



# Underlying Constructs of Farmers' Perceptions towards Bt Cotton Among Former Cotton Farmers in Northern Ghana: Empirical Application of Q Methodology

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## Abstract

**Keyword:** Bt Cotton, Perceptions, Narratives, Q Methodology, Principal Component Analysis, Dimensions and Underlying Constructs

It is often argued that learning from best examples in the neighboring Burkina Faso and elsewhere, Ghana can succeed in revamping the collapsing cotton industry by introducing Bt cotton to farmers. This paper therefore presents a survey findings on farmers' views and perceptions towards the possible introduction of Bt cotton. A stratified random sampling technique was applied in selecting 254 farmers from the four cotton producing zones in northern Ghana and Q methodology adopted in collecting narratives and perceptions towards Bt cotton. Principal Components Analysis (PCA) was applied in extracting the underlying constructs from farmers' narratives on Bt cotton. The extraction method was guided by Kaiser's Eigenvalue-greater-than-one rule follow by Parallel analysis method of Monte Carlo and Scree test techniques. Results of the PCA identified five broad issues representing farmers' views about the introduction of Bt cotton. The broad issues explaining farmers' views and perception towards Bt cotton are 'contractual issues with cotton companies', 'issues relating to problems and challenges in cotton farming', 'issues relating to farmers desire to go back to cotton farming', 'positive views on Bt cotton' and 'some reservations on Bt cotton'. This paper therefore recommends that for government and other stakeholders to succeed in revamping the cotton industry, there is the need for farmers' concerns on contractual issues to be addressed and for more information on Bt cotton to be provided to resolve the reservation farmers have about Bt cotton.

## 1. Introduction

Cotton farming and its related economic activities in the textile industry have been a major source of income and foreign exchange earnings in many Sub-Saharan African countries. Cotton is one of the most important cash crops in sub-Saharan Africa, grown almost exclusively by about 1.7 million cotton farmers in rotation with the cultivation of food crops (Peltzer and Röttger, 2013). Cotton production in Sub-Saharan Africa is largely undertaken by smallholder rural poor farmers and in most places, especially in the Sahelian and Savannah regions, cotton serves as the major cash crops and income earning agricultural commodity to the peasant farmers who are engage in its cultivation (NORC, 2011). The crop is therefore critical in the fight against rural poverty and ensuring sustainable income

among smallholder farmers. The contribution of cotton farming to rural economies of developing countries in the area of generating significant farm income and rural employment have long be demonstrated in available literature (Vognan, Ouedraogo and Ouedraogo, 2002 and Vitale, Ouattarra and Vognan 2011). For instance, in Burkina Faso and Mali, cotton is regarded as the region's "white gold", serving as one of the leading sources of export earnings and a major source of employment and household income in rural areas accounting for 60% of household income (Vognan et al, 2002., Teft, 2004).

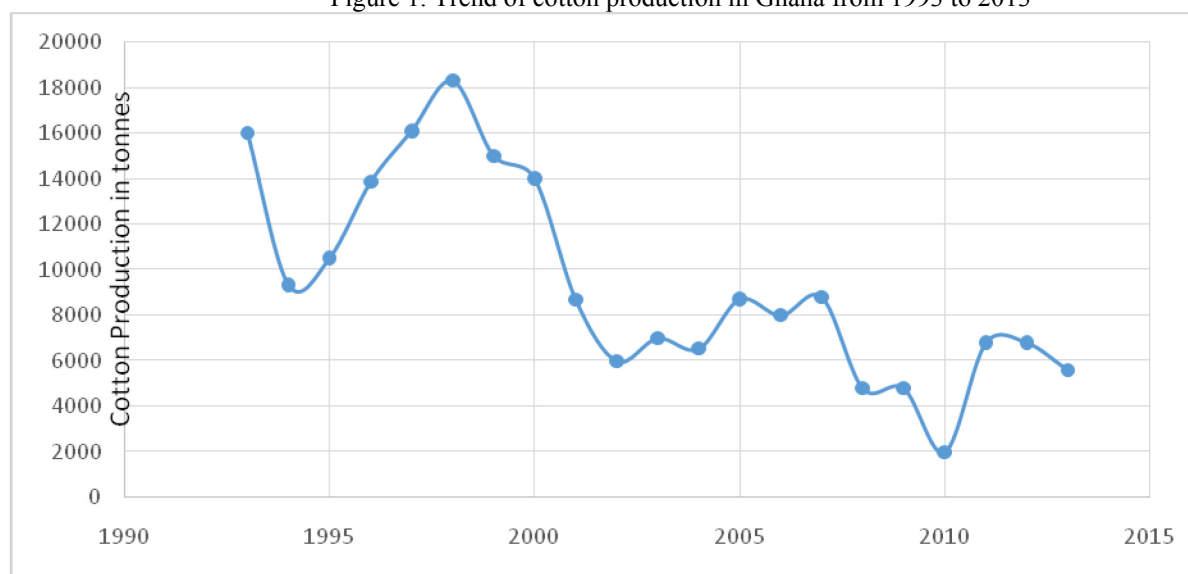
### 1.1 Cotton Production in Ghana

Ghanaian smallholder farmers have been engaged in cotton farming since its introduction in the 17<sup>th</sup> century (Seini, 2002). Government of Ghana

in promoting cotton production established the Ghana Cotton Development Board (GCDB) in 1968 with the mandate to organize and coordinate activities aimed at enhancing cotton production for the domestic textile industry and for export (Scholtes et al. 2011). The three northernmost regions of Ghana namely Upper East, Upper West and Northern Regions are the major cotton growing areas in the country. Incidentally, these regions are the poorest regions in the country (GSS, 2010) and therefore cotton farming in these areas is strategic for any efforts to help

reduce poverty among the people. Analysis of statistics from FAO STAT (2016) on volume of cotton production in Ghana over the last two decades (1993 to 2013) as shown in the Figure 1, illustrate rather erratic and steady decline in cotton production in the country. The highest production the country had recorded within the last two decades was 18,300 tonnes in 1998 which declined steadily to as low as 2,000 tonnes in 2010 representing 89 percent decrease in cotton production within the period.

Figure 1. Trend of cotton production in Ghana from 1993 to 2013

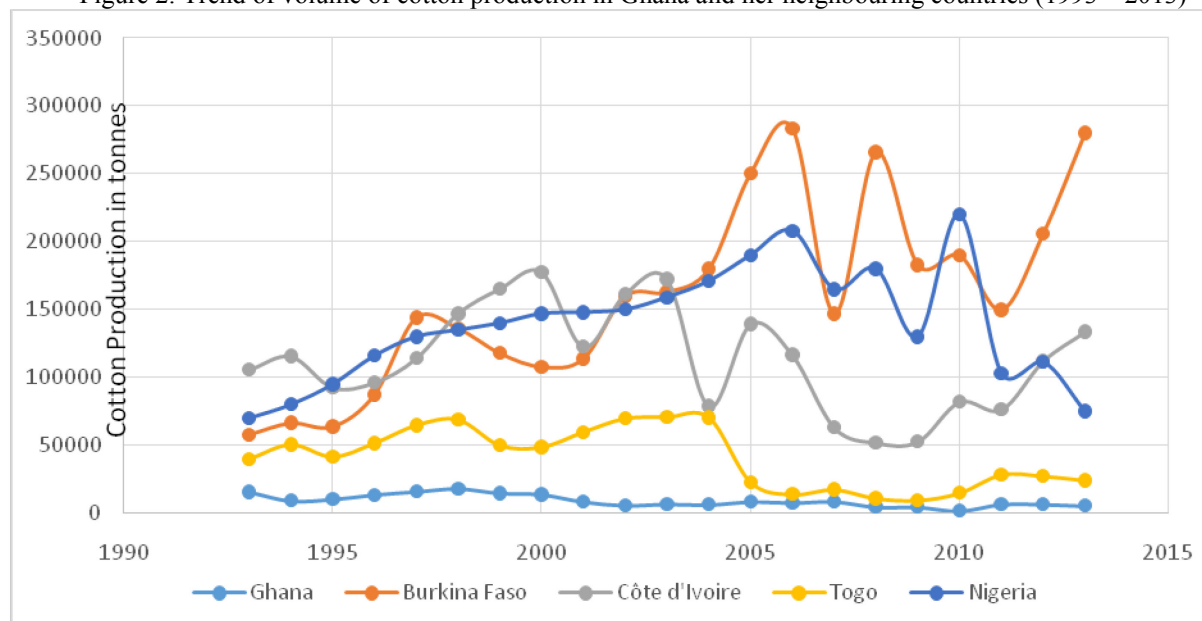


Source: Analysis of Data from FAO STAT (2016)

Comparing Ghana's cotton production trend within the context of her neighboring countries namely Burkina Faso, Cote D'Ivoire, Togo and Nigeria as illustrated in the Figure 2 show general declining trend of cotton production within the last two decades with the exception of Burkina Faso which had seen a quit steady and impressive increasing trends in her cotton production volumes. Ghana's production volumes over years have consistently been the lowest compared with her five

neighboring countries. Burkina Faso in 1993 was in the third position among the five countries being compared, with production volume of just 58, 000 tonnes and thereafter moved to the first position in 2004 with production volume of 171, 000 tonnes and increasing rapidly thereof to nearly 3 million tonnes in 2013. This demonstrates a striking contrast in production volumes between Burkina Faso and Ghana inspite of similar conducive environment for cotton production.

Figure 2. Trend of volume of cotton production in Ghana and her neighbouring countries (1993 – 2013)



Source: Analysis of Data from FAO STAT (2016)

### 1.2 The Success of Bt cotton in the Neighboring Burkina Faso

The significant increasing trend of Burkina Faso's volume of cotton production can be attributed to among other things the progressive stand the country have taken towards agro biotechnology leading to commercialization of Bt cotton in 2009 (Vitale, Ouattarra and Vognan, 2011 and Vitale, 2010). Vitale, (2010) found significant increase in yield of Bt cotton by an average of 18.2% over conventional cotton following Burkina Faso's 2009 commercialization of Bt cotton. Also Vitale, (2011) concluded in a study on cotton production system in West Africa, that Bt cotton increased cotton yields in Burkina Faso by an average of 21.3% and raised income by \$106.14 per ha. Their study also observed that the introduction of Bt cotton in the country would also result in a 6.6% saving in energy use. They further observed that the significant increase in productivity and economic returns could be the catalyst for Burkina Faso, and other African countries, to emerge from the decade or so of stagnation and regain their competitive stance in the international cotton market while ensuring environmental and social benefits accruing from Bt cotton. Similar yield gains have been made possible in Sudan, South Africa and India as a result of commercialization of Bt cotton and they are all developing countries like Ghana.

Similar impressive results of Bt cotton is being realized in Sudan. In the fourth year of commercial planting of Bt cotton in Sudan, a total of 90,000 hectares of Bt cotton were planted, up from

61,530 hectares, representing an increase of 46% over the 2013 figure. As such about 80% of Sudan's total national hectreage of 109,200 hectares in 2014 were biotech cotton. Close to 30,000 farmers with an average land holding of 2.5 hectare planted Bt cotton in 2014 representing threefold from initial 10,000 beneficiaries who adopted Bt cotton cultivation in the first year of commercialization (James, 2014). Biotech cotton have brought many benefits to Sudanese cotton farmers and the country's cotton industry at large, ranging from reduction in cost of production, increasing yields to environmental benefits as a results of reduction in pesticide spraying. As observed by James, (2014) that in 2012, Bt cotton saved 37% of the direct cost of cotton production in Sudan. Producing conventional cotton was much higher at US\$930 per hectare compared with US\$615 per hectare for Bt cotton. The net profit for a farm planted with Bt cotton, compared with conventional cotton was US\$400 per hectare.

Also, elsewhere in Indian, another developing country, the success of Bt cotton is abound. According to Choudhary and Gaur, (2015; p4) in the thirteen year period, from 2002 to 2014, India allowed commercial production of Bt cotton, the country 'tripled cotton production from 13 million bales to 39 million bales in 2013, with a projected 40 million bales in 2014'. Also estimates from (Brookes and Barfoot, 2015) indicate that India enhanced farm income from Bt cotton by US\$16.7 billion in the twelve year period 2002 to 2013 and US\$2.1 billion in 2013 alone. The adoption of Bt cotton in India had seen yield gain increased up to

31% and a significant reduction in chemical used up to 39% leading to an 88% increase in profitability (about US\$250 per hectare) which has contributed to the alleviation of poverty for over 7 million small resource-poor farmers and their families in 2011 alone, and the future prospects look encouraging (James, 2011).

### 1.3 Ghana Agrobiotechnology Agenda

Bt cotton being a transgenic crop variety, requires biosafety measures, regulations and institutional framework to be put in place before its commercialization can be allowed. In terms of policy, Ghana have express policy of utilizing the tools of agro biotechnology in her agricultural development. Ashitey, (2013) observed that agro biotechnology as a tool for crop improvement is increasing being regarded in Ghana as a promising technology for propelling agricultural development and increasing farm income. Impressive progress has been made in terms of enactment of regulatory and biosafety regimes and agro biotechnology research to ensure safety application of agro biotechnology in Ghana. The country now had biosafety act (Act 831) passed in 2011, laying out the necessary institutional and regulatory bodies required in the smooth implementation of commercial application of biotechnology in food production and marketing. Also the National Biosafety Authority (NBA) had been put in place to supervise and coordinate the activities of agro biotechnology research and possible production of biotech crops (GNA, 2015)

With regard to progress in biotechnology research and Genetically Modified (GM) crops development and commercialization, Savannah Agricultural Research Institution (SARI) of the Council for Scientific and Industrial Research (CSIR) is currently undertaking adoptive trials and research into genetically modified cowpea and Bt cotton. SARI had established a biotechnology cowpea farm at Nyankpala in the Tolon District and a biotechnology cotton farm at Kpalkore in the Mion District (Ashitey, 2013 and GNA, 2013).

In spite of all these progress towards possible introduction of Bt cotton and GM cowpea by SARI, very little is known about the perceptions and views of farmers towards Bt cotton. It is important to explore farmers' narratives about cotton farming in general and Bt cotton in particular with the view of understanding the underlying constructs informing such views so as to help guide implantation of policies and programmes as the country prepares to introduce Bt cotton to farmers. It is in line with this, that the current paper presents findings of a survey undertaken to analyze farmers' views and perceptions towards the possible introduction of Bt cotton among cotton farmers in Northern Ghana.

### 1.4 Organizational Model of Ghana Cotton Sector

Organizing and coordinating 'effort or measures designed to make players within cotton market system act in a common or complementary way or towards a common goal is very critical in ensuring efficiency and guaranteeing standards (Poulton et al., 2004). Tschirley et al. (2010) identified five types of African cotton sector, based on the structure of the market for the purchase of seed cotton and the regulatory framework in which firms operate. They first distinguish between 'market-based' and 'regulated' sectors, and argued that since all markets function within some type of regulatory framework, 'regulated' in this context means that competition for the purchase of seed cotton is not allowed. Two market-based sector types can be distinguished: those with 'many' buyers of seed cotton (competitive systems) and those with 'few' such buyers (concentrated systems). Firms in competitive sectors tend to compete on the seed-cotton price paid to farmers, while those in concentrated sectors compete primarily on the quality of pre-harvest service provision to farmers (Tschirley et al., 2010).

Until 1977 private participation in cotton marketing system was very limited in Ghana with the public sector being the sole agent in cotton marketing. As such, the Government of Ghana in 1968 established the Cotton Development Board (CDB) with the mandate to coordinate the production of cotton, ensure adequate supply of raw materials to local textile industries and undertake research and extension on improved varieties (Scholtes et al., 2011). However, liberalization of cotton marketing begun earnest in 1977 leading to the privatization of CDB which was re-constituted into the Ghana Cotton Company Limited (GCCL) in 1985 with 30% of its shares taken by government (Philippe et al., 2011). The liberalization of cotton marketing system in Ghana led to the entering of the Ghanaian cotton market major private companies such as Nulux Plantation Limited, Intercontinental Farms Limited and Plantation Development which was latter joint by Olam, Wienco and Armajaro.

To ensure smooth operations of the numerous cotton companies, the cotton growing areas were zoned and assigned as exclusive concession to particular companies. Zoning is a principle of demarcating the cotton growing areas into an exclusive zone for particular companies. This means that, farmers within a zone are limited to dealing only with the company assigned to operate in that zone. The zoning principle was initiated by the Ministry of Food and Agriculture to address malpractices in the cotton industry. The zoning topology of organizing

and coordinating cotton production and marketing among purchasing companies fall in the regulatory framework, which ensure that competition for the purchase of seed cotton is not allowed (Tschirley et al., 2010). Scholtes et al.(2011) in their discussion paper ‘revitalizing the Ghanaian cotton sector’ noted that some years back zoning was introduced to bring better order into cotton production and the system of three cotton producing zones still exists. In 2010, Olam, Wienco and Armajaro with partners were the cotton trading companies that have received the concessions for cotton production and assigned to their respective zones and they have since invested \$10-15 million (Schotes et al, 2011).

Farmer organization and grouping also plays a critical role in cotton production and marketing system as it ensure efficiencies and reliability in input distribution and produce purchasing. However, Philippe et al (2011) observed that cotton farmers in Ghana are poorly organized compared to their counterparts in Burkina Faso. This negatively affects the entire cotton production system in Ghana as it causes a lot of inefficiency, both on behalf of the cotton companies in negotiations but also in terms of efficient input supply schemes. Cotton companies have adopted the strategy of working with farmers in small producer groups within communities’ instead of as individual farmers. The sizes of the Cotton Producer Groups (CPGs) vary from about three members to as many as fifty or more members. The CPGs who are basically at the community level and are linked to Cotton Farmers Associations (CFAs) which is form for each zone.

The CFAs performs very important functions including conducting initial screening of members before registration by cotton companies, receive farm inputs from cotton companies for onward distribution to members, recording data on land preparation, farm inputs and seed cotton marketing for use by Cotton Production Assistants (CPAs), contributing to pay any outstanding debts should any member default and monitoring cotton production activities by members (Philippe, et al,

2011. The Cotton Production Groups relate to cotton companies through zonal officers and CPAs. The CFAs are represented at the district, regional, zonal and national levels.

## 2. Materials and Methods

The study was conducted in the three regions of northern Ghana, namely Northern Region, Upper East and West Regions. This part of the country being the major cotton growing area, was zoned into four zones and assigned as concessions among the cotton companies which were operating in the area by the Ministry of Food and Agriculture (MOFA). However, many of these companies are no longer in operation, making cotton production eventual non-existing. As a result of revitalization of the Ghanaian cotton sector, three private companies namely Olam, Wienco and Armajaro join the market and replaced the collapsed companies (Scholtes et al., 2011). The filed survey conducted to collect primary data covered all the four zones as was first constituted to ensure representativeness of the findings.

Multi-stage sampling techniques were employed in selecting participants for this study. Stratified random sampling techniques were employed with the four cotton producing zones being the strata for the sampling. Followed by simple random sampling of communities in each strata (zone) and finally another simple random sampling in selecting participants from a list of former cotton farmers obtained from former Cotton Production Assistants (CPAs) and contact members of Cotton Farmers Associations (CFAs) in the selected communities.

Initially, 260 participants were targeted for the sample size, with sixty five (65) from each of the four zones. However, when the administered questionnaire were prepared for analysis six questionnaire were considered unusable thereby reducing the total sample size to 254 as shown in the Table 1 below.

Table 1. Distribution of sample size

Zone	Sampled District	Sampled respondents
Saboba, Chariponi, East Gonja	East Gonja	64
Gambaga (East Mamprusi )	Gambaga	65
Wa, Bole, Nadawli, Jarapa and Lambusi	Wa and Jarapa	60
Yendi, Savulgu/Nanton, Tolon/Kumbungu, West Mamprusi, East and west Sissala, Nakpanduri (East Mamprusi, Bunkpurugu, Bolgatagna and Sadema	Savulgu/Nanton, Bolgatanga and Sedema	65
Total		254

Author, 2015

### 2.1 Data Collection and Q methodological Process

Q methodological approach, which was invented by William Stephenson in 1935 as a systematic approach of gathering communicability or discourse surrounding a topic under investigation (Stephenson, 1935), were employed in collecting and processing data for this study. This method allows the adoption of participant's point of view and understanding as central to its investigative procedures. Q methodology is seen as a method that provides researchers a systematic and rigorously quantitative means for examining human subjectivity on array of social issues (Purnamita and Bhaskar, 2004). The very essence of Q-study is to capture people's subjective views about an issue and analyse it in order to identify shared views, connectivity, patterns and variations. As such, participants under study, are selected from the people involved in the discourse and asked to sort statements in their preferred order of importance on a large board refers to as Q sorting process. As such this method was considered appropriate in studying former cotton farmers' narratives on cotton production and their perception towards adoption of Bt cotton farming.

In gathering farmers' narratives regarding cotton farming and their knowledge and perceptions towards Bt cotton, both primary and second sources were employed in obtaining exhaustive discourse surrounding cotton farming. These exhaustive narratives or discourse surrounding the topic of interest in Q methodological approach is referred to as *concourse*. As explained by Saheed (2014), a *concourse* can be ordinary conversation, commentary or discourse about everyday life and includes all communication about a specific topic. A *concourse* consists of all that can be thought and said about a situation, event, or phenomenon'. The significant operation in Q methodology is that the collected *concourse* is regarded as evidence of subjective communicability of participants (Davis and Michelle, 2011).

In this study, the *concourse* comprises of all that can be said about cotton farming in general and Bt cotton in particular as perceived by the farmers who used to farm cotton. Open ended questions were developed and eight (8) key informants' interviews, two in each of the four zones, were conducted among experience former cotton farmers to gather primary source of narrative on the issue. In addition, information on farmers' views on Bt cotton were obtained from documentary sources such as published and unpublished research articles, newspapers, working papers and policy briefs. According to Saheed (2014) primary sources include interviews, group discussions and talk shows, while the secondary sources include work files, newspaper, literature and editorials. With this information,

statements were extracted from the *concourse* for Q sorting during the actual filed survey.

From the narratives collected during the extensive eight (8) key informant interviews and information from documentary sources, 46 statements were extracted to constitute the Q sample. This Q sample was presented to all the 254 participants sampled to rate on five point Likert agreement scale as 1 strongly disagreed to 5 strongly agreed. As such the person sample (P sample) in this study was 254 participants which met the minimum criteria of having the P sample being at least five times the Q sample. Although sample size is not important in Q study and factor analysis, there are varying opinions and guiding rules of thumb regarding the appropriate sample size or P sample to be used to ensure reliability of findings (Tabachnick and Fidell, 2007 and Hogarty et al, 2006 as cited in William, Brown and Onsmann, 2012). For the process of selecting the P sample, refer to table 1. The processing of rating the statements presented to the participants in Q methodology is referred to as Q sorting process.

## 2.2 Principal Component Analysis

Principal Component Analysis (PCA) was applied in analyzing the Q sorts to identify inter correlations and patterns among the various sorts of participants. This is to help reduce the dimensions in the set of the data set to manageable size which represent the underlying constructs charactering participants' views on cotton farming and their perception towards Bt cotton. The central idea of Principal Components Analysis (PCA) is to reduce the dimensionality of a data set, consisting of large number of interrelated variables, while retaining as much as possible of the variation present in the data set. This is achieved by transforming the data set to a new set of variables, the Principal Components (PCs), which are uncorrelated, and which are ordered so that the first few retain most of the variation present in all of the original variables (Jolliffe, 2002). To be able to obtain clear and easy to interpret pattern and structure of constructs underlying the narratives of issue being studied, direct Oblimin rotation was undertaken. The aim of rotation is to simplify the factor structure of a group of items, or in other words, high item loadings on one factor and smaller item loadings on the remaining factor solutions (William et al., 2012 and Costello and Osborne, 2005).

Prior to the extraction of the factors, several tests are usually used to assess the suitability of the data set for factor analysis as observed by William et al, 2012). These tests include Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity (Bartlett, 1950; Kaiser, 1970 and Kaiser et al, 1974 as cited in William,

2012). The KMO index, in particular, is recommended when the cases to variable ratio are less than 1:5. The KMO index ranges from 0 to 1, with 0.50 considered suitable for factor analysis. The Bartlett's Test of Sphericity has to be significant ( $p < .05$ ) for factor analysis to be suitable (Tabachnick and Fidell, 2007 as cited in William, et al, 2012).

The number of underlying dimensions to be extracted from a given set of data is aimed at reducing a large number of items into factors. In order to produce scale unidimensionality, and simplify the factor solutions, William, (2012) noted that several criteria are available to researchers. The many extraction methods and approaches include Kaiser's criteria (eigenvalue  $> 1$  rule), the Scree test, the cumulative percent of variance extracted, and parallel analysis.

However, as observed by Costello and Osborne, (2005) and reiterated by William et al, (2012) given the choice and sometimes confusing nature of factor analysis, no single criteria should be assumed to determine factor extraction. Also Thompson and Daniel, (1996) indicated that simultaneous use of multiple decision rules is appropriate and often desirable in settling on appropriate factors to extract. As such in this study Parallel analysis method of Monte Carlo and Scree test techniques were used in guiding factor extraction process. The factor extraction method was relied on in identifying the underlying dimensions of the data set gathered to assess farmers' perception towards Bt cotton. According to Ledesma and Valero-Mora, (2007) Parallel Analysis is a Monte Carlo simulation technique that aids researchers in determining the number of factors to retain in Principal Component and Exploratory Factor Analysis. This method provides a superior alternative to other techniques that are commonly used for the same purpose, such as

the Scree test or the Kaiser's eigenvalue-greater-than-one rule.

### 3. Results and Discussion

#### 3.1 Sociodemographic Characteristics Of Former Cotton Farmers

Most of the farmers interviewed were in their middle ages with mean age of 50 years, living in relatively large households with average household size of 8 person per house (Table 2) compare with the national average of 4 persons per house (GSS, 2010). Until they stopped growing cotton some 4 to 7 years ago (average of 5.5 years), respondents to this survey were well experience in the cultivation of cotton with an average years they engaged in farming cotton of 10 years. Until they stopped growing cotton, the 254 former cotton farmers interviewed were cultivating an average of 5 acre (SD = 2.25) with the range of 2 to 9 acre. They however, cited losses (48.5%) and the fact that the cotton companies stopped purchasing cotton (51.5%) as their main reason why they stop growing cotton (Table 3). Respondents interviewed were mainly engaged in food crop farming with average farm size of about 7 acres (SD = 3.39) dedicated to food crop production and only 1.74 acre were under cash crop cultivation, mainly soybean. They however, indicated that they have large parcel of land which can be put back into cotton farming if condition are right for that. The average land holding, land under cultivation and those left fallow, among the 254 respondents surveyed were found to be 11.97 acres (SD = 5.93).

Most of the former cotton farmers interviewed were males and illiterates with only 14.6% indicating they could read/or write. Majority (71.7%) of the respondents were married, belong to male headed households (80.7%) and a little over two third (69.7%) of them belong to farmer based organizations (Table 3).

Table 2. Descriptive Statistics of Sociodemographic Characteristics

Characteristics	N	Min.	Max.	Mean	SD
Age (in years)	254	32.00	65.00	50.14	7.35
Household size (in persons)	254	4.00	18.00	8.33	3.91
Experience in cotton farming (in years)	254	4.00	17.00	10.19	4.28
Land under food crops cultivation (acre)	254	2.00	13.00	6.90	3.39
Land under cash crops cultivation (acre)	228	1.00	5.00	1.74	0.79
Land left fallow (ha)	220	1.00	4.00	2.27	1.21
Land give out to friends or leased out (acre)	93	1.00	5.00	2.90	1.50
Total land (acre)	254	3.00	21.00	10.97	5.93
Since how long have stopped growing cotton (in years)	254	4.00	7.00	5.54	1.13
Size of last cotton farm (ha)	254	2.00	9.00	5.00	2.53

Source: Analysis of Field Survey, 2015

Table 3. Distribution of Sociodemographic Characteristics

Sociodemographic characteristics		Frequency	Percent (%)
Gender	Female	49	19.3
	Male	205	80.7
	Total	254	100.0
Household Status	female headed	49	19.3
	Male headed	205	80.7
	Total	254	100.0
Literacy	No	217	85.4
	Yes	37	14.6
	Total	254	100.0
Marital Status	single	72	28.3
	Married	182	71.7
	Total	254	100.0
How was land acquired	leased/borrowed	49	19.3
	Family source	205	80.7
	Total	254	100.0
Do you belong to FBOs	No	77	30.3
	Yes	177	69.7
	Total	254	100.0
Why did you stopped growing cotton	the company stop	131	51.6
	loss	123	48.4
	Total	254	100.0

Source: Analysis of Field Survey, 2015

Table 4: Distribution of Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings <sup>a</sup>
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	9.543	20.746	20.746	9.543	20.746	20.746	8.802
2	5.339	11.606	32.352	5.339	11.606	32.352	5.539
3	4.995	10.859	43.211	4.995	10.859	43.211	6.182
4	3.884	8.444	51.655	3.884	8.444	51.655	3.999
5	2.175	4.727	56.383	2.175	4.727	56.383	2.200

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Source: Analysis of field survey, 2015

### 3.2 Farmers' Narratives and Perceptions on Bt cotton

Respondents' agreement rank scores of the 46 statements extracted from farmers' narratives on cotton farming in general and Bt cotton in particular, was subjected to Principal Component Analysis (PCA) in order to reduce the dimensions in the data sets to a manageable size which explain the underlying constructs of farmers' views on the Bt cotton.

#### Number of component extracted

The distribution of total variance explained by a given components extracted is shown in table 4. A single component solution explained only 20.75% of the total variance and two and three component solutions accounts for 32.35% and 43.21% of the total variance respectively. Also, four and five

components solution explained cumulatively 51.66% and 56.38% of the total variance (Table 4). Cumulative percentage of variance (criterion) used as a threshold in determining the number of components to extract varied across disciplines. Henson and Roberts, (2006) indicated that no fixed threshold exists, although certain percentages have been suggested. According to Hair et al.(1995) in the natural sciences, factors extraction should be stopped when at least 95% of the variance is explained. In the humanities, the explained variance threshold used is commonly as low as 50-60% (Pett, Lackey and Sullivan, 2003). As shown in the Table 4, five factor solutions which accumulatively explained about 56.38% of the total variance was taken as the threshold for factor extraction. Therefore, these five factors (components) were extracted as the



underlying construct depicting former cotton farmers' narratives and perceptions towards Bt cotton. The cumulative percentage of variance explained by the five (5) components extracted is 56.38% which fall within the threshold cumulative variance explained percent of 50-60% mostly used in humanities and social science as asserted by Pett et al, (2003). The five (5) components extracted were guided also by scree plot as shown in the Figure (4).

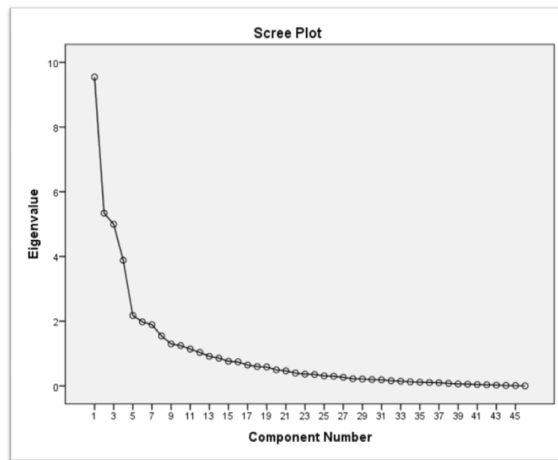


Figure 3. Scree Plot

Source: Analysis of Field Survey, 2015

### Interpretation of Components Extracted

The five (5) components extracted through the PCA were interpreted based on the statements loaded on them. The forty six (46) statements which were rated by the two hundred and fifty four (254) participants were loaded onto the five components extracted and as such the components are interpreted based on the meaning of the statements loaded on them.

#### Component one

In component one (1), eleven (11) statements were loaded onto it as shown in Table 5. The statements loaded onto components one included 'the cost of inputs the cotton companies used to supplied was too high'; 'the pesticides I was being supplied with was not effective in controlling pests on my farm'; 'I will like to farm cotton on my own rather than contract farming arrangement' and 'the zoning of companies did not provide us options for us to get good deals'. Others are 'the extension services the cotton company used to supply me was poor'; 'Inputs supplies from the cotton company was not timely and regular'; 'the requirement of grouping system by cotton companies were not best arrangement for me' and 'the germination rates of seeds I was being supplied was poor'. The rest are 'we were not give opportunity of negotiating the contract with the cotton companies'; 'tractor services

from the cotton company was not timely and regular' and 'the price the company used to buy my cotton was too low'. It is therefore clear that all the statements loaded in component one (1) is dealing with issues relating to problems with contractual agreement they used to have with the cotton companies. Therefore component one (1) is labeled as 'contractual issues' characterizing former cotton farmers in northern Ghana narratives on cotton farming. It can therefore be concluded that issues relating to contractual matters between the farmers and cotton companies are the major concerns of farmers interviewed.

With an average agreement rank score of 3.64 (SD = 1.59), 3.74 (SD = 1.56) and 3.54 (SD = 1.53) as shown in table 6, on the statements 'the cost of inputs the cotton companies used to supplied was too high', 'the pesticides I was being supplied with was not effective in controlling pests on my farm' and 'the zoning of companies did not provide us options for us to get good deals' respectively, all give an indication of general agreement by respondents on the statements. Thus respondents were of the view that the cost of inputs the cotton companies were supplying them were too high and the pesticides were not effective in controlling the pests which were infesting their cotton plants. They also think that the zoning of cotton producing areas, in which cotton companies were exclusively assigned to a particular zone, did not gave them the opportunity to choose which cotton company to enter into agreement with. This arrangement in their view did not encourage competition among companies and as such farmers were not given better deals.

With regard to the statements of poor provision of extension services by the cotton companies (with average rank score of 2.18) and that inputs supplies from the cotton companies were not timely and regular (with average rank score of 1.46), there is general disagreement on them among respondents. This indicates that respondents were satisfied with the extension services and other supplies from the cotton companies and view them as regular, effective and timely. Similar views were held by respondents with regard to timely and regular provision of tractor services and effectiveness of seeds supplies. Respondents generally disagreed that the provision of tractor services were not regular and timely and that the germination rate of the seeds they were supplied with was poor. However, respondents generally perceived the price cotton companies were offering them as too low and that they were not given opportunity to negotiate the contracts entered to with the companies. But they were in general disagreement (with average rank score of 2.21) that

they will like to farm cotton on their own instead of contract farming arrangement with cotton companies.

In general former cotton farmers in northern Ghana have mixed views regarding issues in the contractual arrangement they used to have with the cotton companies when they were farming cotton. While they viewed supplies of inputs and extension service from the cotton companies as timely and regular, but only have problem with the effectiveness of the pesticides and cost of the inputs they were being supplied with, they were generally dissatisfied with the price they were being offered for their cotton by the cotton companies and they think that they were not given the opportunity to negotiate the terms of contract with the cotton companies.

### Component Two (2)

For component two (2), twelve (12) statements were loaded onto it. The statements loaded onto component two included 'controlling cotton bollworm and other pests was my biggest problem in getting good yields'; 'the returns I used to get from cotton farming was relatively low'; 'cotton farming in general used to exert so much demand on my family labour' and 'I stop growing cotton because of poor yield'. The others were 'I stopped growing cotton because the company that contracted me folded up'; 'I have lost trust in the Ghanaian cotton industry because of it 'on and off''; 'frequent spraying of cotton farm was too demanding of my time and labour'. The rest are 'scarcity of land made me stop growing cotton'; 'frequent spraying of my cotton farm use to exposed me to high health risks'; 'frequent application of agrochemicals have negatively affected my land' and 'Increasing demand to produce food crops to feed my family made me stop cultivating cotton'. All of these statements are related to issues which made them stopped farming cotton and as such this component is labeled as 'problems and challenges in cotton farming'. Thus component two extracted are dealing with farmers views on the problems they used to faced which made them stopped the cultivation of cotton.

Respondents generally were of the view that, controlling cotton bollworm and other pests was their biggest problem in getting good yields with average agreement rank score of 3.85 (SD = 1.35) and that the returns they used to get from cotton farming was relatively low, registering average agreement rank score of 3.52 (SD = 1.17). Analysis of agreement rank scores also revealed that respondents were of the view that cotton farming used to exert so much demand on their family labour with an average agreement rank score of 3.55 (SD = 1.54) indicating a mere agreement on the statement. Because smallholder farmers in general are subsistence food producers, the need to produce food crops to feed

their families while engaging in cash crop farming for their household cash security. Respondents agreed on the statement (with average agreement rank score of 4.09) that 'increasing demand to produce food crops to feed my family made me stop cultivating cotton' but they however disagreed on the statement that 'scarcity of land made me stop growing cotton' with average agreement rank score of 1.8 (SD = 1.34). It is therefore clear that former cotton farmers in Northern Ghana perceived land to be available for the cultivation of cotton or any other cash crops and that it is not one of the reasons why they stopped farming cotton.

They however agreed, with an average agreement rank score of 3.79 (SD = 1.42) on the statement 'I stop because frequent spraying of my cotton farm was too demanding of my time and labour'. They also held the view that they stopped because the cotton companies which used to contract them to farm cotton have folded up in the area. Poor yield of cotton also contributed to farmers weaning interest on cotton cultivation. With an average agreement rank score of 4.13 (SD = 1.64) on the statement 'I stop growing cotton because of poor yield' indicating a general agreement among the 254 respondents. Thus respondents generally were of the view that poor yield of their cotton farms is one of the reasons which made them stop the cultivation of cotton. However, respondents could neither agreed nor disagreed on the statements 'I lost trust in government commitment to revamp the cotton industry', 'frequent spraying of my cotton farm used to exposed me to high health risks' and 'frequent application of agrochemicals have negatively affected my land'. Thus respondents appeared not be convinced with government commitment in revamping the cotton industry. As such much need to be done to convince farmers on the commitment of government in revitalizing the cotton industry in the country.

### Components three (3)

The component three extracted were loaded with seven (7) statements, all of which are dealing with the suitability of cotton production to farmers' farming system and how desirable they are to go back to the cultivation of cotton. As shown in the Table 5, the statements loaded onto component three are 'the climate here is good for cotton growing'; 'My household cash security situation was better when I was farming cotton than now'; 'I haven't had any best alternative cash crop since I stopped growing cotton'; 'I was adequately trained on how to produce high quality cotton but it is now being underutilized' and 'I was adequately trained on how to spray my cotton farm but it is now being underutilized'. The others are 'I have huge

experience in cotton growing and this can make me efficiency if I resume cotton cultivation'; 'Cotton is the best cash crop for my family' and 'I will go back to cotton growing because it lucrative'.

The analysis of agreement rank score shown in the Table 6, indicate that respondents generally were of the view that the climate in northern Ghana is conducive for the cultivation of cotton (with average agreement rank of 3.50), and that their household cash security situation were better when they were farming cotton than now scoring an average agreement rank of 4.03 (SD = 0.89). There is also a general perception by farmers interviewed that there is very limited alternative cash crops to cotton in northern Ghana. As shown in the Table 6, the average agreement rank score on the statement 'I haven't had any best alternative cash crop since I stopped growing cotton' is 4.05 (SD = 0.87) indicating respondent generally agreed that they haven't had any best alternative cash crop since they stopped the cultivation of cotton. Similarly, respondents perceived cotton to be the best cash crop for their family (with an average agreement rank score of 3.85). Respondents were also convinced on their experience in the cultivation of cotton and that they were willing to go back to the cultivation of cotton given the opportunity. However, respondent disagreed strongly that their skills and experience in spraying cotton farms and producing high quality cotton is being underutilized, indicating that they are applying the skills in the production of other crops such as soybean, cowpea and maize.

#### **Component four (4)**

This extracted component (component 4) contains eight (8) statements basically dealing with respondents views on the positives of Bt cotton. The statements loaded on this extracted components are 'the early maturity nature of Bt cotton makes it appropriate for the short duration of rainy season in this part of the country'; 'I will adopt the cultivation of Bt cotton because it has a potential of bring in more returns than the conventional cotton'; 'since Bt cotton reduces number of spraying, cultivating it will reduce the risks to my health and the environment' and finally 'since Bt cotton reduces number of times of spraying, cultivating it will reduce my labour demand for cotton production'. The others are 'given better deal by the cotton companies' I will prefer to go back to the cultivation of cotton if it is Bt cotton'; 'Bt cotton, which is bred to produce toxin against cotton pest is the best cotton variety I being hoping for'; 'since Bt cotton reduces number of spraying, cultivating it will reduce my cost of production' and finally 'the fact that Bt cotton is resistance to cotton bollworm will make me adopt it cultivation'. This

component therefore illustrates respondents' views on the positives of Bt cotton.

A further analysis on respondents' agreement level regarding the positives of Bt cotton, revealed a general agreement rank on the statements 'the early maturity nature of Bt cotton make it appropriate for the short duration of rainy season in this part of the country'; 'I will adopt the cultivation of Bt cotton because it has a potential of bring in more returns than the conventional cotton' and 'since Bt cotton reduces number of spraying, cultivating it will reduce the risks to my health and the environment' with agreement rank scores of 3.71 (SD = 1.08), 4.40 (SD = 1.09) and 4.30 (SD = 1.02) respectively. It therefore illustrate the fact that respondents hold positive views towards Bt cotton regarding it appropriateness to the short duration of rainy season characterising the climate of the guinea savannah ecological zone where northern Ghana is located and its economic benefits through reduction of cost of pest control and the overall cost of production.

Similar views illustrated by agreement ranks were observed on the statements 'given better deal by the cotton companies, I will go back to Bt cotton cultivation' and 'Bt cotton, which is bred to produce toxin against cotton pest is the best cotton variety I being hoping for' with average agreement rank scores of 3.75 (SD = 1.08) and 3.68 (SD = 0.89) respectively. Clearly farmers were excited on the fact that Bt cotton is bred to produce resistance against cotton bollworm (one of the major problem they used to faced when they were involved in the cultivation of cotton). As such respondents in general strongly agreed on the statement that 'the fact that Bt cotton is resistance to cotton bollworm will make me adopt it cultivation' registering an average agreement rank score of 4.72 (SD = 1.13) (tab 6). However respondents were unable to form an opinion on the statement 'since Bt cotton reduces number of spraying, cultivating it will reduce my cost of production' with an average agreement score of 2.68 (SD = 1.11)

#### **Component five (5)**

The seven (7) statements loaded onto the last component extracted contain issues relating to farmers reservations on Bt cotton or negative statements about Bt cotton. These statements as shown in the Table 5 are 'the cost of Bt cotton seed might be high than what smallholder farmers can afford'; 'I don't think the solution to Ghana's cotton industry is Bt cotton'; 'Bt cotton might have untold effect on the environment and the ecosystem' and 'Bt cotton might failed me if I adopt its cultivation'. The rest are 'I will need more information on Bt cotton before I adopt its cultivation'; 'Because Bt cotton is

new here I will have to wait and observe how good it is before I make my decision on its adoption' and 'Bt cotton might suffer the 'on and off' situation of the Ghanaian cotton industry'.

Results of agreement rank scores as shown in the Table 6, reveals that respondents generally held the view that Bt cotton is not the solution to Ghana's cotton industry, Bt cotton might have negative effect on the environment and the ecosystem, and as such will need more information on Bt cotton before taking any decision to cultivate it. As shown in the Table 6, respondents generally agreed on the statements 'I don't think the solution to Ghana's cotton industry is Bt cotton'; 'Bt cotton might have untold effect on the environment and the ecosystem' and 'I will need more information on Bt cotton before I adopt its cultivation' with average agreement rank score of 3.58 (SD = 1.46), 4.03 (SD = 0.81) and 3.68 (SD = 1.29) respectively. However, former cotton

farmers interviewed in this survey were yet to form an opinion on the statements 'the cost of Bt cotton seed might be high than what smallholder farmers can afford'; 'Bt cotton might failed me if I adopt its cultivation'; 'Bt cotton might suffer the 'on and off' situation of the Ghanaian cotton industry' and 'Because Bt cotton is new here I will have to wait and observe how good it is before I make my decision on its adoption' with agreement rank scores of 3.40 (SD = 1.08), 2.92 (SD = 1.20), 3.24 (SD = 2.47) respectively. It can therefore be adduced that former cotton farmers in northern Ghana have some reservations about the cultivation of Bt cotton regarding its effects on the environment and whether it can provide solution to the collapsing cotton industry in the country. They however, could not tell whether they can afford the seed of Bt cotton and whether if they adopt its cultivation it will not failed.

Table 5.: Component Matrix of Factor loading

Statements	Factor Loading				
	1	2	3	4	5
<b>Component one (1): Contractual Issues</b>					
The cost of inputs the cotton companies used to supplied was too high	0.85				
The pesticides I was being supplied with was not effective in controlling pests on my farm	0.82				
I will like to farm cotton on my own rather than contract farming arrangement	0.80				
The zoning of companies did not provide us options for us to get good deals	0.79				
The extension services the cotton company used to supply me was poor	0.79				
Inputs supplies from the cotton company was not timely and regular	0.77				
The requirement of grouping system by cotton companies were not best arrangement for me	0.61				
The germination rates of seeds I was being supplied was poor	0.59				
We were not give opportunity of negotiating the contract with the cotton companies	0.50				
Tractor services from the cotton company was not timely and regular	0.47				
The price the company used to buy my cotton was too low	0.42				
<b>Component two (2): Problems with cotton farming</b>					
Controlling cotton bollworm and other pests was my biggest problem in getting good yields	0.69				
The returns I used to get from cotton farming was relatively low	0.64				
Cotton farming in general used to exert so much demand on my family labour	0.61				
I stopped growing cotton because the company that contracted me folded up	-0.55				
I stop growing cotton because of poor yield	0.55				
I lost trust in government commitment to revamp the cotton industry	0.41				
Increasing demand to produce food crops to feed my family made me stop cultivating cotton	0.40				
Scarcity of land made me stop growing cotton	0.42				
I stop because frequent spraying of my cotton farm was too demanding of my time and labour	0.82				
Frequent spraying of my cotton farm used to exposed me to high health risks	-0.64				
Frequent application of agrochemicals have negatively affected my land	0.50				
Some farmers used to divert some of the inputs meant for cotton to other crops	0.43				
<b>Component three (3): Desire to come back to cotton farming</b>					
The climate here is good for cotton growing				0.81	

Statements	Factor Loading				
	1	2	3	4	5
My household cash security situation was better when I was farming cotton than now			0.81		
I haven't had any best alternative cash crop since I stopped growing cotton			0.80		
I was adequately trained on how to produce high quality cotton but it is now being under utilized			0.73		
I was adequately trained on how to spray my cotton farm but it is now being under utilized			0.72		
I have huge experience in cotton growing and this can make me efficiency if I resume cotton cultivation			0.67		
Cotton is the best cash crop for my family			0.68		
I will go back to cotton growing because it lucrative			0.08		
<b>Component four (4): Positive statements on Bt cotton</b>					
The early maturity nature of Bt cotton make it appropriate for the short duration of rainy season in this part of the country					-0.96
I will adopt the cultivation of Bt cotton because it has a potential of bring in more returns than the conventional cotton					-0.94
Since Bt cotton reduces number of spraying, cultivating it will reduce the risks to my health and the environment					-0.90
Since Bt cotton reduces number of spraying, cultivating it will reduce my labour demand for cotton production					-0.68
Given better deal by the cotton companies, I will prefer to go back to the cultivation of cotton if it is Bt cotton					0.65
Bt cotton, which is bred to produce toxin against cotton pest is the best cotton variety I being hoping for					0.55
Since Bt cotton reduces number of spraying, cultivating it will reduce my cost of production					0.55
The fact the Bt cotton is resistance to cotton bollworm will make me adopt it cultivation					0.32
<b>Component five (5): Negative Statements on Bt cotton</b>					
The cost of Bt cotton seed might be high than what smallholder farmers can afford					-0.96
I don't think the solution to Ghana's cotton industry is Bt cotton					0.90
Bt cotton might have untold effect on the environment and the ecosystem					0.83
Bt cotton might failed me if I adopt its cultivation					0.68
I will need more information on Bt cotton before I adopt its cultivation					-0.45
Bt cotton might suffer the on and off situation of the Ghanaian cotton industry					0.41
Because Bt cotton is new here I will have to wait and observe how good it is before make my decision on its adoption					0.32
Extraction Method: Principal Component Analysis.					
Rotation Method: Oblimin with Kaiser Normalization.					
5 components extracted.					

Source: Analysis of field survey, 2015

Table 6. Descriptive Statistics of Agreement ranks

Components	Mean	S D
<b>Component one (1): Contractual Issues</b>		
The cost of inputs the cotton companies used to supplied was too high	3.64	1.59
The pesticides I was being supplied with was not effective in controlling pests on my farm	3.74	1.56
I will like to farm cotton on my own rather than contract farming arrangement	2.21	1.36
The zoning of companies did not provide us options for us to get good deals	3.54	1.53
The extension services the cotton company used to supply me was poor	2.18	1.36
Inputs supplies from the cotton company was not timely and regular	1.46	0.94
The requirement of grouping system by cotton companies were not best arrangement for me	3.41	1.26
The germination rates of seeds I was being supplied was poor	2.18	1.61
We were not give opportunity of negotiating the contract with the cotton companies	3.70	1.35

Components	Mean	S D
Tractor services from the cotton company was not timely and regular	1.76	1.25
The price the company used to buy my cotton was too low	4.18	0.93
<b>Component two (2): Problems with cotton farming</b>		
Controlling cotton bollworm and other pests was my biggest problem in getting good yields	3.85	1.35
The returns I used to get from cotton farming was relatively low	3.52	1.17
Cotton farming in general used to exert so much demand on my family labour	3.55	1.54
I stopped growing cotton because the company that contracted me folded up	3.52	1.35
I stop growing cotton because of poor yield	4.13	1.64
I lost trust in government commitment to revamp the cotton industry	3.38	1.49
Increasing demand to produce food crops to feed my family made me stop cultivating cotton	4.09	1.33
Scarcity of land made me stop growing cotton	1.88	1.34
I stop because frequent spraying of my cotton farm was too demanding of my time and labour	3.79	1.42
Frequent spraying of my cotton farm used to exposed me to high health risks	3.33	1.08
Frequent application of agrochemicals have negatively affected my land	3.01	1.40
Some farmers used to divert some of the inputs meant for cotton to other crops	2.89	1.51
<b>Component three (3): Desire to come back to cotton farming</b>		
The climate here is good for cotton growing	3.50	1.48
My household cash security situation was better when I was farming cotton than now	4.03	0.89
I haven't had any best alternative cash crop since I stopped growing cotton	4.05	0.87
I was adequately trained on how to produce high quality cotton but it is now being under utilized	1.16	0.51
I was adequately trained on how to spray my cotton farmbut it is now being under utilized	1.16	0.51
I have huge experience in cotton growing and this can make me efficiency if I resume cotton cultivation	3.87	1.02
Cotton is the best cash crop for my family	3.85	0.97
I will go back to cotton growing because it lucrative	4.05	0.95
<b>Component four (4): Positive statements on Bt cotton</b>		
The early maturity nature of Bt cotton make it appropriate for the short duration of rainy season in this part of the country	3.71	1.08
I will adopt the cultivation of Bt cotton because it has a potential of bring in more returns than the conventional cotton	4.40	1.09
Since Bt cotton reduces number of spraying, cultivating it will reduce the risks to my health and the environment	4.30	1.025
Since Bt cotton reduces number of spraying, cultivating it will reduce my labour demand for cotton production	3.75	1.08
Given better deal by the cotton companies, i will go back to Bt cotton cultivation	3.68	0.93
Bt cotton, which is bred to produce toxin against cotton pest is the best cotton variety I being hoping for	4.15	1.03
Since Bt cotton reduces number of spraying, cultivating it will reduce my cost of production	2.68	1.11
The fact the Bt cotton is resistance to cotton bollworm will make me adopt it cultivation	4.72	1.13
<b>Component five (5): Some reservations on Bt cotton</b>		
The cost of Bt cotton seed might be high than what smallholder farmers can afford	3.40	1.08
I don't think the solution to Ghana's cotton industry is Bt cotton	3.58	1.46
Bt cotton might have untold effect on the environment and the ecosystem	4.03	0.81
Bt cotton might failed me if I adopt its cultivation	2.92	1.20
I will need more information on Bt cotton before I adopt its cultivation	3.68	1.29
Bt cotton might suffer the on and off situation of the Ghanaian cotton industry	3.24	1.47
Because Bt cotton is new here I will have to wait and observe how good it is before make my decision on its adoption	3.41	1.03

Source: Analysis of field survey, 2015

#### 4. Conclusion and Recommendation

The principal component analysis as a data reduction method undertaken to examine former cotton farmers in northern Ghana narratives about

cotton farming and their perceptions towards the introduction of Bt cotton, identified five broad issues representing farmers views about the introduction of Bt cotton. These five components extracted explained

about 56% of the variance in the data set. The broad issues explaining farmers' views and perception towards Bt cotton are 'contractual issues with cotton companies', 'issues relating to problems and challenges in cotton farming', 'issues relating to farmers desire to go back to cotton farming', 'positive views on Bt cotton' and 'some reservations on Bt cotton'. With regard to the contractual issues with cotton companies, farmers have concerns on cost of inputs they were being supplied, price at which the companies used to buy their cotton, the zoning and assigning of cotton producing areas, low representation of farmers in negotiating the terms of the contracts and delays in the supply of farm inputs and services by the companies.

With regard to problems and challenges, farmers were concern with poor yields, demand for them to cultivate food crops to feed their families while engaging in cotton farming, difficulties in controlling cotton pests, particularly cotton bollworm and the labour intensiveness nature of cotton farming. For issues relating to farmers desire to go back to the cultivation of cotton, farmers view were that their household cash security situation were better when they were farming cotton than now and that they haven't had any better alternative cash crop to cotton. They also perceived the climate of northern Ghana to be very conducive for the cultivation of cotton and that given the opportunity they will be willing to go back to the cultivation of cotton if it is Bt cotton.

Farmers were excited about the fact that Bt cotton is bred to provide resistance to cotton bollworm which was their biggest problem when they were farming cotton, they were also of the view that reduction in number of spraying to control pest is an important quality of Bt cotton which might attract them to cultivating it when it is introduce in the country. They also perceived Bt cotton to be an early maturity variety based on the information available to them and that makes the crops very suitable to the fragile climate and short duration of rainy season in northern Ghana. However, they were having concerns about the possible effects of Bt cotton on the environment, the possibility that Bt cotton seed might be too expensive for them as smallholder farmers.

This paper therefore recommend that for government and other stakeholders to succeed in revamping the cotton industry, there is the need for farmers' concerns on contractual issues to be addressed and for more information on Bt cotton to be provided to resolve the reservation farmers have about Bt cotton and to convince them to adopt its cultivation when it is introduce. The fact that farmers are excited about the possibility of Bt cotton reducing chemical control of cotton bollworms is an important

starting point to achieve impressive uptake of the technology when it is introduce.

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