COMPARATIVE ANALYSIS OF THE PROFITABILITY OF ON-FARM AND INSTITUTIONAL STORAGE OF MAIZE IN THE EJURA SEKYERE-DUMASE DISTRICT OF GHANA

BY

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THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ARTS DEGREE IN AGRICULTURAL ADMINISTRATION

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DECLARATION

I, Apenteng Peprah, author of this dissertation do hereby declare that the work presented in this dissertation **"Comparative Analysis of the Profitability of On-farm and Institutional Storage of Maize in the Ejura Sekyere-Dumase District of Ghana"** was done by me in the Department of Agricultural Economics and Agribusiness, University of Ghana, Legon, from March 2004 to December 2004.

This dissertation has never been presented either in whole or in part for any other degree of the University or elsewhere. Studies by other authors which serve as source of information have fully been acknowledged.

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DEDICATION

To the Glory of the Almighty God, this dissertation is dedicated to my beloved wife, Mrs. Alexandra Aseidu Apenteng for her contributions in various ways for my education at this level.

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This work has assumed its present form through the direction and assistance by some well meaningful people. It is, therefore, fitting to express my heartfelt appreciation for their effort.

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ABSTRACT

The research was conducted during the minor season at Sekyere Dumase and Bonyon towns and their environs in the Ejura Sekyere-Dumase District of Ghana. The objective of the research was to find out in comparative terms the profitability of on-farm and institutional storage of maize.

The research also found out size and distributions of reasons why farmers/traders prefer one storage system to other, ranked the identified constraints/problems that influence preference for each storage system. The cost, total revenue and net revenue of storage operations were estimated, and from this, the relative profitability was assessed.

Statistical analysis showed agreement between the rankings of the problems/constraints of the two storage systems. Pest infestation is the major constraint facing farmers/traders who use the on-farm storage systems whereas transportation of maize to storage sites was identified in the case of farmers/trader who used the institutional storage system. The total cost for institutional storage was greater than that for the on-farm storage but there was no significant difference between the total costs of the two systems. For the total revenue and the net revenue, the institutional storage systems seem to be better that the on-farm storage systems. However, statistically, there is no significant difference between the two storage systems in terms of revenue and net revenue estimated.

Considering the findings as obtained from statistical analysis of data and visual observations on the field, it is recommended that the institutional storage systems should be expanded for more farmers/traders to store their produce in that:
-the use of this facility has the potential of giving clean and uninfected grains.
-farmers/traders can store produce for a longer period to forestall shortage of maize, thereby enhancing food security in the country and the sub-region as a whole.

TABLE OF CONTENTS

CHAPTER THREE

CHAPTER FOUR

RESULTS AND DISCUSSION

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

LIST OF TABLES

CHAPTER ONE

INTRODUCTION

1.1 Background

One of the necessary conditions for Ghana to achieve its objective of becoming a middle income country is the transformation of its agricultural sector into a highly productive and responsive sector capable of achieving and sustaining 6% annual growth rate (Vision 2020, 1995).

The agricultural sector continues to contribute a substantial share of the Gross Domestic Product (GDP) in relation to other sectors. In 2002, it contributed 39.5% as compared to 33.0% from the service sector and 27.5% from the industrial sector (MoFA – SRID, September 2003).

In Ghana the agricultural sector is made up of sub-sectors such as the fisheries, livestock, forestry, cocoa and crops. The crops sub-sector is made of plantation, cereals, roots and tubers and others of which maize is a major component of cereals. Maize is a major staple food grown across the length and breadth of the country and Ejura Sekyere-Dumase district is one of the major maize producing areas in Ghana. (SRID MoFA – February, 2004)

Out of the total quantity of 1,288,600 metric tons of maize produced in Ghana, in 2003, Ashanti Region contributed 193,920 metric tons which was the fourth highest in Ghana. Total production from Ejura Sekyere-Dumase was 22,500 metric tons which was second best to Sekyere West district, which contributed 25,220 metric tons to the total production of Ashanti Region (SRID, MoFA – February, 2004).

Table 1.1 Production of major cereals in Ghana – 2003 (Figures in Metric Tons)

Regions	Maize	Rice	Millet	Sorghum
Western	86,520	22,090		
Central	247,110	4,430		
Eastern	244,000	21,340		
GT Accra	2,610	3,390		
Volta	58,630	46,750		6,100
Ashanti	193,920	11,630		
Brong Ahafo	295,680	3,530		
Northern	79,050	93,970	55,830	62,300
Upper-East	60,710	3,770	54,630	127,820
Upper-West	20,370	27,910	65,280	141,450
Total	1,288,600	238,810	175,740	337,670

Source: Statistics, Research and Information Directorate (SRID) MoFA – February 2004

However, while considering the assistance given to farmers to market grains, comparatively little attention is paid to the storage of maize. Attention must be paid to the development of efficient post-production systems as well as encouraging people to store their produce during the major season.

The government of Ghana set up a guaranteed minimum price scheme for maize in addition to a marketing company (Ghana Food Distribution Corporation) to provide some form of storage and marketing service to maize producers and consumers in November, 1971. Although this scheme was not credited with much success because of ineffectiveness, it was a bold step to recognize the importance of maize storage.

There is substantial profit margin that farmers can obtain through the ability to store produce for several months without deterioration. Caswell (1961) shows clearly that in Nigeria if farmers had the means to store cowpeas in good condition of six months, the result would be a saving of 10 kilos per ton of foodstuff, which is eaten by insects and not by man. Also maize stored at harvesting period when prices are low could be sold in periods of scarcity when prices are high enough to make storage economic as well as make maize available to consumers during the period of scarcity. Farmers, traders and governments all have reasons for storing grain apart from the profitability of the storage enterprise itself. For small farmers the main purpose in storing maize is to ensure household food supplies. Storage also provides a form of saving to cover future cash need through sales. Maize is also stored for seed and as inputs into household enterprises such as beer brewing, or preparation of cooked food. When there are significant inter-seasonal price variations, farmers and traders often store for speculative gain.

Farmers store maize by themselves in various structures or storage places in or outside their homes. In this study, this type of storage is termed as on-farm storage. With the on-farm storage, the storage site may be on the farm, close to the farmers' house, or in the

house in the village or town. Individual farmers may also store maize in facilities operated by institutions such as Bonyon co-operative farmers association and the Ghana Food Distribution Cooperation located at Sekyere-Dumase. This is termed as institutional storage of maize.

There are three major forms in which farmers store maize on farm, depending on the climatic conditions, storage structure and cultural habitats. These are the cob-with-husk-on (husked), cob-without-husk (dehusked), and shelled grain forms of storage. Cribs or barns are the most popular and widely distributed traditional maize storage structures used by farmers. Others include granaries, baskets, clay pot, gourds ordinary rooms and roofs of houses, especially the part over the kitchen or fireplace. The shape of a crib may be circular, or rectangular with simple or circular platform, with radiating sticks. The width or diameter of these cribs range from 1 to 3 meters and may be up to 2.5 meters high (FAO, 1985). They are mainly constructed with sticks, thatch and other local materials found at the storage site. Granaries, baskets, sacks and clay posts are mainly used in the drier climates, for the storage of dry dehusked or shelled maize and other grains. Where the crop is stored in the living room or roof over the part of the kitchen, dehusked cobs are the major forms of storage. The kitchen fire provides hot air which passes through the stored produce to effect insect control, effective drying and prevention of mouldiness. With the On-farm storage, further drying of the cobs in the sun in trays or on the ground may be done at or near the storage site to avoid heating and fungal growth. This reduces the moisture content to between 12 and 18 percent (Nyanteng 1970). Visual

selection of cobs is carried out, and damaged cobs or those with poor husk cover are rejected before the crop is finally stored.

A major disadvantage of the on-farm is the long pre-harvest field and post-harvest drying periods (FAO, 1985 a). During pre-harvest field drying, the crop is exposed to wind, rain, mould, termites, rodents, birds and most importantly field-to-store insect pests. The insect infestation may not be noticed early in the field or at harvest. However there can be a build-up after a few weeks through the high reproductive capacity of these insect pests.

The institutional storage of maize is where maize is stored in modern facilities such as silos, and warehouses. The institutional storage is economically valid for storing large quantities. Nevertheless, certain projects have been successful in introducing small metal silos and warehouses at farm or village level. The silos are made of smooth or corrugated galvanized metal which helps prevent risk of penetration by water and prevention of mould. With these systems there are few problems with rodents and insects (Anon, 1982).

1.2 Problem Statement

Even though the warehouses at Bonyon and Sekyere-Dumase have all the needed facilities that farmers can take advantage of to store their maize, most farmers within Bonyon and Sekyere-Dumase town do not patronize these facilities and prefer to store maize in their houses. Reports from Bonyon and Sekyere-Dumase indicate that lack of patronage of the storage facilities in these places has resulted in the facilities being under-utilized. However, farmers who store in their houses always face higher incidence of pest

infestation as compared to those who store in the warehouses at Bonyon and Sekyere-Dumase. Bergvison (1991) indicate the crucial importance of effective pest control for a broad range of storage entrepreneurs, including resource-poor farmers, commercial operators and national marketing organization; and a wide variety of storage situations in which simple, traditional on-farm systems and large scale bag-storage system predominate.

In the diversification of Ghana's agricultural exports, maize could be an export commodity. However, quality is a critical determinant of competition in exports of any commodity. Therefore if maize is to be exported, its quality must be maintained during storage. Secondly, expanded production for exports means that farmers will now have large quantities of maize that cannot be handled by traditional storage systems.

Farmers usually obtain minimum return from the sale of their produce during the major season, yet most farmers sell all their produce without storing some to be sold during the lean season when prices are high. Attipoe (2000) indicates that in Techiman, price variability over seven year period has ranged from a low in 1988/89 when May/June prices were between five percent and thirty-five percent above those in the previous September, to a high in 1991/92 when differences were between 205 percent and 230 percent (Coulter and Sherpeds 1995). Dittoh (1985) states that there is too much variation in prices due mainly to lack of storage facilities and insufficient supply. The price of maize during the lean season is typically 75 to 250 percent higher than the price at

harvest time due to factors such as market inefficiencies caused by poor roads, and lack of storage facilities.

The following questions therefore emerge:

(i) What are the reasons why farmers prefer one storage system to the other?

(ii) What are the constraints involve in storing maize by using on-farm or the institutional storage system?

(iii) What are the costs and returns of storing maize on farm?

(iv) What are the costs and returns of storing maize in a modern facility?

(v) What policies should be recommended to ensure maximum profitability of institutional storage of maize?

1.3 Objectives of the Study

The primary objective of the study is to compare the profitability of On-farm and institutional storage of maize. The following specific objectives are pursued:

(i) To determine reasons why farmers prefer one storage system to the other.

(ii) To test the degree of agreement in the ranking of identified constraints of storing maize by each system.

(iii) To determine the costs and returns of storing maize on the farm.

(iv) To determine the costs and returns of storing maize in a modern facility.

(v) To make appropriate recommendations for increased use of modern storage systems.

1.4 Relevance of the Study

Farmers in the Ejura Sekyere-Dumase area produce maize on commercial basis and net profit is the main concern. There is therefore the need for them to get better storage facilities to store and manage their supply of produce to the market when prices are low. Even though Bonyon and Sekyere-Dumase towns have the institutional storage facilities, most farmers are not storing their maize there. There is therefore the need to find out why farmers are not storing their produce there. If the study is able to show which of the storage practices gives the better benefit, it will go a long to recommend measures that will help farmers increase their net benefit from storage as well as help the nation at large by decreasing instability of seasonal maize supplies.

1.5 Organization

The study consists of five chapters. Chapter one deals with the introduction to the study, Chapter two covers review of relevant literature and Chapter three details the methodology of the study. The results and discussions are presented in Chapter four while Chapter five reports the conclusion and recommendations from the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Production of maize in Ghana is mainly for human and animal consumption. Food and Agriculture Organization (FAO) reports (1983) observed that maize is the single most important crop in Africa and cites Ghana as one of the countries with very suitable agro climatic conditions for its production.

It is accepted that an increase in the amount of food available to man and his animal cannot be achieved solely through increase in crop production. Attention must be paid to the development of efficient post-production systems and to the reduction of losses, which occur after harvest. Storage losses according to Aye (1981) are the major factors that reduce net benefit.

2.2 Maize Storage Systems

2.2.1 On-farm storage of maize

Many of the small-scale farmers store maize on farm. In this system, when the crop is physiologically matured, it is left on the field to dry before it is harvested. The period of drying in the field depends on climatic conditions.

FAO (1985a) indicates that, under this traditional system, maize is stored in an open place or ventilated structures and left husked, dehusked or as shelled grains. Considerable levels of losses or damage is caused by insects, moulds, rodents and birds to the stored maize, hence the need to encourage farmers to use protective chemicals treatment to reduce losses and damage so as to increase income of farmers.

2.2.2 Institutional storage of maize

This is a system where storage is done using silos and warehouses. Under this system driers are used in reducing the moisture content hence the produce is not left in the field for a longer period as compared to the on-farm storage. Lesser considerable damage is done to the stored produce.

Increasing produce stored using institutional storage system can relieve farmers/traders of their financial burden since more profit can be accrued when adopting this system of storage. However, the maize market is subject to considerable short-term and inter-seasonal price fluctuations, which affect the interests of both producers and consumers. Successful on-farm and institutional storage will enable farmers to sell grains when prices are most attractive.

Underlying short-term and inter-seasonal price fluctuations problem is lack of liquidity, and particularly, shortage of funds to finance stocks of stored products. Grain traders and small farmers have few dealings with banks and vice versa. Lack of adequate trade financing impedes the ability of farmers to attain self-sufficiency in food production,

which fuels the need for imported food. This situation is exacerbated by high opportunity cost of capital which makes it difficult for an individual farmer/trader to increase holding cost of stocks from harvest to the lean season. In some cases this may lead to domestic production being less competitive than imports. Under these constraints and circumstances it is not surprising to find that Ghanaian poultry industry relies on imported yellow maize (FAO, 1994).

During the 1980s and 1990s, Tanzania and Mali moved from a statutory grain monopoly to a private-sector system. Ghana followed suit by eliminating farmer-support prices in the 1980s and reducing the financial capacity of the parastatal Ghana Food Distribution Corporation (GFDC) in 1980s. These reforms in the cereal marketing system brought benefits to all three countries by reducing the budgetary cost of supporting politically determined prices. However the emerging private-sector marketing systems are still weak. The emerging private sector is mainly composed of small-scale traders who seek rapid turnover of stocks with few cereal traders involved in inter -seasonal storage (Coulter, 1998).

2.3 Who Stores and Why?

Farmers, traders and governments all have reasons for storage other than the profitability of the storage enterprise itself. Storage is a component within a farming system, a trading enterprise, or a government policy instrument and may be undertaken because of its contribution to other activities or objectives within these broader contexts. (FAO, 1994).

In relation to the level of profitability, one therefore needs to find out under which of the storage system that the farmers, trader or government will be able to maximize profit based on the constraints, losses and cost associated with each of the systems.

2.3.1 Farm storage

For small farmers the main purpose in storing grains is to ensure household food supplies. Farm storage also provides a form of saving, to cover future cash needs through sale, or for barter exchange or gift giving. Grain is also stored for seed and as inputs into household enterprises such as beer brewing, or the preparation of cooked food. When there are significant inter-seasonal price variations, small farmers often store for speculative gain, that is to say they 'play the market'. This is the most common in more prosperous areas, such as the southern highlands of Tanzania and southern Mali, which produce a mixture of cash and food crops, and where farmers financial circumstance make it easier for then to sell when the price is best. Speculative consideration is even more important in the storage decisions of large-scale commercial farmers (FAO, 1994).

There is an ongoing debate about whether farmers are forced to sell because of debt and economic dependence on others, or whether they sell because they regard storage as too costly in terms of time, or too risky, given the risk of losses and unpredictability of future prices, or unprofitable in relation to the system of storage. There is no single answer to the debate, since there is such variation in the circumstance under which individual farmers store their maize.

Selling of grains just after harvesting (forced sales situation) has been documented by some authors in South Asia (Crow, 1987); however some farmers who keep their grains until the next season have been found in South-East Asia. In Sahelian countries of Africa, conflicting findings have been reported. Carefully documented work by Dione (1989) has shown that in Mali 'head taxes' have resulted in forced sales, but Bergvison (1991) report indicated several authors who have reached opposite conclusion.

Sale at or before harvest has the advantage that the farmer is saved the cost and time involved in preparing the crop for storage. Transport, threshing, winnowing and drying are all leaving the farmer free to attend to the next crop, or to other farm or off-farm activities. Nyanteng (1970) deduced that policies must encourage short-term price stabilization and support floor prices as asserted by Adade (1980). The issue of long-term price stabilization is not addressed but it is believed to be controlled by buffer stock establishment. This issue is not peculiar to the on-farm storage system only. There is also the need to consider which of the storage systems will be more profitable than always thinking about buffer stock and policies to stabilize prices.

FAO (1980) observed that declining carry over stocks renders the grain economy sensitive to ordinary market forces of demand and supply and that annual fluctuation in production leads to changes in prices and volume of maize storage could control supply and demand and smoothen out short run variations in supplies and stabilize prices over a long run trend.

2.3.2 Trader storage

The role of traders in cereal storage varies enormously between different parts of the world and between different crops. In most African countries traders carry out very little inter seasonal storage of grains, but buy and sell quickly, earning a moderate profit on each transaction. Most storage is carried out by farmers using traditional storage system and to a lesser degree by government marketing boards and consumers who buy in anticipation of future household needs. Given a general situation of capital shortage, long-term storage of staple grains is insufficiently profitable to attract the interest of traders, who can earn more money by investing in fast moving consumers' goods (FAO, 1994).

In a country like Ghana where most farmers and traders are their own storage agents, much is not gained from the traditional way of storage. It is worth noting that neglect of storage has brought some countries on their knees to a point where they import food. This is a stigma on developing countries where storage policies are given back door treatments. Man on the other hand has experienced food shortages and hunger over the years due to lack of reservoirs hence the need to use the appropriate system of storage that will enable us store for a longer period and to reduce losses.

2.3.3 Government storage

As already mentioned, government may become involved in storage for the purpose of stabilizing prices and revenues to farms. Government may keep different types of storage

reserve, depending on how much they wish to intervene in the grain market. Some of the options are:

A food security reserve to be sold or distributed free in times of extraordinary shortage or famine such reserves can be found in Sahelian countries like Mali and Chad. They are not designed for the purpose of stabilising prices for both producers and consumers.

A price stabilization stock; as in the case of Indonesia. Here the government has no monopoly role in grain procurement and distribution but buys and sells grains in competition with private operators.

National storage reserves designed to supply most or all consumer needs in urban areas, and in rural deficit areas. In this case the government has either a statutory trading monopoly, or a monopoly of all inter-regional shipments, and is the only party allowed to store significant quantities of grain. Between the 1960s and the early 1980s, such systems were the norm in many African countries, before the onset of liberalisation. Even now, the grain marketing systems in some countries, including Zimbabwe and Kenya, are still partially structured in this way.

There are some countries where it would seem most appropriate for government to maintain some sort of price stabilization role; such is the case in landlocked countries like Zimbabwe and Malawi, whose production fluctuates between surplus and deficit. If the governments of these countries totally withdraw from price stabilization, prices are likely to be subjected to very wide inter annual fluctuation, with adverse effects on production incentives and consumer welfare (Pinkey 1993)

2.4 Costs and Incentives to Store

Inadequate storage activity is identified by Adade (1986) as a cause of price instability. Instability of price is a major set back to increased production in most farm enterprise especially when farmers are risk averse, Adade (1986) noted. This he said is because of extreme price variation, which creates uncertainty on the side of the producer.

Both consumers and producers benefit from stable prices, which reduce uncertainties associated with planning farm investment and household expenditure. However storage involves costs, and the only way in which these costs can be recuperated is through a price spread. If storage is to be profitable, people who store grain must receive a price on sale, which at least covers the cost of storing the grain since harvest. This cost includes:

- The cost of the store itself (often a rental cost in relation to institutional storage);
- Labour and supervision;
- Pest control;
- Storage and spillage losses and
- Cost of capital invested in the grain.

The costs of storage depend on the commodity stored, on the type of storage system, and on unpredictable and variable factors such as pest incidence and climatic conditions. Storage costs also depend on the circumstances of the person, the business or the institution who is storing. The most variable component of storage costs is the cost of capital. For a small farmer or trader, capital may be scarce and costly, and their only access to loans may be from moneylenders charging high rates.

Storage of food makes it possible for some countries to offer food aid to other countries who have been hit by famine as a result of bad weather, pest invasion, and civil wars. Most farmers face the problem of shortage of seeds for sowing during the planting seasons. If grains are stored well, the quantity needed to be sown in order to expand the acreage of cultivation will be a problem of the past. Agro processing industries that use stored produce will be in operation continuously throughout the year thereby not lying off workers during the lean seasons. This in turn will help the nation to control the problem of ever-growing unemployment situation which seems to threaten development in general.

2.5 The Role of Storage in the Economy

In most countries grains are among the most important staple foods. However they are produced on a seasonal basis, and in many places there is only one harvest a year, which itself may be subject to failure. This means that in order to feed the world's population, most of the global production of maize, wheat, rice, sorghum and millet must be held in storage for periods varying from one month up to more than a year. Grain storage therefore occupies a vital place in the economies of developed and developing countries alike (FAO, 1994).

The market for food grains is characterized by fairly stable demand throughout the year, and widely fluctuating supply. New varieties that have shorter growing periods, variations in climatic conditions and farming systems in different regions of a country, can help to even out the fluctuations in market supply. But even in a country such as

Indonesia, which has diverse climatic and farming conditions and where 90 percent of rice land is under short duration high yielding varieties about 60 percent of production is harvested within three months period.

Effective storage serving as a security for the economy will narrow "hunger gap" and strengthens economic development among emerging nations of the world. It can cut down on imports, which allows the economy to apply the capital accumulated in the sector, as well as reduce the cost of urban food, thereby reducing the level of inflation. Effective storage will also reduce fluctuations in farm income and eliminate the exploitation of farmers by traders (Coulter, 1995)

2.6 Grain Trade

In June 1998, a meeting was held at the office of the Food and Agriculture Organization (FAO) of the United Nations in Rome between a number of leading institutions and representative from Africa to review new approaches to post-harvest research. One aspect of problem tackled was that of cereal trading in Africa, considering storage to play a major part.

Most traders store relatively small amount of grain over short time period, that is, a few weeks. This may be attributed to difficulties in handling storage grains, lack of proper storage system, the impact of earlier official policies, which made them afraid that stocks would be seized on the grounds that they were "hoarding" and lack of contact with the banks for financing.

According to Asante, Assuming-Brempong and Bruce (1989), maize marketing involves both the private and public sectors. Ghana Food Distribution Corporation was the main public agency involved in maize marketing. To a lesser extent the grains warehousing company and public sector poultry and feed mill establishments also purchase maize. Market women who sell smaller quantities in standard assorted containers (American tin or 'olonka') are also in the private maize retailing business. There are wholesale traders who move around the rural markets and houses and farms of producers and buy maize. The private sector control over 90 percent of the maize market in Ghana. Analysis of farm gate and wholesale prices indicate that there are large variations in inter-year and intra-year prices. The year-to-year price fluctuations may be due to the weather and decisions of farmers based on their price expectations, which are normally adaptive in nature. When there is market failure, the intervention of the government is desirable. In November 1971, the government intervened in the maize market of Ghana in a price-support scheme with the aim of ensuring remunerative prices for maize farmers.

2.7 Losses Caused by Storage

There are three main causes of post-harvest losses in storage. These include insects, wet heating and rodents. Although all the three loss causal factors contribute significantly to energy loss within the food pipeline in Ghana. Maize which is a major grain crop grown in Ghana is affected in storage by about 20 different insect pest including the maize weevil and the Agronomous grain MoFA (Mould, 1973). Both of these pests attack the maize crop in the field and in storage and it is estimated that 20 – 25 percent of the maize produce in Ghana is destroyed by the weevil alone (Rawsley, 1969; Mould, 1973). Control measures against storage pest of maize in Ghana generally include dusting the

sheathed, desheathed or shelled maize with DDT, lindane, Malthion, sevin, bromophos or fumigating the shelled maize with ethylene dibromode (EDB) (Mould, 1973).

2.8 Application of Profitability Analysis to Storage Investments

Cost-Benefit Analysis is used for choosing between different options, by comparing the net benefits of each option. To simplify calculations, only the differences in costs and benefits need to be compared. Indeed in many cases one is comparing projects which provide identical services and therefore benefits; in such cases it is only necessary to compare the difference in the costs between the options compared (FAO, 1994). According to a research conducted by Bergvison (1991), an economic analysis was required to determine whether charges in storage practices by small farmer were profitable. In order to measure the costs and benefits of different options the following factors had to be accounted for:

i) Capital costs

ii) Other fixed costs

iii) Losses

iv) Other variable costs

The objective of the exercise was to assess whether recommended changes in storage practices were profitable for farmers. Therefore the analysis was of a financial, not in economic kind. A number of assumptions were made concerning capital costs; the opportunity cost of capital, labour costs and losses suffered under different storage

systems. It was assumed that all stores would be used to maximum capacity throughout their useful lives.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter is mainly concerned with the methods used for the analysis of objectives of the study. They include descriptive statistics, the Kendall's coefficient of concordance, financial profitability (benefit).

3.2 Determining Reasons why Farmers Prefer One Storage System to Another

Descriptive statistics such as, frequency tables and percentages were used to determine the size, distribution, and level of preferences for each of the storage systems in the communities of the study areas so as to achieve objective one of the study (determine reasons why farmers prefer one system to the other).

The concept of financial profitability demonstrates the financial returns expected to be generated by the investment and comparing it to the cost involve in the operations.

3.3 Testing the Agreement in Ranking of Identified Constraints in Storing Maize by Farmers

The second objective of the study (testing the agreement in ranking of constraints in storing maize by farmers) is addressed using the Kendall's Coefficient of concordance (W). The Kendall's coefficient of concordance measures the strength of relation in a

direct and easily understood way. The Kendall coefficient has an intuitively simple interpretation and simpler than Spearman coefficient. It can even be computed from the actual observation without first converting them to ranks (Edward, 1964). The Kendall's Coefficient of concordance (W) is the measure of the degree of agreement among 'm' (number of rankers i.e. farmers who store maize using on-farm or institutional storage systems) set of 'n' (number of constraints) ranks. W is an index that measures the ratio of the observed variance of the sum of ranks to the maximum possible variance of sum of ranks. The idea behind this index is to find the sum of the ranks for each constraint being ranked and then to examine the variability of this sum. If the rankings are in perfect agreement, the variability among these sums will be a maximum (Mattson, 1986).

This analysis is a statistical procedure through which the degree of agreement /concordance between a given set of constraints/problems identified and ranked from the most pressing constraint/problem to the least pressing one is measured. The identified constraints/problems are ranked according to the most pressing to the least pressing using numerals; 1,2,3,4...n, in that order. Computing the total rank score for each problem, the problem with the least score is ranked as the most pressing; whilst the one with the highest score is ranked as the least pressing problem. The total rank scores computed are then used to calculate the coefficient of concordance (W), to obtain measure the degree of agreement in the rankings.

The coefficient of concordance W ranges from zero (0) to one (1). It will be 1 when the ranks assigned by each judge (farmer) are exactly the same as those assigned by other

judges (farmers), and it will be 0 when there is a maximum disagreement among the judges (farmers). If we let T represent the sum of ranks for each problem/constraint being ranked (i.e. socio-economic factors and storing characteristics that influence farmers preference for storage system), the variance of the sum of ranks is found by the formula:

$$(1) \quad Var_T = \frac{\sum T^2 - (\sum T)^2 / n}{n}$$

The maximum variance of T is then given by:

$$(2) \quad m^2 (n^2 - 1) / 12$$

Where 'm' is the sets of rankers (farmers) and 'n' is the number of constraints/problems being ranked (socio-economic factors and storage characteristics that influence farmers' preference for each storage system).

The formula for the coefficient of concordance (W) is then given by:

$$(3) \quad W = \frac{(\sum T^2 - (\sum T^2) / n) / n}{m^2 (n^2 - 1) / 12}$$

This simplifies to the computational formula for W as

$$(4) \quad \frac{12 [\sum T^2 - (\sum T)^2 / n]}{nm^2 (n^2 - 1)}$$

Where: T = sum of ranks for each constraint.

m = number of rankers (farmers), and

n = the number of constraints/problems being ranked.

Hypothesis and Significant Test for W: (F – Test)

Ho: there is no agreement between the rankings of the problems/constraints.

Hi: there is an agreement between the rankings of the problems/constraints.

The coefficient of concordance (W) may be tested for significance in terms of the F – distribution. The F – ratio is given by:

F-ratio = [(m – 1)* Wc]/ (1 – Wc),

Degree of freedom for the numerator = (n -1) – (2/m).

Degree of freedom for the denominator and (m – 1) [(n – 1) - (2/m)]. Wc is the calculated Kendall's Coefficient of Concordance (W) (Edwards, 1964).

3.4 Financial Analysis of Storage Investments

The profitability assessment performed in this study is limited to a financial analysis. Financial analysis provides a practical means of assessing the profitability of investments and their likely financial impact on potential investors.

The concept of financial viability has two dimensions – the financial profitability and solvency of the existing operations of an enterprise, and the viability of a new enterprise. In assessing the on-farm and institutional maize storage activities, the main objective of

the analysis is to demonstrate that financial returns expected to be generated by the investment are attractive to the prospective investors, thus inducing them to contribute equity funds to a particular storage activity rather than to employ such funds elsewhere. The analysis begins with an identification of the cost and revenue streams as outlined in the following section.

3.4.1 Enumeration of cost

The total cost can be classified into variable costs and fixed costs.

Variable Costs

Variable costs vary with size of enterprise. They depend on the amount of grain in store, the length of time of storage and include losses, bags, handling labour, storage insecticides, fuel, and electricity to operate equipment. Care is needed in estimating the cost of bags in a particular operation as they are generally re-used and when deteriorated can be sold on to other users. This can be estimated by multiplying the cost of sack to operation by the number of times used.

In economic analyses, quantitative losses can be valued as the difference between the realizable valued of the stock in its original state and its value in deteriorated form. In financial analysis the loss in value is simply the net financial loss to the operator. This is estimated by multiplying the percentage storage loss per kilogram by the estimated valued of maize after storage. The total variable cost is the summation of the various variable cost items per quantity of product stored over the study period. This is given as:

$$TVC_i = \sum_{j=1}^{n} VC_{ij}$$

Where TVC_i = Total Variable Cost for the i^{th} farmer or trader.

VC_{ij} = is the j^{th} variable cost item for the i^{th} farmer or trader.

n = number of variable cost.

The mean total variable cost for each storage system was obtained as follows:

$$MeanTVC = \sum_{i=1}^{n} TVC_i \Big/ n$$

Where n = number of farmers or traders in each storage system

Mean TVC = Mean Total Variable Cost for all respondents.

Fixed Costs

Fixed costs are costs, which do not vary with the level of utilization, and will be incurred each year even if the technology is not used. Capital costs are likely to be the most important fixed costs. Others include maintenance, supervision, security, rent, information systems, and managerial overheads. In practice it can be difficult to decide whether or not a particular cost, such as storage management, is a fixed cost or variable cost. Interest on capital, if there is any, is included in accounts since the farmer pays it to the bank or tender. The overhead costs are costs of total indirect materials and indirect labour such as management office staff, office expenses and maintenance of vehicle.

The Total Fixed Cost

The total fixed cost for each respondent was obtained by summing the various fixed cost components. This can be represented as:

$$TFC_i = \sum_{j=1}^{n} FC_{ij}$$

Where TFC_i = Total Fixed Cost for the i^{th} respondent in each category

FC_{ij} = j^{th} Fixed Cost item for the i^{th} respondent in each category.

n = number of fixed cost items

Summing the various respondents' total fixed cost and dividing by the relevant sample size n, gives average fixed cost for those in one storage system.

$$MeanTFC = \sum_{i=1}^{n} TFC_i \Big/ n$$

Mean TFC = Mean Total Fixed Cost for all the respondents.

TFC_i = Total fixed cost for the i^{th} for the respondent.

n = Number of respondents.

The interest on capital is applicable to both storage systems if there is any, but costs such as maintenance, supervision, security, rent, office staff management, office expenses are more applicable to the institutional storage system. Summation of these costs is the total overhead cost (TOC).

$$MeanOverhead = \sum_{i=1}^{n} TOC_i \Big/ n$$

The total cost (TC) of a storage cycle for the i^{th} respondent therefore, is the sum of the Total Variable Cost (TVC_i), Total Fixed Cost (TFC_i), and Total Overhead Cost (TOC_i). This can be represented as:

$TC = TVC_i + TFC_i + TOC_i$ ..... (1)

Mean TC = Mean TVC + Mean TFC + Mean TOC.

3.4.2 *Revenue Estimation*

Revenue arises from the sale of the stored maize; it is the cash value realized during the accounting period or a storage cycle. Sales revenue is estimated as the total quantity of maize sold, multiplied by the prevailing price of 130 kg bag of maize.

Thus:

$$TR_i = \sum_{i=1}^{n} PmQm_i \quad \text{..... (2)}$$

Where TR_i = Total revenue (sales) for the i_{th} respondent.

Pm = Prevailing price per 100 kg bag of maize for each month.

Qm_i = Quantity of maize sold for each month, by the i^{th} respondent.

Average total revenue was estimated for the two types of storage system using the equation

$$MeanTR = \sum_{i=1}^{n} TR_i / n$$

Where: n = Sample size (number of respondent) for each storage system

Mean TR = Mean total revenue of all respondents

TR_i = Total revenue for the i^{th} respondents

Net Revenue (π)

The difference between the total revenue and total cost for each storage cycle is the net revenue or profit. This is represented as follows:

$\pi_i = TR_i - TC_i$ .....(3)

Where π_i is the net revenue or profit for the i^{th} respondent.

The average net revenue was estimated for the two groups of storage systems as follows:

$$Mean\ \pi = \sum_{i=1}^{n} \pi_i / n$$

Where n = Sample size for each storage system

π_i = Net revenue of the i^{th} respondents

Mean π = Mean net revenue of all respondents

Efficiency of operation (Operating Ratio) for the respondents is computed as follows:

$$\text{Operating Ratio } (OR_i) = (TVC_i / TR_i) \times 100$$

Where: OR_i = Operating Ratio for the i^{th} respondent

TVC_i = Total Variable Cost for the i^{th} respondent

TR_i = Total revenue for the i^{th} respondent

This ratio gives an indication of the operating efficiency of each respondent as well as the method of storage used. The lower the ratio, the better the operating performance.

The student t-test was used to test whether there is a significant difference between the two storage systems in terms of:

- Quantities stored for major and minor
- Prices of 130kg of produce for major and minor
- Cost components
- Revenue
- Net revenue
- Operating cost

Hypothesis

H_0 = there is no significant difference between the quantities stored by each storage system.

H_1 = there is a significant difference between the quantities stored by each storage system.

This hypothesis is repeated for total variable cost, overhead cost, total fixed cost, total revenue, net revenue, and operating ratio.

Test of the difference between means:

The difference between two means is tested using the statistical expression stated below

$$tcal = \frac{\left(\overline{Y_1} - \overline{Y_2}\right)}{S_{\left(\overline{Y_1} - \overline{Y_2}\right)}}$$

Where:

$\overline{Y_1}$ = On-farm storage system sample mean

$\overline{Y_2}$ = Institutional storage system sample mean

$S_{\left(\overline{Y_1} - \overline{Y_2}\right)}$ = Standard error difference of the storage system

The estimated t-value is compared to the theoretical (tabular) values which define the critical region in the two-tailed test with n_1+n_2 -2 degrees of freedom.

If t* falls in the critical region, we reject the null hypothesis, and accept the alternative that $\left(\overline{Y_1} - \overline{Y_2}\right)$ is statistically significant (Koutsoyiannis, 1979).

3.5 Source of Data

A field study was undertaken to identify farmers who are involved in the use of on-farm and institutional storage of maize in Bonyon and Sekyere-Dumase town. Random selection of farmers for the study was used for the on-farm and institutional storage. Out of 90 farmers and traders who use the institutional storage system, thirty (30) respondents were randomly selected and out of about 115 traders and farmers who use the on-farm storage 50 respondents were randomly selected and interviewed. A structured questionnaire was used to collect data on all the variables needed for the analysis. The information collected included the income and expenditure on storage of maize, the general information on the assets of the farm. The study concentrated on storage by small farmers who store maize by themselves at home or on the farm and those that patronize storage facilities of Bonyon and Sekyere-Dumase.

A preliminary test of the questionnaire was carried out in the Ashanti Mampong area using five farmers who store maize by themselves and five farmers who use the silos operated by Ministry of Food and Agriculture at Mampong-Ashanti. The questionnaires were handed out to the farmers and those farmers who cannot read were helped to complete the questionnaires within two weeks.

The data was collected and compiled into one list for each storage practice. Direct contact and participation of the farmers and research approach was adopted especially for those that store on their farm and in their various houses.

3.6 Limitation of Study

This study is limited to the Ejura Sekyere-Dumase district and may not be a true reflection of the situation in other areas in the country.

The data on the various systems of storage and revenue together with storage cost were mostly obtained from the farmers' interview. This data would either have been under-estimated or over estimated since the area is beset with too many illiterate farmers who do not have any records on their stored maize.

Also most people who kept records on their storage at the Bonyon and Sekyere-Dumase have just begun keeping records of their activities and therefore, had very little information.

Most farmers and traders do not have any knowledge about losses that occur during storage hence a lot of assumptions were made to cover the losses that do occur during the period of storage. This problem could be partly attributed to negligence on the part of the few educated farmers. This is because they consider the practice of keeping records cumbersome and waste of time since the stored maize is solely owned by them and no one else has interest in it. Besides, some farmers were not willing to give out information on their operations. Therefore, all things being equal, it was necessary to limit the study to available data in the study area.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results of the study and covers issues relating to the reasons why farmers and traders prefer one storage system to the other, ranking of constraints/problems that are encountered during storage as well as the cost, revenue and the net benefit estimates of the two storage systems.

4.2 Size and Distribution of Reasons Why Farmers Prefer One System to the Other

The Table 4.1 summaries the distribution of reasons for preferring on-farm storage.

Table 4.1 Size and distribution of reasons for on-farm storage system

Reasons for the use of on-farm storage system	*Frequency*	*Percentage %*	*Valid percent*
Convenience and less expensive	30	60	60
Less space at the institutional storage site	12	24	24
Availability of crib facilities	3	6	6
Have more storage spaces in their various houses (rooms) to store	8	10	10
Total	**50**	**100**	**100**

Source: Field Survey, 2004

Majority (60%) of respondents prefer on-farm storage system because it is convenient and less expensive. Twenty-four percent (24%) cited lack of space at the institutional storage site as the reason why they would rather store maize themselves. Therefore the

greatest advantage of the on-farm storage system is that it is less expensive and convenient to use. On the other hand, good quality of stored grain is the most preferred reason for storing in an improved storage system (Table 4.2). However, nearly a quarter of respondents also preferred this system because it is more convenient.

Table 4.2 Size and distribution of reasons for institutional storage system

Reasons for the use of institutional storage system	*frequency*	*Percentage %*	*Valid percent %*
Convenient and less expensive	7	23.3	23.3
Lack of crib facilities	2	6.7	6.7
Clean and uninfected grains	31	70	70
Total	**30**	**100**	**100**

Source: Field Survey, 2004

4.3 Ranking of Problems/Constraints to the Two Storage Systems; using coefficient of concordance analysis (W)

Different storage constraints/problems influence farmers/traders preference for various storage systems. The identified constraints/problems were:

1. Pest infestation
2. Transportation of maize to storage site
3. Difficulty in getting chemical for treating maize for storage
4. Maintenance of storage structures
5. Difficulty encountered during drying of maize

From Table 4.3 the most pressing problem in the on-farm storage system based on the total rank score was pest infestation followed by difficulty encountered during drying, with total ranking scores of 79 and 107 respectively. Transportation of maize to storage site was ranked the third most pressing constraint with a total ranking score of 120. Difficulty in getting chemical for treating maize for storage and difficulty in maintenance of storage structures were ranked as the least pressing constraints. The coefficient of concordance (W) was used to measure the degree of agreement in the rankings. The coefficient of concordance (W) calculated was 0.73 (73%), indicating that, 73% of the respondents agree or disagree to the rankings hence the need to test the level of significance using the F-ratio test.

An F–ratio of 132 was calculated. The F-critical value at 1% and 5% level of significance was 3.32 and 2.37 respectively. Since the F-calculated ratio is greater than the F-critical ratio at 5% level significance (2.37) and at 1% level of significance (3.32), the null hypothesis (Ho) is rejected and the alternative hypothesis (Hi) accepted, indicating that there is an agreement between the rankings of the problems/constraints of the on-farm storage of maize in the area of study.

Table 4.3 Ranking of problems/constraints to on-farm storage system

Problems/constraints	*Overall ranks*	*Total score (T)*
Pest infestation	1	79
Difficulties encounter in drying	2	107
Transportation of maize to storage site	3	120
Difficulties in getting chemicals for treating maize for storage	4	213
Maintenance of storage structures	5	231

Source: Field Survey, 2004

Transportation to convey maize to and from storage site was ranked as the most pressing problem/constraint with institutional storage system while difficulty encounter in drying, easily accessible of chemical for treating maize for storage, pest infestation and maintenance of storage structures follow in that order. The total ranking scores of the constraints are presented in Table 4.4 The coefficient of concordance (W) is 0.72 (72%), which is an indication that, 72% of the respondents agree or disagree with the ranking hence the need to test the level of significance using the F-ratio test.

The calculated F-ratio to test the level of significance for the rankings of the problems/constraints for the institutional storage is 75; compared to the F-critical value at both 1% and 5% level of significance of 3.48 and 2.45 respectively. Therefore the null hypothesis (Ho) is rejected and we concluded that there is agreement between the rankings of the problems/constraints of institutional storage.

Table 4.4 Ranking of problems/constraints to institutional storage of maize

Constraints/problems	*Overall rank*	*Total score (T)*
Transportation of maize to storage site	1	44
Difficulties encountered in drying	2	66
Difficulties in getting chemicals for treating maize for storage	3	78
Pest infestation	4	128
Maintenance of storage structures	5	137

Source: Field Survey, 2004

4.4 Cost Estimate of On-farm and Institutional Storage of Maize Produced During the Minor and Major Seasons

The profitability assessment performed in this study is limited to a financial analysis and it is only to measure the returns or profitability of the storage system. The analysis also took seasonality into consideration. Hence the data is presented according to the major season, which usually begins in August/September, and the minor season, which usually begins in November/December. Table 4.5 summaries the price of maize before storage and the quantity stored during the major and minor seasons. It was observed that more people store during the minor season as compared to the major season. From Table 4.5, 42 of the respondents stored maize during the minor season as compared to 30 who stored in the major season using on-farm storage system. The reasons given were that it is difficult to store during the major season due to problems with drying. Also farmers need money to go into the main season farming.

From Table 4.5, the minimum price of 130 kg of maize before storage during the major season was ¢70,000 and a maximum price of ¢95,000 for 130 kg of maize in year 2003. The mean quantity of maize stored during the major season was 44.4 bags with a mean price of ¢84,166.77 as compared to 52.24 bags with a mean price of ¢126,046.50 during the minor seasons with a price range of ¢95,000.00 to ¢140,000.00

The percentage price spread of 130 kg bag of maize before storage for both major and minor seasons were 35.71% and 47.37% respectively. This indicates that the price variation is wide using the on-farm storage system.

Table 4.5 Descriptive statistics of quantity and price of maize before storage for on-farm

Item	*Number of respondents*	*Minimum*	*Maximum*	*Mean*	*% Price spread*
Price of 130 kg bag of maize before storage (major)	30	70,000.00	95,000.00	84,166.67	35.71
Price of 130 kg bags of maize before store (minor)	42	95,000.00	140,000.00	126,046.5	47.37
Number of bag of maize store (major)	30	5	250	44.40	
Number of bag of maize stored (minor)	42	4	450	52.24	

Source: Field Survey, 2004

Table 4.6 summarizes the quantity and price of maize before storage for the institutional storage. From the table, 14 of the respondents stored during the major season as compare 25 respondents who stored during the minor season. The minimum price of maize before storage was ¢80,000 and maximum price of ¢95,000 for the major season. For the minor season the price ranges from ¢110,000 to ¢140,000 with a mean price of ¢83,333.33 for

the major season and ¢120,958.30 for the minor season. The quantity stored ranges from 20 bags of the 130 kg bag to 239 bags of the 130 kg bag for the major season and for the minimum season; it ranges from 18 bags to 303 bags of the 130 kg bags, which indicates that more farmers/traders prefer to store during minor season. The total quantity of maize stored for the major and minor seasons was 1,262 and 1,909 bas with a mean of 90.143 bags and 76.36 bags respectively.

The percentage price spread of 130kg of maize before storage for both the major and minor seasons were 18.75% and 27.27% respectively. This indicates that the price variation is not wider as compared to the situation for the on-farm storage system. The reason being that maize is dried to a require moisture content and winnowed down before it is sold, whereas in the on-farm storage system moisture content and chaff are not cared for during sales in the early part of the season when storage normally begins.

Table 4.6 Descriptive statistics of quantity and price of maize before storage for institutional storage

Item	*Number of respondents*	*Minimum*	*Maximum*	*Mean*	*% Price spread*
Price of 130 kg bag of maize before storage (major)	14	80,000.00	95,000.00	83,333.30	18.75
Price of 130 kg bags of maize before store (minor)	25	110,000.00	140,000.00	120,958.3	27.27
Number of bag of maize store (major)	14	20.00	239.00	90.14	
Number of bag of maize stored (minor)	25	18.00	303.00	76.36	

Source: Field survey, 2004

The result show the mean differences between the storage systems in terms of mean quantity stored for major season is statistically significant at 5% level. However, it was not statistically significant even at 10% level between the two storage systems for the minor season.

In terms of mean prices in the major season, the results show that there is no significant difference even at 10% significant level for the mean prices. This indicates that the null hypothesis (Ho) is not rejected. The statistical test showed that during the minor season there was a significant difference between the mean prices for both storage systems at 5% significance level.

In comparing the mean quantities stored for both on-farm and institutional storage, the institutional storage has a greater mean quantity in both the major (90.143 bag) and minor (76.36 bags) as compared to on-farm storage major (44.40 bags) and minor (52.24 bags)

The summary of the variable cost for both major and minor seasons is presented in Table 4.7. The variable cost ranges from ¢28,551.72 to ¢427,142.86 with a mean variable cost of ¢218,542.78 during the major season and the minor season variable cost ranges from ¢12,666.67to 230,000 with a mean variable cost of ¢142,273.47 for on-farm storage. For institutional storage system the variable cost for the major season ranges from ¢12,004.00 to ¢424,333.33 with a mean variable cost of ¢201,570.40. The minor season variable cost also ranges from ¢98,470.59 to ¢166,054.69 with a mean variable cost of ¢135,363.75.

The total variable cost account for 89% for the major season and 94% for the minor season total cost of on-farm storage. For institutional storage, total variable costs account for 87% and 92% of the total cost for the institutional storage during the major and minor seasons respectively. In comparing the variable cost for the on-farm and institutional storage, the total variable cost for major season for on-farm is higher than that of the institutional storage. Statistical results obtained on the mean total variable cost for both storage systems in the major and minor season showed no significant difference between the total variable cost even at 10% significance level. There are clear indications that, the variable costs form the major component of the total cost in both the on-farm and institutional storage.

Table 4.7 Variable Cost (¢) per 130kg bag

Storage system	*Season*	*Minimum*	*Maximum*	*Mean*
On-farm storage	Major	28,551.72	427,142.89	218,542.78
	Minor	12,666.67	230,000.00	142,273.47
Institutional storage	Major	12,004.00	424,333.33	201,570.40
	Minor	98,470.59	166,054.69	135,363.75

Source: Field Survey, 2004 (see appendix 7)

From the summary of the total fixed cost presented in Table 4.8, the minimum and maximum fixed cost for both the major and minor seasons range from ¢364.58 to ¢138,888.89 and ¢333.33 to ¢178,571.43 with a mean fixed cost of ¢20,511.87 and ¢28107.19 for the on-farm storage. Fixed cost of the institutional storage range from ¢3020.69 to ¢32583.33 for the major season and ¢5125.00 to ¢22894.74 for the minor season. The major and minor season mean fixed cost was ¢13677.63 and ¢12869.58

respectively. The result showed a statistically significant difference in the mean total fixed cost between the two storage systems during the major and minor seasons at 5% significance level.

Table 4.8 Total Fixed Cost (¢) per 130kg Bag

Storage system	*Season*	*Minimum*	*Maximum*	*Mean*
On-farm storage	Major	364.58	138888.89	20,511.87
	Minor	333.33	178,571.43	28,107.19
Institutional storage	Major	3020.61	32,583.33	13,677.63
	Minor	5125.00	22,894.74	12,869.58

Source: Field Survey, 2004 (see appendix 7)

Total overhead cost for the major and minor season for the on-farm storage ranges from ¢700.00 to ¢20,000 and ¢333.33 to ¢17555.56 with a mean variable cost of ¢6332.13 and ¢5689.84 respectively as presented in Table 4.9. For the institutional storage, it ranges from ¢2490.57 to ¢8400.00 with a mean overhead cost of ¢5995.72 and ¢5050.00 to ¢7411.76 with a mean overhead cost of ¢6154.56 for the major and minor season. The mean overhead cost for the institutional storage was less than that of the on-farm storage in the major season. Statistically, there is no significant difference even at 10% level between the two storage systems when comparing the mean overhead cost of the major season and the minor seasons. (See appendix 5)

Table 4.9 Total Overhead Cost (¢) per 130kg bag

Storage system	*Season*	*Minimum*	*Maximum*	*Mean*
On-farm storage	Major	700.00	20000.00	6332.13
	Minor	333.33	17555.56	5689.85
Institutional storage	Major	2490.57	8400.00	5995.72
	Minor	5050.00	7411.76	6154.56

Source: Field Survey, 2004 (see appendix 7)

The total cost for on-farm storage system as presented in Table 4.10 ranges from ¢35275.86 to ¢447142.86 with a mean total cost of ¢237243.30 for the major season while in the same season, the range for the institutional storage is ¢24484.00 to ¢462916.67 with a mean total cost of ¢219932.20. For the minor season, the total cost ranges from ¢13730.00 to ¢408571.43 with a mean of ¢157201.20 for the on-farm storage, while the institutional storage system's total cost ranges from ¢105882.32 to ¢187421.88 with a mean of ¢146927.30. The mean total costs for the institutional storage for both the major and minor seasons are less than those of the on-farm storage system. The result showed a statistically significant difference in the mean total fixed cost during the major and minor seasons at 5% significance level when the systems were compared.

Table 4.10 Total Cost for On-farm and Institutional Storage (¢) per 130kg Bag

Storage system	*Season*	*Minimum*	*Maximum*	*Mean*
On-farm storage	Major	35,275.86	447142.86	237243.30
	Minor	13,730.00	408571.86	157201.20
Institutional storage	Major	24,484.00	462916.67	219932.20
	Minor	105,882.35	187421.88	146927.30

Source: Field Survey, 2004 (appendix 7)

4.5 Total Revenue Estimates

Table 4.11 Total Revenue for On-farm and Institutional Storage (¢) per 130kg bag

Storage system	*Season*	*Minimum*	*Maximum*	*Mean*
On-farm storage	Major	100000.00	300000.00	174375.00
	Minor	140000.00	290000.00	191547.61
Institutional storage	Major	120000.00	260000.00	174000.00
	Minor	150000.00	250000.00	210833.33

Source: Field Survey, 2004

The total revenue for the on-farm and institutional storage are presented in Table 4.11. The summary showed that, the total revenue ranges from ¢100,000.00 to ¢300,000.00 and ¢140,000.00 to ¢290,000.00 for the major and minor season of the on-farm storage with mean revenues of ¢174375.00 and ¢191547.61 respectively. The total revenue for the institutional storage ranges from 120,000.00 to ¢260,000.00 with a mean of ¢174,000.00 in the major season and ¢150,000.00 to ¢250,000.00 in the minor season with a mean revenue of ¢210,833.33. From Table 4.11 the mean revenues for both the major and minor seasons for the institutional storage seem to be higher than the mean revenues of the on-farm storage which is an indication that more revenue was received from institutional storage as compared to on-farm storage. The statistical test conducted for the major season showed that there is no significant difference between the mean total revenue for the two storage systems at 10% significance level. Again, the test conducted for the minor season showed that there is no significant difference between the mean total revenue for the two storage systems even at 10% significance level.

4.6 Net Benefit Estimates

The net benefit estimates for the on-farm storage ranges from a loss of ¢28,000.00 to a gain of ¢237,301.33 for the major season and a loss of ¢28,571.43 to a profit of ¢136,777.78 for the minor season with a mean net loss of ¢62,868.30 and a benefit of ¢34,346.41 respectively. This is an indication that, the profit made for the minor season was greater than that of the major season. The structure of the net benefit estimate ranges form a loss of ¢16550.00 to a profit of ¢229857.87 for the major season.The net benefit estimated in the minor season for the institutional storage system ranges from a loss of ¢11158.73 to a profit of ¢112,500.00. The mean net benefit made for both the major and minor season storage were a loss of ¢45932.20 and a gain of ¢63906.03 respectively.

Statistical results obtained on comparing the net benefit for both on-farm and institutional storage systems in the major season show that there is a significant different between mean total net benefit at 10% significant level. In the minor season, statistically, there was no significant difference even at 10% significance level on the mean total net benefit for the two storage systems. In comparing the mean benefit for both the major and minor season for the on-farm and institutional storage, the indication is that the mean net benefit in each of the season of the institutional storage seem to be greater than the on-farm storage. This also shows that, even though the cost aspect was higher in institutional storage, it is still profitable as compared to on-farm storage. This may be attributed to quality of maize after storage, which also has effect on the selling price of the stored maize.

Table 4.12 Total Net Benefit for On-farm and Institutional Storage of Maize (¢) per 130kg bag

Storage system	*Season*	*Minimum*	*Maximum*	*Mean*
On-farm storage	Major	(28,000.00)	237,301.33	(62,868.30)
	Minor	(28,571.43)	136,777.78	34346
Institutional storage	Major	(16,550.00)	229,857.87	(45,932.20)
	Minor	(11,158.73)	112,500.00	63906.03

Source: Field Survey, 2004

4.7 Efficiency of Storage Operation

The summary of the operating efficiency presented in Table 4.13 was measured by relating various income and expenditure figures to each other. The operating ratio for the on-farm storage ranges from 0.17 to 2.85 and 0.07 to 1.15 for the major and minor seasons respectively, while the institutional storage operating ratio ranges form 0.6 to 3.03 and 0.53 to 0.89 for the major and minor seasons respectively. The mean operating ratios for the on-farm storage were 1.25 and 0.74 for the major and minor seasons respectively, while those of the institutional storage were 1.16 and 0.64 for the major and minor seasons respectively. This is an indication that the operating ratio for on-farm storage for the major season (1.25) was slightly greater than that of the institutional storage, which was 1.16. This means that the two storage systems are inefficient since the ratio in each case is greater than 1. Comparatively, the institutional storage during the major season is less inefficient than that of the on-farm storage operation. Also, the operating ratio (0.64) for the institutional storage during the minor season is less than that

of the on-farm (0.74) of the same season. This indicates that, the institutional storage operation is more efficient as compared to the on-farm storage.

Table 4.13 Descriptive Statistics of Operating Ratios for On-farm and Institutional Storage Systems

Type of storage	*Season*	*Range %*	*Mean %*
On-farm storage	Major	0.17 – 2.85	1.2533
	Minor	0.07 – 1.15	0.7428
Institutional storage	Major	0.6 – 3.03	1.1585
	Minor	0.53 – 0.89	0.6420

Source: Field Survey, 2004

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter deals with the summary of the study, conclusions from the results of various analyses, and makes relevance policy recommendations from these results. The study sought to investigate reasons why farmers/traders prefer one storage system to the other, constraints/problems in using any of the storage systems and to determine and compare the costs and returns of on-farm and institutional storage of maize in the Ejura Sekyere-Dumase District of Ghana.

5.2 Summary and Conclusion

The results of the study indicate that out of the fifty respondents interviewed from the various communities in the Ejura Sekyere-Dumase district of Ghana, thirty of the respondents representing 60% preferred using the on-farm storage system because it was convenient and less expensive to use. This is the main reason why most farmers prefer using the on-farm storage system. Twenty-four percent (24%) of the respondents said, there is less space at the modern storage site that is why they prefer too store using traditional systems while 10% said they have spaces in their various houses to store their maize, 6% said they have access to cribs to store their maize.

For the institutional storage, majority (70%) of the respondents said they are using that storage system because it gives farmers/traders clean and uninfected grains, thereby helping to maintain the quality of grains for sale at the end of the storage period. Approximately 23% said it is convenient and less expensive, while approximately 7% said they are using it because they do not have cribs to store their maize. Since the use of modern facilities has the potential of giving clean and uninfected grains and also farmers can store for a longer period, there is the need to create more awareness for farmers/traders to patronize the use of those modern facilities. There should be an expansion of the modern storage facilities to enable more farmers/traders to store their maize there.

There is a significant difference in the quantities stored by the two storage systems in the major season. This is due to the fact that farmers/traders prefer institutional storage facilities since it is difficult in using sun drying. The results of the study showed that farmers/traders are faced with certain constraints/ and barriers that hinder the use of the various storage systems. For the on-farm storage system, the major identified problems were pest infestation, difficulty during drying of maize for storage and the transportation of maize to and from the farm and market centres to the storage site. There should therefore be education for farmers/traders on the use of the appropriate chemicals that will help reduce pest infestation during storage. Simple drying machines should be made and readily available to farmers/traders to enable them dry their maize well to avoid mouldiness and pest infestation. Farmers should be encouraged to form co-operatives to enable them access loans from banks to purchase tractors that they can use to convey

their maize at a fee. Also through the Poverty Alleviation Funds the Ministry of Food and Agriculture can help by providing some sort of transport services to farmers during harvesting time to minimize the difficulties farmers/traders go through.

On the institutional storage, the major constraint identified was transportation followed by cost of drying. There is therefore the need for transport services to be provided by the appropriate authorities as wee as reducing the cost involve in drying which can cause a rise in cost of storage. There should also be a flexible loan scheme to enable farmers/traders meet storage cost and to acquire certain simple equipments for storage.

The study showed a mean loss of ¢62,868.33 during the major season and a net benefit of ¢34,346.41 was got in the minor season when using the on-farm storage system. Using the institutional storage system, a mean loss of ¢45932.20 resulted during the major season, whereas during the minor season there was a mean profit of ¢63906.03. It was also shown during the study that the operating ratios for the two storage systems during the major season were greater than 1, meaning that the two storage systems are not efficient. However operating ratios of less than 1 were registered for the two storage systems during the minor season indicating that both storage systems are efficient during the minor seasons. Comparatively, the institutional storage system proved to be more efficient than the on-farm storage system.

5.3 Policy Recommendation

Based on the result of the study, the following policy recommendations are made:

Since farmers and traders perceive on-farm storage as less expensive and convenient to use, there should be an education as well as providing the needed facilities that will enhance the storage of maize. There should also be more research into both the on-farm and institutional storage to minimize the cost involve in using institutional storage system to enable more farmers and traders to use that system. Even though, some farmers and traders are using the institutional storage system there is need to create more awareness about institutional storage system that maintain the quality of grain after storage and enhance the profitability level of storage.

Last but not the least, to solve the problem of the sharp increase in the price of maize during the minor season in the study area and elsewhere in Ghana, structural development support for storage activities is required to increase the quantity of maize during the major season.

5.4 Suggestion for Future Research

The study focused on reasons why farmers prefer one storage system to the other, constraints and the costs and returns on on-farm and institutional storage of maize in the Ejura Sekyere-Dumase District of Ghana. Future research could consider the same research in other regions or different product that can be stored which are economically and socially important as maize for this study in the same region. It will also be very interesting to look at the costs and returns in relation to the length of time (months).

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APPENDICES

APPENDIX 1

Cost and Revenue Components

Variable cost on-farm major	Variable cost on-farm minor	Variable cost institution major	Variable cost institution minor	Total fixed cost on-farm major	Total fixed cost on-farm minor	Total fixed cost institution major	Total fixed cost institution minor
28551.72	129888.3	.	131462.1	3879.31	2513.97	.	.
137777.8	.	.	122215.9	56111.11	.	.	.
165555.6	230000	.	130731.7	138888.9	178571.4	.	
183636.4	114444.4	.	124000	9090.91	11111.11		.
102666.7	.	92068.18	.	12000	.	4000	
.	140000	.	118782.1	.	.		.
.	115076.9	.	113372.1		22307.69	.	9273.26
297333.3	167272.7	157254.1	133611.9	8055.56	6590.91		.
.	172000	94314.72	.	.	72500	5126.9	.
.	12666.67	292159.1	140169.2	.	1063.33	16022.73	12200
150000	159400	102096.6	.	1500	.	3020.69	.
248500	162750	99914.89		9125	7250	3659.57	.
351500	148333.3		141730.2	49000	19333.33	.	.
.	83000		130263.2	.	66666.67	.	22894.74
95000			128800	38050	.	.	.
98333.33	.	227128.2	128400	5000	.	23435.9	20150
.	146222.2	.	98470.59	.	333.33	.	.
54250	.	12004	.	10125	.	4080	
.	101300	110264.2	.	.	.	25933.96	.
86400			128048.8	4000	.		
122833.3	164000	424333.3	166054.7	3333.33	.	32583.33	15273.44
423000	145384.6	293600	153869.3	12500	.	18500	13607.84
328804.3	149424.5	257848.5	147600	.	.	6212.12	5125
178250	143555.6	.	131204.5	42857.14	.		.
237777.8	185625	.	153913		.	.	6304.35
299000	132000		152360	.	.		11600
270500	150000	267199	149500	11250	.	7553	9055.17
	147525.4	326000	147333.3		5593.22	32000	19111.11
271000	142400	267371.3	144430	.		9358.65	9840
259000	130400	.	132407.4	.	.		
245833.3	136000	.	.	364.58	.	.	.
.	125789.5	.		.		.	.
180980.4	159843.8		.	.		.	.
224604.4		.		10000	.	.	.
.	124000	.	.	.	14933.33	.	.
.	156842.1	.	.	.	42763.16	.	.
.	144000	.	.	.	.	.	.
427142.9	122941.2	.	.	.	.	.	.
.	129666.7	.	.	.	.		.
127173.9	.	.	.	.	.	.	

276956.5	168043.5	.	.	18913.04	18913.04	.	.
.	151530.6	.	.	.	.	.	.
.	138333.3	.	.	.	12500	.	.
.	145555.6	.	.	.	.	.	.
228375	142651.5	.	.	9062.5	10984.85	.	.
.	146000	.	.	.	.	.	.
421111.1	192800	.	.	16666.67	12000	.	.
183100	102375	.	.	2000	.	.	.
.	148235.3	.	.	.	.	.	.
288421.1	168208.3	.	.	.	.	.	.

APPENDIX 2

Total operating cost on-farm major	Total operating cost on-farm minor	Total operating cost institution major	Total operating cost institution minor	Total revenue on-farm major	Total revenue on-farm minor	Total revenue institution major	Total revenue institution minor
2844.83	3687.15	.	.	170000	210000	.	230000
.	.	.	.	150000	.	.	220000
.	.	.	.	200000	200000	.	220000
12545.45	17555.56	.	6450	100000	150000	.	180000
.	.	.	.	180000	.	160000	.
.	.	.	6153.85	.	220000	.	180000
.	769.23	.	7244.19	.	150000	.	150000
1111.11	1363.64	8311.48	6000	180000	200000	220000	220000
.	11000	6152.28	.	.	200000	260000	.
.	.	6136.36	7215.38	.	170000	120000	210000
.	1000	6758.62	.	220000	220000	150000	.
3750	5000	7000	.	220000	220000	140000	.
.	.	.	7111.11	160000	180000	.	160000
.	1333.33	.	7368.42	.	190000	.	200000
.	.	.	7000	250000	.	.	220000
.	.	6307.69	6000	130000	.	220000	220000
.	6666.67	.	7411.76	.	290000	.	180000
.	.	8400	.	250000	.	210000	.
.	2000	2490.57	.	.	180000	220000	.
700	.	.	.	220000	.	.	220000
5000	3000	6000	6093.75	160000	220000	140000	220000
.	615.38	5000	5163.4	180000	180000	140000	220000
6684.78	6726.62	6090.91	5475	160000	230000	140000	220000
.	.	.	6272.73	150000	200000	.	220000
6222.22	7875	.	6000	160000	180000	.	200000
15000	6666.67	.	5720	140000	160000	.	220000
2000	2173.91	5050	5068.97	160000	220000	170000	250000
.	6372.88	5200	5200	.	235000	150000	200000
3684.21	2600	5042.19	5050	200000	250000	170000	250000
2300	2500	.	5092.59	120000	190000	.	250000

4166.67	3000	.	.	180000	250000		.
.	7368.42		.	.	150000	.	
8000	8000	.		130000	220000		.
7777.78	.	.	.	300000	.	.	.
.	6000		.		170000	.	
	.	.	.	.	190000		
	.	.		.	150000	.	
20000	10294.12		.	150000	160000		.
.	333.33				170000	.	.
	.	.	.	190000	.	.	
11978.26	15782.61	.	.	150000	150000	.	
.	6428.57	.	.		150000		.
.	6250	.	.	.	170000		
.	12222.22	.	.	.	140000	.	.
5275	6363.64	.	.	120000	190000	.	.
.	5000	.		.	160000	.	.
4444.44	4800	.	.	200000	220000		
.			.	160000	180000	.	.
.	9705.88	.	.		160000		
3157.89	3000	.	.	140000	220000	.	

APPENDIX 3

Net benefit on-farm major	Net benefit on-farm minor	Net benefit institution major	Net benefit institution minor	Total cost on-farm major	Total cost on-farm minor	Total cost institution major	Total cost institution minor
157565.5	73910.61	.	98537.88	35275.86	136089.4	.	131462.1
66333.33	.	.	97784.09	193888.9	.		122215.9
28000	-208571		89268.29	304444.4	408571.4	.	130731.7
41636.36	6888.89	.	49550	205272.7	143111.1	.	130450
147466.7	.	137586.4		114666.7	.	96068.18	.
	80000	.	55064.1	.	140000		124935.9
.	11846.15		20110.47	.	138153.8	.	129889.5
111366.7	24772.73	180237.7	80388.06	306500	175227.3	165565.6	139611.9
.	16927.5	229857.9	.	.	183072.5	105593.9	.
.	3270	39409.09	50415.38	.	13730	314318.2	159584.6
68500	59600	119801.4	.	151500	160400	111875.9	
157425	45000	109357.4	.	261375	175000	110574.5	
40700	12333.33	.	11158.73	400500	167666.7	.	148841.3
	39000	.	39473.68	.	151000	.	160526.3
192950	.	.	84200	133050		.	135800
105333.3	.	144830.8	65450	103333.3	.	256871.8	154550
	136777.8	.	74117.65		153222.2		105882.4
229025	.	195119.2	.	64375	.	24484	.
.	76700	169522.6	.	.	103300	138688.7	.
198020			91951.22	91100	.	.	128048.8

28833.33	53000	16550	32578.13	131166.7	167000	462916.7	187421.9
82900	34000	57780	47359.48	435500	146000	317100	172640.5
87554.35	73848.92	76127.27	61800	335489.1	156151.1	270151.5	158200
71492.86	56444.44	.	82522.73	221107.1	143555.6	.	137477.3
106222.2	-13500	.	33782.61	244000	193500	.	166217.4
65200	21333.33	.	50320	314000	138666.7	.	169680
103888.8	58033.7	103957.2	86375.86	283750	152183.7	279802	163624.1
.	75508.47	47600	28355.56	.	159491.5	363200	171644.4
142115.8	105000	102124.9	90680	274684.2	145000	281772.2	159320
65900	57100	.	112500	261300	132900	.	137500
126302.1	111000	.	.	250364.6	139000	.	.
.	16842.11	.	.	.	133157.9	.	.
85803.92	52156.25	.	.	188980.4	167843.8	.	.
237301.3	.	.	.	242382.2	.	.	.
.	25066.67	.	.	.	144933.3	.	.
.	-9605.26	.	.	.	199605.3	.	.
.	6000	.	.	.	144000	.	.
44571.43	26764.71	.	.	447142.9	133235.3	.	.
.	40000	.	.	.	130000	.	.
164565.2	.	.	.	127173.9	.	.	.
63717.39	-52739.1	.	.	307847.8	202739.1	.	.
.	-7959.18	.	.	.	157959.2	.	.
.	12916.67	.	.	.	157083.3	.	.
.	-17777.8	.	.	.	157777.8	.	.
59987.5	30000	.	.	242712.5	160000	.	.
.	9000	.	.	.	151000	.	.
94666.67	10400	.	.	442222.2	209600	.	.
121380	77625	.	.	185100	102375	.	.
.	2058.82	.	.	.	157941.2	.	.
79157.89	48791.67	.	.	291578.9	171208.3	.	.

APPENDIX 4

Operating ratio on-farm major	Operating ratio on-farm minor	Operating ratio institution major	Operating ratio institution minor
0.17	0.62	.	0.57
0.92	.	.	0.56
0.83	1.15	.	0.59
1.84	0.76	.	0.69
0.57	.	0.58	.
.	0.64	.	0.66
.	0.77	.	0.76
1.65	0.84	0.71	0.61

.	0.86	0.36	.
.	0.07	2.43	0.67
0.68	0.72	0.68	.
1.13	0.74	0.71	
2.2	0.82	.	0.89
.	0.44	.	0.65
0.38	.	.	0.59
0.76		1.03	0.58
.	0.5	.	0.55
0.22	.	0.06	.
.	0.56	0.5	
0.39	.	.	0.58
0.77	0.75	3.03	0.75
2.35	0.81	2.1	0.7
2.06	0.65	1.84	0.67
1.19	0.72	.	0.6
1.49	1.03	.	0.77
2.14	0.83		0.69
1.69	0.68	1.57	0.6
.	0.63	2.17	0.74
1.36	0.57	1.57	0.58
2.16	0.69	.	0.53
1.37	0.54	.	
.	0.84	.	
1.39	0.73	.	.
0.75	.		.
	0.73		.
.	0.83		
	0.96	.	.
2.85	0.77	.	.
.	0.76	.	.
0.67	.	.	.
1.85	1.12	.	.
.	1.01	.	
.	0.81		.
.	1.04	.	
1.9	0.75		
.	0.91	.	
2.11	0.88		.
1.14	0.57	.	.
.	0.93	.	.
2.06	0.76	.	.

APPENDIX 5

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Total quantity sold-major	Equal variances assumed	3.880	.055	-2.692	45	.010	-43.5479	16.1752	-76.1265	-10.9694
	Equal variances not assumed			-2.368	20.642	.028	-43.5479	18.3923	-81.8372	-5.2586
Total quantity sold-minor	Equal variances assumed	.510	.478	-1.207	64	.232	-23.2679	19.2739	-61.7719	15.2362
	Equal variances not assumed			-1.325	61.055	.190	-23.2679	17.5550	-58.3706	11.8348
Price per 130Kg-major	Equal variances assumed	.043	.837	.028	45	.978	375.0000	13288.0002	-26388.4062	27138.4062
	Equal variances not assumed			.029	28.442	.977	375.0000	13105.1107	-26450.8043	27200.8043
Price per 130Kg-minor	Equal variances assumed	2.782	.100	-2.423	64	.018	-19285.7143	7958.3710	-35184.3881	-3387.0405
	Equal variances not assumed			-2.603	58.414	.012	-19285.7143	7408.5096	-34113.2190	-4458.2096
total variable cost-major	Equal variances assumed	1.668	.203	-2.030	45	.048	-7699467.0833	3793259.9714	-15339484.8467	-59449.3200
	Equal variances not assumed			-1.759	20.070	.094	-7699467.0833	4376580.4100	-16826804.5171	1427870.3504

overhead cost -major	Equal variances assumed	1.634	.210	-2.117	33	.042	-277476.1905	131086.5058	-544173.6919	-10778.6891
	Equal variances not assumed			-2.089	26.734	.046	-277476.1905	132836.6662	-550161.3001	-4791.0808
total fixed cost-major	Equal variances assumed	1.246	.272	-2.236	36	.032	-413108.9286	184724.5636	-787747.7078	-38470.1494
	Equal variances not assumed			-2.121	23.181	.045	-413108.9286	194803.0703	-815915.7075	-10302.1497
total variable cost minor	Equal variances assumed	.496	.484	-1.060	64	.293	-3000931.5476	2830541.1156	-8655587.4720	2653724.3767
	Equal variances not assumed			-1.161	60.804	.250	-3000931.5476	2584057.8426	-8168411.9260	2166548.8308
overhead cost-minor	Equal variances assumed	.985	.326	-.938	52	.353	-133562.9412	142459.1017	-419428.0425	152302.1601
	Equal variances not assumed			-1.091	51.491	.280	-133562.9412	122442.8402	-379320.2865	112194.4041
total fixed cost-minor	Equal variances assumed	.598	.446	-2.100	28	.045	-501811.1111	238908.1853	-991192.3441	-12429.8781
	Equal variances not assumed			-1.971	18.660	.064	-501811.1111	254596.6604	-1035346.5518	31724.3296
revenue major	Equal variances assumed	1.462	.233	-1.890	45	.065	-7515281.2500	3975392.1648	-15522132.0813	491569.5813
	Equal variances not assumed			-1.793	24.235	.085	-7515281.2500	4190488.3629	-16159586.1957	1129023.6957
revenue minor	Equal variances assumed	.445	.507	-.934	64	.354	-4821309.5238	5162880.3950	-15135348.7907	5492729.7431
	Equal variances not assumed			-1.043	62.648	.301	-4821309.5238	4623017.2556	-14060687.2052	4418068.1576
net benefit-major	Equal variances assumed	1.521	.224	-1.686	46	.099	-5475964.4242	3247739.0698	-12013324.1044	1061395.2559
	Equal variances not assumed			-1.566	22.995	.131	-5475964.4242	3496992.9163	-12710137.8911	1758209.0426

net benefit-minor	Equal variances assumed	.503	.481	-.673	64	.503	-1514800.0000	2250526.6566	-6010743.8397	2981143.8397
	Equal variances not assumed			-.780	63.978	.438	-1514800.0000	1942498.1067	-5395412.2090	2365812.2090
total cost-major	Equal variances assumed	1.875	.177	-2.317	47	.025	-9011042.3529	3888382.1953	-16833458.3481	-1188626.3578
	Equal variances not assumed			-1.981	19.611	.062	-9011042.3529	4548782.2205	-18511701.3088	489616.6029
total cost-minor	Equal variances assumed	.304	.584	-1.140	64	.259	-3426509.5238	3006707.6936	-9433098.6451	2580079.5975
	Equal variances not assumed			-1.233	59.314	.223	-3426509.5238	2779555.3984	-8987770.6942	2134751.6466

APPENDIX 6

Descriptive Statistics

	N	Minimum	Maximum	Mean
operating ratio on-farm per 130kg bag-major	32	.17	2.85	1.2533
operating ratio on-farm per 130kg bag-minor	42	.07	1.15	0.7428
operating ratio for institution per 130kg -major	15	.06	3.03	1.1585
operating ratio for institution per 130kg-minor	24	.53	.89	0.6420
Valid N (listwise)	6			

APPENDIX 7

	N	Minimum	Maximum	Mean
variable cost institution per 130kg-major bag	15	12004.00	424333.33	201570.4013
variable cost institution per 130kg bag-minor	24	98470.59	166054.69	135363.7515
variable cost on-farm per 130kg-major bag	32	28551.72	427142.86	218542.7762
variable cost on-farm per 130kg bag-minor	42	12666.67	230000.00	142273.4746
total fixed cost per 130kg on-farm major	32	364.58	138888.89	20511.8715
total fixed cost per 130kg on-farm minor	42	333.33	178571.43	28107.1877
total fixed cost institution per 130kg bag-major	15	3020.69	32583.33	13677.6328
total fixed cost institution per 130kg minor	24	5125.00	22894.74	12869.5754
total overhead cost on-farm per 130kg bag-major	32	700.00	20000.00	6332.1327
total overhead cost on-farm per 130kg bag-minor	42	333.33	17555.56	5689.8480
total overhead cost institution per 130kg bag-major	15	2490.57	8400.00	5995.7218
total overhead cost institution per 130kg bag-minor	24	5050.00	7411.76	6154.5574
total rvenue on-farm per 130kg bag-major	32	100000.00	300000.00	174375.0000
total rvenue on-farm per 130kg bag-minor	42	140000.00	290000.00	191547.6190
total revenue institution per 130kg bag-major	15	120000.00	260000.00	174000.0000
total revenue institution per 130kg bag-minor	24	150000.00	250000.00	210833.3333
Net benefit on-farm per 130kg bag major	32	-297142.86	185625.00	-62868.2668
Net benefit on-farm per 130kg bag minor	42	-208571.43	156270.00	34346.3708
Net benefit institution per 130kg bag major	15	-322916.67	185516.00	-45932.1989
Net benefit institution per 130kg bag minor	24	11158.73	112500.00	63905.9963
total cost on-farm per 130kg bag major	32	35275.86	447142.86	237243.2668
total cost on-farm per 130kg bag minor	42	13730.00	408571.43	157201.2482
total cost institution per 130kg bag major	15	24484.00	462916.67	219932.1989
total cost institution per 130kg bag minor	24	105882.35	187421.88	146927.3370
Valid N (listwise)	0			

UNIVERSITY OF GHANA, LEGON – ACCRA

DEPARTMENT OF AGRICULTURAL ECONOMICS AND AGRIBUSINESS

A SURVEY IS BEING CONDUCTED TO ESTIMATE THE COSTS AND BENEFITS OF ON FARM AND INSTITUTIONAL STORAGE OF MAIZE AND THE CONSTRAINTS INVOLVED IN EACH SYSTEM OF STORAGE IN THE EJURA SEKYERE-DUMASE DISTRICT OF GHANA

A DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENT CHOICE

1. Serial Number of Farmer/Trader .....
2. (a) How old are you?
   (b) Sex 1. Male ( ) 2. Female ( )
   (c) How many people depend on you?
3. (a) Are you involve in maize production or maize business?
   Yes ( ) No ( )
   (b) If yes, is it your full-time job? .....
   (c) If no, what is/are your other occupation(s)?
   1. Teaching ( ) 2. Driving ( ) 3. Other (Specify) .....
4. Do you produce/buy and store maize?
5. (a) Do you store maize only?
   (b) If no, what other foodstuffs do you store?
6. How long have you been in the storage business?
7. How many bags of maize did you store last year?
8. For how long did you store your maize (month(s))?
9. Did you store for:
   1. Family consumption ( ) 2. To sell when prices moves up ( )
   3. Other (Specify) ( ).
10. What system do you use in the storage of your maize?
    1. Institutional (warehouse, silos etc) ( )
    2. On-farm storage (traditional) ( )

11. Why do you prefer the storage system chosen?

Explain .....

B. CONSTRAINTS IN STORAGE

12. (a) Do you face problems in the use of the system chosen?

Yes ( ) No ( )

(b) If yes, Explain .....

.....

13. What are the solutions to the problems?

.....

Rank the following constraints/problems base on the scale provided below:

1. Very high ( )
2. High ( )
3. Not a problem ( )

Please, tick the appropriate box provide below base on the scale above

Constraint(s)	STORAGE SYSTEM					
	Institutional			On farm		
	1	2	3	1	2	3
Pest infestation						
Transportation to convey maize to storage site						
Chemicals for treating maize for storage						
Maintenance of storage structures						
Drying						

14. Do you agree that most people sell al their maize during the major season?

Yes ( ) No ( )

15. Why do they sell all their produce during the major season?

1. Lack of storage facilities ( )
2. Cost involve in storage ( )
3. Lack of storing materials such as chemicals ( )
4. Not profitable to store ( )
5. Other (Specify) .....

16. Does the price of maize go up during the lean season?

    Why does it go up? .....

17. How do you convey your produce to storage site?

18. Do you pay for transportation/labour involve in conveying maize to storage site?

    1. Yes ( ) 2. No ( )

19. How easy is it to use the system chosen?

    1. Very easy ( ) 2. Quite easy ( ) 3. Very difficult ( )

20. (a) Should the facility for institutional storage be expanded?

    1. Yes ( ) 2. No ( )

    (b) If yes, explain .....

    .....

    (c) If no, explain .....

21. On the average what quantity of maize is lost during storage:

    (i) On farm storage

    (ii) Institutional storage

C. ESTABLISHING COST

22. What was the price of 11 kg bag of maize before storage?

23. How many bags did you store?

24. Cost of chemical use if applicable.

25. Cost of local materials for the structure erected if applicable.

26. Cost of drying your maize if applicable.

27. Warehouse/silo charge for storing 11 kg bag of maize per month.

28. How long did you store (months)?

29. Cost of transportation where applicable

30. (a) Do you sell at storage site after storage?

    (b) If yes, what is the cost of transportation to market?

31. (a) Do you use your family/dependants during storage?

    1. Yes ( ) 2. No ( )

    (b) If no, how much is each person paid?

(c) If no, how do you easily get accesses to labour in your operations?

32. Averagely what is the total cost of labour?

33. Other cost(s) incurred (specify).

Equipment	Economic life (yrs)
Basket	
Polysack	
Cribs	
Platforms	
Enclosed structures	
Other (specify)	

34. What is the cost of maintaining an already existing structure for storage for one year?

D. FINANCIAL CONSIDERATION

35. Source of capital

1. Personal savings ( )
2. Bank credit ( )
3. Credit from friends ( )
4. Other (specify) ..... ( )

36. If the source is credit, please give the following details.

Amount ¢	Duration	Interest payment	Principal payment

37. Do you face any serious financial constraints?
If yes, what is it? .....

38. Are you able to meet your financial obligation? (i.e. payment of debt such as loans)

1. Regularly ( ) 2. On time ( ) 3. Not able to pay ( )

E. SERVICES / SUPPORT FACILITIES

39. Do you have access to storage facilities?

1. Yes ( ) 2. No ( )

40. Do you have access to market for the stored maize?

41. Do you have access to agricultural extension officers?

1. Yes ( ) 2. No ( )

42. If yes, what kind of service(s)/assistance do you receive from the extension officers?

1. Technical advice
2. Chemicals
3. Other, Please specify .....

43. Do the services provided relate to storage?

1. Yes ( ) 2. No ( )

If yes, what is it? .....

F. ESTIMATION OF REVENUE

Please, give the following details:

Respondent Serial N°	Month		Quantity sold		Price/130 kg bag of maize	