal with side marketing and protect the farmer from ginners who partially finance the farmer and claim the entire harvest of seed cotton. However, AMA indicated that the quota system is failing to work properly because ginners are secretive; they do not submit their returns on input funding. These returns record farmers who have been financed by the ginner and the amount of financing, among other things. Without these returns, it becomes difficult to implement the quota system.

The Government also introduced a three-year Presidential Input Scheme that gives farmers free inputs. However, regarding the scheme's crowding out effect on ginners, AMA perceives that the free input scheme is complementary to the ginners' input schemes, since the ginners are providing inadequate inputs to the farmers. According to AMA, the free input scheme has helped cushion farmers at a time when they are facing low prices and inadequate inputs, which have resulted in low seed cotton production.

In response to the perception by farmers that most seed cotton production inputs are not as widely available in agro-dealer shops, as the case for other crops, such as maize, AMA indicated that all the inputs except cotton planting seed are available in agro-dealer shops. However, the cotton planting seed is available in all cotton depots throughout the country. The challenge with the farmers is that even if the planting seed is made widely available they could not afford the seed. Usually the farmers are given the planting seed on credit under a contract farming agreement.

In order to avoid abuse of inputs availed through the Presidential Input Scheme, AMA indicated that there are mechanisms in place – such as registering and following-up on beneficiaries, targeting of bona fide farmers only, and limiting input package to one hectare, with a provision for special cases of farmers who have a record of managing more than one hectare.

6.8. Perceptions of the Ministry of Industry and Commerce

The Ministry of Industry and Commerce indicated that it co-chairs the Zimbabwe Agenda for Sustainable Social Economic Transformation (ZIMASSET) cluster on value addition and beneficiation, the mission of which is to identify high impact value chains, promote growth of

value addition and beneficiation activities and create an enabling policy, institutional and regulatory framework for enhanced productivity and competitiveness. The cotton-to-clothing value chain is identified as a priority area under the value addition and beneficiation cluster. The government's vision of the cotton value chain, as captured in the Cotton-to-Clothing Strategy (2014-2019), is to create a competitive and sustainable cotton value chain that maximizes the linkages and elevates socioeconomic development in Zimbabwe, based on quality and value.

Among other challenges that the Ministry of Industry and Commerce notes as hindering the development of cotton by-products are: the lack of adequate downstream infrastructure; weak enabling policy and institutional environment to support the development of cotton by-products industries; poor market information on cotton by-products; and the lack of data to assess economic viability of opportunities for investments in cotton by-products industries.

Some of the initiatives that the Ministry has undertaken to promote cotton by-products value addition include the development of the Cotton-to-Clothing Strategy (2014-2019), undertaking study visits to Kenya and Egypt on policy development for the cotton value chain, development of a seed cotton pricing model that rewards quality and contamination free cotton, and the promulgation of Statutory Instrument (SI) 64 of 2016 to protect local industry from import competition. The Cotton-to-Clothing Strategy seeks to improve the management and packaging of cotton by-products, such as cotton motes and linters, and incentivize development of new products, such as special paper from linters and other products such as soap and margarine, instead of throwing away or selling by-products in raw form.

7. LEARNINGS FROM UGANDAN INPUTS SCHEME

Until recently in Zimbabwe, ginners traditionally provided cotton farmers with inputs on credit, recovering costs from the final purchase price through an individual contract with the farmer. Through the Presidential Inputs Scheme, the Government used to augment inputs supplies by distributing planting seed, for example in 10kg packets. In the 2015/16 season, the Government introduced a three-year free inputs scheme, through which it provides a full package consisting of seed, fertilisers and chemicals. In the 2016/2017 season, the Government provided inputs worth USD 42 million, thereby supporting more than 90 percent of the season's crop.

The parallel government and ginner inputs schemes risk double contracting the crop and creates conditions for side marketing. For example, in the 2016/17 season, some farmers took the free inputs from the government scheme and also received inputs from ginners. Through the Agricultural Marketing Authority (AMA), the Government sets the minimum inputs package. However, ginners have continued to exercise caution in providing the inputs to farmers. Input packages have been based on the basis of a farmer's repayment history, and not necessarily on the minimum hectarage package.

Uganda has a common fund managed by Cotton Development Organisation. The establishment in Zimbabwe of a similar common fund for all ginners would ensure that inputs are procured in sufficient quantities and at the correct times in the season. In the absence of a common fund, the timing of the purchase of inputs is determined by individual ginners' cash flow. The quality of the inputs procured is again at the discretion of an individual ginner, making the rotations of chemicals difficult as the chemicals provided are based on the discretion of the ginner as opposed to farmer choices.

In the 2014/15 season, ginners agreed among themselves on the maximum quantity of seed cotton each ginner could procure, based on the amount of inputs it distributed. Whilst this helped in reducing side marketing, it did not create a sustainable crop, as there was no guarantee that farmers would receive adequate inputs on time. One major short coming of this arrangement was that inputs delivered late were valued the same as those that arrived on time, despite their differential impact on yield.

The arrangement to share the crop only lasted for one season, as the Government introduced a free scheme in the 2015/16 season. Whilst there are common input distribution points, ginners disburse inputs according to the stock they have on hand. Meanwhile, the government's free input scheme could be used as the basis for establishing a common fund, from which ginners would then fund the next season's inputs, with each ginner's contributions to the fund based on their purchases of seed cotton in the previous season.

While the three-year free inputs scheme will likely boost production, the sustainability of this arrangement is unclear. A zoning model would not provide sustainability in Zimbabwe, as the cotton growing areas have different climatic conditions with some areas more suitable for cotton production. For example, before Uganda implemented a common fund for ginner input purchases, an earlier zoning scheme was abandoned due to the political outcry from small ginners, who resented the smaller purchasing allocations they received under the scheme. Zimbabwe could therefore improve the sustainability of its national input scheme by adapting the Ugandan common pool model, with ginners' seed cotton purchases tied to their contributions to the pool.

8. CONCLUSION AND RECOMMENDATIONS

From the results of the survey and the analysis in this report, we recommend the following actions to develop the cotton by-products sector in Zimbabwe:

1. There is a need for capacity building and knowledge sharing / awareness on the full potential for value addition to cotton and cotton by- products. For example, farmers can be capacitated with knowledge to explore opportunities for farm-level value addition, either as individual farmers or as a collective (i.e. in village-level cooperatives/clubs).
2. Incentives are needed to improve yields, which, in turn, result in growth in the volume of seed cotton, a prerequisite to achieving economies of scale for value added activities on cotton by-products.
3. There is also need for deliberate policy incentives to encourage investment in or adoption of technologies to add value to cotton stalks, which can increase farmers' incomes. The incentives will also help to increase the competitiveness of the production of kraft paper locally. These policy incentives may include tax credits on imports of capital equipment/appropriate value addition technologies. This may include provision of Special Economic Zones (SEZ) status for selected cotton areas to encourage value addition at source.
4. Enhanced cotton production will increase feedstock to ginneries, with a resulting increase in the production of lint and by-products, such as ginned seed, motes and cotton linters. Building the capacity of state actors and industry players to address side marketing is critical for the development of cotton production and improvement of yields of cotton farmers. Ginners are reluctant to invest in adequate input packages where they are not assured that the will buy the entire crop they financed. Furthermore,

empowering smallholders with knowledge of value creation in the entire value chain, transparency in pricing and fair treatment of the smallholder farmers is essential to increasing cotton production.

5. Development and multiplication of seed varieties that result in improved yields; increased use of cost-effective and time saving technologies; and adoption by farmers of sound agronomic practices are critical for the enhancement of production and productivity of cotton. The debate on the merits and demerits of use of Genetically Modified Organisms (GMOs) also need to be settled in a way that provides clear policy guidelines to the sector.[19]
6. Investing in the technology to remove gossypol from the cottonseed meal will enhance demand for the cottonseed cake by stockfeed industry is critical for the uptake of cottonseed cake for the production of stock feeds for ruminants and non-ruminants. However, recent investments in modern plants in the stock feed are largely underutilized due to lack of demand for feed as well as the limited supply of the raw materials to produce to capacity.
7. There is need to set viable cotton producer prices and improve transparency in the determination of cotton producer prices to eliminate mistrust between farmers and ginners. Most farmers (92.5%) identified cotton producers price as a key determinant in increasing the volume of cotton produced.
8. Provision of adequate input packages comprising of fertilizer, seed, chemicals and tillage support was noted as being essential to avoid diversion of inputs to pay for tillage by farmers.
9. Adoption of standard modes of payment (i.e. cash, eco-cash and electronic transfers), using a common pricing formula (i.e. a consensus, public pricing formula) was seen as a strategy for avoiding side marketing.
10. Reduce farmers' transaction costs by making cotton inputs being readily available in retail shops and reducing the costs of the farmer registration process.
11. Rebalance the cotton contracting system in the country, which is currently tilted in favour of the buyers, with an adverse effect on farmers' incentives to grow cotton.
12. Adapt the Ugandan model of a common fund for input provision to the Zimbabwean context. This is likely to address crowding out and side marketing that result from the current competition between the public and private input schemes.
13. There is a need for monitoring by the ginners technical staff to ensure that amount of inputs provided is accurate for the targeted hectarage. Also, the distribution of inputs should be based on the historical performance of the farmer rather than the hectarage that the farmer intends to plant.

[19] While GMOs are a topical debate, the subject deserves more exhaustive and technical research on the pros and cons to be able to come up with practical recommendations. This analysis is beyond the scope of this survey.

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