

**ASHESI UNIVERSITY COLLEGE**

**IMPROVING THE EFFICIENCY AND  
ACCOUNTABILITY OF THE FERTILISER SUBSIDY  
PROGRAMME IN GHANA USING TECHNOLOGY**

**AMA SARPOMAA AGYEI-BOAHENE**

**2013  
Applied Project**

**ASHESI UNIVERSITY COLLEGE**

**IMPROVING THE EFFICIENCY AND ACCOUNTABILITY  
OF THE FERTILISER SUBSIDY PROGRAMME IN  
GHANA USING TECHNOLOGY**

**AMA SARPOMMAA AGYEI-BOAHENE**

Dissertation submitted to the Department of Computer  
Science,  
Ashesi University College  
In partial fulfillment of Science degree in Computer  
Science

**APRIL 2013**

I hereby declare that this dissertation is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:.....

Candidate's Name:.....

Date:.....

I hereby declare that the preparation and presentation of the dissertation were supervised in accordance with the guidelines on supervision of dissertation laid down by Ashesi University College.

Supervisor's Signature:.....

Supervisor's Name:.....

Date:.....

## **Acknowledgements**

I would like to thank the Almighty God for his guidance and providence. He has been the one in charge from the beginning.

I would like to specially thank my supervisor and lecturer, Aelaf Dafla, for guiding me through this project. Your patience is astonishing. You are awesome.

To Nana Oye Ofei-Kwapong who would attempt to debug code even though she does not understand it.

To Edem Diaba, Ahinei Amatefio and Emmanuel Nkansah who kept my head out of the clouds and in my code.

To Frank Anamuah-Kuofie for lending me his time again and again.

To Kwabena II, Acheampomaa, Akosua, Kwabena Payin and Kwabena Kakra, I did this for you too.

## **Abstract**

The fertiliser subsidy system introduced by the government of Ghana in 2008, was designed to increase crop yield in the country thereby reducing overall food prices. The inefficiencies in the system have however prevented this goal from fully materialising. There has therefore arisen the need for a system that can manage the fertiliser subsidy system. This system must be secure, efficient and allow for accountability. This paper proposes a Fertiliser Subsidy System aided with Web and Mobile technology that is equipped to solve the fertiliser subsidy management problem.

# Table of Contents

<b>ACKNOWLEDGEMENTS</b>	<b>III</b>
<b>ABSTRACT</b>	<b>IV</b>
<b>CHAPTER 1</b>	<b>1</b>
<b>1 INTRODUCTION</b>	<b>1</b>
1.1 INTRODUCTION & BACKGROUND TO THE PROJECT	1
1.2 PROBLEM DESCRIPTION	2
1.2.1 SMUGGLING	2
1.2.2 HIGH COSTS	3
1.2.3 FRAUD	3
1.2.4 FAKE VOUCHERS	4
1.3 OBJECTIVES	4
1.4 MOTIVATION	5
1.5 OUTLINE OF DISSERTATION	5
<b>CHAPTER 2</b>	<b>7</b>
<b>2 FERTILISER SUBSIDY SYSTEM</b>	<b>7</b>
2.1 BACKGROUND	7
2.2 DESIGN OF THE FERTILISER SUBSIDY SYSTEM	7
2.2.1 THE VOUCHER SYSTEM	7
2.2.2 THE WAY BILL RECEIPT SYSTEM	8
2.2.3 THE FERTILISER DISTRIBUTION SUPPLY CHAIN UNDER THE VOUCHER SYSTEM	11
2.3 PROPOSED SOLUTION	12
<b>CHAPTER 3</b>	<b>13</b>
<b>3 DESIGN</b>	<b>13</b>
3.1 FUNCTIONAL REQUIREMENTS	13
3.2 USER REQUIREMENTS	13
3.3 SYSTEM REQUIREMENTS	15
3.3.1 FUNCTIONAL REQUIREMENTS	15
3.3.2 NON FUNCTIONAL REQUIREMENTS	17
3.4 UML	17
3.4.1 SCENARIOS	17
3.5 DATABASE DESIGN	19
3.6.1 ENTITY RELATIONAL MODEL	21
<b>CHAPTER 4</b>	<b>22</b>
<b>4 IMPLEMENTATION</b>	<b>22</b>
4.1 TOOLS	22
4.1.1 THE DATABASE LAYER	22
4.1.2 THE APPLICATION LAYER	22
4.1.3 THE INTERFACE LAYER	23
4.1.4 MOBILE COMPONENT	24

<b>4.2</b>	<b>APPROACH</b>	<b>24</b>
4.2.1	FLAGGING	24
4.2.2	CONFIRMATION	25
4.2.3	REPORT COMPARISON	26
<b>CHAPTER 5</b>		<b>28</b>
<b>5</b>	<b>TESTING AND RESULT</b>	<b>28</b>
<b>5.1</b>	<b>DEVELOPMENT TESTING</b>	<b>28</b>
<b>5.2</b>	<b>UNIT TESTING</b>	<b>28</b>
<b>5.3</b>	<b>SYSTEM TESTING</b>	<b>28</b>
5.3.1	REQUIREMENTS-BASED TESTING	29
5.3.2	COMPATIBILITY TESTING	30
<b>5.4</b>	<b>CHALLENGES</b>	<b>30</b>
<b>CHAPTER 6</b>		<b>32</b>
<b>6</b>	<b>CONCLUSIONS AND RECOMMENDATIONS</b>	<b>32</b>
<b>6.1</b>	<b>CONCLUSIONS</b>	<b>32</b>
<b>6.2</b>	<b>RECOMMENDATIONS FOR FUTURE WORK</b>	<b>32</b>
<b>BIBLIOGRAPHY</b>		<b>33</b>
<b>APPENDIX</b>		<b>35</b>
<b>FSS WEB APPLICATION</b>		<b>35</b>
<b>MOBILE J2ME APPLICATION</b>		<b>37</b>

# Chapter 1

## 1 Introduction

### 1.1 Introduction & Background to the project

Governments in Africa have, for years, sought ways to make their countries food sufficient. The continent of Africa has great potential for massive crop yields because of its fertile lands. In spite of these advantages, many countries in Africa struggle to feed their people. The reasons for this phenomenon are many. One of the main problems however, is the fact that most farmers in African countries are poor rural people who cannot afford expensive materials, tools and equipment that would lead to increase in crop yields.[1] The average African farmer cultivates for subsistence and sells what his left of his yield in the market. As a solution to this problem, most countries in Africa introduced systems to subsidise agricultural inputs, tools and material.

Similar to these African countries, Ghana also began subsidising fertiliser in 2008 as a result of low yields that resulted in extremely high food prices.[2] The subsidy system has however been proved to lack efficiency and does not allow for accountability of the materials being subsidised. The current system also lacks security and it is difficult for the government to ascertain how much money needs to be paid to the companies who import and distribute the fertiliser bags. These problems continue to persist because there is a lot of paper work involved in the systems that are currently being run and many bags fall between the cracks, unaccounted for. However with the increase in



technology, the government stands to gain by using technology to solve its problems while gaining the relevant information to make sound economic decisions.

## **1.2 Problem Description**

The problems this paper tries to solve lies in the inefficiencies and failures of the Fertiliser Subsidy Systems in Ghana. In the year 2008 when the fertiliser subsidies were introduced to farmers, the voucher system was used.[2] However, this system had high overhead costs and the fertiliser was being diverted from the farmers. To solve these problems, the waybill system was introduced. Like the voucher system, the waybill system is berated with discrepancies that affect distribution, efficiency and accountability. The specific problems of both the voucher and waybill systems are further described below:

### **1.2.1 Smuggling**

Smuggling has been a major problem affecting the Fertiliser Subsidy Program. There have been many reports of farmers who have not received their share of subsidised fertiliser because of the mass smuggling that the distributors are involved in. This is because the government is unable to trace the bags of fertiliser that are imported by the fertiliser companies. They are also unable to track their subsequent journey down the supply chain to the final consumers who are presumed to be Ghanaian farmers. According to an article by William N-lanjerborrJululah, "Some unpatriotic Ghanaian agents engaged in the distribution and sale of subsidised fertilisers in the Upper East Region are now taking advantage of loose security monitoring and patrols at the borders and numerous unapproved routes into neighbouring countries, to

smuggle the commodity in large quantities into Togo and Burkina Faso for huge profits.”[3] The article describes how some smugglers have trained their donkeys to manoeuvre their way to the borders loaded with fertiliser for sale in neighbouring countries.[3] The Regional Director of the Ministry of Food and agriculture, Mr Cletus Achaab highlighted the high numbers of fertiliser agents as a cause of smuggling. In Bawku alone there were sixty-seven fertiliser agents when only five agents would have sufficed.[3]

### **1.2.2 High Costs**

Secondly, the use of the voucher system and waybill system has not been efficient due to the high costs involved in implementing these systems. With the voucher system, the cost of printing and importing vouchers was high. With the waybill system as well, every farmer has to be equipped with “pass books” which also costly. Another cost incurred in both of these systems is the amount of personnel that are employed to try and ensure that these systems work. Personnel are needed to distribute the vouchers or ensure farmers are equipped with “pass books” as with the waybill system. Personnel are also needed especially in the waybill system to reconcile the figures the districts have with those of the farmers. This of course poses a problem if farmers are not available or if books have been misplaced or destroyed.

### **1.2.3 Fraud**

Under the voucher system there were inefficiencies in the payment system. Since only fertiliser importers were allowed to redeem vouchers for cash. The fertiliser importers therefore gained a lot of power because they were not only controlling the flow of fertiliser into the country but also the “flow of

subsidies from government to the farmers”.[4] The retailers therefore began to refuse vouchers from farmers because they were “unable to redeem the vouchers with their own suppliers or it was too expensive or difficult to do so”.[4]

#### **1.2.4 Fake Vouchers**

Another problem that can be perceived from the structure of the old system is the possibility of fraudulent people creating fake vouchers and passbooks. Although this situation has not been reported in Ghana other countries such as Zimbabwe have experienced this phenomenon.[17] The creation of fake passbooks and vouchers is a possibility if security is not improved in the system.

### **1.3 Objectives**

The objective of this project is to develop a web application supported by a mobile application that will enable the Ministry Of Food and Agriculture to ensure that the farmers have received bags of fertiliser allocated to them. The government can therefore be assured of the number of bags that have been supplied to farmers and therefore pay the importers and distributors accordingly. The application will also enable the ministry to monitor the bags of fertiliser at every point in the supply chain. With this functionality, the ministry will be able to easily detect at which point, in the supply chain, bags got stolen or missing. Thus they will be able to investigate, make enquiries, fix loopholes and ensure that the appropriate people be accountable for any discrepancies in the system.

The application also serves as an electronic source of agricultural data that can be used to make meaningful national and economic decisions for the agricultural sector and the nation as a whole.

### **1.4 Motivation**

I have always believed that for Ghana to begin tackling its economic problems, we need to focus on the agricultural sector. The agricultural sector is one of the biggest industries in this nation, contributing to 24.6 percent of GDP in the year 2005[5] and employing about 55.8 percent[6] of the nation's total workforce force. The industry however has suffered a lot of setbacks, reducing its overall impact on the nation's economy. The fertiliser subsidy system that was introduced by the government is an attempt to salvage this industry. The inefficiencies and problems that the current system faces do not mean outright failure but an opportunity to find an even better solution to the agricultural sector problem. I believe technology and innovation is the way to solve this problem.

### **1.5 Outline of Dissertation**

This paper will be outlined as follows:

Chapter 2 will review the literature on the fertiliser subsidy system in Ghana and the different solutions the government has introduced to ensure the farmer receives the subsidised bags of fertiliser. Chapter 3 will describe the design of the application and the functional and non-functional requirements of the application. Chapter 4, on the other hand will focus on the implementation of the application, describing the technology, tools and platforms that were used and the reasons for which they were chosen. Chapter 5 will deal with the testing of the application and the results from

the testing. Lastly, Chapter 6 will make conclusions and recommendations on the application created.

## **Chapter 2**

### **2 Fertiliser Subsidy System**

#### **2.1 Background**

In the year 2008, as a result of general spikes in food prices, the food and fertiliser prices rose to a record high.[7] According to Banful, the price of maize rose by 77 percent in Accra and Tamale during that time. Nitrogen-Phosphorus-Potassium (NPK), the most widely used fertiliser in Ghana increased from GH¢26 to GH¢35 between June 2007 and March 2008.[2] The government at the time began the Fertiliser Subsidy Programme to serve as a temporary solution to the high food and fertiliser prices at the time. The program was therefore designed to subsidise just four kinds of fertilisers: NPK 15:15:15, NPK 23:10:05, urea and sulphate ammonia.

#### **2.2 Design of the Fertiliser Subsidy System**

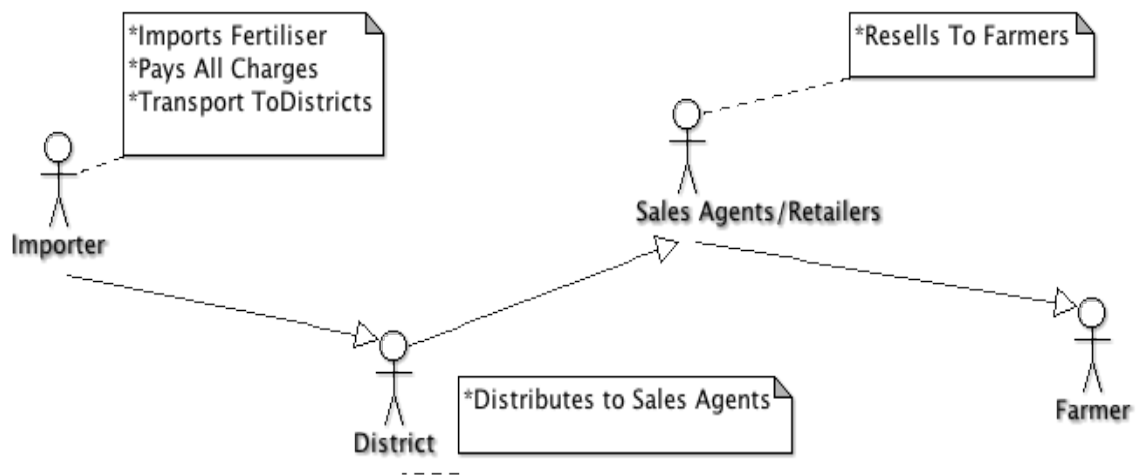
##### **2.2.1 The Voucher System**

Unlike what took place in other countries such as Malawi, the government did not enter the business of importing fertiliser. Rather, the government formed a public-private partnership with the Fertiliser importing companies in the country.[2] These companies namely, Yara Ghana Ltd, Golden Stork, Dizengoff Ghana and Chemico Ltd, import approximately 100 percent of all the fertiliser in the country. The government negotiated the retail price of a 50kg bag of fertiliser in each region's capital. They agreed on a price and the government ordered for the printing of vouchers, which indicated 50 percent off the purchase of particular fertilisers.[2]

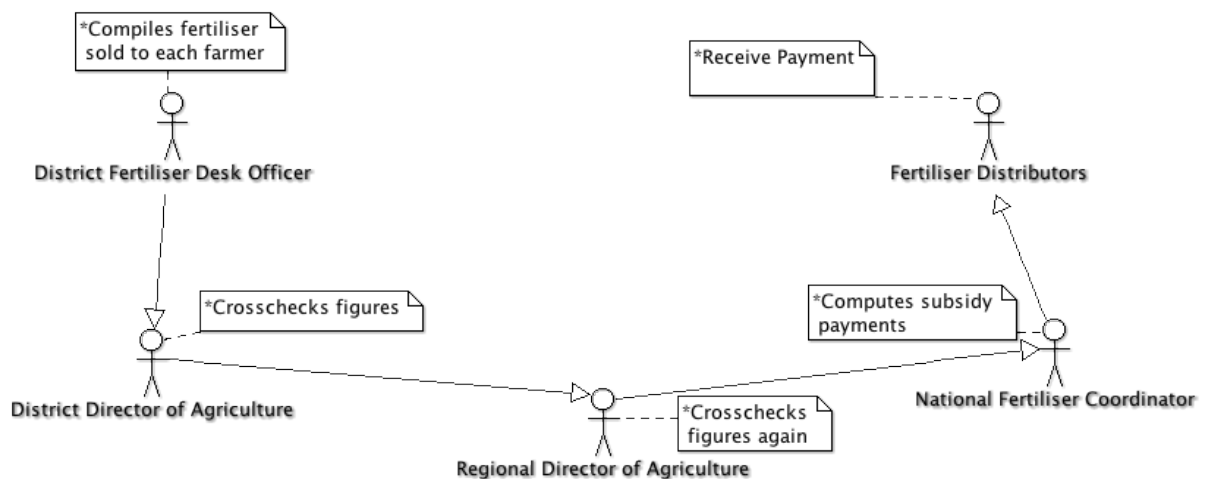
The farmers were to be given region specific vouchers from their agricultural extension officers. The farmers could then purchase bags of fertiliser from retailers who were willing to accept the vouchers. The retailers would in turn receive the vouchers and send them to the importer who would pay the retailer the amount stated on the voucher and finally the importer would take the vouchers to the Ministry of Finance.[8] The Ministry promised to reimburse the importer after a week. However, the use of vouchers was plagued with problems such as “high overhead and administrative costs, diversion of fertiliser from intended target beneficiaries and large amounts of time spent by the Head Office and District Directors and the staff of MOFA in policing the distribution process.”[8]

### **2.2.2 The Way Bill Receipt System**

As a result of the problems associated with the voucher system, the government revamped the program. They got rid of the vouchers and implemented a passbook known as the waybill system.[7] The waybill system was introduced in 2010 and was set up most importantly to ensure that the fertiliser reached the farmers at the subsidised prices. “The operational details of the subsidy included determining the subsidy price, ensuring distribution, monitoring and oversight, and payment based on validated sales receipts.”[8] The retail prices of fertiliser for the market was set after negotiations between the government and importers. However, the price of fertiliser on the international market, the cost involved in the domestic fertiliser supply chain and the expected exchange rate fluctuations were also considered in pricing.



**Fig 2.1** shows the flow of fertiliser bags in the Waybill System



**Figure 2.2** shows the procedure for payment in the Waybill system.

Under the waybill system, the fertiliser importing companies import the fertiliser and pay all port charges. The importers then transport the requested amount of fertiliser to the Districts. These importers are then paid the subsidy and reimbursed for port handling and shipping costs after they have presented the relevant waybill receipts and the receipts have been reconciled. The fertiliser is then moved further down the supply chain to the



registered sales agents who in turn sell to the farmers. The payment mode however was quite complex. The district fertiliser desk officer compiles the quantity of fertiliser sold to each farmer and the District and Regional Directors of Agriculture then crosscheck the figures. Finally the waybill receipts are passed onto the National Fertiliser Coordinator who computes the subsidy payments that is due the fertiliser distributors. According to a 2010, Ministry of Agriculture report, "a total of 91,244 MT of subsidised fertiliser was sold, of which almost 80 percent reached farmers directly via purchases in the market".[8]

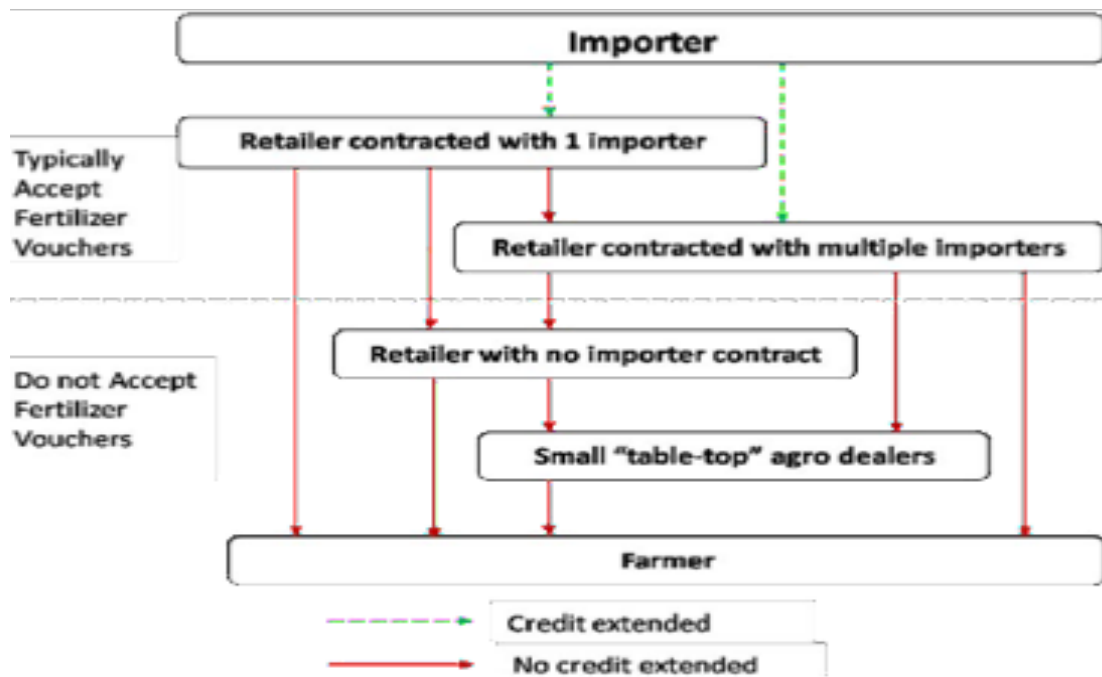
Although the waybill system was put in place to solve the problems of the voucher system, there are still complains about farmers not receiving the fertilisers they need and also issues of smuggling. This indicates that a lot of the issues arise from the inefficiency in the program's supply chain. According to E. Dante, the actual cost of losses made during distribution is always underestimated because the countries do not realise just how much is lost.[9] Some of the reasons for losses are "spillage caused by torn bags", damage and theft.[9] One of the ways the IFA suggests to help reduce this problem is to improve management supervision. This means that the responsibility of management at each stage should be clearly spelt out. There should also be adequate documentation and a way to trace distributed bags. This way, fraud will be discouraged and the system can be made more efficient.[9]

### **2.2.3 The Fertiliser Distribution Supply Chain Under the Voucher System**

According to Branful (2009), all the imports made by the fertiliser importers arrive at the Tema port, in the Greater Accra region or the Takoradi port in the Western region. These importers also “distribute wholesale, and retail fertiliser”. They sell to private firms who might in turn sell to retailers or sell directly to the farmer. Branful (2009) identified four types of fertiliser retailers:

- Type 1: Those that have contracts to sell products from one importer
- Type 2: Those that have contracts with multiple importers
- Type 3: Those that have no contracts with any importer
- Type 4: Small retailers who repackage and sell fertiliser sourced from larger retailers

Types 1 and 2 retailers get fertiliser directly from importer. They may receive the fertiliser on credit or may also receive bulk concession discounts and free transportation. On the other hand, Types 3 and 4 would receive fertiliser from Types 1 and 2 retailers. These are mostly located in rural areas. They repackage and sell less than 50kg a bag.[2]



**Figure 2.2** Diagram Describing the Fertiliser Supply Chain[2]

## 2.3 Proposed Solution

From the literature reviewed above, I am proposing a web based application aided by a J2ME application that will help the government to trace every bag of fertiliser and whether or not it reaches the final consumer, which is the farmer. The solution will take into consideration the physical relationship between the main stakeholders who are the Government: Ministry of Food and Agriculture, the District Offices, Retailers and the Farmers. It will also clearly outline the responsibilities of each member in the supply chain thus reducing fraud.

## **Chapter 3**

### **3 Design**

#### **3.1 Functional Requirements**

The functional requirements were also gathered from the way the Fertiliser System is run currently, which is the Waybill System. The main purpose of the application will be to allow the government to trace each bag of fertiliser from the time it arrives at the port to the time it is placed in the hand of the farmer through the use of barcodes or RFID. This is to ensure that both retailers and importers get their fair share of subsidies (i.e. subsidies for the number of fertilisers that farmers have received). The application must ensure that the government has the relevant data to continue to make relevant decisions concerning the Fertiliser Subsidy Programme. Given the nature of the Fertiliser subsidy system, each stakeholder, has a different role to play in the system and thus they will each have unique functional requirements.

#### **3.2 User Requirements**

This gives a general overview of what the Ministry of Food and Agriculture and what the user, at each point in the supply chain, will expect out of the FSS application.

##### **MOFA**

- The application must allow the Ministry to know the transfers that occur between the units in the supply chain (i.e. Importer, District, Retailer and Farmer)

- The system should register have every member of the fertiliser subsidy system with a unique ID.
- The system should be secured from unauthorised access to the information that it holds.
- The application must aid the Ministry to easily analyse data to make timely decisions.
- The application should eliminate all paperwork regarding orders sent from the Ministry to the importer.

### **Importer**

- The application should allow the importer to receive orders from the Ministry without paperwork.
- The application must let the importers to allocate batches of fertiliser bags to particular districts and regions.

### **District Officer and Retailer**

- The system should enable both the retailer and district to acknowledge receipt of fertiliser bags.
- The system must also allow them to record sales.

### **Farmer**

- The application must notify the farmer of every transaction he/she makes.

## **3.3 System Requirements**

### **3.3.1 Functional Requirements**

The functional requirements are generated from the user requirements specified above.

#### **MOFA**

- The application should generate reports for the Ministry that describes the transactions between the units in the supply chain.
- The application should have a login in system that will authenticate a user before he/she is allowed to have access to the information in the system.
- The system must have a registry system that allocates unique id's to every member of a supply chain unit.
- The system should be able to compare two generated report and provide an analysis for the Ministry.
- The system should allow the Ministry to place orders that can be sent to the Importer

#### **Importer**

- The system should automatically update the importer with the Ministry's orders.

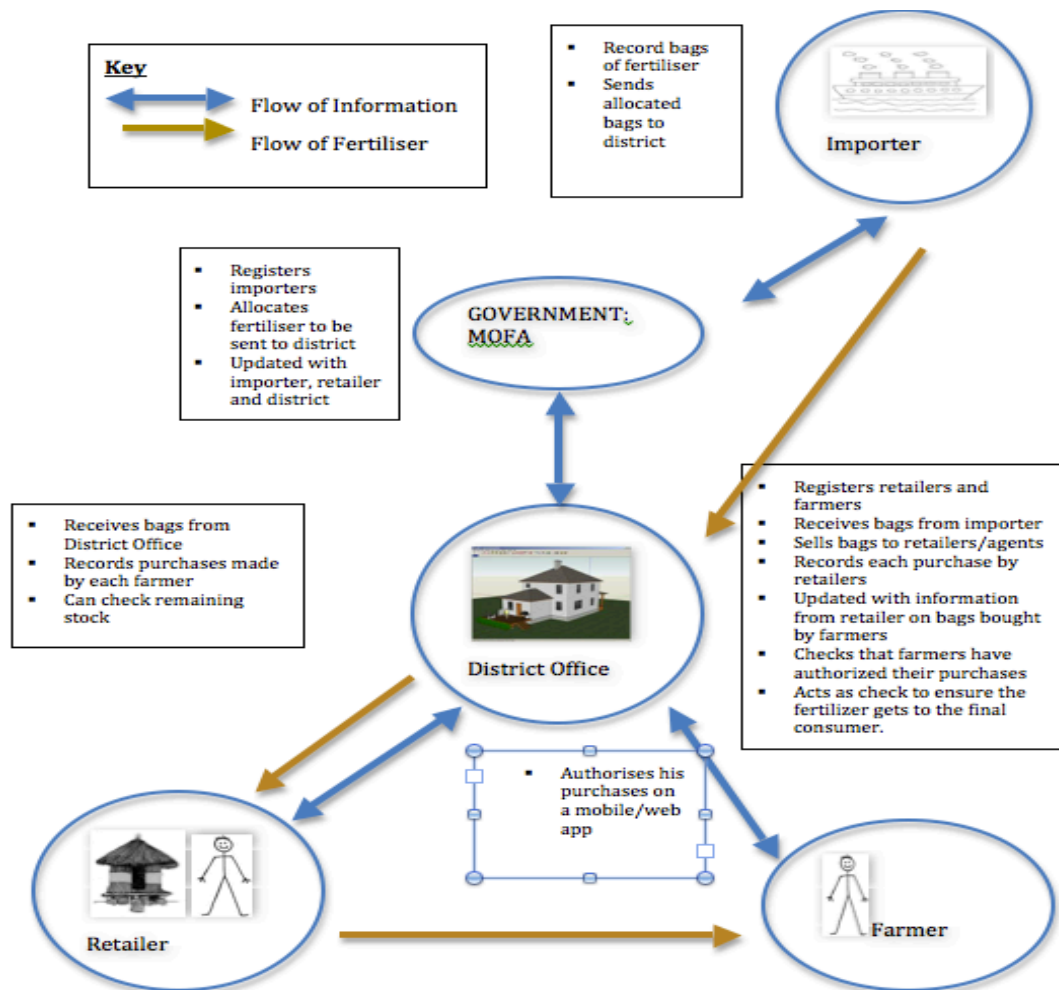
#### **District and Retailer**

- The mobile feature of the application should allow them to enter batches of fertiliser bags for acknowledgement of receipt.

- The application must have a feature to enter sales made and the information should update the database.

### **Farmer**

- The application should send a text message to the farmer after he makes a transaction.



**Figure 3.1** shows the relationship between stakeholders.

### **3.3.2 Non Functional Requirements**

#### **3.3.2.1 *Product Requirements***

##### **3.3.2.1.1 Usability Requirements**

The user interface must be easy to use and the user should be able to navigate the system without needing to be prompted.

##### **3.3.2.1.2 Performance Requirements**

The system should be able to perform the basic function of generating fertiliser data for the Ministry of Food and Agriculture. It should also be able to allow users to save information pertaining to the fertiliser subsidy system in the database.

##### **3.3.2.1.3 Security Requirements**

The system should be able to authenticate a user to verify that they are authorized by the Ministry to operate the system. Unauthorized users should not be able to by pass the system to modify or have access to information stored in the system's database.

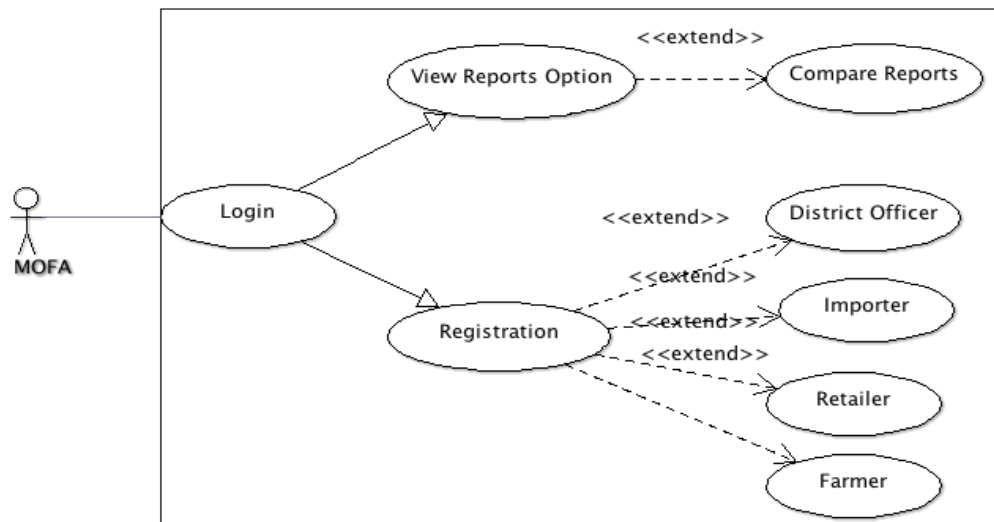
### **3.4 UML**

As indicated in Section 3.1, there are will be four users of this system; the Ministry Of Food and Agriculture, the primary users; the Importers; the District Officers and the Retailers. A visual representation of how each of these users will interact with the system is represented in Section 3.6, below.

#### **3.4.1 Scenarios**

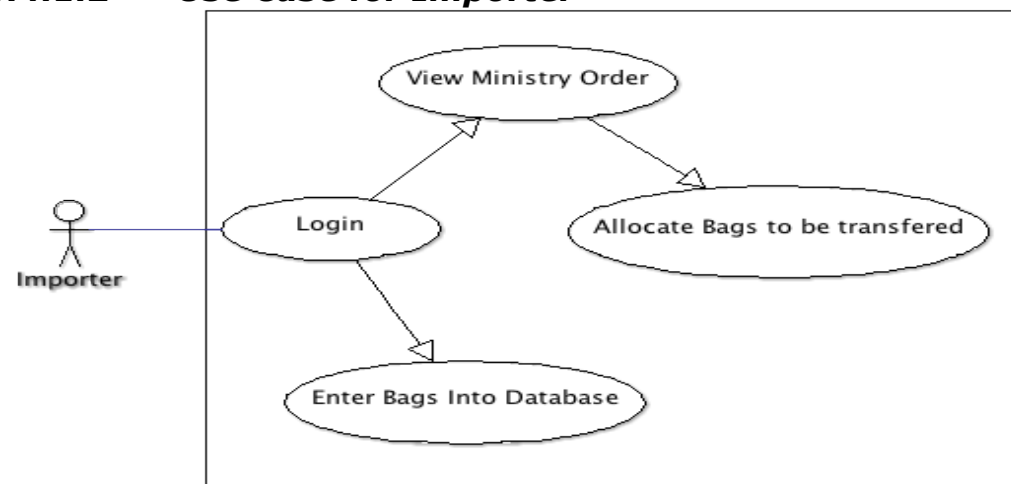
##### **3.4.1.1 Use Case for Ministry**





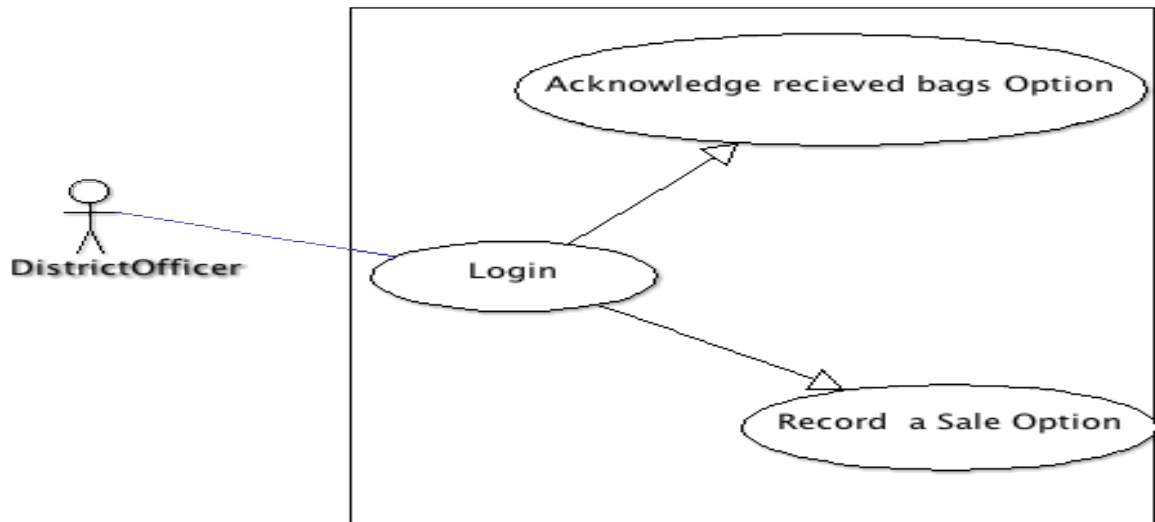
**Figure 3.2** shows a use case diagram for the Ministry of Food and Agriculture.

#### **3.4.1.2 Use Case for Importer**



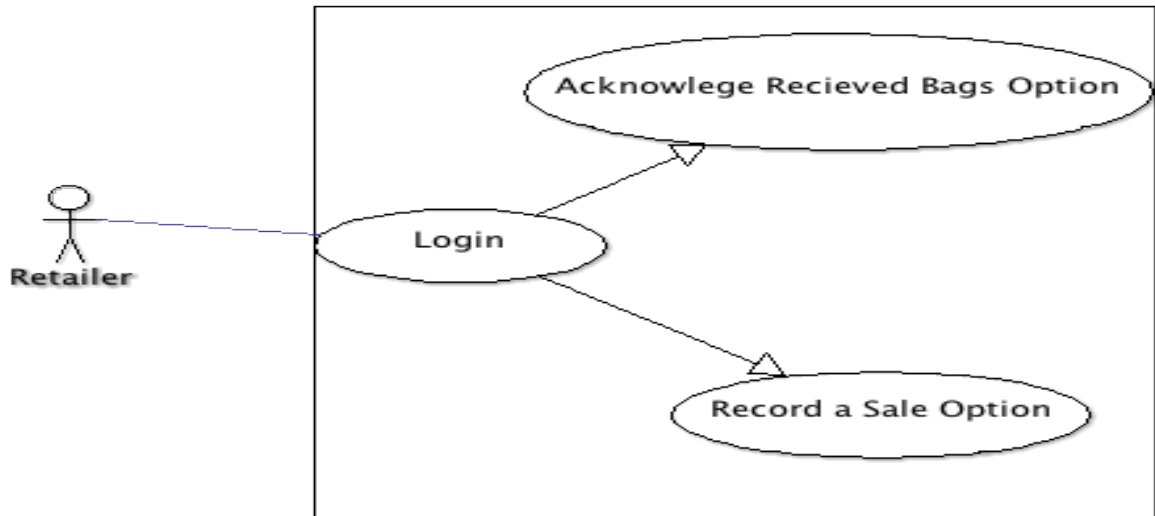
**Figure 3.3** shows a use case for the importers of fertiliser

### 3.4.1.3 Use Case for District



**Figure 3.4** shows a use case diagram for the district heads.

### 3.4.1.4 Use Case for Retailer



**Figure 3.5** shows a use case diagram for the retailers.

## 3.5 Database Design

The database structure and design is the backbone of the FSS application.

With the sheer amount of information that a fertiliser subsidy system promises to hold, it is important that the database be robust. The database tables were structured in such a way that data integrity is ensured and redundancy is removed. Ensuring data integrity means, "all of the data in the database are consistent"[10]. Removing redundant data makes the database

more efficient because there will be less data to process when queries are made. It also reduces the amount of storage that is needed and also reduces errors.[11]

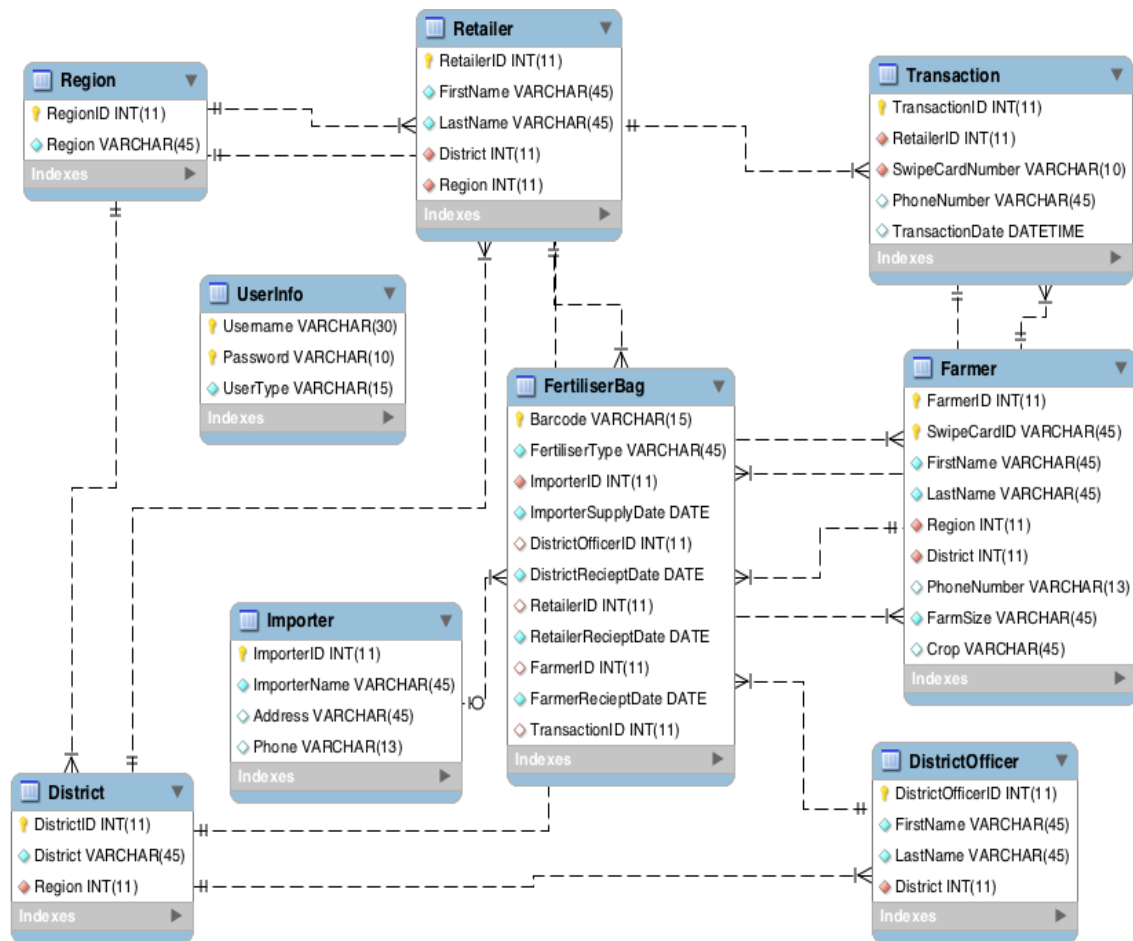
The FSS application database consists of eight tables, namely *Farmer*, *Importer*, *Retailer*, *District*, *DistrictOfficer*, *FertiliserBag*, *Region* and *UserTable*. The *Farmer*, *Importer*, *Retailer* and *DistrictOfficer* tables record information about each of the members of the fertiliser supply chain. Each of these tables make references to the *Region* and *District* tables which give more information about the whereabouts of the players (i.e the Importers, District Officers and the Farmers) in the industry. There was also the need to add a *Transaction* table that logged in batches of transferred bags between the *Retailer* and the *Farmer* as one transaction. The most important table however in the database structure is the *FertiliserBag* table, which records and logs where a bag has reached in the supply chain. The structure of the *FertiliserBag* table is diagrammed in Figure 3.6 below.

Table 3.1 shows the components of the *FertiliserBag* Table.

<b><i>FertiliserBag</i> Table</b>	
Barcode	INT
FertiliserType	VARCHAR
ImporterID	INT
ImporterSupplyDate	DATE
DistrictOfficerID	INT
DistrictReceiptDate	DATE
RetailerID	INT

RetailerReceiptDate	DATE
FarmerID	INT
FarmerReceiptDate	DATE

### 3.6.1 Entity Relational Model



**Figure 3.7** shows the entity relational model of the FSS database.

## **Chapter 4**

### **4 Implementation**

The FSS application has three main layers, the Database layer, the Application layer and the Interface layer. With each layer different tools were used depending on how well they suited the functions of the application.

#### **4.1 Tools**

##### **4.1.1 The Database Layer**

###### **4.1.1.1 MySQL**

The MySQL database system was used in the database layer of the FSS application. MySQL was chosen over the MS SQL because the developer has more experience and is more familiar with the MySQL platform. Secondly, the use of MySQL was more relevant because I was working with an Macs OS system. Since MySQL is more compatible with a wide variety of platforms, it was chosen over the MS SQL, which is most compatible with Windows systems.[12] Another reason why I chose to use this platform is because it is open source and free.

##### **4.1.2 The Application Layer**

###### **4.1.2.1 HTML**

I used Hypertext Mark-up Language (HTML) to make the web pages of the FSS application functional. HTML is an open source language that is supported by almost every browser. It is widely used because of its efficiency and consistency.

###### **4.1.2.2 JavaScript**

JavaScript is an Object Oriented Programming scripting language, developed by Netscape, Inc. This language is used in HTML documents to “provide

levels of interactivity to web pages that are not achievable with simple HTML".[15] I used JavaScript to implement algorithms that were needed to make the FSS application functional. For example, JavaScript was used to implement the flagging algorithm that informs MOFA when a particular point in the supply chain is receiving or distributing more than all the others on average.

#### **4.1.2.3 PHP**

Hypertext Preprocessor, PHP is an open source language, which is free as well. [13] It is a server side script that can be used on most of the major operating systems including the Mac OS and Microsoft Windows. PHP was used as the platform to support the MySQL queries making it simpler for the rest of the FSS application to sync with the database.

#### **4.1.2.4 JpGraph**

This is "an Object Oriented Graph creating library for PHP"[14]. This library helps to create graphs from numerical data using PHP. I employed the use of this library to aid MOFA in the comparison reports from the different points in the supply chain.

### **4.1.3 The Interface layer**

#### **4.1.3.1 CSS**

Cascading Style sheet is file that contains different styles and layouts of a webpage. This makes it easier and faster to maintain a common theme through web pages. The styles in the CSS are brought to life through the HTML. I used CSS as a support to HTML to form the basic layout of the web pages of the FSS application.

#### **4.1.3.2 Twitter Bootstrap**

This is a CSS toolkit developed by a team from Twitter. This kit has in built styles for designing any element in HTML. This reduces time spent on creating CSS to make web pages more appealing and user friendly.

#### **4.1.4 Mobile Component**

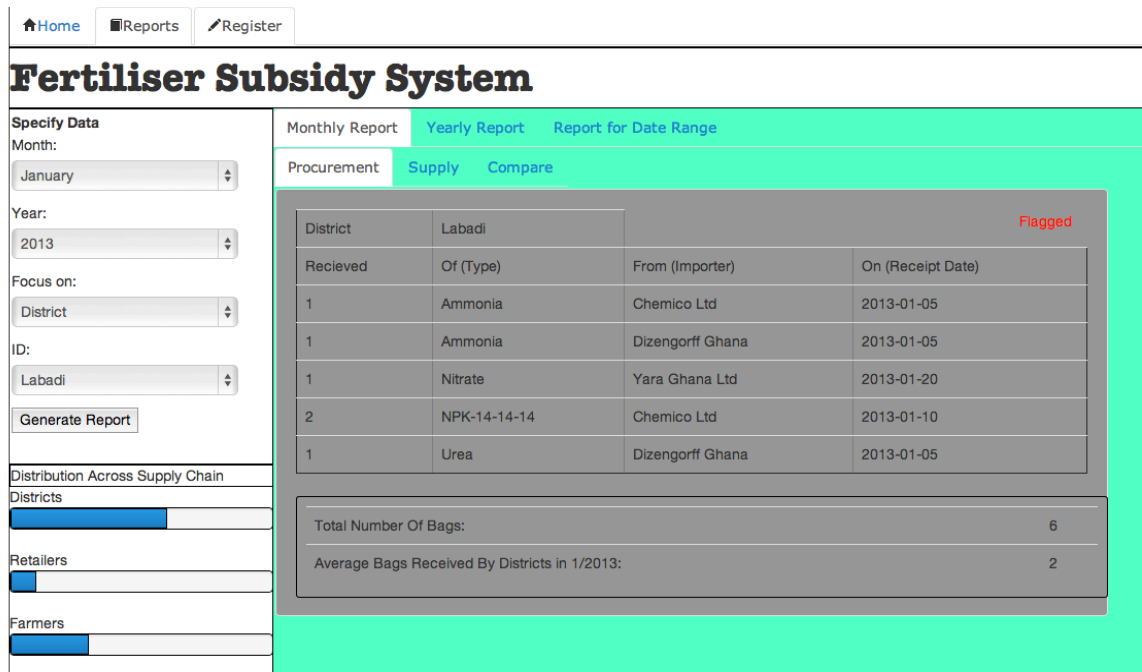
##### **4.1.4.1 J2ME**

J2ME is Java for Mobile. This platform allows you to create mobile applications for feature phones. It was used to create a feature that will allow users to confirm their receipt of fertilizer bags. The record store and text-messaging feature of J2ME was also incorporated into the mobile application.

### **4.2 Approach**

#### **4.2.1 Flagging**

The concept of flagging is to alert the ministry when a particular point in the supply chain is receiving or supplying more than the average in the whole system. To implement the flagging function, the total number of bags within a particular period of time associated with a particular member of the supply chain, say a particular importer is calculated. This sum is then compared with the total average of for all importers for that particular time range. If the sum is greater than the average by 10 percent that particular report is flagged to indicate to MOFA that there may be a need to investigate that particular importer. It is important to note however that the terms of comparison can be adjusted as MOFA deems fit.



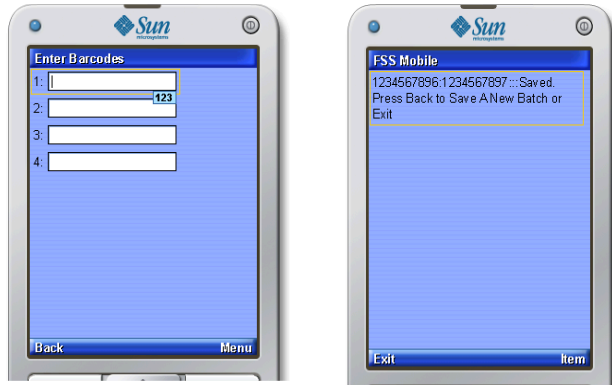
**Figure 4.1** shows the Ministry View with a flagged monthly report

#### 4.2.2 Confirmation

Another essential feature of the FSS application is confirmation. This feature helps MOFA to know where each bag is in the supply chain and when it was received. This feature is a J2ME component, which updates the main database specifically the *FertiliserBag* table. After the Importer enters the barcodes of the bags for supply, the other members in the supply chain use a simple mobile to confirm the receipt of each bag. The user logs in to the FSS mobile app, if his details are valid then they are shown a form where they are asked to enter their ID's and the number of bags they wish to conform. On clicking the next button, they are shown a list of empty text boxes equal to the number that was requested in the earlier form. The user then enters the barcodes of the bags to be confirmed. However, at the retailer point the user can confirm bags he/she has received or log in a sale he has made to a farmer. The retailer is asked to input the farmer's Swipe Card Number. When all the details have been taken, the farmer is sent a text message using SMS



GH that asks him/her to confirm the sale. The farmer confirms the sale by sending a short code(The transaction ID). The confirmation is done using Frontline SMS.



**Figure 4.2** shows the process of confirming receipt of fertilizer bags using the phone.

#### **4.2.3 Report Comparison**

This feature of the FSS application, allows MOFA to compare two reports. After the user has requested for a report to be generated, the user can click on the compare button. This leads the user to another page that allows the user to generate another report that can be compared to the first one. The comparison is done with the aid of the JpGraph tool, which generates visual graphs. These graphs will help MOFA to compare reports from different years, months and even how different two districts or importers are.

localhost/FSS/Ministry\_CompareYrlyRep.php?Year=2013&FocusOn=District&focusID=1&cmd=3

Home Reports Register

## Fertiliser Subsidy System

Compare:

Year: 2013

Focus: District

ID: 1

With:

Year: 2013

Focus on: District

ID: Berekuso

Generate Report

District	Labadi		
Recieved	Of (Type)	From (Importer)	On (Receipt Date)
1	Ammonia	Chemico Ltd	2013-01-05
1	Ammonia	Dizengorff Ghana	2013-01-05
1	Nitrate	Chemico Ltd	2013-03-22
1	Nitrate	Golden Stork	2013-03-31
1	Nitrate	Yara Ghana Ltd	2013-01-20
2	NPK 14-14-14	Chemico Ltd	2013-01-10
1	Urea	Chemico Ltd	2013-03-31

District	Berekuso		
Recieved	Of (Type)	From (Importer)	On (Receipt Date)
1	Nitrate	Golden Stork	2013-03-31
1	Urea	Yara Ghana Ltd	2013-03-29

District	Berekuso		
Supplied	Of (Type)	To (Retailer)	On (Receipt Date)
1	Nitrate	Elysia Sade	2013-02-11

Fig 4.3 shows two reports being compared

## **Chapter 5**

### **5 Testing and Result**

To ensure that the FSS application is sound enough to be deployed, the application was subjected to a series of tests.

#### **5.1 Development Testing**

During the development of the FSS application, tests were constantly being taken on the system. As each component of the system is dependent on the other, it was important to ensure that all the individual components were functioning correctly before I linked them to each other.

#### **5.2 Unit Testing**

Each unit of the application was tested to make sure that it worked. A unit in this case refers to each outlined feature of the system. In the database layer for example each query was tested to make sure it was running. The feature of the application that generates reports was also tested by creating and recreating the different kinds of information a user would like to know. Each feature at every layer of the application was tested thoroughly before being infused with the main system.

#### **5.3 System Testing**

The system as a whole was also tested to ensure that the different component of the system interact as they are supposed to. For example, with the comparison feature, the graph was tested several times on its own before it was integrated with the html page. However, when it was integrated I discovered that jpGraph was designed to open in its own window and this affected my plan for the pages design. The problem was solved however by

using the iframe tag in HTML. This tag allowed a new window to be open but the window remained embedded in the original page.



**Fig 5.1** shows the jpGraph embedded in the page using iframe

### 5.3.1 Requirements-Based Testing

The FSS application was also tested using the functional requirements that were outlined in Section 6.1 of this paper. This was done to ensure that the system met all of the system requirements that were outlined to make it fully functional. The application met all of the requirements except for the feature that will allow the users to view their inventories and sales that they have made. The ministry is able to see the bags that have reached their final destination through the *Deliveries* feature. The Ministry is also able to compare information from different years and months and can therefore make decisions that are more informed. The *Flagging* feature has also been implemented making it easier for the Ministry to spot any point in the supply chain where there might be a breach of security. Lastly the J2ME App allows

the members of the supply chain to confirm all purchases they receive. This increases security and makes it easier for bags to be tracked.

### **5.3.2 Compatibility Testing**

The application was also tested for compatibility to the various browsers that are available. In conducting this test it was discovered that the application worked very well in Google Chrome. On the other hand, the date tag that was used in the application was not compatible to the other browsers such as Safari and Firefox. This flaw however affects the functionality of the application because it means that in other browsers it will be difficult to validate the dates and so users may enter wrong data causing the application to fail.

## **5.4 Challenges**

The biggest challenge was finding a working solution to the problems in the fertiliser system. The process of finding a solution was very iterative because there were no examples of such systems available to guide me through the process. Another big set back at the beginning of the project was displaying the records from the database using AJAX and JSON. I realised through the help of my supervisor however that, setting a button in a form as a submit button resets the page, which makes it appear as if the records were never displayed.

Another significant challenge I faced was with the J2ME component. With this, I had to figure out how to update multiple rows in the *FertiliserBags* table at the same time. To eliminate the problem of asking the user to type in just one barcode every time the application is opened, I designed it such that the user can enter more than one barcode in one session. This however,

does not work well because all the threads use one run function and the last thread overwrites the rest. This leaves only one row updated. This problem was solved by removing the loop in the J2ME. The list of barcodes was concatenated into one string and the string was exploded in the PHP that held the query. The “for each” method was used to run the queries given each barcode.

```
if(UserType.equals(caseStringOne)){
    barcode="";
    //Thread[] t= new Thread[barTextFields.length];
    for (int i = 0; i < barTextFields.length; i++) {
        barcode=urlEncode(barTextFields[i].getString());
        //url to be sent activate update query
        theUrl = "http://localhost/FSS/FSS-MobileLogin.php?cmd=2&DistrictOfficerID=" + userId+ "&Barcode="+ barcode;
        //thread
        Thread t = new Thread(this);
        t.start();
    }
    switchDisplayable (null, getTransitForm ());
}
```

**Fig 5.2** the thread is constantly being called in the loop so it never finishes the process of updating until the last barcode is given.

## Chapter 6

### 6 Conclusions and Recommendations

#### 6.1 Conclusions

The main features of this application, which are report generating, report comparing, receipt confirmation and the ability of the Ministry to know how many bags the farmer has received in order to pay importers and distributors accordingly, are complete and fully functional. These features fulfill the main purpose of this application, which is to aid the Ministry of Food and Agriculture to track bags of fertilizer through the supply chain and provide them with information that they can use to investigate, make decisions and payments. The application can however be further improved in many ways.

#### 6.2 Recommendations for Future Work

As indicated above, this application has many avenues for improvement. The following are some of the ways I believe can improve the application and make it more useful to the Ministry of Food and Agricultural.

- A feature that will compare the sales and receipt of members in the supply chain who are directly related. For example the sales table of an Importer will be compared to the receipt table of a District. The entries that do not match can be pulled out and the necessary actions can be taken as to why a bag has not been received or has not been reported as received.
- The inventory and sales feature for each member in the supply chain can also be implemented. This feature will help the users keep personal track of what they have received and sold.

## Bibliography

- [1] David O Yawson, Frederick A Armah, Ernest K.A Afrifa, and Samuel K.N Dadzie, "Ghana's Fertilizer Policy: Early Field Lessons From Farmers In The Central Region," *Journal Of Sustainable Development In Africa*, vol. XII, no. 3, pp. 191-203, 2010.
- [2] Afua Branoah Banful, "Operational Details Of The 2008 Fertiliser Subsidy In Ghana- Preliminary Report," *International Food Policy Research Institute*, May 2009.
- [3] William N-lanjerborr]alulah. (2012, August) Modern Ghana. [Online]. "http://www.modernghana.com/news/412700/1/fertiliser-smuggling-booms-in-upper-east.html2012"  
<http://www.modernghana.com/news/412700/1/fertiliser-smuggling-booms-in-upper-east.html2012>
- [4] Kenneth Baltzer and Henrik Hansen, "Evaluation Study: Agricultural Input Subsidies In Sub-Saharan africa," Evaluation, Ministry Of Foreign Affairs of Denmark, Denmark, 2012.
- [5] Index Mundi. (2013) Index Mundi. [Online]. "http://www.indexmundi.com/ghana/economy\_profile.html"  
[http://www.indexmundi.com/ghana/economy\\_profile.html](http://www.indexmundi.com/ghana/economy_profile.html)
- [6] Kwabena Nyarko Otoo, Clara Osei-Boateng, and Prince Asafu-Adjaye, "The Labour Market In Ghana: A Descriptive Analysis of the Labour Market Component of the Ghana Living Standards Survey(V)," Labour Research & Policy Institute, Accra, Research Paper 2009/01, 2009.
- [7] Afua Branoah Banful, "Old Problems in the New Solutions? Innovations in Fertiliser Subsidies and Politically Motivated Allocation of Program Benefits,," 2011.
- [8] Samuel Benin et al., "Evaluation of Four Special Initiatives of the MInistry of Food and Agriculture, Government of Ghana," Ministry of Food and Agriculture, Draft November 8, 2011.
- [9] K F Isherwood, "Mineral Fertiliser Distribution and the Environment," International Fertiliser Industry Association, Paris, 2000.
- [10] DB Grussell. (n.d) DB Grussell. [Online]. "http://db.grussell.org/section008.html"  
<http://db.grussell.org/section008.html>
- [11] Database Primer. (2005) Database Primer Web site. [Online]. "http://www.databaseprimer.com/normalization.html"



<http://www.databaseprimer.com/normalization.html>

- [12] Robin Schumacher. (2013) Dev MySQL. [Online]. "http://dev.mysql.com/tech-resources/articles/move\_from\_microsoft\_SQL\_Server.html"  
[http://dev.mysql.com/tech-resources/articles/move\\_from\\_microsoft\\_SQL\\_Server.html](http://dev.mysql.com/tech-resources/articles/move_from_microsoft_SQL_Server.html)
- [13] Peerbits. (2012, March) Peerbits Web site. [Online].  
"http://www.peerbits.com/the-advantages-of-php-mysql-development.html"  
<http://www.peerbits.com/the-advantages-of-php-mysql-development.html>
- [14] JpGraph. (2012, October) JpGraph Web site. [Online]. "http://jpgraph.net/"  
<http://jpgraph.net/>
- [15] Java. Java Web site. [Online].  
"http://www.java.com/en/download/faq/java\_javascript.xml"  
[http://www.java.com/en/download/faq/java\\_javascript.xml](http://www.java.com/en/download/faq/java_javascript.xml)
- [16] Emmanuel Agyei, "Peasant Farmers Blame Fertiliser Smuggling on Distribution System," *Myjoyonline*, August 2012.
- [17] The Herald Online, "5 defraud govt of fertiliser, seed", *The HeraldOnline*, March 2013.

# Appendix

## FSS Web Application

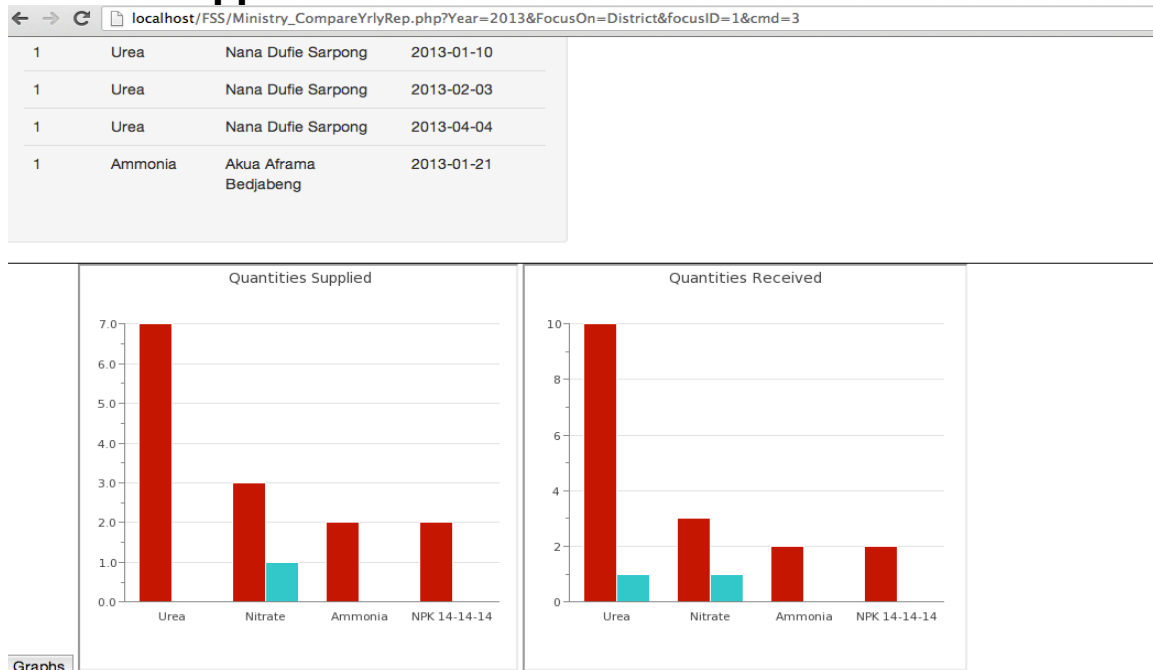


Fig 1 shows a comparison of reports using graphs

localhost/FSS/Ministry\_Orders.php

[Home](#) [Reports](#) [Register](#) [Orders](#)

## Fertiliser Subsidy System

[New Order](#)  
[View Orders](#)

Create New Order

Authorised By:

Continue

Fig 2 shows the order view that allows the Ministry to make a new order

localhost/FSS/Ministry\_Orders.php

Home Reports Register **Orders**

## Fertiliser Subsidy System

New Order

View Orders

Enter Order

Order No.

81

Importer District

Yara Ghana Ltd Labadi

☐ Urea 56
 ☐ Nitrate 65
 ☐ Ammonia 72
 ☐ NPK 14-14-14 90

Order Add Row Delete Row

Fig 3 shows the order page where the Ministry can order how much should be supplied to each district

Home Reports Register **Orders** Deliveries

## Fertiliser Subsidy System

To Farmer To Retailer To District

Barcode	Fertiliser Type	Date of Delivery
0	Urea	2013-04-05
1234567811	Urea	2013-04-05
562382390834	Nitrate	2013-03-31
8126737984089	Nitrate	2013-02-28
18762490843789	Urea	2013-01-30
9780130384881	NPK 14-14-14	2013-01-27
872874390335	Ammonia	2013-01-23
9780132336222	NPK 14-14-14	2013-01-21
546289203790	Urea	2013-01-20
326048589054	Urea	2013-01-18
28732908489	Ammonia	2013-01-18

Total Deliveries: 11

Pending Deliveries: 13

Fig 4 shows the bags delivered to the farmers and the total bags delivered and total bags pending.

## Mobile J2ME Application

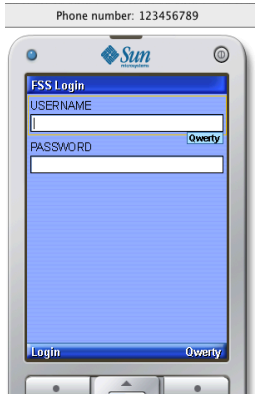


Fig 5 shows the login screen of the FSS J2ME Application



Fig 6 shows the menu screen of the mobile app giving the retailer an option to either login in a sale or confirm receipt of bags.

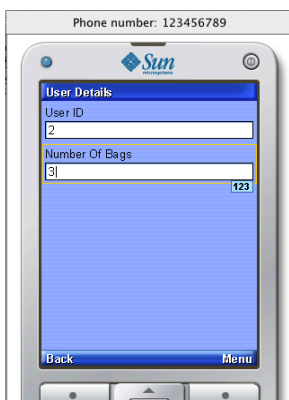


Fig 7 shows the screen which asks for a users ID and the number of bags they would like to confirm.

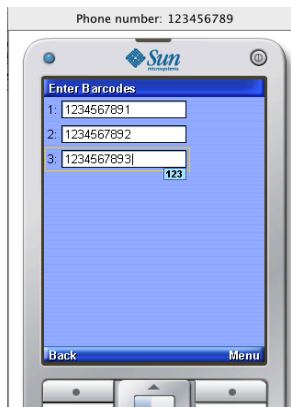


Fig 8 shows the following screen that opens with the exact number of textboxes as the bags that were specified by the users.



Fig 9 after the confirm button is pressed, a message appears on the screen telling the user the confirmation has been acknowledged



Fig 10 shows the first screen that opens when a retailer decides to log in a sale to a farmer. The retailer needs to enter the farmer's Swipe card number as well as the number of bags for confirmation.