

# Study Protocol

## **PROPOSAL ON AUTOMATIC COCOA QUALITY TESTING AND PROCUREMENT IN GHANA**

### **Abstract**

Cocoa industry of Ghana employs above a million people across Ghana areas of cocoa-growing, and it is the principal source of revenue for above 6 million people. The government of Ghana spends an important amount of money yearly on cocoa procurements in addition to farm inputs. However, the business of cocoa stays to meet many obstacles in testing and procurement, leading to lower annual yields. The study seeks to examine the issues of Ghana's cocoa purchasing process and develop IoT based automatic cocoa quality testing system. The method of the study will be descriptive design with quantitative method to pinpoint the procurement process and quality assurance process of cocoa in Ghana. The quantitative results will be used to develop IoT based automatic cocoa quality testing system to address cocoa testing issue. The study will analyze the impact of the proposed system for procurement process on the cocoa quality testing and procurement process in Ghana.

**Keywords:** Cocoa, procurement system, testing system, IoT, quality assurance process

### **1.1 Introduction**

Cocoa cultivation has been economic backbone of Ghana beyond 6 decades, and it continues to be Ghana's main source of foreign money. Cocoa industry of Ghana employs above a million people across Ghana areas of cocoa-growing, and it is the principal source of revenue for above 6 million people (Ghana Cocobod, 2010; Tutu, 2009). The government of Ghana spends an important

amount of money yearly on cocoa procurements in addition to farm inputs for example fertilizers, cocoa seedlings, and mass cocoa spraying. However, the business of cocoa stays to meet many obstacles, leading to lower annual yields and, consequently, a substantial decrease in the effectiveness and efficiency of the general cocoa sector. So as to increase yearly yield and improve cocoa sector efficiency, it is precarious to examine, identify, and address post-production problems in the industry of cocoa on a likely in order to restore productivity and promote cocoa sector sustainability. This research goal was to “examine the issues of Ghana's cocoa purchasing process.” The issues facing cocoa sector in Ghana were addressed and explored in this study, and recommendations based on the study's findings were made to ease the identified challenges effects. Cocoa industry's value in Ghana cannot be overstated.

The cocoa sector produces in excess of 9% of Ghana's Gross Domestic Product (GDP), as said by Bank of Ghana (2012). A Ghanaian, Tetteh Quarshie who in 1879 traveled to Fernando Po “(now Bioko in Equatorial Guinea)” and reverted with cocoa pods of Amelonado, is endorsed for the large-scale cultivation of cocoa in Ghana. Cocoa in Ghana supply to the world market rapidly ascended to twenty thousand Metric Tonnes (MT) in 1908, and in 1911, Ghana became the principal cocoa producer of the world with a trade volume of over forty-one thousand Metric Tonnes (MT). The agricultural sector is a considerable contributor to the economy of Ghana and in 2014, responsible for about forty-five percent of the country's GDP with the cocoa sector responsible for around twenty-five percent. According to Anang (2015), nearly 1/3 of every export revenue in Ghana is accounts for by cocoa sector, accounting for between 25 and 30% of general earnings of export and contributing around ten percent of GDP. As said by Anim-Kwapong & Frimpong (2004), over eight hundred thousand smallholder households depend on

cocoa production for their livelihoods, and several more depend on it for a substantial portion of their income. For over six decades, cultivation of cocoa was Ghana's backbone economy. In 1947, the Cocoa Marketing Board (CMB) was allocated and formed the single exporting cocoa duty via its subordinate, the Cocoa Marketing Company (CMC). "Following the country's independence in 1957, the CMB's responsibilities in reorganizing the cocoa sector remained constant until 1961, when the many-buying approach was replaced with a monopsony structure". "In 1966, this technique was phased out, and licensed buying businesses were created to take its place".

Together, the Produce Buying Firm (PBC) was built to grip internal cocoa purchases from cocoa farmers in every cocoa-growing district in Ghana. In 1984/85, the primary stage of the cocoa sector reform started with the CMB being rearranged. The Cocoa Marketing Board was restructured to brand it extra effective by decreasing employees' number to 6,000 from 100,000. Consequently, the CMB is today called Cocoa Board of Ghana (COCOBOD). The 2<sup>nd</sup> stage of cocoa sector in Ghana restructuring started, leading to the reinstatement of numerous LBCs to contribute in cocoa procurement together with the Producer Buying Company-PBC in 1993 (Varangis and Schreiber, 2001). Numerous partners are included in Ghana's cocoa purchasing process, comprising: CMC (Cocoa Marketing Company) is accountable for sales and marketing of cocoa in Ghana in addition to providing services of administrative and additional assisting duties as stated by Cocobod; Quality Control Company (QCC) safeguards cocoa beans' total quality of Ghana; while COCOBOD Ghana which regulates the cocoa sector in Ghana; Licensed Buying Companies (LBCs) are firms that participate directly in the process of purchasing cocoa from upcountry cocoa producers and transport the beans to facilities of CMC. The COCOBOD oversees every activity of all main involved partners in the external

and internal marketing of cocoa in Ghana by safeguarding great quality standards, issuing and issuing licenses to LBCs, in addition to controlling and financing LBCs' activities, establishing producer price margins, and formulating export and sales rules for both local and international sales of cocoa.

It is precarious to comprehend that the private sector's involvement in cocoa purchasing, due to the sector's liberalization, has helped every cocoa player. Since many cocoa buying companies contribute in the purchase of cocoa process, all participants need to get reasonable rewards and treatment to back the cocoa sector's lasting growth and overall performance. Cocoa supply chain of Ghana will be sustainable only if it is well-organized and competitive, whereas likewise providing mutually and fair helpful economic benefits to every key stakeholder in the industry. "Supply Chain Management for Total Quality Cocoa," ICCO (2006). Providing the several economic benefits provided by the cocoa sector to the economy of Ghana, it is valuable to assess and investigate the matters that the sector meets to advance remedial swift movements that will improve productivity and produce foreign money for Ghana. These elements prompted the researcher to conduct this study in order to learn more about the matters that the purchasing cocoa process in Ghana meets.

## **1.2 Statement of the Problem**

Since the independence of Ghana, production of cocoa has stayed the mainstay of Ghana's economic advancement. Above a million people are employed in the sector, and it is yet the main source of income for numerous people in the country. The government of Ghana invests a considerable money amount yearly on purchases of cocoa and additional inputs for agriculturalists, still the industry endures to meet many matters that have a significant influence on

total cocoa output. In order to improve the industry's efficiency and efficacy, many reform structural adjustment projects, such as Ghana cocoa sector liberalization were implemented (Laven,2007).The main goal of the cocoa sector in Ghana liberalization was to increase rivalryvia a system of multiple-buying, permitting manyindividuals to contribute in the cocoa purchasing process, which was formerly dominated by the state-owned PBC (Produce Buying Company).

Because of the cocoa industry deregulation, approximatelytwenty-eight other LBCs, Vigneri & Santos(2001), today dominate the sector. The cocoa sector ofGhana has seen numerouschanges, nonetheless as a portion of Ghana's Structural Adjustment Programs, Cocobod and its subsidiaries manage the entire purchasing process.Consequently, the government of Ghana liberalized the cocoa sector, permitting LBCs to contributeto the marketing process of internal cocoa. According to COCOBOD (2010), the only economy of cocoa-growing in the world isGhana to retain complete control over and partial liberalization of itsbusiness in cocoa. This aids the government to decidethe amountbeans of cocoa must be bought from cocoa producers. Due to cocoa sector liberalization, the number of LBCs competing for profit shares market has prolonged. Nevertheless, sinceCOCOBO states the floorprice, LBCs should purchasebeans of cocoa from cocoa farmers.

However, research majority on cocoa sector in Ghana focuses on improving production output, with only a few publications covering the purchasing cocoa problems and process. To enhance the sector's effectiveness and efficiency, it's precarious to address, assess, and identify complications early sufficient to improve the sector's performance in becoming the leading world producer and cocoa beansofhigh-quality supplier. This study'sgoal is to look in the purchasing

cocoa process issues in Ghana. The stressed obstacles consequences were evaluated, and recommendations were made to remedying these matters. If every other elements were equal, the sector of cocoa would have loved far extra growth than it currently does, providing the sector's investment by government, which is yet stressing to face its aim of producing above a million cocoa metric tons annually.

The following difficulties are adding to the sector's inability to fulfill its general annual supply of cocoa goal: farmers and elderly cocoa trees, poor farming methods, widespread disease and insect outbreaks, input price volatility, cocoa price volatility, and cocoa smuggling (Anang, 2015). Ghana, for instance, produced a million cocoa tonnes throughout 2010-2011 crop year, surpassing the board's target. Annually cocoa output of Ghana has been deteriorating for many years due to poor conditions of weather and outmoded farming techniques, leading to total production of about eight hundred and fifty thousand tonnes. The industry of cocoa has been affected by Ghana cedi depreciation due to cocoa price volatility. Conversely, good cocoa prices are accessible in numerous close cocoa-growing countries, for example Ivory Coast, encouraging cocoa bean smuggling across Ghana's borders, depriving the country of an important money amount.

Another significant matter challenging the sector is huge cocoa estate tracts' illegal mining, "galamsey." The country's total cocoa productivity is projected to descent by twenty-two percent in the 2014-2015 cocoa crop seasons, as said by the "International Cocoa Organization". As said by Daryl (2015), cocoa production in Ghana, as the second largest producer of the world, was estimated to have dropped by one hundred and fourteen thousand tonnes to six hundred and ninety-six thousand tonnes, suggesting a twenty-two percent yearly drop. Structure factors,

consistent with the International Cocoa Organization (ICCO). This has encouraged Cocobod, the industry regulator, to implement a number of reforms to maintain its aim of retaining Ghana's premium cocoa quality, while this is being threatened by many other matters with a high risk severity and impact level. For these reasons, the researcher was inspired to look into the influence of these alleged issues on Cocobod operations and design an automatic cocoa quality testing and procurement in Ghana to help improve Cocobod's overall efficacy and efficiency.

### **1.3 Aim of the Study**

This study's aim is to design an automatic cocoa quality testing and procurement in Ghana to address testing and procurement issues.

### **1.4 Objectives of the Study**

The specific objectives aim to:

1. Examining the procurement process and quality assurance process of cocoa in Ghana.
2. Develop IoT based automatic cocoa quality testing system.
3. Achieve a secured and transparent quality procurement for cocoa in Ghana.
4. Analyze the impact of the proposed system for procurement process on the cocoa quality testing and procurement process in Ghana.

### **1.5 Research Questions**

The research questions aim to address:

1. What are the procurement process and quality assurance process of cocoa in Ghana?
2. What IoT based automatic cocoa quality testing system can address cocoa testing issue?

3. What are these secured and transparent quality procurement for cocoa in Ghana?
4. What are the proposed system for procurement process on the cocoa quality testing and procurement process in Ghana?

### **1.6 Significance of the Study/Justification of the Study**

The research results will, firstly, substantially aid the country's inner purchasing cocoa process. Consequently, factors that impede effective Cocoa acquisition will be uncovered in this study, allowing appropriate steps to be taken to offset those issues, and ii) the study's suggestions will be appreciated to the Cocoa sector of Ghana and other commodities trading companies. Most remarkably, this study is anticipated to make several theoretical and practical contributions. Theoretically, this study findings must aid Cocobod's procurement procedures and processes for purchases of cocoa in the business of cocoa. This study findings are expected to perform as a guiding strategy for "COCOBOD management and the government" in addressing the risks related with Ghana cocoa purchasing. This study findings are likewise projected to back COCOBOD and Ghana Government in "developing a comprehensive cocoa industry" purchasing (supply chain) sustainability administration strategy. "This is projected to increase the sector's plea to other stakeholders and LBCs whereas likewise ensuring its viability.

### **Literature review**

#### **2.1 Procurement (Purchasing) Cycle/Process**

The procurement cycle portrays the end-to-end stages of a definite procurement or purchasing activity that result in the fulfillment of an organization's needs. A process, as said by Lysons and Gillingham (2005), is a collection of activities that work together to achieve a wanted outcome or

purpose. The procurement process portrays the activities included in getting a definite request for an organization and is utilized for tactical purposes. As said by Emmett and Crocker (2008), the method involves making a flow chart to visually define a process using symbols and arrow lines to connect each operational phase. The procurement process is cyclical, beginning with planning, which involves defining specifications, sourcing, which includes inviting and evaluating bidders, contracting, which includes awarding and managing contracts, and storage, distribution, and disposal (of process).

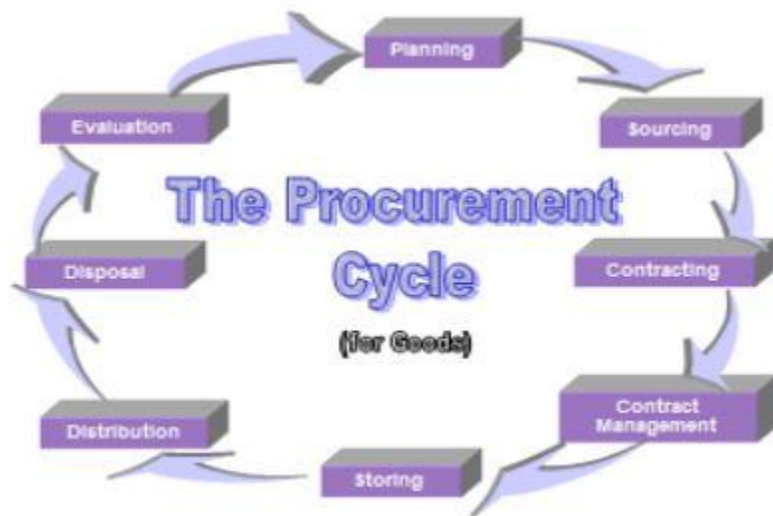


Figure 1: Show the procurement cycle

Source: Emmett and Crocker (2008).

### 2.1.1 Need Identification

After sufficient planning was done to establish what to acquire, the quantity to buy, and the place to buy, the requirement is identified. The planning step takes into account: The goal of annual procurement needs planning is to achieve economies of scale. Organizations and individuals must obviously describe what they seek for with the correct requirement, at the right time; of the

right quality; in the right number; provided to the right place; from the right source; and at the right price before identifying a need. A firm's need is established by its goals of operation. Consequently, what the firm stands for, what it does, and what settings impact its business operations are every factor to ponder.

### **2.1.2 Determine Specification**

A specification stipulates what the organization or entity wants to acquire or buy and, consequently, what the provider should provide. A specification must deliver sufficient info to safeguard that the service or product achieve the user's necessities. In accordance with basic procurement principles, item specifications must react to these 3 objectives: their specific function is to describe the products, works, or services that the procurer wishes to obtain with accuracy and precision; they must be written in a way that promotes competition among potential suppliers; and tenders should be evaluated in an objective and tradable manner. This activity should begin at the project's or supply service's planning stages. Technical, functional, performance, sample, brand, and design are some of the several sorts of specifications (Burt et al 2006; Lysons and Gillingham 2003). "A good specification must: clearly explain the item" to be briefly, reasonably, unmistakably, and procured; "with enough detail to allow suppliers to supply only the most significant qualities or attributes of the things to be procured".

### **2.1.3 Sourcing**

Sourcing is the method of determining likely supplies in linking to the procurement entity's necessities. Suppliers who have already registered with the procurement; present market suppliers; trade websites or sources; or expressions or pre-qualification of interest are every example of supply sources. Services or goods contract acquisition, procurement method is

assessed when detailed necessities have been advanced. Restricted or competitive 2-stage tendering; national or international; demand for single or quotations source procurement; demand for consultant services proposals are instances of procurement techniques Emmett and Crocker, (2008).

#### **2.1.4 Evaluation**

Before any contract is awarded, the bids are assessed. Any potential bidder should achieve evaluation criteria before a contract is awarded. An award might be given based on the cost and quality, lowest bidder, preference margin, or any other element that conforms to the organization's criteria and is in the long run in organization's best interests. This phase is precarious in the acquisition of goods and services since the priority located on the evaluation process defines product quality to be attained. Supply contractors should deliver wide information on their organization's operations, financial accounts, facility and logistics investments, and experience in similar services representing capability in contributing in similar procurement activities, as said by Emmett and Crocker (2008). Most critically, at this stage, every bidder's financial and technical capabilities are identified to begin the bidder's capability for any exact procurement activity.

#### **2.1.5 Negotiating**

Negotiation is the method of defining a mutual stand. Following the evaluation process, procurement entities start discussing with likely sellers, which concludes to a contract award. Nevertheless, specific conditions should be accomplished before negotiations in the public sector, as said by Thai law (2009).

### **2.1.6 Ordering and Progressing**

Following discussions and evaluation, the contract is fixed to the greatest responsive economically bidder whose suggestion matches the conditions and terms or agreement defined in the document tender earlier to bidding. The successful contractor or supplier is acquainted of the contract award and is given the chance to in person sign the contract paperwork before starting the contract work, service contract, or supply contract. Both parties are expected to fulfill their promises and obligations following the signing of the contract agreements to minimize delays and complete on time the conditions of the contract. “In Ghana, the Public Procurement Act (663, 2003)” commands the adherence and adoption to a standard tender document established for an exact procurement transaction.

### **2.1.7 Delivery of Goods**

“One of the most important procurement principles is to ensure that goods or services are delivered on schedule, in the correct amount, and in the right quality to meet the intended requirement”. To avoid contract delays, the supplier and procurement organization need to guarantee cooperation in their respective commitments and responsibilities. Under contract terms, early delivery of services or goods in compliance with the specification, quality, and satisfying the basic procurement objectives is suggested. Accepting a delivery of “goods or services entails completely inspecting the quality of the items or services in reference to the agreed-upon specifications before providing” a final certificate or payment receipts. If the receiving authority lack comprehensive specification knowledge of the service or product, they must contact the specialists or technical department.

### **2.1.8 Payment and Receiving**

The contract's conditions and terms, in addition to the payment terms, control the payment of services or goods contracts. A contract term might comprise a mobilization fund or pre-finance to permit the supplier to respond to the contract at procurement process outset, before goods are delivered. Contract payment conditions, such as, safeguard that payments are made when a contract was completed or supplied.

## **2.2 Procurement Performance**

Emmett and Crocker (2008) claim that procurement performance is just measured by how successfully the process of procurement is carried out and how well the end result is. Procurement effectiveness and efficiency are supposed to be the 2 constituents that compose procurement performance. The foundation for evaluating how well an organization is performing concerning its planned objectives, pinpointing areas of strength and weakness, and determining on future actions with starting purpose of performance improvements is evaluating procurement results. "The gap between efficiency and effectiveness was established by CIPS Australia (2005)". "Efficiency refers to whether a company is doing things well, whereas effectiveness refers to whether a company is doing the right thing." It is likely for an organization to be inefficient and effective; the challenge is defining the difference.

## **2.3 Why Investigating Procurement (purchasing) Performance?**

According to Muhwezi (2006), it is crucial to study each organization's performance to establish how well they use their funds and the reason they must assess performance of procurement. The following are some of the motives why firms must review their performance, according to the London Centre of Excellence: to identify areas for improvement, particularly in contracts and service quality; to "ensure that procurement directly contributes to the achievement of the entity's

objectives; to determine the value added after changes (i.e., to justify its existence); and to assess the impact on improving outcomes for the entities” and their participants.

## **2.4 Supply Chain**

The meeting process of customer's request at individual supply chain stage is known as supply chain management. “A supply chain includes all parties engaged in meeting a customer's demand, whether directly or indirectly”. Suppliers and manufacturers are only supply chain part; it likewise comprises warehouses, transporters, retailers, and even customers. As said by Chopra and Meindl(2007), new product creation, marketing, operations, distribution, customer support, and financing are instances of these functions. Supply chain defines every process involved in satisfying a customer request, whether directly or indirectly. Instead of profit generation, supply chain management goal is to enhance overall value generated. The transfer of goods and services from 1 place to another is occasionally stated as the supply chain. To be successful, supply chain management (SCM) seeks to develop competitive delivery of services and goods by carefully integrating internal functions in an entity and successfully connecting them with external operations of suppliers and other members. Once a satisfied customer has paid for her or his deal, supply chain activities come to a halt.

## **2.5 The Cocoa Purchasing Process**

The entire cocoa purchasing process in Ghana is prudently regulated, which gives it distant from numerous additional cocoa-producing countries for instance Nigeria, Indonesia, and Côte d'Ivoire. The government in Ghana has set COCOBOD and its subsidiaries exclusive authority to certify interested registered organizations to contribute to the cocoa purchasing process. A company that needs to contribute to internal cocoa marketing must initially apply to COCOBOD. The

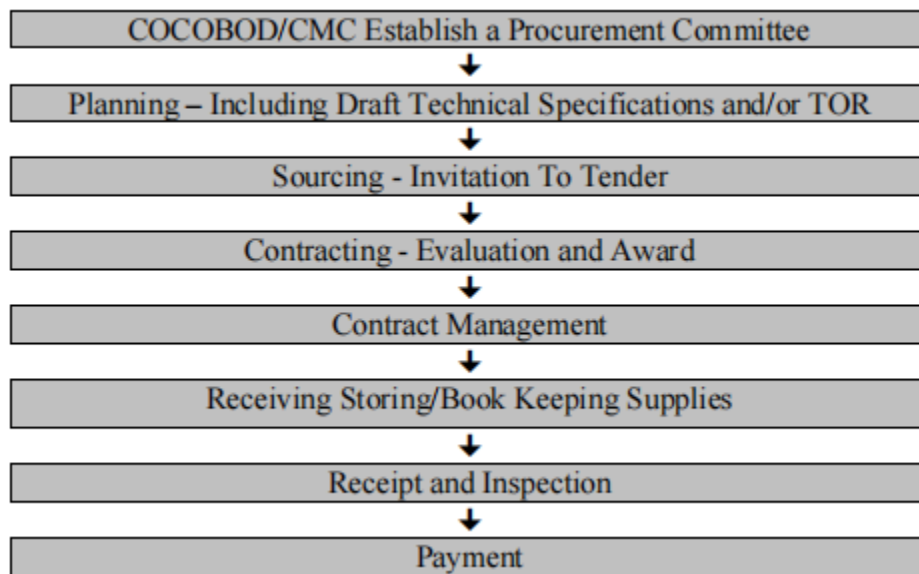
COSMARC (Cocoa Sector Marketing Committee) is a committee that COCOBOD approves after discussion with the Finance Minister. Responsibilities of COSMARC comprise evaluating applicants who need to participate in internal cocoa marketing and suggesting to COCOBOD if or not they must be allowed a license to participate in interior cocoa marketing. The next elements are considered in the evaluation and assessment for the supply contract award by the License Buying Company: Whether the entity expressing interest has the capacity to participate in interior purchase cocoa for as a minimum 2 years (hence 2 crop cocoa periods). The firm stating an interest in purchasing cocoa should prove financial abilities. Namely, sufficient cash to purchase as a minimum 10,000 cocoa metric tons for 2 yield seasons in a row.

The organizations should have sufficient workers with the essential practical skill and understanding in purchase commodities and internal marketing. Ghana Cocoa Board Law (Ghana Cocoa Board Law PNDC.L.81). COCOBOD grants a purchasing cocoa license to the winning organization as Buying Licensed Organizations, allowing them to involve in interior cocoa marketing. COCOBOD provides added support finance in Seed Funding form, also known as Funds Stabilization, to fruitful businesses. COCOBOD asks for a progressive bond performance in bank assurance form to defend itself in the occasion that the LBC fails to perform or defaults. PBC (Produce Buying Company Limited), Akuapa, Armajaro, Cocoa Abrabopa, Cocoa Merchant, and others are some of the license buying firms. Second, after an organization is licensed as LBC, COCOBOD offers a purchasing order in Seed Fund form, permitting qualified organizations to contribute to the cocoa purchasing activity. LBC employs District Officers and purchasing clerks in growing-cocoa areas to directly obtain cocoa from farmers consistent with purchasing laws and norms. The Purchasing Clerks get cash from the LBCs through the District officials to purchase cocoa directly from farmers. Licensed Buying Companies Clerks buy dry

beans from farmers. The purchase cocoa clerks are responsible for bagging and sorting the dry beans in COCOBOD bespoke of Ghana-branded cocoa jute bags. COCOBOD Cocoa is a high quality Ghanaian product, with 67 kg per bag average weight.

Cocoa certification follows this, which includes grading and sealing beans high-quality following complete review by experts of quality control. The beans are concisely contained at the LBCs warehouse, likewise called the shed Cocoa, before being evacuated to cocoa sheds or district depots, where quality is again certified by a Control Quality Officer from Quality Control Division of COCOBOD. Primary evacuation defines the initial conveyance mode to the district cocoa shed. The second evacuation happens once LBCs transmit cocoa from their District warehouse to Take-over Centers Cocoa, where it will be located in Cocoa Marketing Company custody. The Cocoa Marketing Company (CMC), a COCOBOD subsidiary, receives the beans, which are classified in standard and substandard by Quality Control Unit of COCOBOD, with every cocoa bag posturing a quality seal and a station identification number. Beans of cocoa that do not meet the Control Quality department's quality standards are rejected. Beans that have not been completely dried, undesirable elements, mixed beans, and chaffs can cause cocoa beans rejection. The Control Quality section likewise documented the received cocoa to decide the general cocoa tonnage on hand. Furthermore, QCD led a fumigation experiment to protect cocoa beans from insects. Final grading and quality checks are performed at this stage in the supply chain, preparing the chocolate for sale and export. Before last export, the beans bagged are transported to the port, where CMC receives and rechecked for QCC quality. Secondary evacuation is this procedure's another name.

## **2.6 Overall Procurement Process**



*Figure 2: Shows the overall procurement or purchasing process.*

### **2.6.1 Main Perceived Challenges Affecting Purchasing Cocoa Process and its Influence on effectiveness of COCOBOD**

The study looks in the matters that the purchasing cocoa process faces, in addition to their insinuations for COCOBOD Ghana's operational act and long-term viability of cocoa sector. Regarding the assessment of World Bank on cocoa sector of Ghana from 2011. Ghana's cocoa sector has some hurdles, as stated by assessment of World Bank. However, this research focus is on Ghana cocoa purchasing process issues. The following are some perceived issues in cocoa purchasing process of Ghana: Cocoa price and rate of exchange volatility, Ghana cedi depreciation because of inadequate monies to license purchasing organizations, warehouse facilities and insufficient logistics, macroeconomic instability, and a poor transport network obstruct efficient cocoa bean evacuation from cocoa growing communities to various cocoa takeover centers. Environmental issues, like bushfires, severe weather, other natural disasters, and floods, pose severe threats to Ghana's cocoa sector's growth and sustainability. The industry of cocoa is likewise affected by a lack of supply chain integration and communication among

LBC, COCOBOD, other cocoa players, and farmers. Inadequate staffing, poor road networks, traffic congestion at various processing cocoa facilities, profit margins of smaller buyer, counterparty risk (one party tendency in a contract agreement), and other factors variety are entirely factors to consider. The matters that cocoa purchasing process in Ghana face are several, and they must be given the attention they deserve to improve the sector's general growth and sustainability.

### **2.6.2 Cocoa Price Instability**

Cocoa price volatility is a thoughtful concern in cocoa production and purchasing process in Ghana. Cocoa price on the international market has been unexpected and volatile for years. The global market's cocoa price unpredictability is an enormous matter for cocoa economy in Ghana. Cocoa international price in 2000 was \$714 each ton, nonetheless in 2002, it rose to \$1,280 each ton, with nearly \$1,600 average in the 2nd quarter, and cocoa international price improved radically in 2003/04. The 3rd quarter of 2005/06 cocoa season, on the other hand, had a lot of price volatility, according to the ICCO report (2006). Cocoa market volatility affect COCOBOD as it assure cocoa higher price to cocoa farmers yearly at the beginning of every cocoa season, even if there is a decline in international cocoa price. In reaction to increasing price of cocoa volatility on the international market, COCOBOD created the Stabilization Fund. The long-term viability of stability fund is reliant on the board's financial administration and efficient administrative. Consequently, COCOBOD started significant and sensible cash flow responsibilities to better fulfill its purpose. Once cocoa prices rise on the international market, COCOBOD profit margin it pays to farmers of cocoa rises, and vice versa. As stated by Ghana Cocoa Board 43rd Annual Report (2012), the 2011/12 crop year began on

October 14, 2011, with a 2.5 percent increase in the producer price of cocoa from GH3,200 per ton to GH3,280 per ton, compared to the earlier year's pricing.

Throughout disaster years while main world producing cocoa nations met intermittent unfavorable civil wars, climatic changes, as in Cote d'Ivoire case, combined with poor farming management, bush fire leading to a strong cocoa price decrease margins, which sometimes even twisted negative (World Bank report 2011). Throughout 2011/2012 cocoa season, cocoa prices on the global market dropped. The ICCO's regular global prices of cocoa down 22.81 percent, closed at US\$2,396 from earlier year's US\$3,104 price. Throughout 2011/12 season, price swings were asymmetrical because of the unexplained European debt crisis and its spillover effect on consumption of cocoa, in addition to diminishing demand pessimistic news in the markets of Europe. West Africa's improved weather degradation contributed to another significant element in global price of cocoa volatility. Throughout the 2013/14 season, international prices of cocoa rose progressively, attaining US\$ 3,313/Metric Tonnes average at September 2014 ending. Instead, on 29th October 2014, cocoa international price dramatically fell to US\$3,104/Metric Tonnes. Price volatility degree in cocoa is a main source of cocoa industry concern, particularly COCOBOD, in addition to other key stakeholders for example LBCs and farmers.

Most importantly, prices of cocoa change, making it difficult to predict fluctuations of price because of dynamics of market influenced by supply and demand. As said by 2006 International Cocoa CO report, price of cocoa differs because of market speculations that tend to deliberately create shortage of cocoa on the international market to force price upward. However, Ghana COCOBOD, as the only regulator and marketer for cocoa produce of Ghana locally and internationally, fixes cocoa purchasing prices locally to safeguard long-term viability of cocoa

sector. The government formed Stabilization Cocoa Fund through the board to encourage producers of cocoa for production increase levels irrespective of world cocoa prices' volatility. The stabilization cocoa fund's aim is to maintain stable local prices even if global market's cocoa prices decline. In summary, the COCOBOD created the stabilization fund to safeguard that given prices to producers of cocoa are maintained even if prices of cocoa vary on the international market. For detrimental impact reduction of volatility price on cocoa farmers, the government created the Producer Price Review Committee (PPRC) consistent with rules of COCOBOD, after consulting with suitable bodies included members from farmers, numerous corporate groups, and LBCs. The COCOBOD purchasing cocoa price floor is the lowest price at which LBCs are allowed to purchase cocoa, and LBCs are not allowed to purchase cocoa agreed unit at a price higher or lower than the purchasing price floor.

Cocoa procuring at a price higher or lower than the COCOBOD controlled price is forbidden and Ghana COCOBOD operating guidelines' and regulations' violation. Instead, LBCs offer incentives to cocoa farmers in short-term credits' form to influence them to sell their cocoa produce to them. This is because profits of LBC in the purchasing cocoa process are determined mostly by the total amount of purchased cocoa during the season of harvest. Ghana's cocoa industry has been largely liberalized but remains tightly regulated. Consequently, COCOBOD institutes a price floor for LBCs to purchase farmers' cocoa. Consequently, LBCs develop their profit market share by applying buying methods to increase overall quantity, which in turn increases their profit. Consequently, as stated by Poku and Lamptey (2014) study, LBCs use purchase of cocoa strategies to improve their market share. The study revealed that purchasing cocoa promotional tactics aid rise the total cocoa purchases by LBCs and impact LBCs choice by the farmer of cocoa. LBCs impact farmer of cocoa by giving free gifts in fertilizers' form,

spraying machines repairs and wellington boots donation, solar panel streetlights, construction of bridges, pre-financing, and mosquito nets scholarships.

These free offers that some LBCs offer to cocoa farmers work to reinforce their relationship in addition to decrease their expense, permitting them to recall the LBC during the seasons of cocoa by selling their produce of cocoa. Volatility of price has an important influence on most agricultural commodities, comprising cocoa. There are 3 aims why most agricultural commodities are dependent on volatility of price. First, agricultural produce fluctuates in price because of problems for example pests, adverse weather, and diseases, and the low price paid to farmers because of cocoa sector liberalization inclines to deterrence cocoa farmers, leading to lower total cocoa production. Second, many companies in the global market influence pricing by guessing on future cocoa prices increases. This is because, in the short run, responsiveness degree to changes in quantity demanded is extra significant than price. Volatility of price is an agricultural product market's natural constituent, because of supply and demand dynamics that have a negative influence on prices. Third, because agriculture products take longer to mature, farmers of cocoa are incapable of swiftly responding to variations of market in the short term. Poor agricultural techniques and a lack of investment in farming inputs also have a substantial impact on output.

Effect of price volatility on Cocobod Effectiveness: Due to the influence made by price of cocoa, there is a high severity level of negative effect on COCOBOD and total cocoa sector with respect to price of cocoa volatility, on external and internal players. Every concern in relation to the entire sector of cocoa are regulated and controlled by COCOBOD under COCOBOD Ghana Act 1984. Since prices of cocoa are indeterminate in the international market, price volatility danger is very probable, with a very high severity impact level. As a result of COCOBOD's ability to

offer the best price of cocoa to farmers of cocoa, several individuals are demotivated to cultivate cocoa, resulting in a significant revenue loss for the state. This is due to the disincentive of cocoa prices set by COCOBOD as it continues to manage and control the cocoa sector. The matters affecting cocoa sector of Ghana can be decreased through sufficient systems of risk control for the sector's viability of long-term preservation. COCOBOD can control these risks or obstacles by using marketing tactics of hedging (forward contracts, option calls, and futures) and selling a big crop amount early through Cocoa Marketing Company Ghana Limited. Hedging is a risk management method for the supply side. Hedging is done by establishing an internationally portfolio isolated of amenities and suppliers, so that a natural disaster or changes in currency do not effect the entire company's undertakings at the same time.

Risk management tactics comprising hedging products and private insurance can aid to control volatility of price. Prior to cocoa business of Ghana liberalization, the government controlled prices of cocoa, which it stays to perform nowadays through COCOBOD. The government sets cocoa price due to the revenue it collects from internal and external marketing. Consequently, the government established the stabilization fund through COCOBOD to help address price of cocoa volatility problem. Most essentially, good policies purposed to addressing these issues will aid progress output and long-term viability of the sector by: (1) transparency increase in sector of cocoa market in Ghana; (2) removing local trade rules (for example high tariffs on products commodity) to reduce trade margins and distortion; and (3) increasing private and government investment to improve production of cocoa; (Staatz and Weber 2011). COCOBOD can likewise apply market-based instruments to support mitigate price volatility consequences. These market-based instruments' or methods' goal is to prevent income insecurity from becoming a problem (which have tendencies to affect production and consumption). In practice, this means

empowering COCOBOD itself to protect its operations against price disparity dangers through futures, forward contracts, call options, and put options, variations harvest insurance crop, and weather insurance index) CRMG stands for Customer Relationship Management Group (2008). Price instability reasons are an important aspect in price stabilization methods' and programs' effectiveness (Galtier 2009).

## **2.7 The Reforms and Structures of Ghana's Cocoa Sector**

Cocoa sector of Ghana arrangement prior to the reform of cocoa sector was characterized by comprehensive market control structure. Government controlled the market through Cocoa Marketing Board as the only authorized nationwide exporter and buyer of beans in cocoa. The COCOBOD performed its obligations through LBCs and its subsidiaries. Such as Quality Control Company (QCC) as subsidiary COCOBOD is accountable to controlling quality cocoa (Laven, 2005). QCC carried out activities of sampling check to confirm the cleanliness of every sealed cocoa consignment LBCs deliver to CMC at the Take-Over Centers. QCD also double-checks samples before sending them out, both domestically and abroad. In 1984, the first stage of Ghana's cocoa sector restructuring began. The industry was restructured with the goal of reducing the number of employees at the Cocoa Marketing Board (CMB) to 6,000 from roughly 100,000. The CMB's name was altered to Ghana Cocoa Board (COCOBOD) due to operational and institutional developments. Efforts were undertaken early on to enhance cocoa production outputs, which were aided by supplying farmers with seedlings to replace aged trees (Van Duursen and Norde, 2003). The 2nd stage, which began in 1993, saw the reintroduction of numerous purchasing businesses, meaning that singular LBCs are permitted to participate in internal activities alongside the PBC (Varangis and Schreiber, 2001).

### **2.7.1 COCOBOD (Ghana Cocoa Board)**

Ghana's cocoa supply chain is well-known for its unique selling technique, which sets it apart from other major cocoa-producing countries. It combines liberalization aspects with effective government regulation and supervision. The COCOBOD Ghana is the country's major cocoa regulatory organization, and it accomplishes so through its board of directors (CMC and QCC). The following specialized departments apply COCOBOD's post-production policies. COCOBOD Ghana (2010).

### **2.7.2 Cocoa Marketing Company (Ghana) Limited (CMC):**

CMC is a COCOBOD company with the primary responsibility of exporting and selling cocoa beans of Ghana domestically and internationally. Its main responsibilities include: purchasing classified and cocoa sealed beans from LBCs; 2) storing cocoa before supplying; 3) taking complete benefit of exchange foreign revenue and ensuring the best prices; 4) managing revenues and sales; and 5) solving dissimilarities among purchasing players through negotiation. CMC (2010) continued to ship and market cocoa on a contract basis to international and local purchasers from the ports of Tema and Takoradi.

### **2.7.3 Quality Control Company (QCC)**

Sealing, grading, and cocoa disinfestation bought by COCOBOD during each season of cocoa are among the primary duties of the Quality Control Company. Quality assurance of Ghana's cocoa produce was carried out by QCC through selection activities to check the quantity of purchased cocoa given to CMC at the Taken-Over Centers by the LBCs. In addition, in compliance with Cocoa Industry Regulations 1968/LI 598, the company inspected and certified the storage areas of Cocoa CMC and Licensed Buying Companies facilities across the country. As part of its

responsibilities, the company also assists in the education of cocoa farmers on the best recognized practices of farming aimed at enhancing Ghana's cocoa quality.

#### **2.7.4 Licensed Buying Companies (LBCs)**

The LBCs are organizations that have been granted permission to participate in Ghana's cocoa beans' internal marketing based on the Quality Control Division of COCOBOD's assessment and certification standards. LBCs are a collection of companies that have been approved by Ghana COCOBOD to participate in Ghana's internal purchasing of cocoa directly from farmers and selling it to a cocoa marketing company. Cocoa beans are sold by farmers to LBCs after they have been completely dried (LBCs). COCOBOD oversees LBCs, which are responsible for purchase cocoa beans from farmers at a set price (the "producer price") and transporting them to regional cocoa takeover centers. They all have a clear commitment to only supply cocoa that fulfills COCOBOD's stringent quality criteria. LBCs are required to score the beans for quality consistency, color, and size. The cocoa is kept in the warehouse of LBCs till it is emptied to Centers of CMC Taken Over once the bag is sealed. The profits of LBCs are determined on the purchase of tons of cocoa. LBCs basically obtain a set of revenue amount per cocoa quantity provided because they meet COCOBOD fixed price of sale and a price floor for farmers. COCOBOD financially pre-finances LBC specifically for the purchase of cocoa at the beginning of each season of cocoa buying.

Since marketing internal was unlocked up to competition in 1990, the number of registered LBCs has constantly increased. Currently, there are approximately 28 LBCs in use. COCOBOD has continuously raised syndicated loans for annual cocoa purchases from local and international lenders. The COCOBOD raised US\$ 2 billion through a syndicated pre-export facility in the

2014 and 2015 crop seasons to allow it in the 2016 to buy around 900,000 metric tons of cocoa beans and 17 cocoa seasons. The syndicated loan has a low interest rate of 1.19 percent and is repayable at the end of the crop season. COCOBOD will use the financing to pre-fund cocoa beans purchase from farmers via LBCs. The government pre-finances LBCs' purchasing cocoa activities of through COCOBOD in loan form. Such loans are repaid from COCOBOD's net overall supply of cocoa via its subsidiary CMC firm. COCOBOD has created tight principles and norms to oversee usage of loan, in addition to sanctions to direct the operations and conduct of LBCs involved in supply cocoa chain of Ghana. COCOBOD distributes monies to Licensed Buying Companies (LBCs) at 1% to 2% prime rate, compared to the current open market 18.5 percent interest rate.

To get a license and work as an LBC, a firm needs to adhere to and meet COCOBOD's requirements for the company's registration certificates, operating strategy, and financial competence. Again, interested companies must show that they have made significant expenditures in warehouse and logistic transport facilities, as well as in competent and skilled people resources. Companies interested in purchasing cocoa should have sufficient financial resources to purchase at least 2,000 cocoa metric tons in the initial year. LBCs that meet requirements of COCOBOD must give bank guarantees in the event of a breach of internal purchasing conditions and terms. COCOBOD protects itself from credit risk. Source: COCOBOD Research. COCOBODs award funding to LBCs founded on their market share and historical performance, which has likewise aided sustain the status quo. Before being given authorization licenses or temporary licenses, the eligible LBC must meet the Quality Control Division's requirements.

QCC's Managing Director may revoke this accreditation if the grounds seem unfit for cocoa storage for any cause that appears to be in violation of the Cocoa Sector Regulations Act. The CSMC, which includes members from Cocobod management and other stakeholders, reviews the application to turn into an LBC. LBC license is upgraded on an annual basis based on the LBC's success in meeting the Cocobod's aim. The license of the company is withdrawn for capacity absence due to non-performance if the LBC fails to achieve quantity specifications for two consecutive crop seasons. According to Laven (2007), LBCs employ Purchasing Clerks (PCs) to acquire cocoa on commission from villages and hinterland communities at a set amount per cocoa bag bought. After passing quality checks certified by the QCC, the LBCs carry the cocoa from cocoa hinterland growing societies to designated take-over centres, where it is delivered to the proper Cocoa Take-over Centres.

## **2.8 Liberalization Ghana's Cocoa Sector Purpose**

The liberalization process goal was to increase competition in internal cocoa marketing and expand chain of supply. The measures are targeted at assuring the sector of cocoa efficiency. The cocoa Ghana sector's internal market has been liberalized partially, nonetheless it is heavily controlled by the Ghanaian government. Fold, p. 103, 2008. COCOBOD, as the Ghana cocoa sector's regulator, ensures that LBCs that breach the laws and regulations governing internal cocoa procurement face appropriate punishments to retain the cocoa sector's discipline.

### **2.8.1 Internal Purchasing and Marketing of Cocoa in Ghana**

Cocoa marketing and procurement in Ghana is rigorously regulated and managed by COCOBOD and its firms' subsidiary, and any other firm discovered exporting, marketing, or selling cocoa in Ghana is guilty of a serious crime punishable by law under PNDCL 81, (the Cocoa Board Law of

1984). The board's objectives are outlined in section 2 of the Cocoa Ghana Board Law, 1984, and the board's marketing and acquisition of Ghana cocoa is completely reserved to the board.

### **2.8.2 External Ghana Cocoa Beans Marketing**

As of now, no full export licenses for cocoa have been given, while the government intends to allow license-buying enterprises with strong financial capabilities to apply. According to an interview with certain COCOBOD employees and management, the government has no plans to implement the reform. The government's justification for preserving the sector's regulatory structure is to ensure high-quality cocoa production in Ghana in order to benefit from a price premium on the global market. Because it is difficult to control export activities as a result of full liberalization of the cocoa business, the government is concerned that quality would worsen and Ghana will lose its internationally recognized premium cocoa quality. COCOBOD further claims that the LBCs are not interested or ready in exporting, and thus the nation, and that the government, today directly gains from exports of cocoa. Interview conducted on the spot. COCOBOD is entirely accountable to the sale and marketing of cocoa in Ghana, and it is prohibited for any other company to involve in any type of external or internal market minus the COCOBOD's valid consent or authority. As a result, CMC (the Cocoa Marketing Company), COCOBOD subsidiary, is responsible for both external and internal marketing and sales of cocoa, both domestically and internationally. The Ghana Cocoa Board Act of 1984 is the source of this information.

### **2.8.3 Ghana's Cocoa Purchasing Competition's and Cocoa Sector's Liberalization**

Several studies on the industry of cocoa have concluded that cocoa industry in Ghana has a very solid structure. Ghana is the sole producing-cocoa nation minus full liberalization, as said

by Laven (2007) and Vigneri and Santos (2007). Ghana's cocoa industry has been liberalized to some extent. The establishment of LBCs was intended to boost the cocoa sector's efficiency. The deregulation of Ghana's cocoa industry was supposed to increase competition among LBCs (Vigneri and Santos, 2009). Competition among licensed buying organizations, according to Zeitlin (2005), is a crucial component of boosting efficiency in Ghana's cocoa sector. In the cocoa industry, market competition was supposed to boost efficiency (Varangis and Schreiber, 2001). Partially liberalizing the Ghana cocoa sector has allowed new players to enter the market, resulting in increased competition and a loss of market share for the top buyers. From 1998 to 2005, the cocoa sector's reform led in a rise in producer cocoa price from fifty-six percent to seventy percent free on board pricing. Similarly, Varangis and Schrieber (2001:75) disagree with a claim that liberation cocoa has led to arise in producer prices of cocoa, claiming that it instead has led to unfavorable competition and more participation. Internal marketing liberalization adoption has led to a decline in yearly purchase of cocoa by several prominent LBCs with a greater market share, such as PBC. In theory, many researchers believe that higher cocoa prices lead to higher output. Improved farming practices and pest management, according to Amoah (1998), can also lead to increased yield.

#### **2.8.4 Performance of Cocoa Buying among Purchasing Licensed Organizations**

Buying Licensed Organizations assist in the internal high-quality cocoa purchase in Ghana. Many players are involved in cocoa sector organization of Ghana across the full chain of supply process. Cocoa industry in Ghana is stated to be focused, implying that it is made up of multiple LBCs. Each cocoa season is characterised by the involvement of a large number of LBCs in cocoa procurement. For example, 32 out of 35 LBCs registered cocoa purchased throughout the 2011/2012 harvest season, according to COCOBOD (2013). The total amount of cocoa purchased

in the 2011/12 year of crop in consideration was eight hundred and seventy-nine thousand, three hundred and forty-eight tonnes, in 2010/11, down from one million, twenty-four thousand, five hundred and fifty-three tonnes. This tonnage indicated a 14.17 percent output drop compared to the 2010/11 year of crop acquisitions. With a total purchasing share of 35.27 percent, the Produce Buying Company Limited (PBC) continues to be the largest cocoa purchaser. With market shares of 12.82 percent and 8.45 percent, respectively, Armajaro Ghana Limited and Akafo Adamfo came in third and second. The remaining 29 firms made up 43.46 percent of the market. The pie chart below shows the percentage of each LBC's cocoa purchasing performance for the crop season that ended in 2011/2012. Ghana Cocoa Board's Research Department is the source of this information (2012).

### **2.9 Enriched Cocoa Beans Quality:**

Cocoa bean quality of Ghana is due to adequate fresh beans fermentation after harvesting cocoa matured pods, which inclines to greatly advance quality of cocoa bean. Cocoa fresh beans are fermented for around 3 days before being dried in the sun for a week. Cocoa drying beans in the sun develops dried beans flavor whereas lowering their acidity. Quality is crucial since it determines the price and status of cocoa. COCOBOD regulates the sector, encouraging the use of approved farming techniques and bean drying procedures, which has resulted in the standard quality premium cocoa of Ghana. This is combined with a Total Quality Management (TQM) system to ensure cocoa quality of Ghana throughout the chain of supply.

### **Methodology**

The method of the study will be descriptive design with quantitative method to pinpoint the procurement process and quality assurance process of cocoa in Ghana. After, the descriptive

design has been used to examine the procurement process and quality assurance process of cocoa in Ghana, the researcher will use the results to design IoT based automatic cocoa quality testing system to address cocoa testing issue. After designing the automatic cocoa quality testing and procurement system, the study sought to achieve a secured and transparent quality procurement for cocoa in Ghana. After designing the automatic cocoa quality testing and procurement system and implemented, the researcher will use three months to study its operation and after that analyze its effects. So, the descriptive design will be used to analyze the impact of the proposed system for procurement process on the cocoa quality testing and procurement process in Ghana.

#### **COMPETING INTERESTS DISCLAIMER:**

**Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors**

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