THE ECONOMICS OF POST-HARVEST HANDLING AND MARKETING OF LEGUMES IN GHANA: THE CASE OF COWPEA, GROUNDNUTS AND BAMBARA BEANS.

BY

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THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF Ph.D DEGREE IN AGRICULTURAL ECONOMICS.

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DECLARATION

I, Jocyce Afua Bediako, author of this research report do hereby declare that the research work presented in this thesis:

"The Economics of Post-Harvest Handling and Marketing of Legumes in Ghana:

The Case of Cowpea, Groundnuts and Bambara Beans",

was done entirely by me in the Department of Agricultural Economics and Agribusiness, University of Ghana, Legon.

This work has never been presented either in whole or in part for any other degree of the Univeristy or elsewhere.

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DEDICATION

To JEHOVAH GOD

and to

my LORD JESUS CHRIST.

For the gift of

Life and Strength

to complete this work.

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J. A. Bediako

ABSTRACT

The study examined the efficiency of the legume market with respect to post - harvest handling and the structure, conduct and performance of the marketing process. The legume crops involved in the study are cowpea, groundnuts and bambara beans. Bambara beans was however studied only at the farm level because of its limited sale at the wholesale level.

The techniques employed for primary data collection include Rapid Reconnaissance Survey, Participatory Rural Appraisal, Direct Observation, and Case Studies. The data from secondary sources consisted of documented information from institutions. They include wholesale prices collected mainly from the PPMED of the Ministry of Food and Agriculture.

Methods for the analysis of data include descriptive and inferencial statistics.

Results obtained at the production level reveal that farmers have over the years developed many storage structures and protection methods as measures to protect legumes, namely, cowpea and threshed bambara beans, from destruction by insect pests during storage and to promote food security. The treatment of legumes on farms involve the use of traditional methods with limited application of chemicals. It was found that farmers store larger quantities of groundnuts and bambara beans in villages than cowpea, which is stored mainly in the markets by traders. The major marketing functions performed on legume markets by middlemen include purchasing, assembling, and distribution. Transporting, packaging, and storage were found to be important marketing services supporting the markerting functions. Other functions observed include direct and indirect financing through the provision of loans to farmers by traders and stock crediting among traders.

Unlike bambara beans, cowpea and groundnuts were found to have a large number of intermediaries in the trade resulting in a multi-marketing channel. A situation, which contributes significantly to high marketing costs with consequent high consumer prices. Both farmers and traders were found to have limited or no access to market information on legumes prices and supply situations in the country. Insect pest damage on markets was found to be high for untreated stocks, ranging from 3.4 to more than 70 percent in some cases, thereby resulting in price discounts. The results revealed annual

revenue losses to traders ranging from 11.7 — 58.4 percent of net revenue through price discounts for damaged grades of cowpea, caused by weevils.

The results on pricing policies in the cowpea market give the indication of collusive pricing policies, with an imperfectly competitive marketing system resulting from traders' monopoly of the market. The results also indicated weak associations between cowpea markets with only 9 out of 56 market pairs being highly associated, implying the existence of delayed transmission of price changes between cowpea markets. For the groundnuts market, the results indicate the presence of a higher market competition and a faster rate of price transmission between markets resulting in 22 highly associated market pairs

The results of price spread estimations between farmers and wholesalers indicate that groundnut farmers enjoy a higher share of consumer prices than cowpea farmers.

The study recommends that further study be made to identify simple, durable but affordable structures for introduction to farmers for legume storage. The use of underground storage facilities for instance may be additional options for study and consideration. The study also recommends an aggressive approach to insect pest eradication from farms and markets to forestall the incidence of seasonal produce damage and enhance the elimination of revenue losses to traders and farmers particularly in the cowpea market.

It is recommended therefore that trial experiments be undertaken to select the most potent plant materials and their recommended dosage of application for reintroduction to farmers as well as the use of appropriate and affordable solar energy technologies for insect pests eradication. It is also recommended that the problem of farmers' inability to adopt high-yielding varieties be tackled from the market and consumer levels in addition to the farm level.

Extension services need to be introduced to markets to help in educating traders in operational practices and record-keeping as well as the formation of trader groups for linkage to credit institutions for financial assistance.

Pest control and modem storage facilities need to be constructed in the wholesale markets for the proper handling and marketing of grains, cereals and legumes.

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1. FAO	Food and Agricultural Organization
2. GFDC	Ghana Food Distribution Corporation
3. GPRTU	Ghana Private Road Transport Union
4. GRPC	Ghana Export Promotion Council
5. MOFA	Ministry of Food and Agriculture
9. PPMED	Policy Planning, Monitoring and Evaluation Department
10. PRA	Participatory Rural Appraisal
11. UER	Upper East Region
12. UWR	Upper West Region

CHAPTER 1

INTRODUCTION

1.1. Introduction

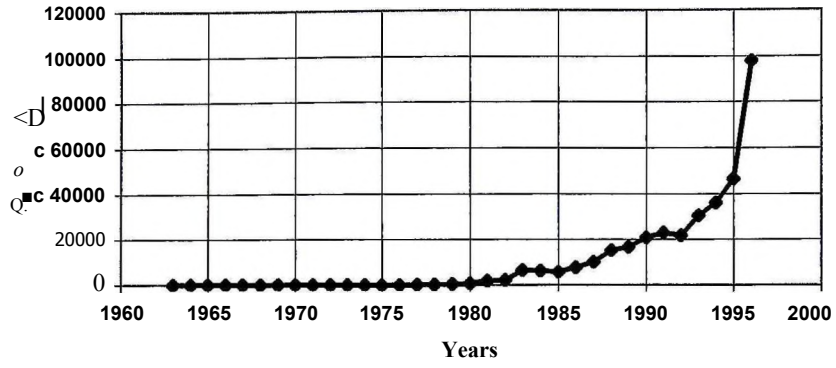
The contribution of post-harvest management to the attainment of food and nutrition security in Ghana cannot be overemphasized. In this chapter the background and importance of marketing in the development of agriculture, and the problems and expectations associated with the post-harvest handling and marketing of legumes are discussed. Also highlighted are the research objectives, scope and limitations of the research as well as a description of the study area.

1.2. Background

There has been widespread public outcry about the rising cost of food in the country in recent times. In particularly, the prices of cowpea and groundnuts, which are important to boarding schools, homes, industries and refugee camps, for instance, continue to rise sharply on our markets. Figures 1.1 and 1.2 show the nominal average price trends for cowpea and groundnuts, both of which present sharp increases from 1980.

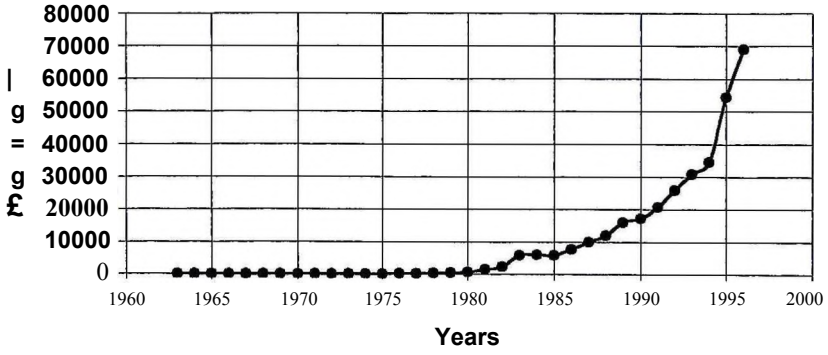
The actual price situations, depicted by the trend of price indexes are also presented in Figures 1.3 and 1.4. The figures reveal that cowpea prices have been persistently unstable with sharp fluctuations over the years. The annual prices for groundnuts show a more stable and regular trend than cowpea prices. For both crops, the price indexes for 1983 is the highest portraying the severity of food scarcity in the country in that year. Although lack of data on annual prices of bambara beans made it impossible in this study to present an illustration of its price trend over the years, the high price and low quality of the crop on the markets indicate similar situations over the years.

Fig. 1.1: Nominal Average Annual Price Trend of Cowpea, 1963 -1996



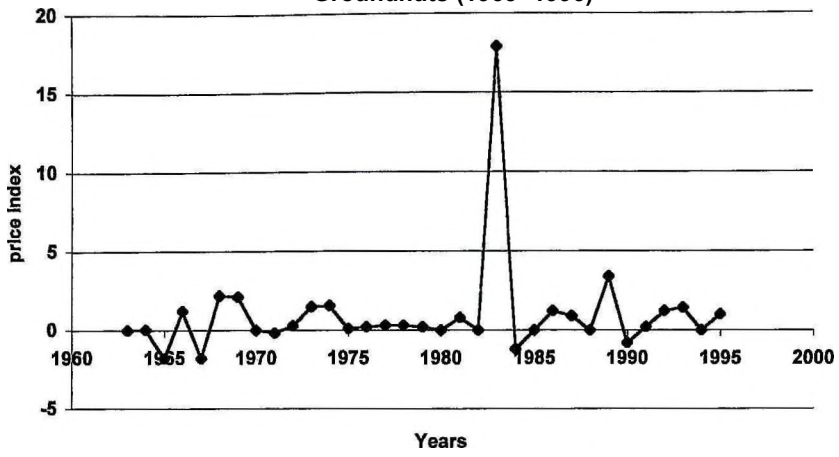
Source: PPMED, MOFA

Fig. 1.2: Nominal Average Annual Price Trend of Groundnuts, 1963 -1996.



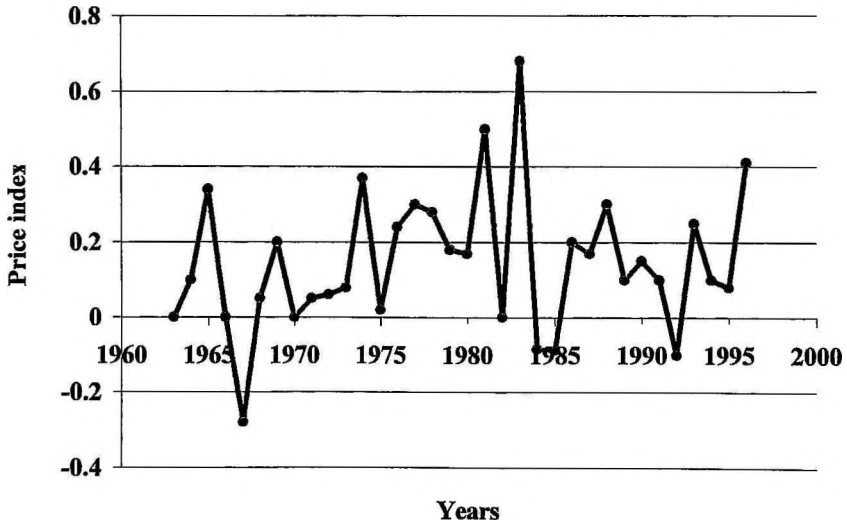
Source: PPMED, MOFA

Fig. 1.3: Trends in Index of Annual Average Price of Groundnuts (1963 -1996)



Source: PPMED, MOFA

Fig.1.4: Trends in Index of Annual Average Price of Cowpea (1963 -1996).



Source: PPMED, MOFA

Olayemi (1972) has indicated that production and marketing constitute a continuum and a lack of development in one retards progress in the other. Marketing can contribute to the development process of an economy in two ways. Firstly, it provides a channel for an efficient allocation of economic resources, ensuring high value production and mayimnm consumer satisfaction. Secondly, it stimulates growth by promoting technological innovation and increased supply and demand (Scarborough and Kydd, 1992). It is only when prices established through the marketing system transmit demand back to producers and supply conditions forward to consumers with a minimum of lag, imperfection and distortion that the economy can achieve efficient allocation and use of its resources in satisfying wants (Bressler and King, 1970). In a market economy, prices guide producers in their choice of enterprises as to which commodity to produce, how much to produce, what production methods to use and when and how to produce for maximum returns. To increase food output therefore, there is the need to develop an efficient marketing system for all food output and food products. The more efficient the stages of the food systems, namely production, protection, marketing, processing and consumption, the more rewarding it is to everyone associated with the food industry and to the national economy (Dittoh, 1994). Resolving the marketing problems of legumes would help increase their production and consumption, with subsequent reduction of Protein Energy Malnutrition (PEM), which is prevalent in Ghana, especially among children. Effective legume marketing would help to stimulate an increase in their output by providing the needed incentives that would encourage the farmer to increase production. Groundnuts, for instance, which serve as a raw material for some vegetable oil and feed mill industries, would be produced in abundance to promote the operation of such industries.

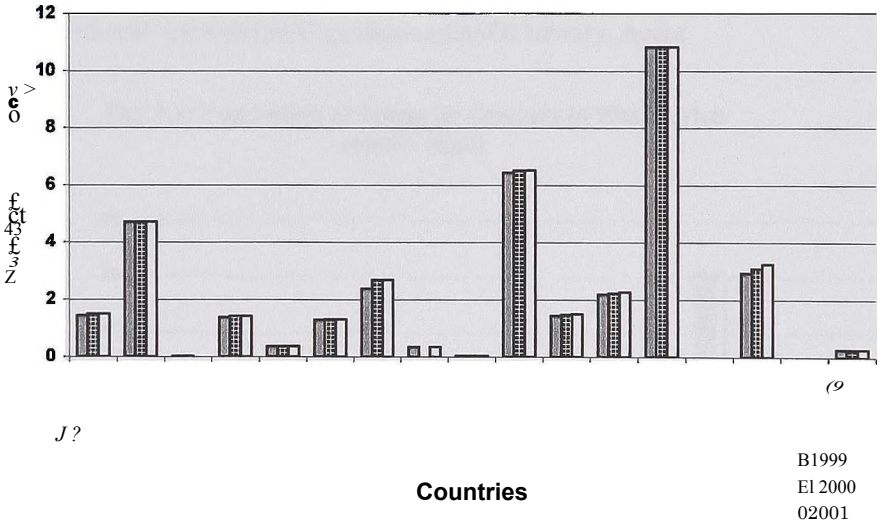
In addition, efficiency in the marketing operations of a commodity lowers marketing costs, resulting in low consumer prices, which encourage consumers to utilise more of the commodity. An improvement in legume marketing would therefore, not only improve the living standards of the producer but would also increase legume supply and plant protein intake in Ghana. Furthermore, an increase in legume production would help improve soil fertility through its nitrogen fixing capability.

It is against this background and the persisting influx of holed legumes, especially cowpea and bambara beans into our markets and also the persistent high market prices, that it becomes necessary to undertake a research study of the operational mechanisms of the post-harvest handling and marketing of legumes in the country.

1.3. The problem

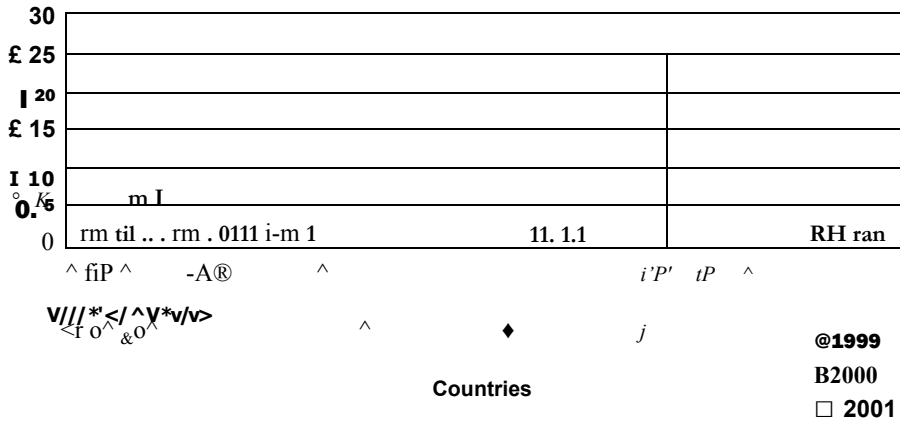
Even though Ghana is one of the countries with a low population of both wild and domesticated livestock per capita as shown by Figures 1.5, 1.6 and 1.7, there is insufficient incentives for the production and consumption of legumes, which are suitable plant protein substitutes.

Fig. 1.5: Population of Cattle by Country in West Africa, (1999-2001)



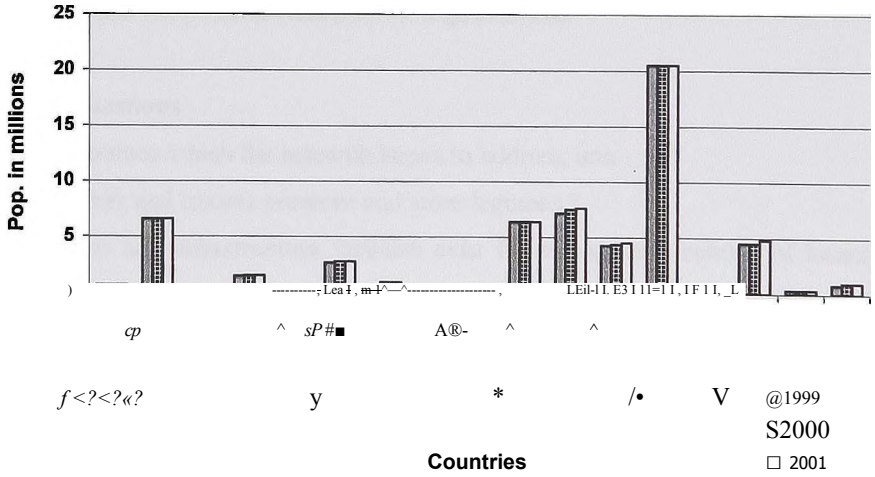
Source: Food and Agricultural Organisation (FAO) Library, Accra

Fig. 1.6: Population of Goats by Country in West Africa, (1999-2001)



Source: Food and Agricultural Organisation (FAO) Library, Accra

Fig. 1.7: Population of Sheep by Country in West Africa (1999-2001)



Source: Food and Agricultural Organisation (FAO) Library, Accra

Over the years, there has been widespread dissatisfaction over the quality of legumes, particularly cowpea and bambara beans, and high consumer prices. Peter Golob et al (1995) have this to say concerning the seriousness of the situation, "..the condition of grain in storage is affected by insect and rodent pests, which cause significant losses".

Even though other grains are also affected, pulses are most heavily damaged, perhaps 20% by weight of cowpea is lost on the average but often the entire crop is damaged in storage. Bambara losses may also exceed 20% but also important is the reduced seed germination.

Inspite of the alarming figures of food losses at the post-harvest level, literature indicates that, " the last three decades have witnessed a dramatic increase in the amount of research on food production issues in developing countries. A growing body of literature therefore exists on topics related to food production, consumption and nutrition. On the contrary, studies on the internal distribution and sale of locally produced crop, livestock and fish products have tended to receive less attention" (Scott, 1995). In Ghana, for instance, several theories of agricultural marketing, are yet to be verified in the domestic marketing contest

The study examines the legume marketing procedures and processes in Ghana including intra-market relationships, type of pricing policies in the conduct of marketing, the status of farmers remuneration from consumers of the major legumes, the causes of related problems and the possible remedies for improvement.

1.4. Research questions

The main questions which the research hopes to address, are:

1. How do fanners and traders preserve and store legumes.?
2. What methods and infrastructure facilities exist for storage and control of losses in the system?
3. What are the structural components of the legume marketing system?
4. What are the functions of participants in the marketing system?
5. How do the major legume markets relate in time and space?
6. How is price determined at the important levels of the marketing channel?

7. What problems exist in the industry between harvesting and the retail level and how can they be resolved?
8. What are the areas needing further research study in the marketing of legume?

1.5. Research objectives

The overall objective of the project is to study the structure, conduct and performance of legume marketing in Ghana. The study seeks to find the problems in the post -harvest management and marketing of legumes, which limit the enhancement of post-production activities for the maximization of returns / satisfaction to producers, traders and consumers.

The specific objectives of the study are to:

1. Examine the post-harvest handling and control of losses at the farm and market levels;
2. Identify the marketing channels for cowpea, bambara beans and groundnuts;
3. Examine the functions of actors in the marketing channel of legumes;
4. Determine the structure of the legume market with regard to entry barriers into cowpea market because of its susceptibility to insect pests;
5. Determine the pricing policies of actors along major channels;
6. Determine the spatial market integration of cowpea, and groundnuts for some selected markets;
7. Determine the producers' share of urban wholesale prices;
8. Identify existing problems and to suggest remedies for redress.

The aim is to provide relevant information for remedial policies to help stabilize supply, reduce post-harvest losses and subsequently curb the rising cost of legumes in the country.

1.6. The need for the study

Very little published information is available on post-harvest **handling** and marketing of legumes in Ghana. Any rational planning as well as economic forecast of legume production and consumption has to be based on a thorough knowledge and understanding of the peculiar characteristics of its market. A knowledge of the processes

and procedures of legume trade will provide guidance for policy changes aimed at enhancing post-production activities in the legume industry.

It is hoped that this study will provide information that may assist policy makers, development planners and the private sector to put in place the required corrective measures towards improving the post-harvest management and marketing of legumes in Ghana and subsequently curb the rising cost and low quality of these crops in Ghanaian markets.

1.7. Scope of the study

Marketing refers to those business activities involved with the flow of goods and services from production to consumption. This study concerned mainly the private sector marketing of cowpea, groundnuts and bambara beans in Ghana. The aspects of operations covered include pricing efficiency, involving mark-up policies, price movement across time and space along the channels and the effect of insect damage to the revenue of traders.

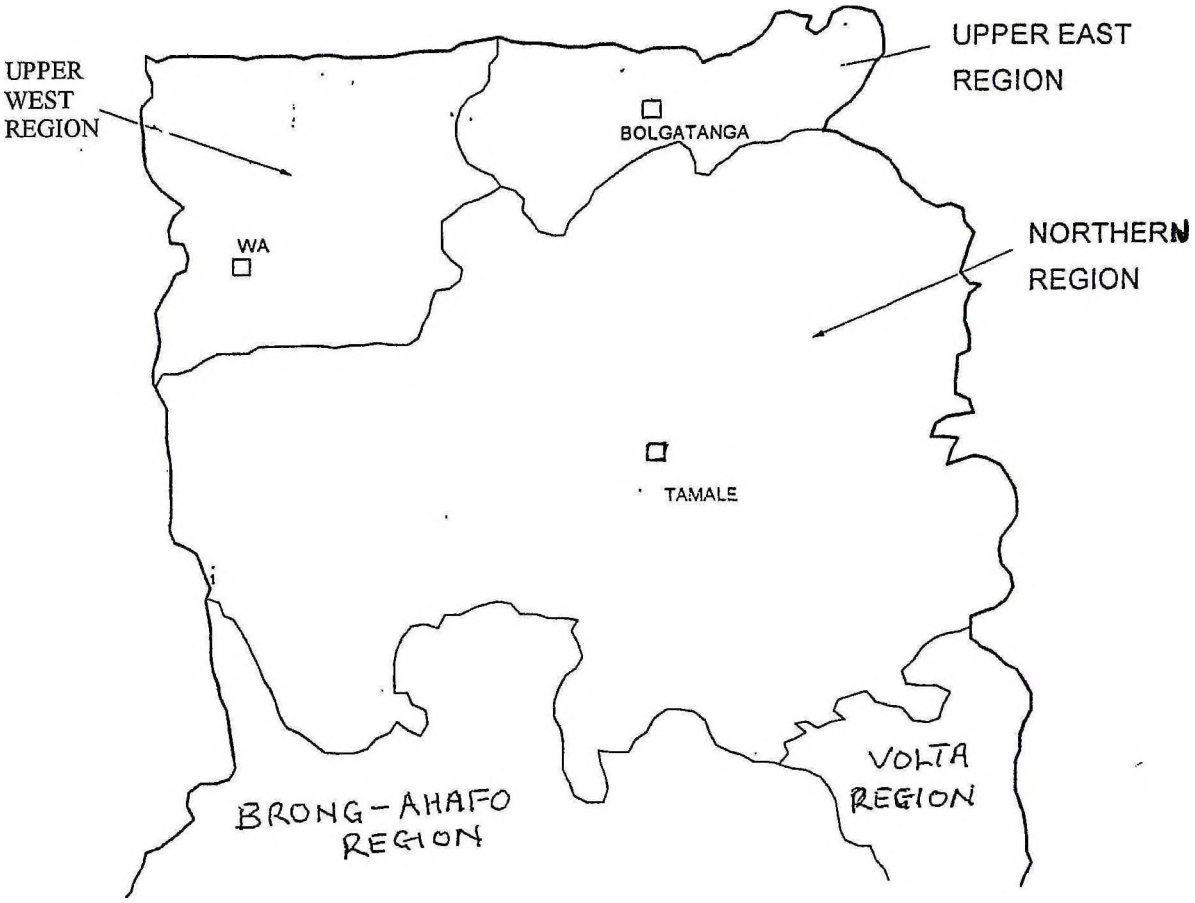
Other aspects considered are the structure of the marketing channel and marketing functions along the channels. Special attention was given to indiginous methods of post-harvest storage and control of losses at farm villages. A wholesaler was simply classified as any middleman or woman selling cowpea, bambara beans or groundnuts in bags of 50 kilogramme weight or more. The sale of cowpea, bambara beans and groundnuts at the retail level was not covered by the study.

1.8. Study area

Areas for the study of post-harvest handling and marketing procedures at the fkrmgate consisted of villages in Upper East, Upper West and Northern Regions of Ghana (Fig. 1.8), which constitute the major producing regions for the three crops.

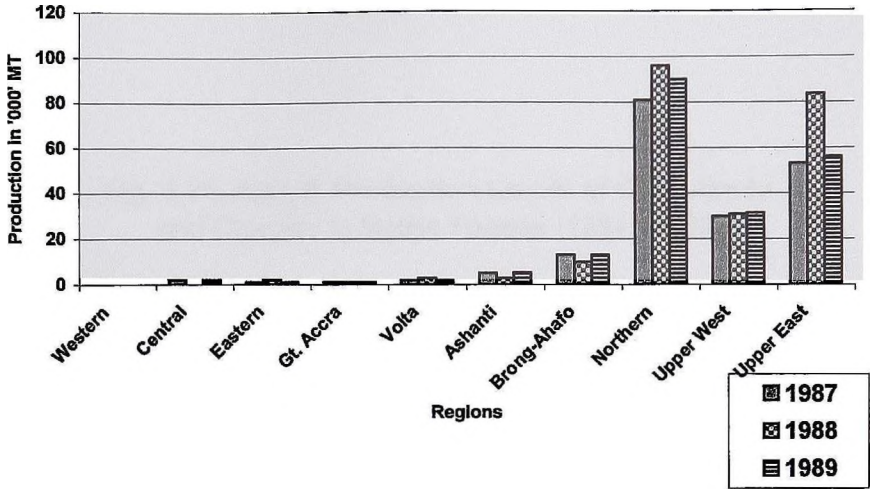
Even though the legumes under study are grown in smaller quantities in other parts of the country, their production on a larger scale occurs in the Guinea and Sudan Savannah

pig L8: MAP OF GHANA SHOWING THE FARM- GATE SURVEYAREAS



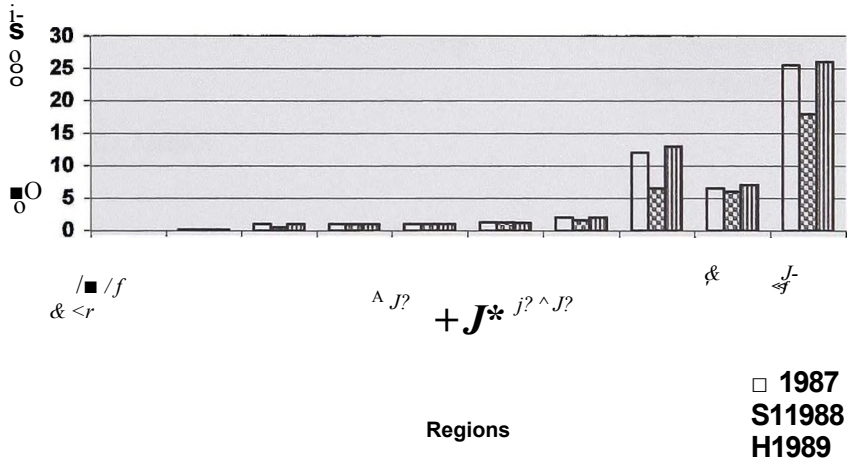
These comprise the Northern, Upper East, and Upper West Regions, and the margins of the semi-deciduous forest of the Brong Ahafo Region (Figs. 1.9 and 1.10), All three legumes are grown under rain-fed conditions. The districts covered are Wa, Lawra, Nadoli and Tumu from the Upper West Region; Tamale, Tolon-Kumbungu, Yendi, Saboba and Walewale from Northern Region; and Bongo, Kasena Nankana, Bawku West and Bawku East from the Upper East Region.

Fig.1.9: Regional Production Levels of Groundnuts in Metric Tonnes (1987-1989)



Source: PPMED, MOFA

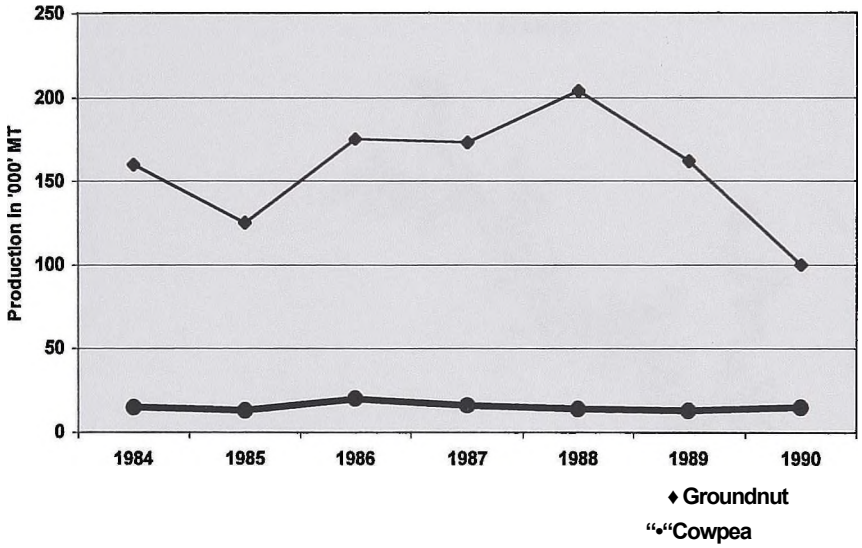
Fig.1.10 Regional Production Levels of Cowpea in Metric Tonnes (1987-1989)



Source: PPMED, MOFA

Available data indicated that unlike groundnuts, which are produced on a larger scale, the ecological adaptability of cowpeas limits its production in the country (Fig. 1.11), thus compelling traders to import cowpeas from neighbouring countries to satisfy demand.

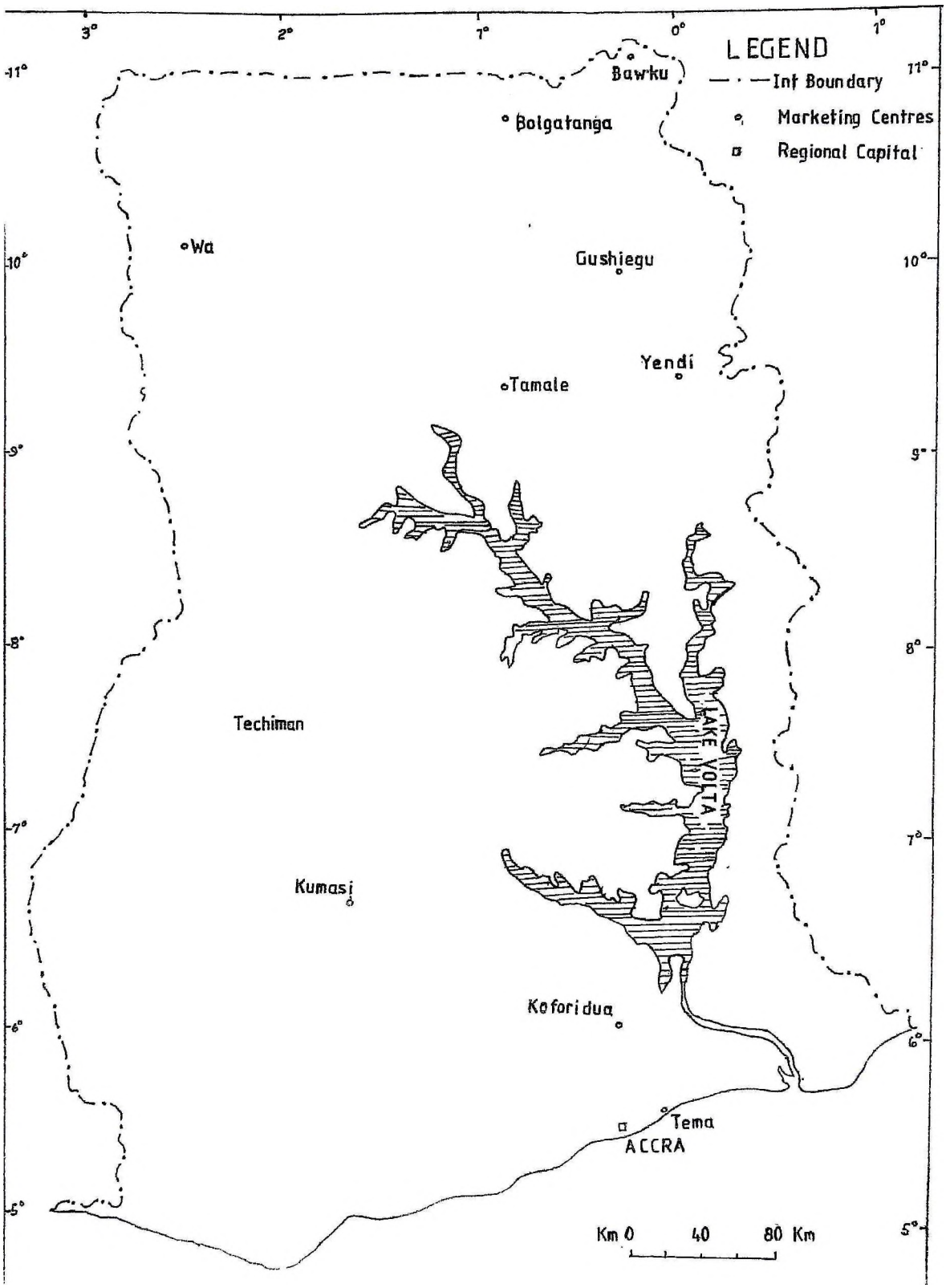
Fig. 1.11: Annual Production Levels of Groundnuts and Cowpea in Metric Tonnes (1984 -1990)



Source: PPMED, MOFA

The study of marketing processes and procedures took place in selected major legume markets. The markets include Bolgatanga, Wa, Tamale and Bawku, which served as rural markets for the study. Others were Techiman market, which served as a transit market while Koforidua, Kumasi, Tema and Accra markets served as urban markets (Fig. 1.12**).**

Fig. 1.12:A MAP OF GHANA SHOWING IMPORTANT LEGUME MARKETING CENTRES



1.9. Organization of the study

The study has been organised into six chapters. Chapter one introduces the subject matter of the study, while the review of existing relevant literature is presented in chapter two. Chapter three comprises an outline of the logical framework and methodology used. The findings of the study and the discussion of results are presented in chapters four and five. In chapter six is presented the summary and conclusions together with recommendations drawn from the study.

1.10. Limitations of the study

Data for the study was varied and had to be collected over a wide area of the country and from different sources. Like most developing countries, the lack of recorded data at the primary level required farmers and traders to depend mainly on memory recovery for the provision of information, requiring trangulation procedures and cross-examination of data, which made the assembling of data from primary sources time consuming and difficult. Secondary data from the Ministry of Food and Agriculture (MOFA) were inadequate and had to be supplemented by data from other offices like the Food and Agricultural Organization (FAO) and the Ghana Food Distribution Corporation (GFDC). For reasons of limited logistics and other facilities, only cowpea, bambara beans and groundnuts were covered in the study. Other legumes, namely, soya beans, pigeon peas, lima beans, geocarpa beans, winged beans and sword beans, which are in any case produced in insignificant quantities in the country, were not included in the study. Another limitation was the lack of current reference material for literature review in the country's libraries.

In spite of these limitations, painstaking efforts were made to obtain reliable data to help render the results of the study accurate and reliable.

CHAPTER 2

REVIEW OF LITERATURE

2.1. Introduction

This chapter discusses some fundamental concepts of marketing and market analysis as a review of related studies to the topic. The discussion dwells on some relevant approaches to the study of commodity markets in developing countries, measures and methods employed and the problems involved in the choice of analytical tools. The review provides the fundamental principles for understanding the basic requirements of the subject area. It also helps to identify appropriate methods of data analysis.

2.2. The process of marketing

The importance of agricultural marketing has long been recognised by economists, planners, and policy makers as a critical component in the process of economic development (Scott, 1995). Marketing has been defined among others as " All those business activities involved in the flow of goods and services from production to consumption" (Abbot, 1958) and also as "...the process that links production to consumption" (Scott, 1995).

Based on these definitions of marketing, agricultural marketing has been described as: "Those processes applied to a commodity from the time it leaves the farm where it was grown to the time it is converted into another form or consumed several months later at a place many miles away" (Whetham, 1972). Like other researchers, Edith Whetham agrees also that, " Marketing may be said to begin when farmers plan their output or the quality of their products in response to expected market prices". Agricultural marketing has also been defined as " the performance of all business activities involved in the flow of goods and services from the point of initial agricultural production until they are in the hands of the ultimate consumer" (Kohls, 1967).

In this study, legume marketing is perceived to comprise all the operations involved in the flow of legumes, in particular cowpea, groundnuts and bambara beans

from production to consumption. It also includes the handling of the produce at the farm that enhances good quality and minimizes waste.

2.3. Market analysis

Market analysis can be classified using descriptive, price efficiency, and organizational criteria (Pomery and Trinidad, 1995).

The descriptive approach contains little statistical analysis and reaches conclusions on market performance and efficiency on the basis of the researchers subjective assessment. Although this method has been extensively used as a basis for studying commodity flows and marketing techniques, it is not regarded as " useful for intercommodity comparisons" (Smith, 1981). "The price efficiency approach analyses marketing in its dimensions of time, space and form" (King and Henry, 1959; King, 1965; Bressler and King, 1970).

Efficiency here refers to the effectiveness with which the marketing system transmits information among the different channel groups of the market, namely producers, wholesalers and retailers or market intermediaries.

The industrial organization approach relies on the theory that the market structure, which forms the environment, determines market conduct, consisting of the behaviour of the economic agents within the environment, and which in turn determines the performance or the standard of operation of the market.

2.3.1. Market structure

Market structure is defined as the characteristics of the organization of a market which seem to influence strategically the nature of competition and pricing behaviour within the market (Bain, 1968). The term market structure refers to "the number of buyers and sellers, their size distribution, the degree of product differentiation, and the ease of entry of new firms into an industry" (Tomek and Robinson, 1990). The structural characteristics of a market may be used as a basis for classifying markets. Accordingly, markets may be classified as perfectly competitive (i.e many buyers and sellers), or oligopolistic (i.e more than one seller but where the number is not large enough to render negligible, the contribution or behaviour of each).

Market structure is the environment in which the firm operates. It includes buyer/seller concentration, product/service differentiation, and entry barriers (Pomeroy et al, 1995)

The market structure, therefore, " determines the market conduct or the behaviour of economic agents within the market environment and thereby sets the level of market performance" (Caves, 1982).

However, problems of time and logistics support, limited this study to the conditions in legume markets, specifically cowpea and groundnuts, which act as barriers to entry into these markets.

2.3.2. Market conduct

Market conduct refers to the patterns of commercial behaviour arising from market structure. Some practical guidelines for analyzing market conduct are buying and selling practices and pricing behaviour (Pomeroy et al, 1995). The types of policies that traders employ in setting prices for commodities along the various stages of the marketing channels constitute the determining factors of the conduct of a commodity market. Consequently, the mark-up policies of traders in the legume market was used in this study to determine market conduct.

2.3.2.1 Mark-up policies

Many researchers have used the analysis of market margins as a basis for the study of market conduct in the marketing of various crops. Allen (1957) in his study of marketing margins and producer prices of the marketing of fruits and vegetable indicated some criteria for identifying mark-up policy types in commodity markets. He identified fixed margins, semi-fixed margins and percentage margins as mark-up policy types used to fix prices by middlemen in food markets. Olayemi (1977) applied Allen's method to determine market conduct for some foodstuff markets in Nigeria. His method was outlined as follows:

Suppose the relationship between the farm-gate price and wholesale price of a commodity is given as:

$Pw = a + pP_F$

Where:

P_w = wholesale price,

P_F = farm-gate price,

a = a constant term, denoting benefits derived from factors other than the price.

P = regression coefficient denoting the rate of price change.

According to Allen, when;

- a equals zero or close to zero, margins are determined by a percentage of the farm-gate prices or purchase price.
- P equal l,.a fixed margin is added to the purchase price.
- a is negative or p is more than twice the value of a, a percentage margin is indicated.
- p is less than one-tbrid the value of *a,* fixed margin is indicated.
- p is between one-third and twice (inclusive) the value of a, semi-fixed margin is indicated.

Other reserchers, namely, MacArthur and Rashid (1971), carried out similar studies with the method on retail margins in the marketing of fruits and vegetables in Egypt, Pakistan and India. With some modifications in procedure and classification they estimated the required relationships with slight contradictory results. A weakness was however detected in Allen's results by Moro (1981) who questioned the absence of inverse margins in Allen's results. According to Hallet (1971) an inverse margin is one which falls in absolute terms when the selling price or purchase price rises and vice versa. A margin is also said to be inverse if the selling price remains unchanged when the purchase price changes.

In developing countries like Ghana and Nigeria, factors that contribute to the presence of inverse margines are:

1. The fear of loosing customers;
2. The belief that it is more difficult to attract customers through price reduction than it is to lose them through price increases;
3. The practice of "expatriate"and "tourist" pricing systems; and
4. Charges from market queens.

In his study on the subject Moro (1981) used margins as the dependent variable instead of selling prices, which were used by Allen. Moro's regression equations were presented as follows;

$Pr - Pf \sim a + PPf$ **(1)**

$P_W - P_F = a + PP_F$. •(2)

$P_R - Pw = a + PP_W$ **(3)**

Where:

p_R . p_F = distributors' margin, representing the whole channel from the producer to the consumer,

P_W-P_F = wholesalers' margin,

P_R - Pw = retailers'margin,

P_F= farm-gate price,

Pw = wholesale price,

P_R = retail price,

a = a constant term representing benefits from other factors other than price.

P = the regression coefficient indicating the change in the margin resulting from a change in price.

A major advantage of this method is that the type of margin shown by the analysis is obvious at a glance.

- If p is negative we have an inverse margin.
- If p is zero we have a fixed margin.
- If a is zero then the margin becomes a proportion of the purchase price and is simply regarded as a percentage margin.

2.3.3. Market performance

The use of the industrial organizational approach, better known in market research as the structure, conduct, performance approach, emerged in the developed countries context, where industries, often dominated by a few very large firms represent a prominent sector of the economy (Bain, 1968). Some researchers have questioned the

applicability of the method to the "atomistic situation typical of mainly agricultural factor and product markets in developing countries" (Smith, 1972). He believed that the structure-conduct-performance framework has limited transferability to the scene of developing countries because of underdeveloped infrastructure, intersectoral relations, and development objectives, as well as the unique social and political structure found in these countries. After further development of new approaches, however, Smith found it only necessary to revise the performance dimension, thus maintaining most of the original framework of the industrial organizational approach

Market performance refers to the impact made on the standard of the marketing system by the elements of structure and conduct. Perfomance is measured in terms of variables like prices, costs and output (Bressler and King, 1970). When a marketing system is allocatively efficient, consumer preferences are transferred without distortion to producers who will use such price information to make production decisions, which are also allocatively efficient (Harris-White, 1995)

The following measures have been used to determine market performance.

1. The type of the marketing channel. The objective is to trace the movement (purchase and sale) of the product from the source of supply through as many steps as exists before it reaches its point of final sale (Mendoza, 1995).
2. Market integration, which illustrate whether legume markets are associated, and how strong the associations are, indicating price movements and pricing efficiency in markets.
3. The producer's share of consumer payments to urban middlemen

2.3.3.I. Marketing channels

According to Weld (1917), two kinds of specialisations may have developed in the evolution of the marketing system The first kind of specialisation is the division of a market into separate trades whereby each class of dealers handle a single commodity or group of commodities. The second is the splitting up of the marketing processes into a number of successive steps, regarded as specialisation by functions. This latter type of specialisation is not generally understood and popular opinion is that the subdivision of the marketing process into a number of successive steps has been carried too far. In other

words, there may be too many middlemen between the producer and the consumer of a commodity. While some researchers studying food marketing in developed ecomomies have argued that the existence of many intermediaries in the marketing channel ensures efficient allocation of available resources, (Wilcock, 1978), others studying the Sub-Saharan African situation have claimed that it results in marketing inefficiencies (Adegeye and Dittoh 1986; Dittoh, 1994).

The functions of the legume market that determine the number and types of channels which form the structure of legume marketing include purchasing, assembling, sorting, grading, processing, packaging, storage, transportation, distribution and financing.

In his study of marketing channels, Stigler (1951) provides a conceptural framework for measuring and anticipating channel structural arrangements. His approach, which involves isolating the reason why channel members would limit themselves to a particular function, is to break down the average total cost curve of the market into functional cost curves. His proposal is that marketing structures consist of various cost-efficient functional channels.

In other studies of marketing channels, Vaile, Grether and Cox (1952), Alderson (1957), and Bucklin (1966) depended on four dimensions of the marketing system which combine to form the structure of a marketing channel. The dismensions are:

i. the number of channel levels identified;

ii. the type of middlemen at each level;

iii. the number of middlemen at each level; and

iv. the number of channels, whether one (single), two (dual) or more than two (multi).

2.3.3.2. Market integration

A considerable amount of research studies have been done on the determination of marketing efficiency. Earlier researchers like Jones (1968, 1972) Gilbert (1969) and Thodey (1969) have used the bivariate market integration as a measure of marketing efficiency. Dittoh (1994) used Ravallion's (1985, 1986) model in its extended version by Dahlgram and Blank (1992) for the estimation of market integration, to infer the

marketing efficiency of vegetable markets in Nigeria. In the various sources mentioned, marketing efficiency has been equated to low price variations across space and time. Waugh (1964) has postulated that it is only in the short-run that food prices can be expected to be determined at the farm level, especially, for storable non-perishable crops. In the long run, demand at the retail level is the dominant force in price formation, thus depicting a one-way price transmission from the retail level to the producer level for a greater part of the year. This phenomenon is prevalent in rain-dependent single or dual farming seasonal areas of developing countries like Ghana and Nigeria.

Olayemi and Olatunbonsun (1974/75) applied Waugh's principle in thier approach to the study of marketing efficiency of some selected food crops in Nigeria. A feature of their studies was the nature and length of time lag between changes in prices at the retail level and those at the farm level. Although farm prices may be expected to lag behind retail prices, the period of the lag should be of interest to researchers.

In their study, unlagged prices as well as prices lagged by one, two and three weeks were regressed for different foodstuffs and between different markets. This enabled them to determine both market integration and the rate of price transmission from urban to rural markets.

The one-way regression equation was presented as:

$$P_R = f(prt\text{-}i),$$

Where;

Pa = Farm-gate price in time t,

Pju-i = Urban retail price in time t-i, and

i = 0,1,2 and 3 weeks.

2.3.3.3. Producer-wholesaler price spread

Another approach to the study of marketing efficiency is the producer-wholesaler/retailer price spread. The price spread describes the proportion or share of the consumers' payments that is received by the farmer, and the proportion received by the wholesaler or retailer. Moro (1981) used the method to determine the percentage of consumer spending at the urban retail level that reached the producer.The method is most

suitable for commodities that arrive in the consumers' storeroom in relatively the same form it left the farm-gate.

The use of farm and urban wholesale prices in this method of analysis is intended to satisfy two important objectives:

1. The need to know the proportion of the consumer's payment that reaches the former's pocket;
2. For the consuming public the need to know the extent to which any rise in urban food price is the result of increases in farm-gate prices, which reflect the cost of direct production and farmers revenue.

A study of the producer-urban wholesale or retail price spread for farm commodities also helps to confirm or dispel the assertion that market intermediaries receive too much for their services at the expense of consumers and producers. The type of price spread in a market system is also an indication of the marketing efficiency in terms of the cost effectiveness of marketing operations along the marketing channel as well as the efficiency in the allocation of resources to enterprises in production, processing and distribution of commodities.

CHAPTER3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the methods used in the analysis. It includes the analytical framework outlining the theoretical concepts within which the analytical models are applied. The framework incorporates descriptive analysis and regression models to determine the market structure and conduct of the legume market with regard to the type of entry barriers and the pricing policies of middlemen. Also included in the analysis are the methods used to determine the efficiency of legume marketing with respect to channel types, market integration and the producer - wholesaler price spread.

3.2 Analyitical framework

The first objective of examining the post-harvest practices used by farmers and middlemen for handling and protecting legumes stocks on farms and markets was achieved through the Participatory Rural Appraisal (PRA) method of informal focus group discussion of indegenous storage practices. This aspect of the study involved a matrix scoring and ranking of storage structures as well as a descriptive analysis of data by statistical estimates of descriptive variables.

The ranking of storage structures was done in the open with the bare ground serving as the ranking board. Farmers were made to sit around a clean open space after they had been briefed on the procedures involved. Objects were used to represent fectors or characteristics that farmers considered important for storage structures. Different objects chosen by farmers were used to represent each of the structures being ranked. A quantity of maize seeds given to groups were used in awarding points to structures according to the importance of a characteristic of the structure. The session was repeated in each of the villages visited and the mean values of the results were tabulated for each structure. Men and women farmers performed ranking sessions together even though women were separated from men in formal interviews whenever it became necessary. Women were sometimes reluctant to offer certain information in the presence of men.

A storage structure possessing the strongest quality for a particular factor or characteristic was given ten (10) seeds in a space below the structure as shown in Table 4.2. The structure with the least satisfaction to farmers for that factor was given only one (1) seed and in between these two levels farmers placed a number of seeds representing their level of satisfaction for any factor or characteristic of the structure.

The second and third objectives of identifying types of marketing channels and the functions of middlemen were addressed by identifying channel members and constructing the marketing channels based on the dimensions used by Vaile and Cox (1952) and later by Alderson (1957), Bucklin (1966) and Mendoza (1995). Depending on the type of channel, the efficiency of the marketing system of a commodity was assessed. The procedure involved the use of descriptive analysis of primary data on the number of middlemen and the functions performed by each middleman or group of middlemen, as well as the sources of supply and destinations of the commodities. Marketing channels can be single, dual or multiple, resulting in a short or long channel from the producer to the consumer. The channel type obtained indicated the cost of marketing operations between the producer and the consumer. Long marketing channels suggests a large number of groups of intermediaries between producers and consumers implying high operational costs, and resulting in higher consumer payments and low marketing efficiency.

The fourth objective, which is to determine the structure of legume markets, was achieved by dertermining the barriers to entry into the legume market. A study was first conducted at the farm level from which the involvement of farmers in the marketing of legumes was assessed. This was followed by cowpea damage and revenue loss assessment for cowpea traders in the 1996/97 trade season. The assessment confirmed the fear of farmers for storing cowpea in contrast to the storage of groundnuts and bambara beans.

3.2.1. Market structure: insect damage to cowpea

Cowpea contributes significantly to farm household and urban food security in Ghana. Given the limitation of cowpea production relative to consumption, the role of storage cannot be over-emphasized. Incidentally, cowpeas are very vulnerable to storage

pests. The infestation of stored grains by bruchids or weevils cause losses in food value to consumers and revenue losses to both farmers and traders. Due to time limitation, a case study of the extent of insect damage to stock; and losses in revenue to traders arising from insect pest activity was undertaken in Tamale market to determine the extent to which insect damage serves as an entry barrier to traders and farmers and their contribution to the type of market structure in the marketing of legumes and in particular in the cowpea market.

3.2.2 Procedure for damage assessment

The case study approach was adopted for an assessment of insect pest damage to stored grains and its impact on traders' revenues. From a list of traders in the Tamale market, four were selected by the simple random method. The selected traders had varying stacks of stocks stored at different locations in the market. A stack or heap is a number of bags of cowpea packed together. The total number of heaps or stacks made available by the four traders for the case study was fourteen. The number of bags per heap or stack ranged from 2 to 200 and the total number of bags examined was 918.

The damage assessment involved a weekly sampling and counting of holed grains out of 100 randomly scooped grains from two different positions of marked bags below each stack. An average of the two results was taken and recorded every fortnight The average of the results for two fortnights within a month was used as the measure of percentage damage for the month. Bags below heaps were chosen to avoid early sale of samples under study. Specially-made containers divided into 25 cells or compartments were used for identifying and counting holed grains. Four grains were dropped into each ceE at random so that 100 grains were examined at each counting. Only one hole made by a weevil was sufficient for a bean to be damaged. The number of holed beans in the container of 100 beans is the percentage damage. Two readings were normally taken for each stack every fortnight and the average recorded as the percentage damage for the stack that fortnight. The average of these records from two fortnights was the monthly damage for the stack.and the study continued throughout the storage period of each of the stack. The Natural Resources Institute (NRI) of the United Kingdom provided the assessment materials needed for the case study.

3.2.3 Revenue loss assessment

The revenue loss assessment involved an analysis of all financial transactions on:

1. Cowpea stocks used for the damage assessment
2. Groundnuts sold by the respondents.

Data used included the date of purchases, purchase prices, treatment cost if treated, shed levy, cost of jute sacks, labour, and all other related costs. Also recorded were dates of sale, selling prices and prices of clean grain in the market at the time of sale. Clean grains as previously stated refer to undamaged and wholesome beans. The data helped to determine revenue actually obtained and revenues expected if grains had remained clean. The price variation represented a loss to the trader and was used to determine the revenue losses on the cowpea and groundnuts.

3.2.4 Market conduct: pricing policies

The fifth objective, which is to determine the pricing policies of middlemen for each commodity market was achieved by assessing the mark-up policies of middlemen along the marketing channels. Following Moro's modification of Allen's original model, the empirical model specified for this study is:

$P_{wi} - P_F = ot + P\,Pp$ .....(1)

$P\,W_2 - Pwi = a + pPwi$.....(2)

$P_R - P_{W2} = CC + P\,P\,W2$..... (3)

$P_R - P_F = a + p\,P_F$ .....(4)

Where:

$Pwi - P\,f$ = the wholesaler's margin in rural market

$P\,w_2 - P\,w\,i$ = the wholesaler's margin in urban market

$Pr - Pw_2$ = the retailer's margin in urban market

$P_R - P_F$ = the distributor's margin

a = the intercept of the graph which indicates an initial benefit resulting from other factors like gifts or bush allowances.

P = regression coefficient indicating the rate and direction of change in the margins

The advantage of the revised model, which was also adopted for this study is that the value and sign of the intercept (a) and the regression coefficient (p) directly indicate what pricing policy is being adopted by the market intermediary:

- a negative coefficient imply the presence of Harris inverse margin;
- a zero coefficient means a fixed margin while;
- a zero intercept indicates that the margin is a proportion or percentage of the purchase price

Unlike Moro (1981) who studied only the retailer and distributor margins, this study identifies the pricing policies at the farm, rural and urban markets for farm-gate middlemen, urban middleman and the entire system known as the distribution system

3.2.5 Marketing efficiency

The efficiency of a marketing system implies the achievement of the least cost commensurate with the performance of the business activities that go into moving a commodity from the producer to the consumer. Marketing efficiency involves two aspects of a commodity market, namely:

- The technical or operational efficiency which focuses on reducing the cost of accomplishing a marketing function without reducing consumer satisfaction, and
- The economic or pricing efficiency, which is concerned with the purchasing, selling, and pricing aspects of the marketing process aimed at providing goods and services to the consumer at the lowest possible cost consistent with the interest of the producer.

While marketing efficiency has been equated to low price variations across space and time, thereby implying the need for strong associations between markets, high market performance is equally reliant on efficient pricing and operational efficiency.

The sixth objective, which is to examine the spacial market integration of legume markets was addressed by determining whether the legume markets were integrated or

associated, after which the strength of the association between the markets were estimated using Timmer's Index of Market Connection or Concentration (IMC).

3.2.6 Market integration

A marketing system is spatially associated when prices in each individual market respond not only to its own supply and demand conditions but also to the supply and demand situations of other markets such that a local scarcity in an integrated system induces the arrival of produce from other locations. For the two-way market integration, prices in the primary market, referred to as the local market in this study, responds to the supply and demand conditions of the secondary market, referred to as the reference market, such that a local scarcity or glut in an integrated system induces the arrival or departure of produce from the secondary market. The reverse also holds.

The two-way regression equations used for the evaluation of spatial market integration were stated as follows:

1.Pl = f (Pr, xl, u).....1

2. Pr = f (PI, xr, u)..... 2

Where,

1 and 2 are the first-way and second-way equations respectively.

PI represents the wholesale price at the local market in a first-way regression equation, and becomes a reference market price Pr in a second-way equation and vice versa.

XI and Xr are dummies representing the seasonal price changes for harvesting and lean periods.

U is the standard error of the equation.

The expanded, distributed lag forms of the equations are:

1). Pit = Plt-l + Plt-2 + Prt + Prt-1 + Prt-2 + Prt-3 + Xi + Uu..... 3,

Stated explicitly,

Pit — S Otit Pit-k 2 Pie P2 t-e ^PlXjt + Uit.....4

(1st way equation)

Where,

Pit = prices in market 1 at time t in the first-way equation;

a ik = coefficients of prices in market 1 for k number of weeks;

Pit-k=prices in market 1 in t-k lags;

k = 1 and 2 weeks for local market status

Pi_e = coefficients of prices in market 2 for e number of weeks;

e = 0,1,2 and 3 weeks for reference market status.

P2t - prices in market 2 at time t;

P2t-e~ prices in market 2 in the three previous weeks;

(pi = coefficient of exogenous variable in first-way equation;

$X]_t$ = exogenous variable in first-way equation;

Uu = error term in first-way equation.

2) $P_{rt} = P_{rt-}i + Prt-2 + Pit + Plt-1 + Plt-2 + Ph-3 + X + U2t$..... 5

Also stated explicitly:

P2t = S0C2k P2t-k + 2 p2e Plt-e + ^2X21 + U2t..... 6

(2nd way equation)

Where,

P2t = prices in market 2 in time t;

<*2k = coefficients of prices in market2 the previous week and two weeks before;

P2t-k = prices in market 2 at time t-k;

k = 1 and 2;

p_{2e} - coefficients in market 1 in time t-e;

e = 0, 1,2 and 3 weeks time lags;

Pn-e = prices in market 1 in at time t-e;

cp_2 = coefficient of exogenous variable in 2nd way equation representing the influence of external factors on the price in market 1

X_{2t} = exogenous variable at time t in 2nd way equation;

U_{2t} = error term in second-way equation 2;

The a's and P's represent the coefficients of local market prices and reference market prices prespectively.

X represents seasonal influences (lean and harvesting seasons) on price;

U represents the standard deviation;

k = 1 and 2 weeks time lags for local market while;

e = 0, 1,2 and 3.weeks time lag for reference markets;

The hypothesis is that, in the short-run;

Pit-e + 0, and

P2t-e =£ 0

This implies the presence of relationships between legume markets in both directions in the specified time lags. However, e = 0 which was regarded as a transit period and e = 3, considered close to a long-run situation, were not given much prominence in the discussion of the results. Similarly, the focus of the study dwelt on local/reference relationships and not on local/local relationships, hence only one and two-week lags were considered in the local/ local situations. The size of the sample used for the market integration was 112 and consisted of the number of prices used for the analysis. The number of markets studied was eight (8), resulting in the derivation of equations, for fifty-six (56) market pairs for each of the two crops, viz. groundnuts and cowpea.

3.2.7 **Degree** of **market integration**

The regression model enabled the identification of the presence or absence of association between markets. In order to measure the strength of the integration,

however, it became necessary to estimate the Index of Market Concentration (IMC), also known as Timmer's Index. The value of the IMC obtained helped to determine whether the association between two markets was high or low. The hypothesis is that the higher the association between market pairs the faster the transmission of price and supply conditions of one market to the other.

From the regression model,

an, a.12 and p2,p2i, P22, P23, are the coefficients of Pu-i, Pit-2, and P_{2t}, P_2t-i, P2t-2, and P_{2t}-3, respectively.

Similarly,

a_2i, $a_2$2, and Pi, Pn, P12, P13 are the coefficients of P_{2t}-i, P2t-2, and $P_{!t>}$ Pn-i, Pi_t-$_2$, and Pk-3, respectively.

IMC 1 = Absolute (an / P21) or

(an / P22)

IMC 2 = Absolute (a_2i / P u) or

(a2i / Pi_2)

IMCs lie between zero and infinity and the closer the value of the IMC to zero the higher the association between the two markets. For statistically significant equations, the IMCs were rated in this study as follows:

IMC up to 1.9 implied high market integration;

IMC from 2.0 to 6.9 implied weak market integration;

IMC > 7 were considered infinity and implied no market integration, a condition which was classified as market independence, market segmentation or market concentration, meaning the two market pairs were found to be independent of one another at the time of the study..

3.2.8 Producer-wholesaler price spread

The model employed for this study was basically the one used by Moro in 1881 to study the producer-retailer price spread in Nigeria. It involved determining the percetage of urban wholesaler prices that reached producers.in 1996 and 1997. Data for the study

comprised urban wholesale prices and farm-gate prices at corresponding periods of the years. Since Accra is the highest consumer of cowpea and groundnuts on account of its high population density, prices in Accra were used for the estimates. For the farm-gate. prices in villages around Tamale were used. The choice of wholesale prices helped to maintain uniformity in the urban prices used.

The producer-wholesaler price spread was determined as follows:

$$\frac{P_F}{P_{w2}} \times 100$$

Where,

P_F = farm-gate price

P_{w2} = urban wholesale price,

Producers in Tamale district were chosen for the exercise while Accra served as the consumer market. This study covered only cowpea and groundnuts since bambara beans are not traded in appreciable quantities at the wholesale level. The data was revised to reflect the producer price of ten percent on the average below prices at Tamale market for the correction of errors arising from overloaded bags at farm gate referred to as bush weight.

3.3 Data requirements

The study covered the period 1996 1997 and covered farm and market level storage structures, produce protection materials and methods. The data required also included types and functions of market intermediaries, regional district and farm-gate wholesale prices for 1996 and 1997, stock damage assessment records, and purchasing and selling prices of cowpea for selected traders. The data types are both qualitative and quantitative comprising:

(a) descriptive information such as marketing functions, sources of supply, customer types, types of market services, storage methods,

length of stroage period, and methods of control of post-harvest losses; and

(b) numerical forms, depicting trends in prices, quantities and costs.

3.4. Data sources

Both primary and secondary data were used for the study. A sample of legume farmers and traders in the study areas formed the major source of primary data. These data were collected at the farm-gate, local markets, transit markets and at urban markets in southern Ghana. The selected farmers and traders were interviewed with the aid of pre-tested structured questionnaire. Additional data on the case study of insect damage to cowpea and revenue losses to cowpea and groundnuts traders were collected in selected markets.

Secondary source data were obtained from both published and unpublished documented materials. Seasonal and annual production levels of the crops, prices, annual production levels and other relevant statistical data were collected from district and regional offices of the Policy, Planning, Monitoring and Evaluation Department (PPMED) the Statistical Division of the Ministry of Food and Agriculture (MOFA), the Statistical Services Department, and the Food and Agricultural Organization (FAO) library.

3.5. Data collection

The methods used to collect data were determined by:

- The type of data required, whether primary or secondary;
- The place of collection;
- The type of respondents involved; and
- The sample size.

The techniques employed for primary data collection included:

1. Questionnaire administration;
2. Participartory Rural Appraisal and Rapid Reconnaissance survey;
3. Direct observation; and
4. Case studies.

Holtzman J. S, (1986) defines a rapid reconnaissance survey as a broad and preliminary overview of the organization, operation and performance of a system, or components thereof, designed to identify system constriaints and opportunities In a Participatory Rural Appraisal the respondents or activists in the system under study participate in the process of data collection and form the basic source of the information so collected.

By directly observing marketing processes and functions, investigators are able to indentify marketing problems and evaluate what key informants say about the organisation and operation of the system against what is actually observed (Holtzman J. S, 1986).

Data types obtained by direct observation included the following:

0 The general state of roads, vehicular availability and conditions;

0 Availability and condition of stores, market sheds, selling and buying measures storage containers, storage structures and the condition of the market environment;

0 Selling and pricing methods.

The case study approach involved a detailed study of the operations of selected traders who performed storage functions in the marketing of cowpea in Tamale market at the time of the study. The severity of insect activity in cowpea and the limitation of logistics prompted the choice of cowpea only for the case study.

The method involved a limited questio nnaire administration and observational survey. Data collected by this method included the financial operations of traders and monthly insect pect activity on stored cowpea, and the length of storage

3.6.Sample size

At the production level where Participatory Rural Appraisal (PRA) techniques were used, focus group discussions formed the main procedure for data collection, and two hundred and thirty-three (233) farmers were interviewed in seventeen (17) villages (Table 3.1)

Table 3.1: Farm Level Coverage

No	Region	District	Town/Village	Group Composition		
				Male	Female	Total
1	U.W.R	Wa	Nakore	11	5	16
2	66	Wa	Kpongu	8	2	10
3	66	Lawra	Brutu	7	4	11
4	66	Lawra	Lawra	9	3	12
5	66	Nadowli	Goli	6	1	7
6	66	Nadowli	Serekpere	6	0	6
7	66	Tumu	Nabolo	7	2	9
8	66	Tumu	Silbelle	8	3	11
9	N.R	Tamale	Wovo-Guma	14	0	14
10	66	T olon-Kumbungu	Tuunayili	12	6	18
11	66	Yendi	Bagbani	11	8	19
12	66	Saboba	Gbenja	12	3	15
13	66	Walewale	Bungoazia	5	6	11
14	U.E.R	Bongo	Bongo Soe	12	7	19
15	66	Kasena Nankana	Nangalikinia	10	8	18
16	66	Bawku West	Komega	9	8	17
17	66	Bawku East	Pialoko Pusiga			20
	TOTAL			155	78	233

Source: Field survey, 1996

A total of eighty-two (82), seventy-seven (77), and seventy-four (74) fanners respectively were involved in focus group discussions in Upper West, Northern and Upper East Regions. Thirty-three percent (33%) of the participants were women farmers

At the market level, only eighty-five (85) out of two hundred (200) wholesalers selected in eight important legume markets were successfully interviewed The number comprised an average of 10.6 traders per market. Apart from the lower numbers of

legume traders in comparison to traders of vegetables or roots and tubers, for instance, the main reason for the low sample size achievement was the reluctance and sometimes refusal of many legume traders to participate in interviews and group discussions. Business secrecy which formed the basis of this position appeared to be an important norm of the legume market.

3.7 Sampling

The simple random sampling technique was adopted for the selection of traders in the markets with a sample frame which enabled all willing traders to be interviewed from one shed out of every three succesive sheds. The choice of one out of three successive sheds made it easy to find replacements for traders who were not willing to offer information. In the villages, focus group discussions which were open to all, were organized for farmers with assistance from district extension officers from the Ministry of Food and Agriculture (MOFA). The selection of districts and villages however, was purposively made with assistance from the regional offices of MOFA to comprise major legume-growing areas of each region.

CHAPTER 4

FARM-GATE AND MARKET LEVEL STORAGE PROCEDURES.

4.1. Introduction

The findings and discussion of results from descriptive analysis are presented in this chapter. The presentation is centered on farm gate and market storage procedures, produce protection practices, insect pest damage to cowpea and its impact on the revenue of traders. Also included in this chapter are the functions of market intermediaries and marketing channels of cowpea, groundnuts, and bambara beans.

4.2. Farm level storage structures and crop protection methods.

The protection of farm produce from destruction by rodents and insect pests is very important for the achievement of food and nutrition security. The practices and procedures employed for the attainment of this goal must therefore be of special interest to agricultural researchers. Legumes in particular suffer great losses from insect damage while on route to the consumer through space and time. In a study of post-harvest management, particular attention should be given to the understanding of traditional methods and practices which are used for the management of these problems on a wide scale on farms and markets in developing countries. Consequently, the structures and methods which farmers and traders use for the storage and protection of legumes in farm villages and markets are covered in this study. The following sections give the findings uncovered for legume storage and protection practices on farms.

4.2.1. Storage structures

The types of storage structures found in each village were related to the ethnic origin of the farmers. For instance, a group of Kokombas living in a village on Dagomba land and among Dagombas, were found using structures originating from Kokomba tribes. In this study, only structures belonging to the ethnic group of villages visited were selected for study in each village. The procedure helped to prevent double counting of structural types in places visited. The results obtained are shown in Table 4.1 in which

local names given in each village are followed by their meanings in brackets. Details of storage structures used in villages visited are given in the table while illustrations of some of these structures are shown in Appendix A.

The results indicate that a variety of storage structures with some similarities have been developed over many years to store different kinds of food products against drought and pests. In many villages men and women farmers use different structures. Women who produce smaller quantities of the crops do most of their storage in small mud silos *{buopla, bugopla,* etc.) and clay pots called *duku, dugo,* or *vigen* in diferent localities or dialects. Some women mould the pots for sale to those who are not able to make them

Men on the other hand prefer the big mud silos and the woven baskets especially the *kunchun.* Threshed and unthreshed legume products are also stored in different structures. Groundnuts are normally stored in pods only on farm villages. Bambara beans is however stored partly in pods and partly in the grain form in limited quantities. Cowpea, however, can only be stored in grains, which renders it more susceptible to insect attack.

The *bowrpla* or *buopla* is a small indoor mud silo used for storing threshed produce by both male and female farmers in the Upper West Region. The other structures were found in all the regions, sometimes with small variations in make and under different local names. Many male farmers were found keeping threshed untreated cowpea in jute sacks signifying only short periods of storage. Some large-scale producers were however found keeping chemically treated cowpea in jute sacks for long-term storage.

Table 4.1: Types of Storage Structures used by Men and Women Legume Farmers

		Unthreshed Groundnut and Bambara Beans: structure used by;		Threshed Cowpea and Bambara Beans: structure used by;	
REGION	VILLATE/ TOWN	MALE	FEMALE	MALE	FEMALE
UW	Brutu	*Bowr* (Large Mud silo)	*Bowr*	1. *Bowr pla* (small *bowr)* 2. Jute sacks	1. *Bowr pla* 2. *Duku* (clay pot)
UW	Lawra	*Bowr* (Large Mudsilo	*Bowr*	1. *Bowrpla* *2.* Jute sacks	1. *Bowrpla* 2. *Duku*
UW	Nakore	*Bool* (Large mudsilo)	*Bool*	1. *Boolpla* *2.* Jute sacks	*X.Dogu* *2.* Jute sacks |
UW	Kpongu	*Bool* (Large Mudsilo)	*Buul*	1. *Buopla* 2. Jute sacks	1. *Dogu* | 2. Jute sacks
UW	Gole	*Bugo* (Large mudsilo)	*Bugo*	1. *Bugopla* 2. Jute sacks	1. *Dugo* *2. Bugopla*
UW	Serekpere	*Bugo*	*Bugo*	1. Jute sacks 2. *Bugopla*	1. *Dogo* (Clay pot) 2. *Bugopla*
UW	Nabolo	*Namvuri* (Brick silo)	*Namvuri*	1. Jute sacks *2. Vijen*	*Vijen* (Fired clay pot)
UW	Sibelle	1. *Namvuri* *2. Pulu* (Wood + *Zana mat)*	1. *Namvuri* *2. Pulu*	1. Clay pot 2. Jute sacks	1. *Vijen* *2.* Jute sacks
NR	Tunayile	1. *Pupure* *2. Napogu (Napoo)* Mud silos	1. *Pupure*	1. Jute sacks 2. Mud silos	1. Clay pots 2. Jute sacks
NR	Gbani	1. *Napogu*	1. *Napogu*	1. Jute sacks 2. *kunchun*	1. Jute sacks
NR	Bomboazio	1. *Napoo* *2.* Lenga	1. *Lenga*	1. Jute sacks	1. Clay pots
UER	Bongo Soe	1. Large basket 2. Mud silos	1. Large basket	1. Jute sacks 2. *kunchim*	1. *Dokoh* (clay pot) 2. Jute sacks 1
UER	Mangalikiia	1. *Napogu* *2.* Mud silos	*Napogu*	1. Large basket 2. Gourd 3. Jute sacks	1. Clay pot 2. Jute sacks
UER	Gbenga	1. Mud silos 2. *Napavo*	1. *Napavo*	1. Jute sacks 2. Bottles	1. *Duk* (clay pots) 2. Jute sacks
UER	Pialoko-Pushiga	1. *Bool* (mud silos) 2. *Napava (Kambori)*	1. Basket	1. Jute sacks	1. *Duk* (clay pot) 2. Jute sacks
NR	Gbenja	1. *Kpachariga* *2. Lipil* (mud silo)	*Kpachariga*	1. Jute sacks 2. *Kunchun* 3. *Lipil*	1. Clay pot

Note: 1. Words in italics are local names of storage structures in villages visited.
2. Abbreviations and sample size: see Table 3.1

Source: Field survey, 1996

4.2.1.1 Factors determining the choice of storage structures by farmers

Generally, farmers do inherit or borrow storage structures from relatives in the early stages of their farming lives. As they settle down to long term farming however, it becomes necessary for them to construct their own structures. Since storage structures are expensive and could last for several seasons, farmers need to consider various factors before installing a particular structure in their home in order to derive maximum benefit from them. The factors listed by farmers during group discussions as the most likely to affect their choice of a storage structure are many. They are presented below:

1. Flexibility in use

This refers to the different types of crops the structure can store. If a partcular structure can be used to store as many crop types as possible, a farmer will not have to construct another one if that structure is available and empty. Assuming a structure was originally constructed for the storage of maize, a farmer would find the structure more functional or serviceable if in the absence of maize he could store other grains like cereals or legumes in that same structure. Being flexible or functional refers also to the ability of a structure to contain more than one item at the same time. Mud silos in particular are often compartmentalized or divided into two or more chambers for storage, making it possible for farmers to store different crops in one structure and therefore, were found to be very popular among farmers.

2. Fire resistance

Farmers rationally prefer to use structures, which will not bum easily.

3. Life span/Durability

A structure is most preferred if it can be used for many years and if possible by many generations of the family.

4. Maintenance

Farmers prefer to use structures which are durable and able to withstand long usage at minimum cost of maintenance per season.

5. Maximum protection against insects and rodents

The structure must be able to protect stored food from insect and rodent destruction. It emerged that many farmers had bitter experiences of the loss of large quantities of food stocks to insects and rodents while in storage. Due to the single raining season in these parts of the country farmers were found to be very sensitive to the problem of food safety from animals.

6. Cost of construction

Depending on the crop to store and the expected quantity of an impending harvest, farmers choose affordable structers in terms of construction cost and the expected benefit.

7. Availability of construction material

Materials required for the construction of the structure should be locally available and in sufficient quantity.

8. Safety from water entry

The body of the structure should be resistant to the entry of water.

9. Capacity of structure

The structure should preferably be able to store all quantities of food harvested. A farmer does not see the need to install a big structure if his harvest is small.

10. Ease of construction

Farmers prefer structures that are easy to make

11. Ease of use

Preferably, it should be easy to fill and remove food from.the structure.

12. Security against theft of produce

Structures preferred are those that provide sufficient resistance to entry by thieves.

4.2.1.2 Ranking results of legume storage structures

The scoring and ranking results of storage structures are presented in Table 4.2.The most preferred storage structure for storing unthreshed groundnuts, and bambara beans was found to be the mud silo which possesses many of the qualities discussed above. It was followed by the clay pot, which is used mainly by women for storing threshed cowpea and bambara beans, while the *kunchun* (conical basket) which came third is used by men to store threshed cowpea and. All three structures are also capable of

storing millet, sorghum, maize, other cereals, and related farm produce. Jute sacks are widely used for temporarily storage of produce ready for sale.

Table 4.2 Racking of Storage Structures by Functional Characteristics

Factors	**Mud silos**	**Clay pots**	*Kunchun**
Purposefulness	10	3	*8*
Fire	8	7	1
Life span	10	7	4
Maintenance	10	10	7
Insect attack	8	7	6
Cost	2	3	8
Storage length	10	8	6
Purity (neatness)	10	10	6
Material availability	1	8	10
Water entry	9	10	5
Ease of construction	1	2	7
Ease of use	2	9	10
Storage capacity	10	3	7
Security	8	5	6
Safety from rodents	10	10	4
Safety from termites	5	9	8
Total	114	111	103
Rank	1st	2nd	3rd

Note:
*Kunchun = Conical local storage basket

Source: Field survey data, 1996

4.2.2 The protection of legume stocks on farms

The study results indicated that for the crops under study many farmers prefer the use of traditional materials, which they obtain locally, for the protection of farm produce Farmers maintained that, unlike chemicals, traditional materials have the advantage of being free of poisons and produce treated with them were safe for use the same day it is applied.

For groundnuts, drying was the only form used for protecting the pods before storage by all the farmers interviewed. Seventy-three **(73)** percent of the farmers interviewed stored bambara beans in pods after drying without the application of any other protection. Twenty-seven **(27)** percent, mainly women, thresh bambara beans and protect the grains with traditional materials like harbal preparations, oils, heat, or ash before storage.

None of the farmers was found to apply chemical insecticides to bambara beans and groundnuts. Even though cowpea is always stored as grains, forty-six **(46)** percent of the farmers who stored cowpea during the review period did not apply any treatment as protection against insect attack; thirty-eight (38) percent used traditional materials in the form of powdered herbs, ash, or heat for protection; and only sixteen **(16)** percent used chemicals. The chemicals applied were mainly acetylic as powder, liquid or gas, and phoxtoxine tablets. The methods of applying the various materials by both farmers and traders are described in Table **4.3.**

Apart from parboiling and shea butter application, which are used for treating only threshed bambara beans, all methods applicable to cowpea were also used to treat bambara beans. As already stated, sun-drying was found to be the only method used for treating both threshed and unthreshed groundnuts. Unthreshed bambara beans were also found stored as dried pods.

Table 4.3: Materials and Methods used for Produce Protection on Farms

Region	Village/Town	Treatment Materials/Chemicals	Method of Treatment
N.R	Wovo-Guma	1. Phoxphine tablets 2. Acctyic liquid 3. *Shea* butter residue	1. One Phoxphine tablet covered with rag and placed in the middle of grains. 2. Mix liquid or powder with grains 3. Mix residue with grains and dry before storage.
	Tunayile	1. Wood ash 2. Powdered pepper 3. *Palega* roots 4. *Shea* butter residue 5. Acetylic gas	1. Grains mixed with wood ash 2. Powdered pepper sprinkled first in the bottom of the container and then on top of grains after filling the container. 3. Roots of a tree called *Palega*: beaten into powder and mixed with grains. 4. Mix with grains 5. Acetylic gas sprayed into container before filled with grains
N.R	Bagbani	1. *Neem* seeds 2. Acetylic powder 3. Acetylic liquid 4. Phosphine (PH_3) of bags	1. Mix with gains and store. 2.Mix a quantity of the powder with grains normaly 10 bags. Mix thoroughly and re-bag for storage. 3. Mix with a quantity of acetyllic liquid. 4. Place a tablet of Phoxtoxine in cotton wool and push into the middle of grains.
N.R	Gbenja	1. Acetylic powder 2. Acetylic liquid 3. Phosphine 4. *Shea* butter residue 5. *Lidikcmja* plant. Arrange the leaves in container and pour small quantities of grain layer by layer with the leaves before closing container. 6. Wood ash mixed with grains.	1. Acetylic powder 2. Acetylic liquid 3. Phoxphine (as above) 4. Mix with grains 5. Arrange the leaves of *lidikonja* plant at the bottom of a container, pour in small quantities of cowpea or bambara beans and cover again with the leaves. 6. Mix grains thoroughly with wood ash then seal the container very tightly and store.
N.R	Bumboazia	1. Wood ash 2. Acetylic powder and liquid 3. Phoxtoxine tablet placed in middle of bagged grains	1. Grain mixed with wood ash. 2. Mix with grains and store 3. Cover with a piece of cloth or cotton wool and place one or two tablets in the middle of filled bags.
U.E.R	Bongo Soe	1. Sun shine 2. *Kpaliok* leaves	1. Thorough sun drying 2. *Kpaliok* leaves are dried, broken into pieces, and mixed with grains and stored.
U.E.R	Nangalikinia	1. Wood ash 2. *Chia* leaves 3. *Kolaa* leaves 4. *Kul-enka* leaves 5. Orange peels	1. Mix with grains. 2. Dry then, pound into pieces, and mix with the grains. 3. Boil and use liquid to parboil bambara beans. 4. Pound dried orange peels and mix with grains.
U.E.R	Kamega (Bawku West)	1. Acetylic 2. Phoxtoxine 3. *Kim-kim* leaves 4. *Dakpe Zungwari* leaves 5. Shea butter residue	1. Mix with grains 2. Cover with a piece of cloth or cotton wool and place one or two tablets in the middle of filled bags. 3. Boil and use liquid to parboil bambara beans 4. Mix with grains
U.E.R	Pialoko, Pus. (Bawku East)	1. Phoxtoxin	1. Mixed with food and thrown around bams to kill and scare away rodents.

1. Words in italics are local plants names
2. Source: Field survey,1996.

4.3. Marketing of legumes at famgate

The marketing of legumes is treated in two sections. The first section deals with legume marketing at the farm level (4.3.1), the second with marketing by traders at the market level (4.3.2).

4.3.1. Household marketing procedures

The results of the farm study indicated that farmers prefer to store larger quantities of groundnuts and bambara beans over a period of four to eight months. Only small quantities of these legumes were sold at harvest to resolve pressing financial problems. The results indicated that on the average only twenty-four (24) percent of the bambara beans harvested was sold out while seventy six (76) percent was kept by the farmers in storage. For groundnuts, the average quantity sold by farmers after harvest during the study period was approximately seventeen (16.8) percent while eighty three (83.2) percent was kept in storage. In contrast, the situation found for cowpea showed that a greater quantity of the crop was sold after harvest. On the average farmers sold seventy-eight (78) percent of the cowpea harvested, storing only twenty two (22) percent during the study period. This result conformed with complaints by farmers that efforts to store cowpea by traditional methods have not succeeded in curbing the distraction of cowpea stocks by insects. According to farmers the high prices of chemicals and the lack of technical knowhow on the use of chemical insecticides contributed to their inability to provide effective protection for cowpea stocks. In contrast, groundnuts and bambara beans could store for longer periods in their hard protective pods, compelling farmers to sell more cowpea as a cash crop at harvest time.

4.3.1.1. Means of transporting produce by farmers.

General observation revealed four main methods by which farm produce were transported from the farm to the village and from the village to the local markets. These are described below:

Portage

Farm produce were carried by portage as head loads mainly by women from farms to homes and from homes to nearby markets. The head loads indicated the quantities that a household could sell in the market at a given time over the storage period. According to respondents however, larger quantities were normally shared among women friends or relations called in to assist in carrying the produce to the market.

Bicycles:

Bicycles were also used by men to transport goods to the market, and the assistance of other men who have bicycles were solicited when necessary.

Donkey Carts

Donkeys saddled with carriages and driven by young boys were observed transporting farm produce to markets in the Upper Regions

Tracks

Trucks are also used to transport foodstuffs from villages to markets. The condition of many village roads, were observed to be almost unmotorable. Transport services were found to be more frequent from one market to the other, than from farm gates to markets. Farmers complained that whenever they were not able to transport their goods to the markets, traders stepped in to buy the produce in the village at low prices.

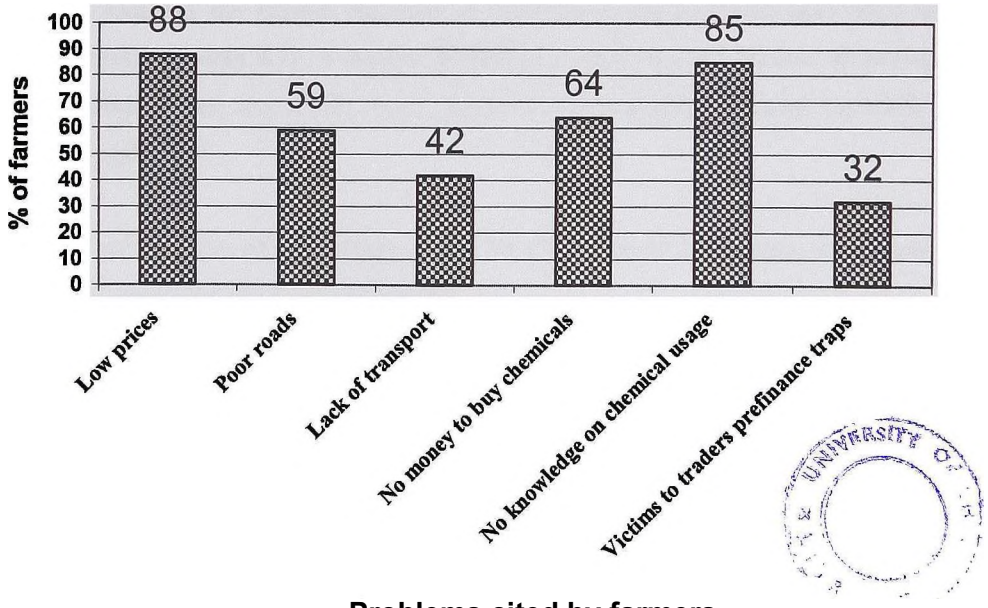
4.3.1.2: Gender role in legume marketing at the farm level.

Apart from the Upper West Region where many women were found in charge of storage bams, men were found in control of household food in the other two regions. Only produce wholly owned by a woman in the Upper East and Northern Regions were permitted according to culture to be stored and controlled by her. However, women visit markets more frequently and for the men are the channels of market information on prevailing prices in the markets and for guidance on the best time to sell. At the household level, when the decision to sell is taken, the required quantity is threshed and measured out into bags with bowls by women and either left with the man for traders to come and buy or sent to the market with his consent for sale. Many women were observed on market days carrying headloads of produce to the market. They walked long distances ranging from half a kilometer to ten kilometres.

43.1.3. Marketing problems on farms

Farmers cited various problems arising from post-harvest handling and marketing of legumes during group discussions in all the villages visited (Fig. 4.1). Approximately eighty-eight (88.5), fifty-nine (59), forty-two (42.5), sixty-four (64) eighty-five (85), and thirty-two (32) percent respectively of the farmers interviewed mentioned low prices, poor roads, lack of transport, inability to buy chemicals for storage, lack of knowledge on the use of insecticides and victims of costly pre-finance help from traders. These factors could interact in a vicious cycle of poverty. For example, low prices which result in low farm revenues with consequent poverty and low standards of living, arise from farmers lack of access to good roads and transport as well as the money and know how for good storage techniques. Situations, which render farmers easy victims to various profiteering strategies like the unfavourable pre-finance (or credit) conditions of traders.

Fig. 4.1: Producers' Marketing Problems



Source: Field survey, 1996

4.3.2. Legume marketing by traders.

This section presesnts the results of descriptive analysis of legume marketing. The results cover the physical facilities in legume markets, the socio-cultural background of legume traders, and the procedures and processes used by traders in the marketing of legumes. These include the marketing functions and services, the operations and problems involved in cowpea storage in terms of stock protection practices, insect pest damage, and their effects on the revenue of traders. Also covered are the channels of distribution and the types of middlemen operating within the channels.

4.3.2.I. The social background of legume traders.

This is described under the following five factors:

1. Ethnicity

Study results indicated that apart from retailing, which is undertaken by women of all ethnic groups, the predominant ethnic groups dealing in legume wholesaling in Ghana come from the producing regions of Northern Ghana, implying that people from these areas have acquired the needed expertise in performing the functions associated with legume marketing (Table 4.4). A number of Hausas, Kotokolis, and Moshis, from Niger, Nigeria, Burkina Faso and Mali were also found wholesaling legumes especially in Bawku, Ho and Tema.

2. Gender

Out of a sample of eighty-nine wholesalers interviewed in markets, only nineteen comprising twenty-one percent were women.

3. Age

The age of traders interviewed ranged from twenty-eight to sixty-five, with 56.8 percent of the respondents above fifty years of age.

4. Education

Formal education among the traders was found to be low. Sixty-seven (67) percent of them had never been to school. Twenty-six (26) percent had attended elementary school, while only six (6) percent had post elementary education.

5. Trading experience

The trading years of experience ranged between one (1) year and twenty-two (22) years, and as much as 68 percent of them had stayed in the trade for over ten (10) years.

Table 4.4. The Social Background of Legume Traders.

Town/ Market	Reg.	Predominant ethnic group	Gender composition of respondents		Total	Age group	Educational status			Yrs. of experience	Inherited busness from relations
			m	f			None	Post ele.*	Post SS+		
Aboabo (Tamale)	NR	Dagombas Gonjas	8	0	8	31-62	6	2	0	8-20	5
Yendi	NR	Dagombas	5	2	7	28-65	4	2	1	8-22	6
Gushiegu	NR	Dagombas	6	0	6	31-62	4	1	1	6-20	4
Bolga	UER	Frafras	4	2	6	36-60	2	4	0	3-14	5
Zebilla	UER	Frafras	1	5	6	25-55	4	2	0	1-12	2
Bawku	UER	Hausas	4	1	5	31-68	4	1	0	2-21	4
Wa	UWR	Wallas Datatis	4	1	5	30-58	3	1	1	4-13	3
Techiman	BA	Dagombas Gonjas	7	1	8	42-65	6	1	1	10-18	5
Sunyani	BA	Dagatis Dagombas	6	I	7	33-58	6	1	0	6-12	2
Central	Ash	Dagombas Hausas	4	1	5	35-65	4	1	0	4-15	5
Nima	GA	Dagombas Hausas Kotokoli	8	2	10	36-66	8	2	0	3-12	7
Timber	GA	Dagombas Gonjas	6	1	7	32-53	3	2	2	2-12	8
Main	VR	Hausas Dagombas	3	0	3	45-58	2	1	0	5-9	2
Kotokoraba	CR	Hausas Frafras Kokomba	2	1	3	36- 52	2	1	0	8-12	5
Main	WR	Hausas	2	1	3	32-55	2	1	0	5-9	3
			70	19	89		60	23	6		66

* Post Elementary School.
+ Post Secondary School

Source: Field survey, 1996

4.3.2.2. Market facilities

Market facilities refer to the physical structures in the form of market space, buildings for keeping or displaying stocks and the containers to measure out grains for storage and/or for sale. Observations in aE markets visited indicate inadequacies in market structures leading to over crowding and the inability of traders to properly stack and fumigate stocks under storage. A summary of information on market structures is provided in Appendix B. The key factors are highlighted below:

1. Storage structures

Conventional warehousing types of storage structures were not available in grain and legume markets at the time of the study. Structures used for storage and selling activities in many markets are constructed from corrugated roofing materials and wood. Thus, in Nima, and Amaamo markets in Accra, and Bolgatanga, Tamale, Yendi, and Techiman markets, legumes were being sold in roughly constructed wooden sheds which were inappropriate for effective fumigation.

About eight percent (7.8%) of the traders interviewed in Tamale and Bolga markets, for instance, have cement block stores outside the market where additional groundnuts and cowpea were found under storage. The remaining traders interviewed were operating in wooden sheds inside the market. Similarly, in the markets of southern Ghana where cowpea and groundnuts are consumed in greater quantities almost ninety (89.6) percent of traders interviewed were operating in wooden market sheds. Inspite of the limitation, traders in all the markets visited preferred to keep stocks in markets to facilitate business operations.

Market sheds in most of the country's markets were loosely and poorly constructed with insecure doors and unhygienic floors which were highly infested with insect pests and rodents and unsuitable for long storage purposes. Storage facilities in Techiman, Sunyani, Kumasi, Accra (Nima and Amaamo Markets), Ho, Cape Coast and Takoradi had equally poor conditions. With a World Bank financial assistance the government through the then Agricultural Sector Investment Project (ASIP), now Village Infrastructural Project was found reconstructing a number of markets at the time of the

study. Markets like Wa, Bolgatanaga, Techiman and Mankesim had then been demolished for reconstruction.

2. Weights and measures

Traders use jute sacks for packaging legumes. The weight of a full bag of cowpea in the market was higher than the 100 kilograms standard used in grain marketing corporations and referred to as maxi bags. Full bags of cowpea arrived from village markets at weights ranging from 112 to 115 kilograms and referred to as "bush weight". The grains would then be poured out and the bags refilled in the market to reduce the weights to between 103 and 109 kilograms. The refilled bags then contain forty (40) of the small retailing bowls weighing 2.5 to 2.75 kilograms. The weights of bags of groundnuts were found to range from 80 to 84 kilograms in the market.

4.3.2.3. Marketing functions

The functions mentioned by traders as the type of duties they were performing in the legume markets comprise the following:

1. Purchasing and assembling

Legumes are mainly produced in the three regions of northern Ghana, namely Northern Region, Upper East Region and Upper West Region (See Figs. 1.9 and 1.10). Like other regions, farmers producing legume and other crops are scattered over a wide area producing small quantities of each crop on small plots of land ranging between one and four acres. The purchasing and assembling of legumes in Ghana are painstaking functions undertaken at the primary levels of the marketing channel of each of the legumes. The traders at these levels comprise local village trader, inter-village market traders, and purchasing or commissioned agents.

Apart from the purchasing or commissioned agents who operate with relatively large amounts of money from their employers, like the Grains Marketing Board and the Ghana Food Distribution Corporation, and therefore buy large quantities at the primary levels, the local village and inter-village traders operate in small quantities. They are important, however, as a channel link to remote farm villages from where they bring

produce for sale in district villages for larger quantity assembling by the bigger traders down the channel.

2. Processing in markets.

This involves picking, packaging and stock treatment.

i. Picking

It involves the removal of moulded and broken nuts, chuff and seeds of other plants, which find their way into stocks during harvesting and winnowing. Only a few traders were observed performing this function during our visits. More picking was done on groundnuts for the separation of broken pieces than cowpea which was found on sale with large quantities of foreign materials. Picking was observed being performed mostly by retailers, even though some wholesalers said they sometimes employ labourers to pick out moulded grains and chuff during rebagging. In Ghana traders have no technology for the removal of stones and broken grains from stocks, accounting for the low quality of legumes on sale in markets.

ii. Packaging

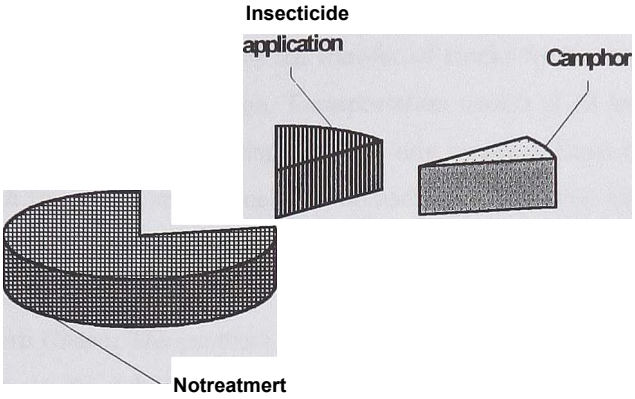
After purchases traders repackage their stocks into standard measures of 105 - 109 kilogram bags of cowpea and 80 - 84 kilograms of groundnuts. Bambara beans are packaged into fifty kilograms mini bags. All legumes are packed into jute sacks for sale and for storage in markets.

iii. Stock Treatment

Stock treatment is done against weevils. Adult weevils lay eggs on the cowpea in the field before it is harvested. The eggs hatch out larvae which penetrate the beans and eat up the contents while developing into adults leaving the beans holed and empty by the time they emerge as adult weevils. Only cowpeas were found treated on a limited scale in markets visited. Nine percent (9%) of the traders interviewed store and sell bambara beans, and none of them applied any chemical to the few bags of bambara beans they had in stock.

Out of 54 wholesalers who stock produce for the creation of time utility, only twelve (12), i.e 22.2% applied insecticides to their cowpea stocks. With the exception of traders who revealed that they kept their stocks under the care of Ghana Food Distribution officials in GFDC warehouses there was no re-application of insecticide by these group of traders. All the traders interviewed have some knowledge on the use of storage chemicals such as phoxtoxine tablets and acetylic gas, powder and Hquid which they buy from quack drug peddlers and have at one time or other used these chemicals. The study revealed that various methods were employed in the application of these chemicals. The most prevalent method described by respondents is placing tablets of phoxtoxine covered with pieces of cloth or cotton wool in the middle of bags of cowpea. Other traders reported mixing ten (10) bags of cowpea with unspecified quantities of acetylic powder or Hquid. These practices are unconventional and unsafe. Some traders also place balls of camphor in bags of cowpea. Approximately eight (8.2) percent of respondents were found using these method, while some three percent (3.2%) had their stocks fumigated for them at a moderate fee at three-month intervals during the storage period by government experts from the Ministry of Agriculture, and the Grains Warehousing Corporation. Approximately eleven (10.8) percent of the traders interviewed fumigate their stocks with assistance from officials of the Ministry of Food and Agriculture (Fig. 4.2). The study revealed that groundnuts and bambara beans are not given any form of treatment in the markets.

Fig. 42: Stock **Treatment in Markets**



Source: Market survey, 1996/7

Seventy-eight percent (77.8%) of the traders interviewed do not apply any chemicals to stored stock for reasons of high treatment cost and yet others believe they have "good" hands and therefore touching the stocks prevent insects from eating the grains. This belief in safety hands was found to be popular in both markets and farms of producing areas

3. Storage

For many reasons like the lack of capital and storage sheds and the fear of insect damage, only 28.9 percent of the traders interviewed did regular storage of cowpea. Eleven of these traders participated in a case study, which helped to provide a better understanding of the operations of cowpea storage. The study was done in Tamale, Bolgataga and Bawku markets. In the three markets, groundnuts were found to be stored in greater quantities in Bolgatanga and Tamale markets while larger quantities of cowpea were stored in Tamale market. Bawku market was found to be playing the role of an all-year-round transit centre for cowpea fanners and traders in Ghana as well as

neighbouring countries. Thus cowpea is sold throughout the year in Bawku, with minimal storage.

4. Transportation

This function involves the transfer of stocks from purchasing centres at all levels to the next point of exchange. Transportation occurs at all levels in the marketing chain including retailer to consuming points. Study results indicate that the transfer of legumes through the marketing channel is done mainly by vehicular means with big cargo trucks. The important points through which stocks are transported in the legume market are from district markets in producing regions through regional markets to consuming centres in Southern Ghana. The problem of transport was found to be insignificant from the district markets to the urban centers during the study period with cargo trucks of many sizes carting large quantities of legumes and grains to districts and regional markets to consuming areas. The groups of traders who were found performing the function of stock transfer through the successive levels of the marketing channel were village market traders and inter-regional middlemen.

Village market traders were found transferring produce from local villages and village markets to district and regional markets in producing regions by passenger and cargo trucks for sale to wholesalers. The means of transferring legumes and indeed other foodstuffs from farms to village markets was found to consist of head portage, carried by women as head load and on bicycles carted by men. The inter-regional middlemen operate between regions transferring stocks by cargo trucks and articulator vehicles from district and regional markets in producing regions of the North of the country to various markets and marketing institutions in consuming centres of Southern Ghana.

A few wholesalers have cooperative vehicles, while the majority depend on public transport services like the Ghana Private Road Transport Union (GPRTU). The GPRTU in addition undertakes the important function of registering food stocks like legumes, cereals, grain and root/tuber stocks leaving district and regional markets on behalf of the Ministry of Food and Agriculture. For every vehicle leaving a market, the quantity of each of these items on the vehicle, date of departure and destination are recorded as part of MOFA's market statistics.

5. Financing

None of the traders interviewed had ever received a loan from any banking institution for the finance of his or her trading operations. The study results showed that traders had no official sources of finanace and that they have devised ways of depending on one another in the food trade business. Thus, traders have developed varieties of credit systmes with interests built into the price of the goods for fellow wholesalers and retailers who buy on credit and pay later. As already indicated, traders also help in financing needy farmers during production seasons.

4.3.2.4 The channels of distribution.

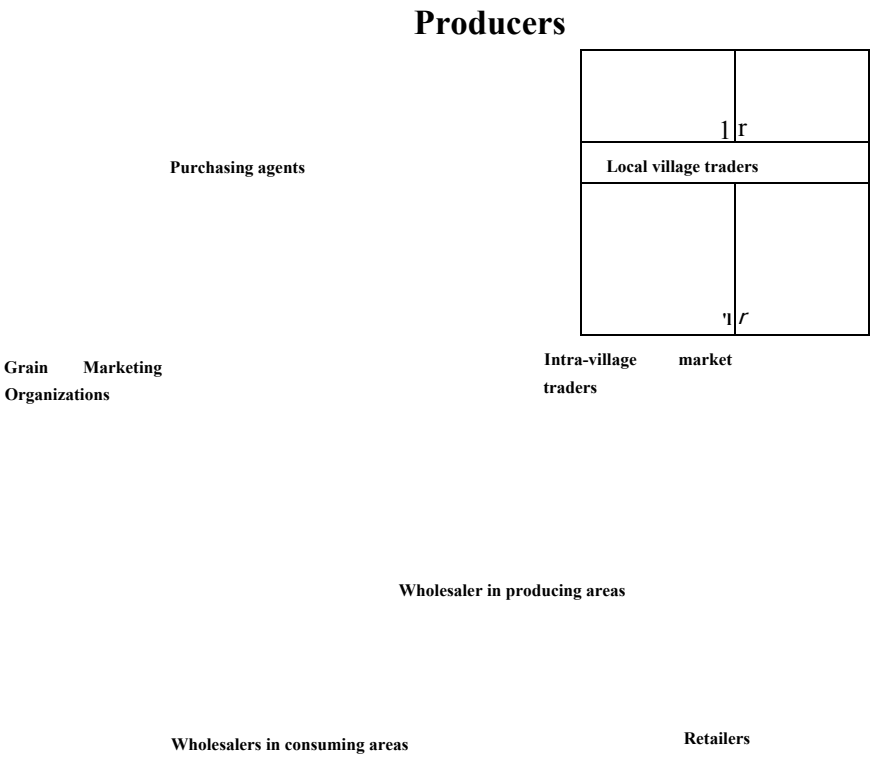
The channels of distribution for cowpea, groundnuts, and bambara beans are shown in Figures 4.3, 4.4 and 4.5 respectively. More than 75 percent of bambara beans produced in northern Ghana is consumed in the territory itself where it forms an important food item. Groundnuts and cowpea on the other hand are used more extensively outside the production areas for food, and on a limited scale, as industrial raw materials for the production of animal feed, cooking oil, infant weaning foods, and peanut paste. The channels for the distribution of these two crops were found to be wide and long in comparison to the channel for bambara beans. The implication is that the marketing channels of cowpea and groundnuts involve many intermediaries including frontmen or market brokers who represent secondary and tertiary wholesalers with no defined value-added functions. Consequently, consumers may be paying more than necessary for these commodities as unnecessary charges for maintaining these groups of middlemen in the cowpea and groundnuts markets.

The channel members found in the legume markets consist of producers, wholesalers and retailers:

1. Producers

They constitute the farmers producing legumes. They are scattered over a wide area comprising the study areas in Northern Regions of Ghana and parts of **neighbouring** countries like Burkina Faso, Niger, Togo and the Ivory Coast.

Fig.4.3: Cowpea Marketing Channel



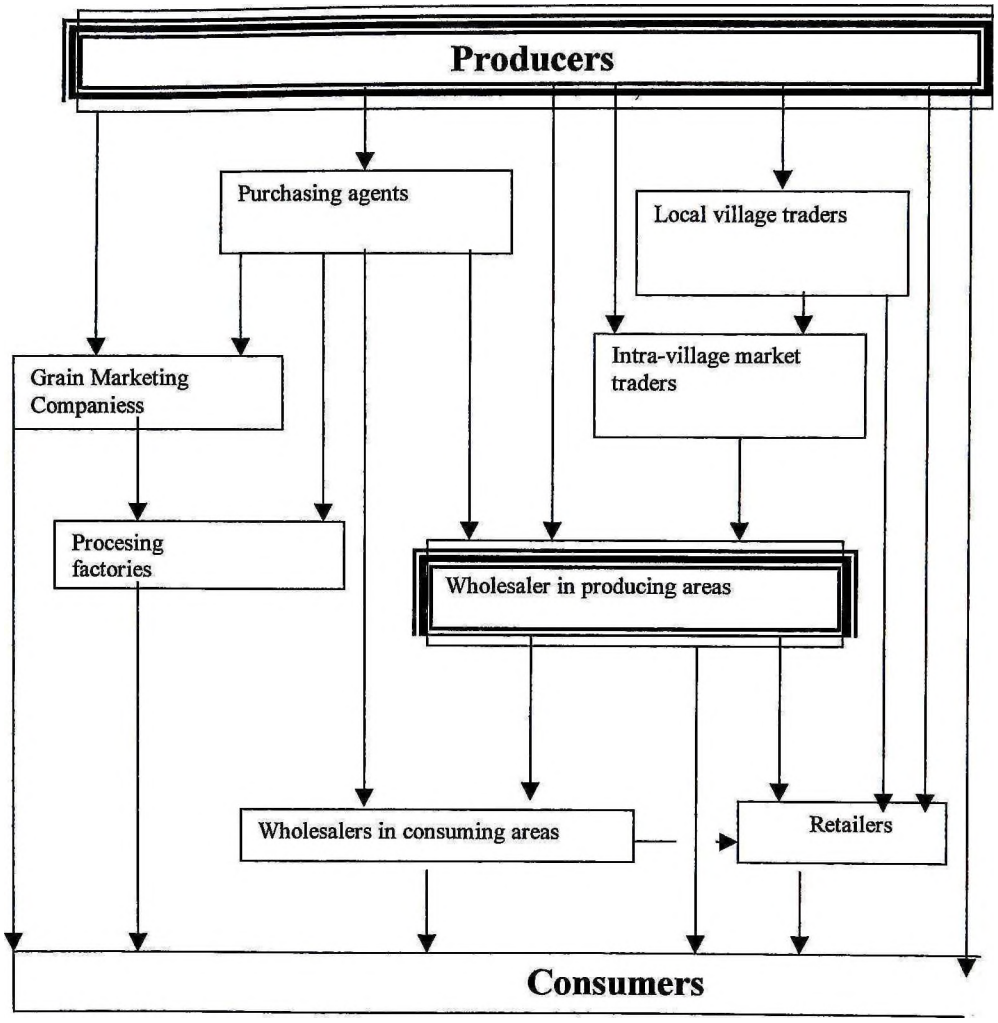
Key:

Main performers of storage functions

Major channels

Source: Market survey, 1996/97

Fig. **4.4:Groundnuts Marketing** Channel



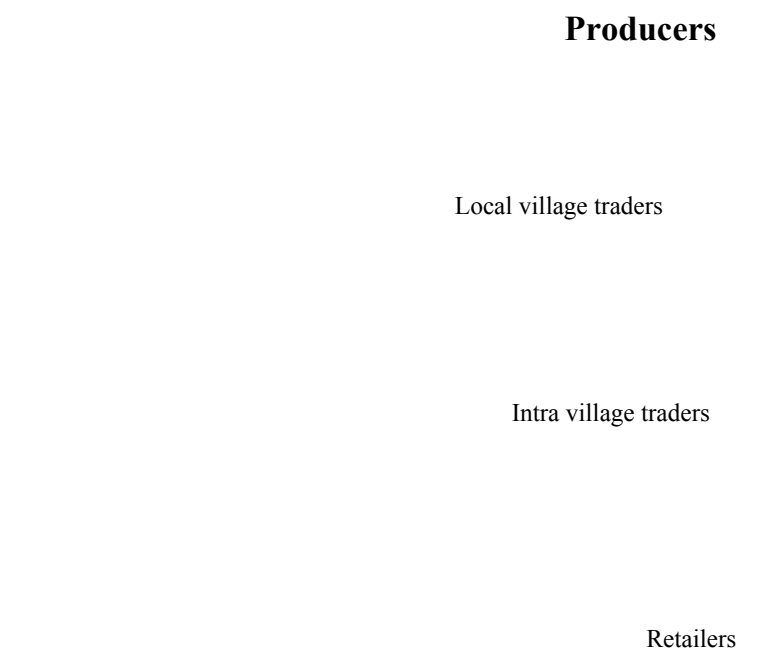
Key;

Main performers of storage functions ||

Major channels —

Source: Market survey, 1996/97

Fig. 4.5: Bambara Beans Marketing Channel



Key:

Main performers of storage functions [f r—:—" ***

Major channels ►----------►---------- ►

Source: Market survey, 1996/97

2. Primary assemblers

These are made up of purchasing agents, local village traders and inter-village market traders. The purchasing agents are normally commissioned by marketing corporations, education and health institutions. Local village traders are normally members of the locality or village. They buy from households within the village for sale in district or regional markets, while inter- village traders are those who go round village markets to buy and assemble produce into larger quantities for sale to secondary assemblers in regional markets.

3. Secondary assemblers

Secondary assemblers are traders in the regional markets of producing areas. Even though some of these traders contact and buy directly from large scale producers, the greater number receive their stocks from the primary assemblers. Secondary assemblers try to avoid transport and other problems associated with purchasing at the primary level by buying and assembling their consignments from primary assemblers who bring the legumes to them in the regional markets.

4. Consuming area wholesalers

This group of intermediaries operates at the consuming areas with the main function of satisfying the demand of the consuming public. They receive supplies from secondary assemblers and distritute to the consuming public or processors either directly or through retailers who sell in smaller units to households.

4.3.2.5. Type of traders

The results portrayed traders in the major legume markets as comprising two major groups, namely, wholesalers and retailers.

1. Wholesalers

Wholesalers in the groundnuts and cowpea trade are mainly men. Only 2.4 percent of the traders interviewed were women with the highest numbers found in Nima market in Accra, Bolgatanaga and Yendi markets. In contrast, the Bambara beans trade is

dominated by women and mainly sold at the retail level. These women operate between villages and in the big markets. However, the retailing operations of groundnuts and cowpea are also exclusively performed by women. The different types of wholesalers revealed by the study are the following.

a. Forwarding wholesalers

Forwarding wholesalers are traders with low capital who cannot tie up trade money in storage. They do not store grain but sell to customers immediately after purchase with a profit margin ranging between 8 and 10 percent. These traders also operate on credit occasionally, by procuring goods from district market suppliers and large-scale storers to sell before making payment. Upon agreement by both parties, the interest on such credit is normally built into the price of the goods. Forwarding wholesalers do significant business on market days, buying and selling up to 50 bags or more of different types of legumes and grains.

b. Front-men

These men do not directly purchase to sell. Their duty is to identify potential customers and direct them to those traders who have stocks to sell. They also operate between suppliers with goods from village markets and the large-scale traders. Their strategy is to act as a trade link by intercepting customers from meeting actual owners of stocks and selling the goods themselves to the customers at a profit. Such victims were found to be new traders who have no trading partners in the markets. Front men are common in Tamale, Techiman, Bawku, Nima and Amaamo markets in Accra, and in Kumasi markets.

c. Large - scale wholesalers

These are traders with large capital who store and sell in large quantities. These traders normally have other businesses and tend to be absentee traders who leave their stock to relations or employees to manage in the markets. They appear periodically for inspection and to give instructions on the conduct of the business. During interview sessions such traders are difficult to get while the caretakers are not able to supply needed

information. Some large-scale wholesalers are able to store as much as ten thousand bags or more of cowpea and groundnuts per season. Most often part of these goods is kept in rented warehouses or in the houses of the owners, outside the market They prefer to sell to big customers like schools, Ghana Food Distribution (GFDC), the Grains Development Board and the World Food Program (WFP) at high profits in the cities. Some large-scale traders own big trucks and articulators for transit operations.

d. Small-scale wholesalers

Small-scale wholesalers operate with smaller capital and store below one thousand bags at a time. They form over 90 percent of legume storage operators in the country. In addition to storing they operate forwarding trade operations, which keep them in business while waiting for peak prices before selling stocks under storage. They are always available in the markets and are therefore useful sources of information to researchers.

e. Off-market wholesalers

These are storers who operate at home and around town where they keep stocks of cowpea or groundnuts. They may be organizations like churches or individuals like workers and housewives who store legumes for sale later in the season.

2. Retailers

These are mainly women traders who buy from wholeasalers for sale in smaller units to consumers. Retailers buy mainly from wholesalers in single bags usually on credit, to retail out in 2 to 3 days. Wholesalers sometimes take advantage of the lack of capital by selling bags of grain containing infested grain to such retailers while keeping grains of better quality. In the Tamale market, retailers commonly put on sale holed cowpea by routinely mixing infested grains with clean grains. The practice is most common from February, and persists up to the next harvest in September and October.

The bambara beans trade was found to be mainly limited to the retail level. The study showed that some retailers from high-consuming centers, travel to the regional and district markets of producing areas to buy all three legumes for short-term storage and then sale. However, for lack of time and logistics, the study did not cover detailed operations of legume retailing.

4.3.2.6 The storage operations of cowpea.

Among the legumes in Ghana, cowpea is the most vulnerable to insect pest destruction. Large quantities of beans are eaten up and damaged by insects annually. Consequently a study of the trading operations of some selected cowpea storers was undertaken over the study period. The aim was to provide a deeper insight into the operations of the cowpea market.

The case study approach was adopted for this study and structured questionnaires were administered to individual traders, willing to provide operational information. The specific areas covered in the case study are:

1. The period of cowpea purchases for storage
2. The trend of the purchase price.
3. Insect damage assessment.
4. The effect of insect damage on revenue.

The results of the last two are presented in chapter 5

1. The period to purchase cowpea for storage

During the trading season of 1996/1997, purchases of small white cowpea for storage in Tamale market began in July 1996, while the purchases of the large white varieties in Bolgatanga and Bawku markets started in October and November respectively (Table 4.8). Stocks of early-maturing varieties bought in July by traders in Tamale market were stored for only one to two months and resold. Due to a price fall in September and October many traders sold out the early purchases at a loss to free capital for the purchase of what they termed “hard grains” for longer storage. Losses of this nature, which seem frequent on food markets, are quietly suffered by traders alone.

Purchases in Bolgatanga and Bawku started in October and November respectively implying that traders in these markets did not store early-maturing grain in the study year. Some of the traders interviewed bought cowpea for long storage in August and September but many traders buy the greater part of storage stocks between October and December; with a few late purchases in January (Table 4.5). October, November and December are the peak harvesting months, and therefore the low price periods of cowpea.

For any serious and rational trader, this is the best period to buy and store cowpea. All purchases made by traders after these months aare resold in ongoing direct trade transactions.

Table 4.5: Purchasing Trend of Cowpea Stock in Northern Ghana.

TAMALE (ABOABO)	BOLGATANGA	BAWKU
July: Purchases for short storage		
August: Purchases for short storage		
Sept: Purchases for early sales and long storage		
October: Purchases for long storage	October: Purchases for early sales and long storage	
November: purchases for long storage	November: purchases for long storage	November: purchases for long storage
December: Purchases for long storage	December: Purchases for long storage	December: Purchases for long storage
January: purchases for long storaage	January: Purchases for long storage	January: Purchases for long storage

Source: Market survey, 1996/97

2. The price trend of cowpea purchased for storage.

Results indicated that during the period under review the prices of cowpea bought for storage varied widely within the harvesting period for the different markets and for the different varieties (Table 4.6). At the onset of the harvesting period prices of new early-maturing varieties which arrived in the markets were higher due to the rush for new cowpea by consumers. This set traders and farmers to push old cowpea stocks into the market at lower prices. In the meantime, more newly harvested cowpea stocks arrive in

the market, causing prices of both old and new stock to fall in September and October. In November the prices reached the lowest level and started rising through December to January when all purchases for storage were complete. From study results 87.5 percent of the storage operators bought stocks for keeping in October and November during the 1996/97 season, in Tamale market.

Table 4.6: Price Trend of Stored Cowpea.

(Prices in '000' cedis per bag in the indicated month}*

Variety	Market	Jul. 1996	Aug.	Sep.	Oct.	Nov.	Dec.	Jan. 1997	Feb.	Mar.
Small White	Tamale	72	70	64	64	62	64	66		
Large White	Bolga				70	70	75	80		
Large White	Bawku					65	68	80	85	90

• These are prices for the 1996/97 season

Source: Market survey, 1996/97

4.3.2.7: The storage of improved cowpea varieties and related problems

Concerns have been raised in many developing countries over what has been termed farmers low adoption rate of produce scientifically developed seeds and **planting** materials of some crops. Since late-maturing and low-yielding local varieties of cowpea still predominate in Ghanaian markets, it become necessary to inquire from traders, the cause (s) of the problem. On the farms, producers blamed traders for their lack of interest in unfamiliar scientific varieties in preference for local cowpea varieties. The **main** reasons given by traders for the problem were:

• Soft grain;

• High water content;

• Consumer preference.

Soft grain

Traders complained during group discussions that early-maturing grains are soft and become powdered after a short period of storage.

High water content

The early-maturing cowpea is havested during the raining season when farmers find it difficult to dry the produce well enough for long storage. Early-maturing cowpeas kept in storage are therefore more vulnerable to mould, and most often become powdered or prone to early insect attack.

Consumer preferences

Traders maintained that consumers prefer the local grains which are said to have a better taste and also increase in bulk after cooking.

4.4. Groundnuts

Unlike cowpea, which is stored mainly by traders, farmers perform the function of storing groundnuts on a larger scale. The farmers store unshelled groundnut pods at home while traders and organisations like the Grains Development Board, Churches, private businesses and individuals store groundnuts in shelled form as grains or nuts.

4.4.1 Damage to groundnuts

The study identified three main causes of damage to groundnuts in the market, as described below.

1. Cracking and peeling of skin cover

The first and most serious cause of damage identified is the peeling-off of skin covering and cracking of nuts in the markets. This problem becomes very obvious from February when humudity is low. The dry air causes over drying of nuts, leading to nut-breaking and skin covers peeling off during handling and when in transit.

2. Moulding

This occurs when nuts do not dry properly before storage. The high water content of the nuts causes moulding and rot with severe health hazard to consumers and economic loss to traders.

3. Insect damage

The nuts are eaten by insect larvae and destroyed.

4.5. Bambara beans

Study findings indicated that wholesalers store insignificant quantities of bambara beans and that the storage function is performed mainly by producers themselves who store the beans in pods to sell periodically in small quantities on villlage market days They are then bought and assembled into larger quantities by village traders, who sell to district and regional retailers for sale to consumers in bowls. Traders from Burkina Faso and Northern Togo were found bringing quantities of bambara beans into the country through Bolgatanga, Zebilla, Bawku and other border markets.

CHAPTER 5

THE STRUCTURE, CONDUCT AND PERFORMANCE OF LEGUME MARKETS

5.1 Introduction

Results on the structure, conduct and perfomanee of the legume markets are presented in this chapter. The market structure, which involved a study of entry barriers of the legume markets, were determined through a case study of insect damage to cowpea and groundnuts, and the effect of the damages on the net income of traders during the study period. The conduct of the legume market was examined by determining the pricing policies of middlemen along the marketing channels of groundnuts and cowpea. The level of association among eight major legume markets in the country, the producer-wholesaler price spread for the two commodities in the 1996 and 1997 trade season, and the type of channels being used by intermediaries for the distribution of the legumes which have already been discussed in chapter four,.were also used to determine the performance and the resulting marketing efficiency of the legume market.

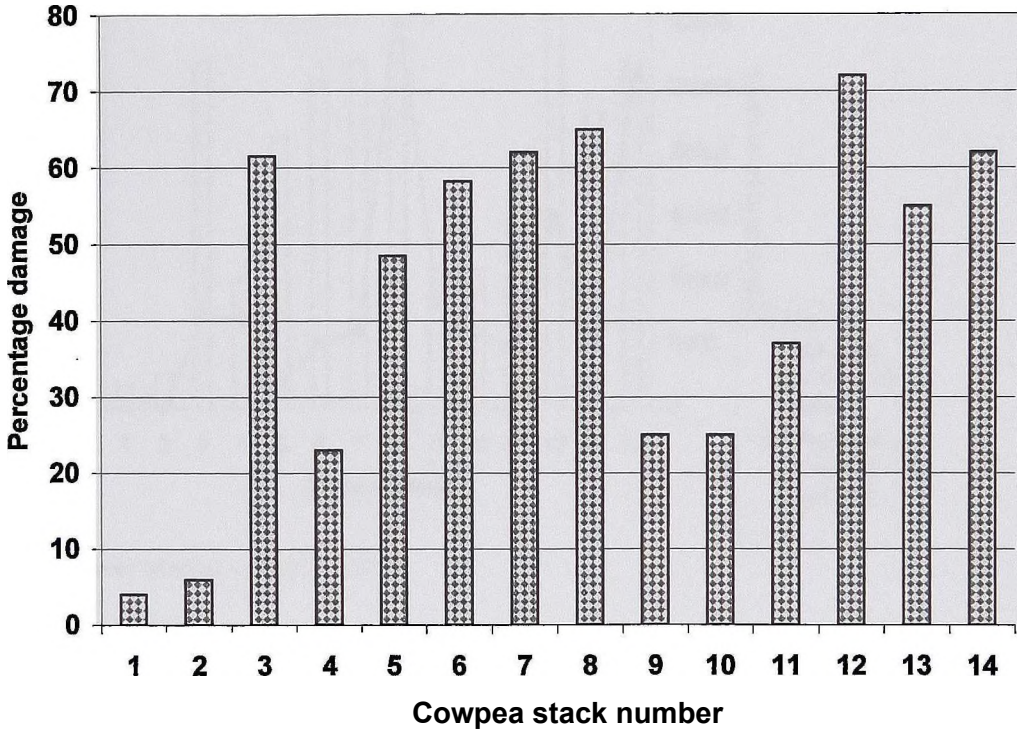
5.2. Legume market structure

5.2.1. Cowpea

A graph of the results on the level of insect damage to cowpea stocks at the time of sale in Tamale market is shown in Fig.5.1 The results show the percentages of cowpea grains damaged in various stocks during storage. The first two stocks, which were mixed with acetylic powder before storage, did not suffer any damage. The chemical treatment prevented insect attack throughout the storage period of five months. The fourth, ninth and tenth stocks were treated after insect attack, which prevented further damage through out the rest of the storage period even though the stock was already damaged to some

extent. The remaining stocks, which were not protected against weevils throughout their storage periods ranging from four to eight months suffered high percentages of grain damage ranging from 38 to 70 percent at the time they were sold.

Fig. 5.1: Percentage grain damage in numbered stacks at time of sale

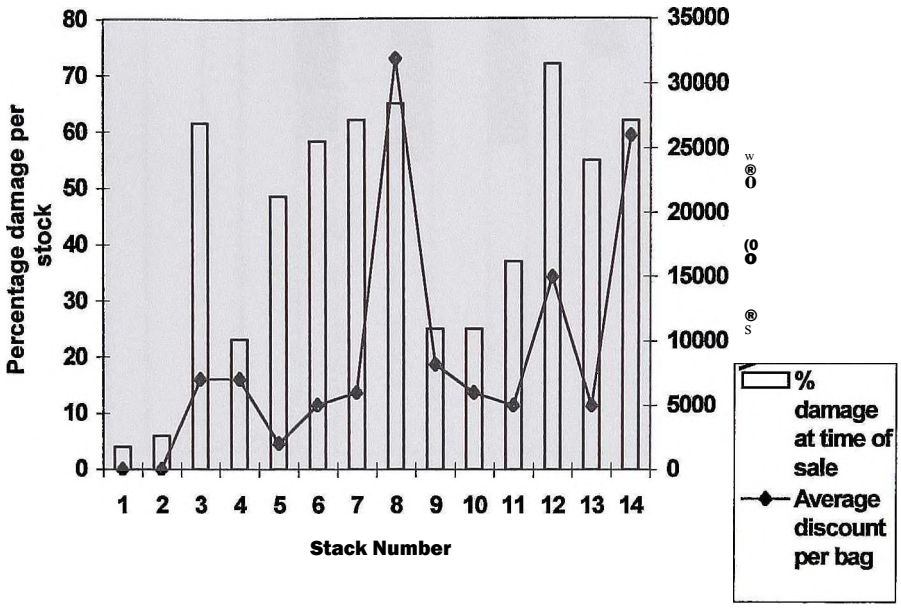


Source: Market survey, 1996/97

5.2.1.1. Revenue losses on cowpea

The damages in Figure 5.1 resulted in price discounts, with consequent revenue losses to the owners (Fig. 5.2)

Fig. 5.2: Average price discount per bag for correspondng % damage to stock.



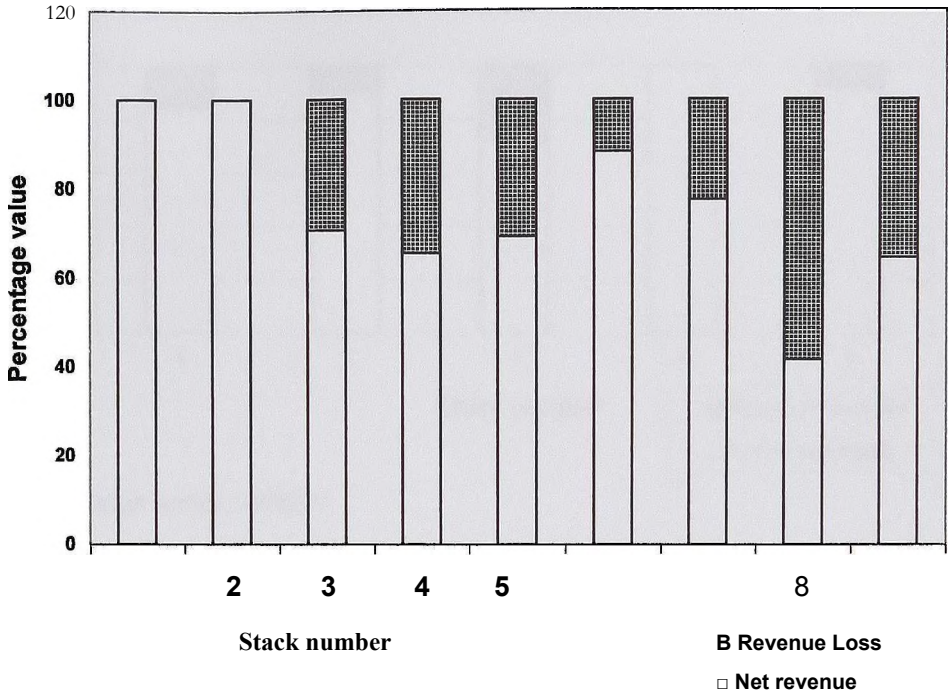
Source: Market survey, 1996/97

Sales in the legume and grain markets are preceded by long bargaining between traders and their customers. The quality of the stock was found to be important for determining what price a customer was willing to pay for the stock. This compelled traders to sell stocks of low grade at discounts

Results on the financial analysis of the stocks are shown in Fig. 5.3. The indication is that price discounts demanded by customers for damaged stock, did cause significant losses in the net revenue of traders during the season. Losses ranging from 11.7 - 58.4 percent of net revenue were made on 63.6 percent of the stocks, while 18.2 percent of them, which were treated did not suffer any revenue loss. The results on the

remaining 18.2 percent of the stocks were not conclusive and have not been represented in Figure 5.3.

Fig. 5.3: Percentage revenue losses by cowpea traders.



Source: Market survey, 1996/7

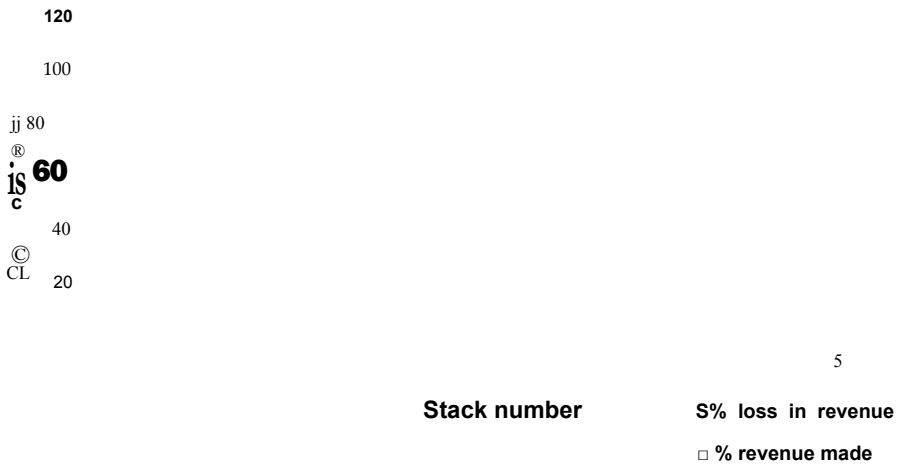
5.2.2. Groundnuts

5.2.2.I. Revenue losses on groundnuts

In contrast, revenue losses estimated on groundnut stocks through a review of the financial operations of groundnut traders for the period under study indicated that the losses made on groundnut stocks were lower even though none of the stocks had been treated against insect attack. In addition to insect damage, losses in groundnuts revenue occurred as a result of moulding, cracking and peeling off of skin covering. The losses

estimated ranged from 5 to 25 percent of revenues for stack numbers 1,2, 3.and 5. There was no loss in revenue on stack number 4 (Fig.5.4). The groundnut stocks did not undergo damage assessment studies.

Fig. 5.4: Percentage revenue losses by groundnut traders



Source: Market survey, 1996/97

The high losses in cowpea revenue resulting from insect damage and the high investment required for the purchase of both groundnuts and cowpea stocks (Appendix C) were found as the main barriers preventing farmers and traders from engaging in legume marketing. The problem particularly affects farmers, many of whom expressed the wish to store at least part of their cowpea harvest after selling a quantity to settle financial responsibilities. Consequently, the operation of cowpea storage services, are vitually left in the hands of traders, who were found to dominate in the storage and marketing of cowpea

5.3. The conduct of legume marketing

The results for determining the conduct of legume markets in Ghana are presented under the pricing policies of traders in legume markets.

5.3.1 The pricing policies of legume traders

The pricing policies operating at three different channel levels were used to determine and characterise the conduct of the legume market. The channel levels at which policies were studied are:

1. The farm gate and the regional market.
2. The regional market and the urban market.
3. The farm gate and the urban market referred to as the overall channel.

The results of pricing policies operating along the marketing channels for cowpea and groundnuts are presented in Table 5.1 and 5.2. By the indication of the adjusted R^2 s, the estimates of the equations fall within acceptable limits. Most of the F and t- statistics indicate that the coefficients are significant at less than 5 percent significance level. The Durbin-Watson statistical tests indicate no serial correlation among the independent variables. While the model is not intended for predicitive purposes, results obtained do provide the required information for determining the pricing policies of middlemen in both cowpea and groundnut and hence the conduct of the legume market in the country

5.3.1.1. Pricing policies of middlemen in cowpea markets.

The results obtained for the farm-gate level in equation (1), page 27, suggest that on the average, the margins made by farm-gate middlemen were found to be 8.8 percent of the farm-gate price plus a fixed sum of 22,842 cedis (Table 5.1).

Table 5.1: Estimated Equations of Cowpea Pricing Policies.

level		a.	b	R^J	R-adj.	DW	Sig. F	**Indication**
1		22.8428	-0.0884	0.9242	0.9165	1.8992	0.0791	Inverse and fixed margin
		(3.7220)	(0.0499)					
	Sig. T	0.0000	0.0791					
2		72.0591	-0.2076	0.9205	0.9127	1.6212	0.1065	Inverse and fixed margin
		(11.6007)	(0.1276)					
	Sig. T	0.0000	0.1065					
3		101.4661	-0.4341	0.9641	0.9567	1.7968	0.0039	Inverse and fixed margin
		(11.0153)	(0.1477)					
	Sig. T	0.000	0.0039					

Standard errors are presented in parentheses.

Source: PPMED, MOFA

The results for middlemen operating between regional markets of producing areas in equation (2) suggests that, on the average the margins of middlemen were 20.7 percent of the prices in the regional markets, plus a fixed sum of 72,000 cedis

For the overall channel or total distribution, the margin was 43.4 percent of the prices at farm gate plus a fixed sum of 101,466 cedis. The implication is that the price charged by intermediaries at all levels comprises the margin plus the purchase price

The signs of all three coefficients for all the channel levels studied in the cowpea equations were negative depicting the presence of Harris inverse margins, which imply that the margins made by middlemen at all the levels did not reflect a positive relationship with the price change at the source of procurement. In other words, a fell or rise in the price of cowpea at the supply location did not necessarily lead to a fall or rise in the margin of intermidiaries at the selling point.

Using both Allen and Moro as well as Harris interpretations, results obtained for the cowpea market suggests the absence of perfect competition. The results indicate a collusive pricing system of market conduct, with oligopolistic marketing tendencies along the cowpea channel especially as trading moves away from the farm towards the cities. This is indicated by the high intercepts of 22,842, 72,059 and 101,466 cedis, portraying high overhead costs, which do not justify transit and other marketing expenses. The indication is that collusive pricing is being operated by large-scale middlemen in the cities, reflecting the domination of traders in cowpea storage. The trend of fixed costs however, show an increase as trading moves from producing areas towards the far away cities which are long distances from the supply markets, as well as increases in channel members and marketing costs, rising from 22,842 for the farm level equations (1), to 72,059 for the transit level equation (2), to 101,466 for the overall equation (3).

5.3 1.2. Pricing policies of middlemen in groundnuts markets

In the groundnuts market, the results show a tendency towards a more competitive marketing system especially at the primary level of the marketing channel This is indicated by the low intercepts and coefficients, most of which are significant at the 5 percent level (Table. 5.2).

Table 5.2 Estimated Equations of Groundnuts Pricing Polices.

Level		a.	b	R^2	R-adj.	DW	Sig. F	Indication
1		-2..969	0.1109	0.9308	0.9123	1.9190	0.0000	Percentage margin
		(2.1597)	(0.0258)					
	Sig. T	0000	.1716					
2		25..91	0.1419	0.9138	0.9068	1.8910	0.0001	Semi fixed margin
		(3.2353)	(0.0329)					
	Sig. T	0.0000	0.0001					
3		18..3246	0.3206	0.9658	0.9607	1.7092	0.0000	Semi fixed margin
		(3.1897)	(0.0376)					
	Sig. T	0.0000	0.0000					

Standard errors are presented in parentheses

Source: PPMED, MOFA

The low intercept value of - 2.96 of equation (1) indicates a highly competitive pricing system in which margins are estimated as percentages of the purchase price. As one moves further down the channel towards urban centres, transit and other marketing costs play a greater role in determining margins. This is shown by the higher but favourable intercepts of 25.91 between the transit and urban market centres and the overall marketing intercept of 18.32 between the urban wholesaler and the fanner.

The positive coefficients for all the equations indicate the absence of inverse margins in the groundnuts market, a condition depicting the existence of interactions and information flow, among groundnut markets. Consequently, unlike the cowpea market, all channel members including producers who store a higher proportion of the crop do influence pricing policies in the groundnuts market.

5.4 Market integration

Details of the market integration results are presented in Appendices D.and E, while Tables 5.3 and 5.4 provide highlights of the areas of specific interest to the study. The results show that the statistical significance of the coefficients of variables, Pu-i, and Pit-2, and P_{2t}, P_{2t}-i, and $P_{2t\cdot3}$, give indications of the presence of associations between the prices of the market pairs. Estimated coefficients, pn and pi_2, of one and two weeks lagged prices, P^ and $Pi_{t\cdot2}$ respectively, are the results for the 1st way price movement, (e.g Accra to Koforidua), while p_2i and p_{22}, represent the coefficients of, P_{2t}-i and $P_{2t\cdot2pj}$ the prices for one and two weeks time lags for the 2nd way price movement (e.g Koforidua to Accra).

The values of the coefficients and the levels of significance shown in asterisk below the tables indicate the existence of associations between prices in the markets studied. The situation of no time lag, $P_{t\cdot}$o, was not vital to the study since the commodities are non-perishable, and could be stored for an appreciable length of time, and also require time for transfer between markets.

The condition of pn-e = *o,* and $p_{2t\cdot e}$=o, implying no association between markets did not occur for all 56 market pairs for each of the commodities studied. In other words, the results of all market pairs studied did reflect some level of integration between market pairs. However, the degree of these associations had to be estimated in order to determine those market pairs with high or weak associations and those whose associations are so low as to be classified as independent, concentrated, or segmented markets.

The coefficients of dummy variables, which for lack of space are not indicated, were found to exhibit some influence on the pricing situation of market pairs by the estimated coefficients. Even though R^2 and the adjusted R^2 are not reliable in this method of determining market integration, the values obtained did confirm the existence of associations between prices in the markets studied. The results of the Durbin-Watson tests indicate the absence of residual serial correlation among variables.

Table 5.3: Highlights of Cowpea Market Integration Results.

Market pairs	1st way estimates after 1st and 2nd Weeks lag period							2nd way estimates after 1st and 2nd weeks lag period						
	P n	std. error	Pl2	std. error	R^2		DW	P21	std error	Pl2	std. error	R^2	R^2adJ	DW EMC
Accra/ Koforidua	0.1115	0.1785	-0.0272	0.1794	0.9068	0.9003	2.0367	0.1333	0.0964	-0.1093	0.0966	0.9334	0.9288	1.9931
Accra/ Kumasi	0.1613	0.1346	-0.2553*	0.1325	0.9185	0.9129	1.9837	-0.1371	0.1179	0.0402	0.1186	0.8901	0.8825	2.0723
Accra/ Techiman	-0.3054*	0.1598	0.1542	0.1606	0.916	0.91	1.9419	-01999*	0.1044	0.0421	0.1045	0.8875	0.8796	2.1190
Accra/ Tamale	-0.0413	0.1152	-0.0129	0.1143	0.9046	0.8980	1.9818	-0.0502	0.1285	0.0126	0.0192	0.7694	0.7535	1.9985
Accra/ Wa	0.2901	0.2359	-0.7020	0.2427	0.9112	0.9050	1.9583	0.0152	0.0707	0.0722	0.0706	0.9333	0.9287	2.0967
Accra/ Bolga	0.1752	0.1548	-0.0419	0.1545	0.9136	0.9076	1.9930	-0.1161	0.1060	0.1595	0.1071	0.9094	0.9031	2.0501
Accra/ Tema	-0.2228	0.0915	-0.1048	0.1186	0.9268	0.9218	2.004	-0.0298	0.1125	-0.0537	0.1121	0.9357	0.9312	1.9981
Tema/ Koforidua	0.1176	0.1750	-0.0785	0.1730	0.9173	0.9116	2.012	-0.1578*	0.0981*	0.1636	0.0992	0.9342	0.9297	2.0310
Tema/ Kumasi	0.0568	0.1337	-0.1480	0.1320	0.9222	0.9168	2.027	-0.1308	0.1185	0.7654	0.1191	0.8899	0.8822	2,0830
Tema/ Techiman	-0.2539*	0.1550	-0.0165	0.1561	0.9230	0.9176	1.9998	-0.1425	0.1057	0.0677	0.1058	0.8859	0.8780	2.1368
Tema/ Tamale	0,0915	0.1119	-0.0595	0.1115	0.9132	0.9072	1.9512	0.0133	0.1320	-0.0631	0.1315	0.7620	0.7455	1.9863
Tema/ Wa	0.1216	0.2437	-0.4714*	0.2495	0.9099	0.9037	1.9628	0.0353	0.0713	-0.0449	0.0714	0.9333	0.9287	2.0154
Tema/ Bolga	0.0554	0.1568	-0.1055	0.1577	0.9131	0.9071	1.9895	0.0466	0.1027	-0.3247	0.1033	0.9155	0.9097	1..9745
Kumasi/ Koforidua	-0.4050***	0.1630	0.1947	0.1677	0.8987	0.8917	2.0148	-0.0454	0.1064	0.5468	0.1030	0.9431	0.9392	1.9736
Kumasi/ Techiman	-0.1020	0.1452	0.1063	0.1454	0.9078	0.9014	2.0222	-0.0389	0.1139	0.6365	0.1134	0,9008	0.8939	2.0539
Kumasi/ Tamale	-0.1691*	0.1074	-0,0534	0.1083	0.8968	0.8869	2.0571	0.0934	0.0674	-0.2291*	0.1359	0.8125	0.7995	1..9270

Table 5.3: (Continued)

Kumasi/ Wa	0.2141	0.2333	-0.2096	0.2403	0.8874	0.8796	2.0442	0.0410	0.0842	0.0200	0.0838	0.7824	0.8726	1.9857
Kumasi/ Bolga	0.7865	0.1445	-0.0424	0.1435	0.9032	0.8965	1.9574	-0.1927	0.1.204	-0.0742	0.1219	0.9123	0,9062	1.9691
Techiman/ Kofbridua	0.3361	0.1566	-0.2504	0.1546	0.8870	0,8791	2.0546	0.3566***	0.1275	-0.2285*	0.1300	0.9381	0.9339	1.9750
Techiman/ Tamale	-0.0275	0.0961	-0.1159	0.0945	0.8914	0.8839	2.0592	-0.1306	0.1631	0.1966	0,1636	0.7983	0.7844	1.9904
Techiman/ Wa	0.1538	0.2100	-0.1738	0.2162	0.8823	0.8741	2.0836	0.0604	0.0981	0.1791*	0.0675	0.8823	0.8741	2.0836
Techiman/ Bolga	-0.0975	0.1347	-0.1476	0.1353	0.8883	0.8804	2.0588	-0.1535	0.1429	0.0215	0.1435	0.9095	0.9032	1.9937
Tamale/ Koforidua	0.0148	0.1853	-0.1768	0.1860	0.7722	0.7564	1.9270	0.0746	0.0865	0.0234	0.0664	0.9377	0.9333	2.0378
Tamale/ Wa	-0.2609	0.2546	-0.0635	0.2581	0.7805	0.7653	1.9756	-0.1337**	0.0664	0.5467	0.0456	0.9334	0.9288	2.0101
Tamale/ Boiga	-0.4146***	0.1541	0.2920*	0.1554	0.8258	0.8119	2.0002	-0.2670***	0.0974	0.1122	0.0962	0.9185	0.9129	1.9920
Bolga/ Koforidua	0.0975	0.1622	-0.1759	0.1585	0.9037	0.8970	1.9826	0.2972***	0.1204	-0.1226	0.1242	0.9378	0.9335	1.9931
Bolga/ Wa	-0.3653*	0.2073	0.1125	0.2154	0.9108	0.9047	2.0158	-0.0467	0.0899	-0.0342	0.0897	0.9377	0.9334	2.0103
Koforidua/ Wa	-0.1086	0.1947	0.0988	0.1994	0.9368	0.9258	2.0417	0.0490	0.1052	-0.1311	0.1055	0..9300	0.9252	2.0007

* denotes significance at the 10% significant level, based on asymtotic t-ratios.
** denotes significance at the 5 % significance level, based on asymtotic t-ratios
*** denotes 1% significant level, based on asymtotic t-ratios

Table 5.4: Highlights of Groundnuts Market Integration Results

Market pairs	1st way estimates after 1st and 2nd Weeks lag period							2nd way estimates after 1st and 2nd weeks lag period						
	Pn	std. error	Pl2	std. error	R^2	R adj	DW	P_{21}	std error	P_{22}	std. error	R^2	R^2adJ	DW IMC
Accra/ Koforidua	0.0594	0.2365	-0.0962	0.2379	0.9512	0.9482	1.9678	-0.0623	0.0780	0.0622	0,0783	0.9730	0.9713	1.9805
Accra/ Kumasi	0.0594	0.0535	0.0583	0.0523	0.9504	0.9473	1.9617	0.3049	0.2297	0,0420	0.2297	0.7804	0.7670	1.9974
Accra/ Techiman	0.0132	0.0559	0.0477	0.0562	0.9514	0.9484	1.9880	-0.0214	0.2427	0.1305	0.2427	0.7951	0.7826	1.8900
Accra/ Tamale	-0.1529	0.1444	-0.2353*	0.1435	0.9623	0.9600	1.9895	-07712*	0.0993	-0.0449	0.0728	0.9548	0.9521	1.9986
Accra/ Wa	0.2166	0.3429	-0.0146***	0.3201	0.9502	0.9480	1.9913	1.5376	1.9276	03192	1.8941	0.1608	0.1097	2.0021
Accra/ Bolga	-0.0441	0.2467	0.3065	0.2424	0.9528	0.9499	1.9391	0.1097*	0.0699	-0.692	0.0706	0.9775	0.9761	2.0777
Accra/ Tema	-0.3687	0.0895	-0.2933	0.0909	0.9731	0.9715	2.0593	-0.3229***	0.1210	-0.1754	0.1199	0.9616	0.9593	1.8928
Tema/ Koforidua	-0.1875	0.2558	0.1158	0.2518	0.9390	0.9359	1.9240	-0.1456***	0.0623	0.1443***	0.0640	0.9754	0.9739	1.9215
Tema/ Kumasi	0.9776	0.0561	0.0475	0.1236	0.9359	0.9320	1.9410	0.1945	0.1961	0.0481	0.1964	07699	0.7559	2.020
Tema/ Techiman	0.0451	0.0616	-0.2144	0.0623	0.9308	0.9265	1.9770	0.0472	0.2126	0.3556*	0.2121	0.7708	0.7568	1.878
Tema/ Tamale	0.0836	0.1498	-0.4164***	0.1479	0.9529	0.9500	1.8910	-0.1376*	0.0867	0.0763	0.0877	0.9504	0.9474	1.986
Tema/ Wa	0.0461	0.2310	0.0325	0.0740	0.9358	0.9318	2.0180	-0.2349	1.5734	0.1641	1.5837	0.1698	0.1193	2.003
Tema/ Bolga	-0.2036	0.2645	0.2541	0.2502	0.9373	0.9334	2.0038	0.0773	0.0581	-0.0746	0.0502	09774	0.9760	2.0602
Kumasi/ Koforidua	-0.4805	0.4429	0.0240	0.4475	07638	0.7494	2.0539	-0.0240	0.0304	0,2753	0.0305	0.9740	0.9724	1.9637
Kumasi/ Techiman	0.0742	0.1306	0.0559	0.1162	07291	0.7126	2.0717	0.6782****	0,0679	0.3111***	0.0846	0.8903	0.8836	1.8732
Kumasi/ Tamale	0.1551	0.2928	-0.2095	0.2935	0,7671	0.7529	2.0623	0.0384	0,0439	0.0712	0.0439	0.9436	0.9401	1.9838

Table 5.4: (Continued)

Kumasi/ wa	0.4326	0.128	0.0100	0.0126	0.7151	0.6978	2.1493	0.9926	0.4175	0.4175	0.7242	0.1486	0.0967	2.0016
Kumasi/ Bolga	-0.2602	0.4410	-1.0869***	0.4363	0.7842	0.7711	1.9446	0.0519*	0.0286	0.0121	0.0190	0.9759	0.9745	2.1217
Techiman/ Koforidua	-0.0844	0.4981	0.7642*	0.5006	0.7490	0.7338	1.9078	-0.0218	0.0341	0.0114	0.0346	0.9725	0.9709	1.9622
Techiman/ Tamale	-0.1496	0.3170	0.3129	0.3184	0.7740	0.7602	1.9070	0.0234	0.0469	0.0574	0.0473	0.9414	0.9407	1.9979
Techiman/ Wa	0.0124	0.0139	0.0135	0.0139	0.7094	0.6917	1.9893	0.2077	0.8312	0.2179	0.8354	0.1209	0.0673	2.0039
Techiman/ Bolga	0.2214	0.5210	-0.5491	0.5148	0.7523	0.7372	1.9538	0.0336	0.0322	-0.0109	0.0324	0.9749	0.9733	2.0515
Tamale/ Koforidua	0.0926	.01939	-0.5065***	0.1943	0.9482	0.9450	1.9876	-0.1347	0.0965	0.4234	0.0976	0.9734	0.9718	1.9500
Tamale/ Wa	0.2312	0.4123	0.1242	0.2341	0.9433	0.9398	1.9791	2.6588	2.3592	-2.1839	2.3809	0.1525	0.1010	2.0026
Tamale/ Bolga	-0.0742	0.2069	-0.1458	0.2053	0.9466	0.9428	1.9928	0.0750	0.0848	-0.1073	0.0679	0.9787	0.9774	2.1055
Bolga/ Koforidua	-0.0220	0.1326	-0.1187	0.1330	0.9736	0.9720	1.9609	-0.2377	0.1500	0.0243	0.1496	0.9736	0.9720	1.9609
Bolga/ Wa	0.4563	0.0115	0.6542	0.3241	0.9735	0.9719	2.0518	2.4619	3.7252	-2.7799	3.6939	0.1333	0.0805	1.9964
Koforidua/ Wa	0.6548**	0.8831	-1.4556	0.6547	0.9734	0.9717	1.9564	0.3603	3.7090	-0.2678	3.7050	0.0837	0.0279	2.0063

- * denotes significance at the 10% significant level, based on asymtotic t-ratios.
- ** denotes significance at the 5 % significance level, based on asymtotic t-ratios
- *** denotes 1% significant level, based on asymtotic t-ratios

5.5: Degree of market integration

The estimated Index of Market Concentration (IMC), which measures the strength of integration for the cowpea and groundnuts markets are presented in Tables 5.5 and 5.6.

For the cowpea market, nine (9) market pairs consisting of six 1st way and three 2nd way associations were found to be highly integrated (H). These are Accra/Wa, Kumasi/Tema, Tema/Wa, Koforidua/Kumasi, Techiman/Kumasi, Kumasi/Bolgatanga, Wa/Tamale, Tamale/Bolgatanga, and Bolgatanga/Wa.

Other levels of associations identified, as shown in the Tables were, weak market integration (W), independent (also known as segmented or concentrated) markets (I), and those whose results were unclear and therefore classified as undefined results (U).

In the cowpea market, weak market integration, were identified for twenty-six market-pairs for both ways of information flow, while the remaining twenty-one market-pairs were identified as being independent or segmented.

In the groundnuts market results revealed twenty-two highly associated markets, consisting of eleven 1st way and eleven 2nd way directions.

They consist of Kumasi /Accra, Techiman/Accra, Accra/Tamale, Tamale/Accra, Tema/Kumasi, Kumasi/Tema, Tema/Techiman, Techiman/Tema, Tema/Tamale, Tema/Bolgatanga, Bolgatanga/Tema, Kumasi/Koforidua, Techiman/Kumasi, Kumasi/Tamale, Kumasi/Wa, Wa/Kutnasi, Kumasi/Bolgatanga, Techiman/Koforidua Techiman/Tamale, Tamale/Techiman, Techiman/Bolga, and Bolgatanga/Wa.

Table 5.5: A Matrix of Cowpea Market Associations with the Determinant IMCs.

Name of market		1	2	3	4	5	6	7	8
		Accra	Tema	Koforidua	Kumasi	Techiman	Tamale	Bolga	Wa
1	Accra	0	W 2.4	W 6.3	W 2.5	W 4.3	I 17.3	W 3.7	H 1
2	Tema	I 9.8	0	W 6.1	W 4.2	W 2.5	I 7.4	W 4.2	H 1.5
3	Koforidua	I 7.5	W 6.1	0	H 1.6	W 2.8	I 38.1	W 3.3	I 9.4
4	Kumasi	W 6.5	H 1.1	W 4.5	0	I 7	I 16.2	H 1.0	W 4
5	Techiman	W 5.5	I 7.6	W 3.2	H 1.3	0	I 8.6	I 7	I 7
6	Tamale	I 13.1	I 10.4	W 3.5	W 2.3	W 2.8	0	H 1.3	W 25.6
7	Bolga	W 5.9	W 2.9	W 5.7	W 4.6	I 43.7	W 3.8	0	H 1.3
8	Wa	I 13.7	I 21.4	I 8	I 12.2	W 5.9	H | 1.9	I 20.7	0

H = High association
W = Weak association
I = Independent

Source: Market survey, 1996

The number of market-pairs identified as having weak associations in the groundnuts market was fifteen. In addition, fourteen market-pairs were found to be independent, while the results of five market-pairs were unclear and declared undefined.

Table 5.6: A Matrix of Groundnuts Market Associations with the Determinant IMCs.

Name of market		1	2	3	4	5	6	7	8
		Accra	Tema	Koforidua	Kumasi	Techiman	Tamale	Bolga	Wa
1	Accra	0	W 2.1258	I 9.3752	I 15.5523	I 19.0838	H 1.0951	W 2.8597	W 4.5235
2	Tema	2.4 W	0	W 3.6821	H 0.7019	H 1.2448	H 1.2754	H 1.3624	I 16.1605
3	Koforidua	I 18.5826	I 7.9773	0	W 4.1754	I 54.28	W 2.6365	W 4.7126	U 0.8144
4	Kumasi	H 0.4421	H 1.0503	H 0.6039	0	I 7.9743	H 0.9651	H 0.1950	H 1.0435
5	Techiman	H 1.2882	H 1.7131	H 0.8954	H 0.7292	0	H 1.9306	H 1.2063	W 3.775
6	Tamale	H 1.1026	W 6.3037	W 2.0177	I 14.3314	H 0.6811	0	W 6.5370	W 4.5099
7	Bolga	I 10.1814	H 1.4282	I 9.7927	I 22.5722	I 35.5357	I 10.0086	0	H 1.9136
8	Wa	W 2.6382	W 2.6053	U 0.1018	H 1.6041	U 0.1921	U 0.0098	U 0.0160	0

H = High association
W = Weak association
I - Independent or Segmented
U = Undefined

Source: Market survey, 1996/97

The overall market integration results indicate delayed price information flow in both directions for both commodities. However, the results of groundnuts markets imply that information flow between groundnut markets are faster than information flow between cowpea markets. In particular, cowpea prices in rural producing markets seem to be little influenced by urban prices while the urban prices are even more so, with veiy minimal relations with rural prices.

5.6. Producer -wholesaler price share

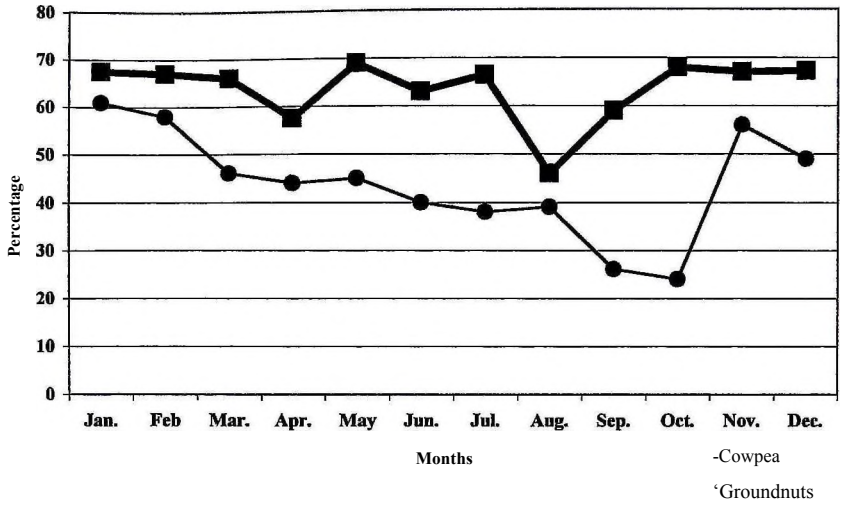
The results obtained for the producer's share of payments made by consumers to urban wholesalers revealed higher dividends to farmers from groundnuts sales than from cowpea sales in both 1996 and 1997 (Figs. 5.7 and 5.8). With the exception of April 1997, during which cowpea farmers obtained a higher share per bag than groundnut farmers, the share of consumer payments that went to groundnut farmers was higher for the two-year period than what was received by cowpea farmers.

In 1996 groundnut farmers obtained shares ranging from 46% to 69% with an average share of 63.7 % of the payments made to wholesalers in urban markets.

In 1997, the average share received by fanners for groundnuts increased to 67%, ranging from 59% to 72% over the twelve-month period.

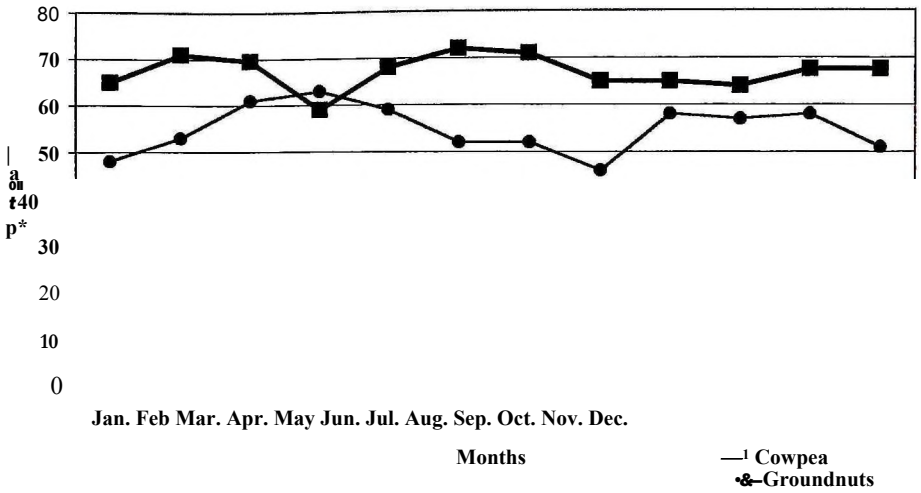
In contrast, the situation identified for the cowpea market indicated lower compensation to farmers with an average share of 43% in 1996, ranging from 24% to 61.5%. The share to farmers however rose to an average of 48% in 1997, with a range of 46% to 63% share.

Fig. 5.5: Producers Share of Urban Wholesale Prices: Cowpea and Groundnuts (1996)



Source: Market survey, 1996/97

Fig. 5.6: Producers Share of Urban Wholesale Prices: Cowpea and Groundnuts (1997)



Source: Market survey, 1996/97

The outcome of the producer-whosaler price spread analysis confirms earlier results at the farm gate, that many farmers are not able to store as much cowpea as they are able to store groundnuts, hence do not benefit from the high prices of cowpea during its off-season. The results also comfirm the outcome of the market conduct analysis for cowpea indicating market monopoly in favour of intermediaries along regional and urban channels.

CHAPTER 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The study examined the procedures of legume storage and the processes involved in their marketing. These included storage structures and treatment procedures used for stock protection, the structure of the markets in terms of entry barriers, the conduct of the markets in relation to the types of pricing policies used by intermediaries, and the marketing efficiency with respect to the types of marketing channels, intra-market relationships, and the share farmers get from the prices paid by consumers to urban wholesalers for the major legumes. The methods employed included statistical procedures involving descriptive, graphical and regression analyses.

6.2. Summary

6.2.1 Farm-gate storage procedures and marketing

The study at the farm-gate revealed that:

1. Farmers have over many years developed different types of storage structures and protection methods in their efforts to protect legumes, in particular cowpea and bambara beans, which are vulnerable to insect pest damage.

2. The main storage structures found in villages for storing threshed legumes are the clay pot *{duk, vijen or dokoh*), mainly used by women, and the conical basket (*kunchun*) and jute sacks; used mainly by men.

3. The mud silos, which are constructed in diferent shapes were found to be widely used by men for storing unthreshed grains and legumes. Different ethnic groupings have different local names such as *lipi*\ among the Kokombas in Northern Region, *bowr, bood* or *buul* in the Upper Regions and *napoo* in some parts of the Northern Region.

4. The use of the improved mud silo, "the mamprusi" mud silo were found to be limited to chiefs and opinion leaders for whom the silo had been constructed by the Ministry of food and Agriculture and the Natural Resources Institute, for demonstration purposes. A temporary storage platform *lenga,* also used for drying grains and legumes was also found in villages.

2. It was found that seventy six (76) and about eighty-three (83.2) percent of bambara beans and groundnuts respectively harvested were kept in storage by farmers during the study period, while only twenty two (22) percent of the cowpea harvested was stored. The low quantities of cowpea storage was found to be caused by the need to sell cowpea for money and the high levels of insect damage to cowpea during storage

5. The inability of farmers to buy chemcials like phoxtoxine and acetylic and the lack of know-how on their application, was found to constitute a limitation to chemical usage on farms.for produce protection. The use of indigenous methods of protection like sun drying and the use of plant materials and wood ash was very popular with farmers.

6. The problems mentioned by farmers during group discussions were, (l).inadequancies of facilities in households for the application of chemicals, (2) low farm-gate prices, (3) lack of transport; (4). poor state of village roads; (5) lack of credit facilities, and (6) exploitation by creditors

6.3 Functions and facilities in legume markets

1. The major marketing functions found on the legume markets visited include purchasing, assembling, processing, and distribution.

2. The marketing services encountered during the survey are transportation, packaging, insecticide application and storage. The results showed however that for reasons of high cost of treatment, the lack of know-how, and the lack of awareness on the need to protect stocks, approximately seventy-eight percent (77.8%) of the traders interviewed did not

apply any chemicals to their stocks during the study period. Indirect financing through stock crediting was also mentioned.

3 The study revealed that many grain and legume markets did not have the conventional facilities required for standard warehousing and storage operations such as fumigation and, like farmers who could only monitor price levels through their wives, traders were found to have limited or no access to market information concerning prices, supply situations and other relevant information on legumes in the country.

6.4.1 Market structure

1. In addition to the high capital required for stock purchases, and expenses on transportation, and insecticides (Appendices B and C), revenue losses resulting from high insect damage to stocks emerged as an important factor influencing the structure of legume markets. Traders who were not able to apply chemicals to cowpea stocks suffered high percentages of insect damage ranging from 38 to 70 percent of the stocks stored over periods ranging from four to eight months.

2. Since good quality influences the price of legumes, many of the traders studied suffered high discounts over stocks, which were rendered low-grade by insects. Income losses ranging from 11.7 - 58.4 percent of net revenue were estimated on 63.6 percent of cowpea stocks. In contrast, revenue losses estimated on groundnut stocks were lower even though all the groundnut stocks studied were not treated against insect attack.

3. The high losses in cowpea revenue resulting from insect damage and the high investment required for stock purchases and assembly were found as the main barriers of entry into legume marketing The results also comfirmed complaints from farmers that even though cowpea is a cash crop many of them would have stored more cowpea for better prices if insect damage to cowpea were not as high and persistent.

6.4.2. Pricing policies

The results of the analysis of pricing policy indicated that:

1. For the cowpea market, price setting at all levels of the distribution channel, were for most part of the year, controlled from the consumer end of the channel. The inverse situations indicated by negative coefficients imply that wholesalers neither pass reductions in prices at supply locations forward for the benefit of consumers, nor increases in prices at the urban level to producers.

2. Using, the Allen, Moro and Harris indicators, the results obtained for the cowpea market suggest the absence of perfect competition, and collusive pricing systems of market conduct, with oligopolistic marketing tendencies along the cowpea channel particularly as trading moves away from the farm towards the cities. This was indicated by the rising intercepts of 22,842, 72,059 and 101,466 cedis from the farm-gate channel to the regional channel and the urban market channel, in that order. The high intercepts also portray rising overhead costs on goods between channel levels.and increases in transfer costs as trading moves from producing areas towards the cities, which are long distances from the supply markets.

3. In the groundnuts market, however, the results show a tendency towards a more competitive marketing system especially at the primary level of the marketing channel This is indicated by the low intercepts and positive coefficients of estimated equations, depicting price interactions and information flow between channel levels.

The low intercept value of - 2.96 for the primary level indicates a highly competitive pricing system in which margins are revealed as percentages of the purchase price. As one moves further down the channel towards urban centres, transit and other marketing costs play a greater role in determining margins. This is shown by the higher but more favourable intercepts of 25.91 between the transit and urban market centres and the overall marketing intercept of 18.32 between the urban wholesaler and the farmer.

4. The positive coefficients for all the equations indicate the absence of inverse margins in the groundnuts market, a condition which depicts the existence of interactions and information flow, among groundnut traders along the marketing channel. The implication is that, unlike the cowpea market, all channel members including producers who store a higher proportion of the crop do influence pricing policies in the marketing of groundnuts.

6.4 3. Market perfomance

The performance of the legume marketing was found by determining the types of marketing channels, market integration, and the producer-wholesaler price spread.

6.4.3.1 Marketing channels

The channels determined for the distribution of groundnuts and cowpea were found to be wide and long in comparison to the channel for bambara beans. The reason was that the marketing channel for cowpea and groundnuts involves many intermediaries including frontmen or market brokers who represent secondary and tertiary wholesalers with no defined value-added functions. From the types of functions performed, the study revealed that these long chains of middlemen do contribute to the high consumer-prices of cowpea and groundnuts.

6.4.3.2. Market integration

1. The overall market integration results indicate better price information flow from producing to urban centers than the reverse. Cowpea prices in rural producing markets in particular seem to be very little influenced by urban prices, implying that cowpea storage and trading in the lean season is limited mainly to traders in the markets.

2. The results of groundnut market integration revealed a better interaction between markets, showing higher market associations in both 1st and 2nd way directions, thus depicting a better information flow among markets and indicating a condition of perfect competition and a wider level of involvement by all intermediaries in the performance of marketing functions and services.

6.4.3.3. Producer-wholesaler price spread

The results of the producer's share of payments to the urban wholesaler revealed higher dividends to farmers from groundnuts than from cowpea in both 1996 and 1997 This confirms earlier results that many farmers are not able to store as much cowpea as they are able to store groundnuts, hence do not benefit from the high prices of cowpea during its off season.

6.5. Overview of study results.

A summary table providing an overview of the study results is given below (Table 6.1.) The Table provides the important features of the farm and market operations which were studied for each of the commodities. These consisted of handling of produce, market structure, market conduct and market performance. The measures for determining these features are storage structures used and treatment of stocks in villages and markets, the entry barriers into the marketing of the commodities, the pricing policies or pricing behaviour of middlemen in the conduct of the market. The market performance was determined by three measures, namely: the type of marketing channel, the integration of legume markets, and the producer-wholesaler price spread or share. The results obtained are shown under each of the commodities studied, namely, cowpea, groundnuts and bambara beans, the last being excluded from some of the studies for lack of stock at the wholesale level. The overall marketing efficiency of each commodity resulting from the influence of each of the measures studied, is indicated.

Table 6.1: Summary of Study Results

Market and farm Characteristic Feature Studied	**Measure of Determination**	Results		
		COWPEA	**GROUNDNUTS**	**BAMBARA BEANS**
Handling of produce	Storage structures and treatment of stock	Ineffective effort at farm level. Less care at markets	Pod storage on farms is very effective. Less care at markets	Pod storage on farms not very effective. Insignificant storage on markets
Market structure	Entry barriers: Insect damage and effect on revenues	Substantial stock damages resulting in high revenue losses	Less damage and minimal revenue losses	Not available at wholesale markers for study
Market conduct	Pricing policies	Prices are inverse and mainly fixed by collusive forces and high demand at retail level. Limited participation by farmers	Prices set by perfectly competitive market forces. Extensive participation by farmers	Not available at wholesale markets for study
Market performance	Marketing channel	Long, broad and overcrowded	Long, broad and crowded	Short and close to consumers
Market performance	Market integration	Many market pairs not associated.	Many market pairs associated in both directions	Not available at wholesale markets for study
Market performance	Producer-wholesaler price spread	Traders keep higher share of consumer payments	Producers get higher share of consumer payments	Not available at wholesale markets for study
Marketing efficiency		Inefficient	Efficient	Inconclusive

Source: Study results

6.6. Conclusions

For an agriculturally dependent economy like Ghana, information on commodity prices are required to guide producers in their choice of enterprises as to which commodity to produce, how much to produce, what production methods to use and when and how to produce for maximum returns. It is expected therefore in the case of legumes that an effective legume marketing system will help stimulate an increase in their output by providing the needed incentives that will encourage the farmer to increase his resource allocation in favour of their increased production

In addition, efficiency in the marketing operations of a commodity lowers its marketing costs, resulting in low consumer prices, which encourage consumers to utilise more of the commodity. An improvement in legume marketing will, therefore, not only improve the living standards of the producer but also increase legume supply and plant protein intake in the country. It is against this background and the persistent influx of holed legume grains, especially cowpea and bambara beans into food markets for sale by traders as well as the persistently high consumer prices, that it becomes necessary to undertake a research study of the operational mechanisms of the post-harvest handling and marketing of legumes in the country.

6.6.1 Sumary of the objectives of the study

The overall objective of this project was, essentially, to determine the structure, conduct and performance of legume marketing in Ghana. Specifically, the study sought to examine the post-harvest handling and control of losses at the farm and market levels; to identify the marketing channels for cowpea, bambara beans and groundnuts; to examine the functions of channel members in the legume market; to determine the entry barriers of the legume market; to determine the pricing policies of middlemen along major channels; to determine the spatial market integration of cowpea, and groundnuts for some selected markets; to determine the producer's share of the urban wholesale price and to identify existing problems and suggest remedies for redress.

6.6.2. Post-harvest handling and control of losses at the farm and market

1. The study revealed that five main structures are used in farm villages for the storage of legumes. These are the big mud silos comprising the improved *mamprusi* silo, which is being used on a limited scale and locally constructed mud silos of variuos types which are extensively utilised. They are used mainly for the storage of unthreshed stocks. Other storage structures found comprise the small egg-shaped container called *buopla* or *mamvuri* and found only in the Upper West Region, the conical basket known locally as *kunchun* found in Northern and Upper East Regions, and the clay pots. These latter structures are all used for the storage of threshed legume stocks.

2. In the markets, jute sacks were the only containers used for packaging legumes.

3. Both chemical insecticides and traditional methods were found being used simultaneuosly by farmers. In contrast, only chemicals sold by drug peddlers were used for stock treatment in the markets. Whereas 46% of the farmers intervieved did not protect their stocks, 38% used traditional methods in the form of botanicals and substances like wood ash and ground pepper. The remaining 16% used chemicals like acetylic powder, liquid or gas and phoxtoxine tablets. In the market as much as 77.8 % of the respondents did not make any attempt to protect their stocks during the period under study. The remaining 22.2% used camphor, acetylic and phoxtoxine.

4. The marketing problems which were revealed in the farm-gate survey consisted of low produce prices at harvest time, cited by 88.5% of the respondents; poor road network: 59 %; lack of transport for carting goods to the market: 42.5 %; the lack of money to buy chemicals for stock treatment: 64%; lack of know-how on the use of chemicals: 85; and the cheating of fanners by prefinance creditors: 32%.

6.6.3. **Channels of distribution and functions of channel members in legume marketing**

1. The marketing channels for the distribution of cowpea and groundnuts were found to be wide and long in comparison to the channel for bambara beans. This implies that

cowpea and groundnut marketing involves a large number of intermediaries. The type of intermediaries encountered in the marketing of these two commodities consisted of secondary and tertiary wholesalers like frontmen or market brokers with no defined value-adding functions. Accordingly, consumers may be paying more than necessary for these commodities as charges for maintaining the long chain of middlemen in the cowpea and groundnuts markets.

2. The channel members found in the legume market comprised:

- Producers who constitute the farmers who produce legumes;
- Primary assemblers who are made up of purchasing agents, village traders and inter-village market traders;
- Secondary assemblers who are traders in the regional markets of producing areas;
- Urban wholesalers who form a group of intermediaries operating at consuming areas with the main function of satisfying the demand of the consuming public and institutions;
- Retailers; and
- Consumers.

Even though some traders contact and buy directly from large-scale producers, the great number of them receive their stocks from the primary assemblers. Secondary assemblers, for instance, try to avoid transport, and other problems associated with purchasing at the primary level. They preferred to buy and assemble their consignments from primary assemblers who brought the legumes to them in the regional markets.

Wholesalers of both producing and consuming areas consisted of large-scale and small-scale operators who operated with assistance from brokers. Some wholesalers operate forwarding services, buying and reselling directly without storage while others perform storage services. Groups of other wholesalers like workers and housewives as well as corporate organizations, churches and institutions were also encountered performing some marketing functions in the legume market.

3. Retail trading was found to be the domain of women who bought from wholesalers to resell in smaller units to consumers. The bambara beans trade was found to be mainly limited to the retail level.

6.6.4. Entry barriers of the legume market

1. The case study on the effect of insect damage confirmed the fears expressed by farmers for weevils on account of which 78 % of average quantities harvested were sold. Even though cowpea is a cash crop like groundnuts, the quatity sold at low prices during harvest could have been less.

2. The results on insect damage assessment revealed that unprotected cowpea stored for periods ranging from four to eight months suffered high percentages of grain damage ranging from 38 to 70 percent. The damage resulted in price discounts.causing losses ranging from 11.7 - 58.4 percent of net revenue on 63.6 percent of the stocks studied.

In contrast to cowpea, revenue losses estimated for groundnut stocks ranged from only 5 to 25 percent. The high losses suffered by legume traders from insect damage in addition to other factors like treatment cost and the high investment required for purchases caused many traders to deal in the marketing of grains and cereals which suffer less losses.

6.6.5. Market conduct: pricing policies of market intermediaries

I. For the pricing policies of cowpea traders, the results of the farm-gate level suggest that margins made by farm-gate middlemen were 8.8 percent of the farm-gate price plus a fixed sum of 22,842 cedis. For middlemen operating between regional markets of producing areas and urban consuming areas the margins estimated were 20.7 percent of the prices in the regional markets, plus a fixed sum of 72,000 cedis. For the overall channel between farm-gate and urban areas, the estimated margin was 43.4 percent of the prices at farm gate plus a fixed sum of 101,466 cedis. However, the presence of negative coefficients indicate Harris inverse margins, implying that the margins made by middlemen at all three levels did not reflect a positive relationship with the price change at the source of procurement. In other words, a fall or rise in the price of cowpea at the supply location is not passed forward at the selling point and vice versa implying a lack

of perfect competition and the presence of monopolistic and oligopolistic operations leading to one-sided type of pricing policies in favour of intermediaries in the cowpea market.

2. Results of pricing policies of groundnuts traders revealed low intercept values of -2.96, 25.91, and 18.32 with positive coefficients of 0.11, 0.14, and 0.32 indicating a highly competitive pricing system in which margins are estimated as 11, 14, and 32 percent plus fixed sums of-2,969, 25,910, and 18,324 cedis respectively for the farm-gate level, regional level and the overall distribution level. The positive coefficients for all the equations indicate the absence of inverse margins in the groundnuts market. A condition depicting the existence of interactions and information flow, among groundnut markets. Consequently, unlike the cowpea market, all channel members inducing producers who store a higher proportion of the crop, do influence pricing policies, in the groundnuts market.

6.6.6. The spatial market integration of legume markets

The spatial market integration was studied in two phases:

1. The first phase required the use of multiple regression models, fitted to determine whether legume markets were associated across space and time in the short-run The results indicated that the condition of Pe=o, which implies no association between markets did not occur for all 56 market pairs studied. In other words all the market pairs studied do have some level of marketing relationship

2. The second phase involved a determination of the strength of the association between markets. This was achieved by determining the Index of Market Concentration (IMC), which indicated markets with high, and weak integration, as well as markets which were independent of other markets. For the cowpea market, the market pairs found to exhibit a high market association were nine consisting of five 1st way and four 2nd way associations These markets pairs were Accra/Wa, Kumasi/Tema, Tema/Wa, Koforidua/Kumasi,

Techiman/Kumasi, Kumasi/Bolgatanga, Wa/Tamale, Tamale/Bolgatanga, Bolgatanga/Wa.

3. In contrast, the groundnut market results revealed twenty-two high market associations consisting of twelve 1st way and ten 2nd way directions. These market-pairs were: Kumasi /Accra, Techiman/Accra, Accra/Tamale, Tamale/Accra, Tema/Accra, Tema/Kumasi, Kumasi/Tema, Tema/Techiman, Techiman/Tema, Tema/Tamale, Tema/Bolgatanga, Bolgatanga/T ema, Kumasi/Koforidua, Techiman/Kumasi, Kumasi/Tamale, Kumasi/Wa, Wa/Kumasi, Kumasi/Bolgatanga, Techiman/KoforiduaTechiman/Taniale, T amale/T echiman, Techiman/Bolga, Bolgatanga/Wa.

6.6.7. Farmers share of payments to urban wholesalers

1. The results revealed that in 1996 groundnut farmers enjoyed a monthly average of 63.7 percent of consumer payments from January to December. The range of farmers share over the same period was 46 - 68 percent. Over the same period in 1996, cowpea farmers obtained a monthly average share of only 43.8 percent ranging between 24 - 61 percent.

2. During the same period in 1997 groundnut farmers enjoyed a monthly average of 67 percent of consumer payments with monthly shares ranging between 59 and 72 percent from January to December while cowpea farmers were trailing with a monthly average share of 54.8 percent. The range of the share of the consumer payments to cowpea farmers in 1997 ranged from 46 to 63 percent for the months of January to December.

6.7. Policy Recommendations

1. Even though farmers have over many years developed different types of storage structures, the study revealed that many of the structures in use are vulnerable to climatic conditions and pest attack, which respectively result in a reduction in the life span of structures and high storage losses. It is recommended, therefore, that further study be made to identify or develop simple, durable but affordable structures for introduction to farmers. The use of underground storage facilities, for instance, may be additional options for study and consideration.

2. The study uncovered many indigenous methods that farmers have developed over the years in their effort to protect grains and legumes, especially, cowpea and bambara beans, from pest damage. The high percentage damage to stocks under the protection of these methods and the failure of farmers to successfully preserve produce for the required length of time portray the limitations and lack of efficacy of these methods. It is recommended therefore that trial experiments be undertaken to select potent practices and recommended dosage of application for reintroduction to farmers. A solution to the problem of pest damage would go a long way to encourage farmers to store part of their cowpea to enable them take advantage of the higher prices of lean seasons to help increase their share of consumer payments, remove the dominance of traders in cowpea storage, and increase and streghten the integration of legume markets.

3. The study revealed also that many grain and legume markets do not have the conventional standard type of facilities required for effective storage and marketing operations. It is therefore recommended that standard warehousing and stock treatment facilities be built in major grain storage and marketing centers to enhance the efficiency of grain and legume marketing in the country.

4. During group discussions in markets, traders persistently complained of their inability to access bank loans for the successful operation of their businesses in this very important sector of agriculture. It is therefore recommended that the Ministry of Food and

Agriculture introduce market extension education services in food markets to educate and assist traders to form groups that could link with relevant banks and institutions, including NGOs, to assist them with loans or in-kind credit facilities to enhance food processing and marketing in the country.

5. The high level of illiteracy among traders and the absence of extention services in the markets created difficulties in the collection of data during the field survey. The absence of operational and accounting records in the operation of the agri-businesses visited led to difficult memory recovery sessions that caused delays in the collection of reliable data. The institution of extension education in markets to assist traders to resolve these issues would be most desirable.

6. Finally, there is an urgent need for the installation of pest control plants and conventional storage facilities in wholesale markets for the proper handling and marketing of grains, cereals and legumes.

6.8. Areas of further research

This study examined some fundamental marketing operations and the factors that control the marketing of the major legumes in Ghana and problems facing post-harvest handling and management. Inspite of the wide coverage and scope of the study, the limitation of time and available logistics did not permit a complete analysis of the industrial organization and marketing of legumes in the country.

For further understanding of the legume market, additional studies are desirable in the following areas.

1. The scale economics of legume marketing in Ghana and cross boundary marketing with neighbouring countries.
2. Responsiveness of the legume industry to policy changes in the country

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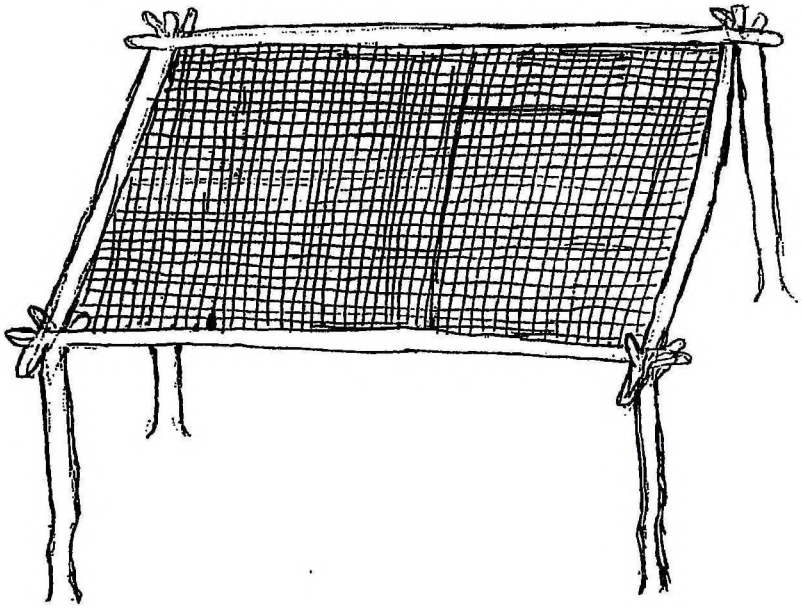
Appendix A

ILLUSTRATIONS OF STORAGE STRUCTURES

I. *Lenga**

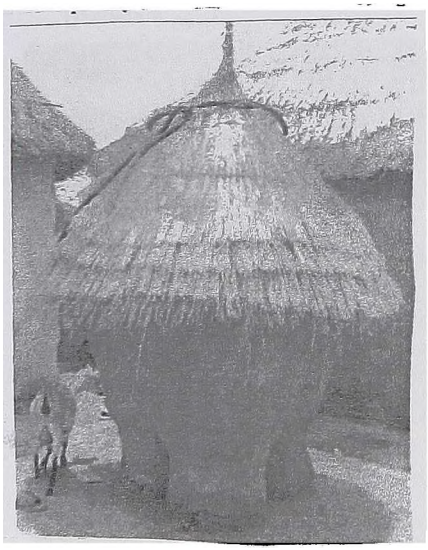


* A wooden platform with *zana* mat Spread on top. It is used for drying and temporary storage.

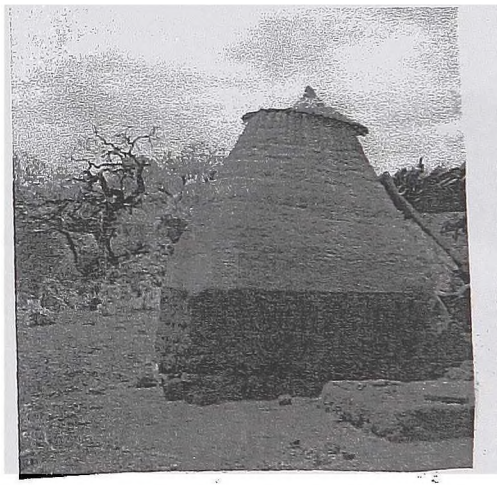
Note:
Also called *kikaafi* in Kokomba areas and *apata* by the Akans.

2. Mud Silos

Traditional mud silos are in all three Northern Regions. As seen in pictures 1 to 7 below, they occur in various shapes and sizes depending on their locality. The local names are *napogu, napoo* (Parts of Northern Region); *lipil* (Kokombas); *bool, buud, bowr* or *baare* (Upper East Region); *bui, bugo, nauvuri* and *mamvuri* or *buopla,* among others (Upper West Region). Apart from the *mamvuri* or *buopla,* the entrance into mud silos are normally at the top and the openings are kept closed by woven grass hats, however some farmers in the Upper East Region also paint or clothe the body of the silos with thatch (pictures 3 and 4) as protection against rain water. Mud silos are built with soil fortified with cement or cow dung and dawadawa herbal preparations and are very popular for the storage of legumes grains and cereals. Termite clay is the best material for mud silo construction and has been used by the kokombas for silo consruction for many years. Some *napogu, napoo, baare, hood, buul* and *bowr* are built on top of short wooden platforms or stones creating a chamber beneath for chicken scoop, while others are built on bear ground. Grounded mud silos are vulnerable to termite attack and the destruction of storage items than those seated on supports. Mud silos are usually cylindrical though other shapes like the *nauvuri* and *buopla* are found in the Upper West Region. They have a big space inside for keeping both threshed and unthreshed produce including cowpea, groundnuts and bambara beans. A type of mud silo called the "mamprusi" mud silo possibly from the Mamprusi areas, has been recommended for extension to other farmers in Northern Ghana by the Ministry of Food and Agriculture (MOFA). The mamprusi mud silo is rounded in shape, built on legs and could have more than one chamber like the *lipil* of the Kokombas.



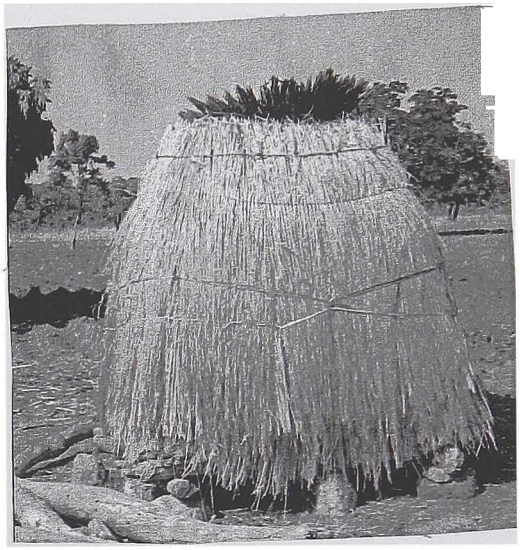
l.Mumprusi mud silo



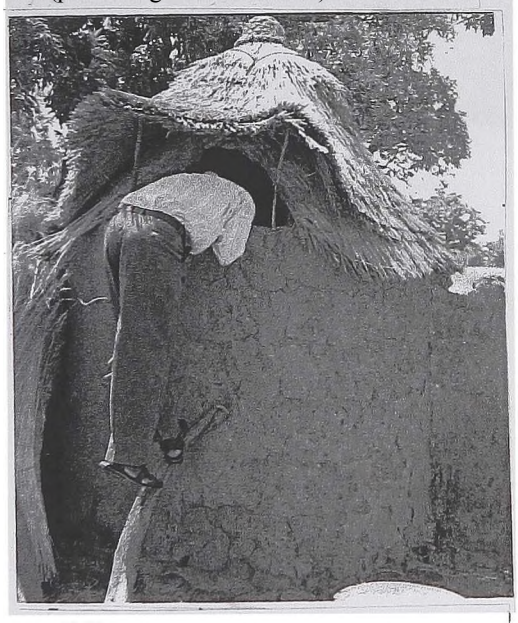
2. Nauvuri (large mudsilo) Upper West Region

Appendix A (Continued)

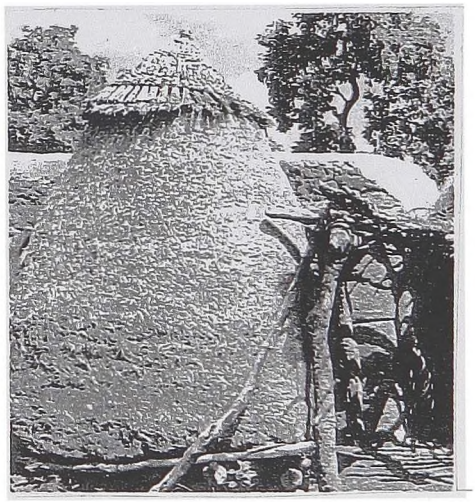
3. A grounded bood, bowr or buul (painted against rain water) -



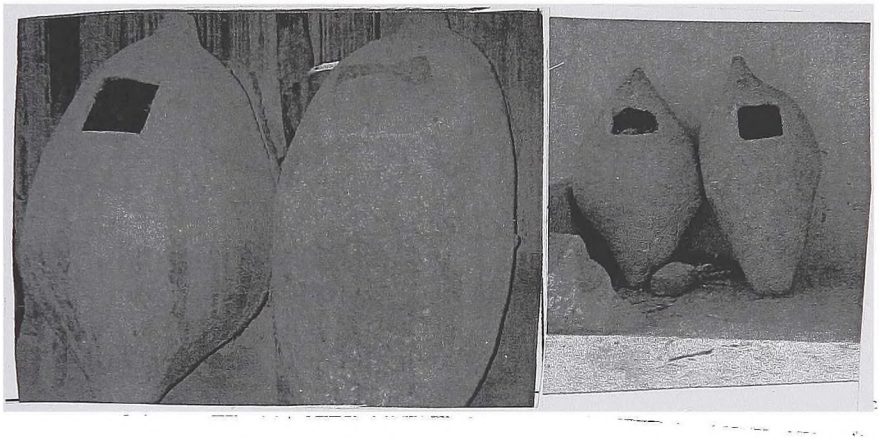
4. Bood, buul or bowr (clothed with thatch)



5. Bowr (opened to remove food)



6: Baare, napoo, napogu (fowls can sleep beneath)



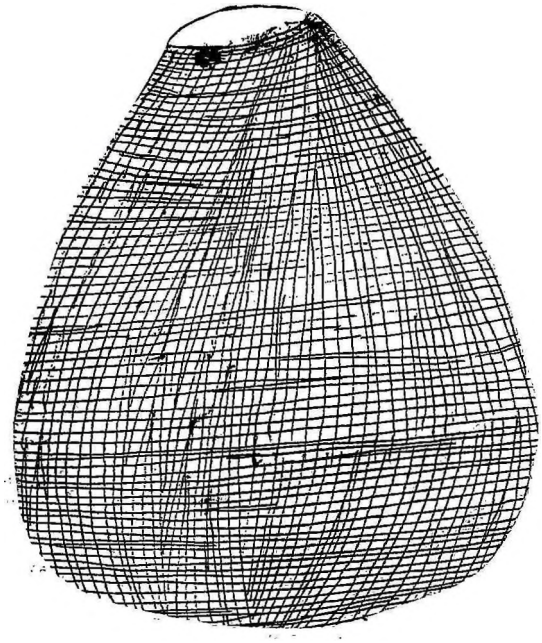
7. *Buopla* or *mamvuri* (small mud silo)

It is a small mud silo oblong or egg-shaped sealed at the top with a small rectangular opening on the mid-top side like a mouth. It can have different shapes in diferent areas. It is used for storing threshed cowpea, bambara beans groundnuts, millet, sorghum, rice and others.

Appendix A (Continued)

3. Storage basket

The storage basket is locally called *lamchun, pupure, kosoku and koyonko* in different villages. The basket is conical in shape and woven from sorghum stalks. After construction the outside is plastered with a mixture of water and cow dung after which it is dried before filled with grains. The structure is widely used in Northern and Upper East Regions for the storage of threshed cowpea, bambara beans, millet and sorghum. It is used mainly by male farmers. After filling with produce, the basket is placed in a room or set on a *lenga* outside the house and covered with a woven thatch hat.



Above: A *kunchun, pupure, kosoku* **or** *koyonko.*

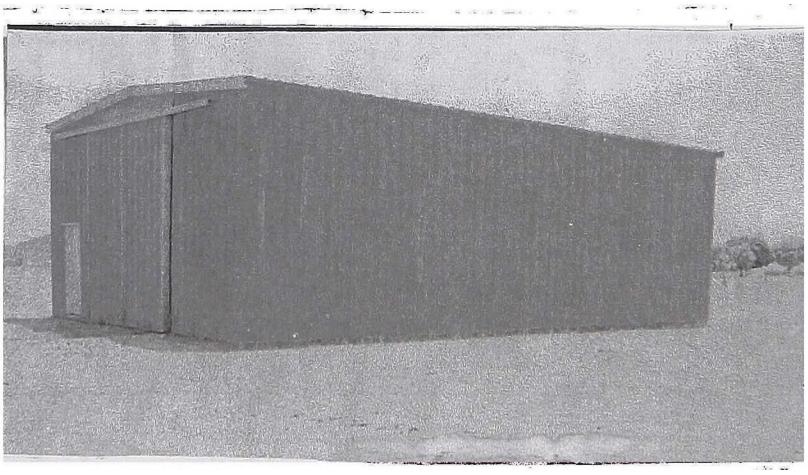
Below: Kunchuns **filled with farm produce, placed on lengas and covered with woven thatch hats.**

4. CLAY POTS

They are called dokoh. dugu, vijen, duk, or yor in various areas of Northern Ghana. They are made from clay by women, who produce them in various shapes and sizes and can either be baked or just dried. They are normally used to store threshed legumes, grains and cereals.

5, MINISTRY OF AGRICULTURE WAREHOUSES (DEPOTS)

They are government storage structures constructed at vantage points in farmin communities in the Upper Regions by the Ministry of Food and Agriculture for communal storage purposes. Farmers call them “depots” and refuse to patronise these structures for fear of inadequate security and care for their food stocks.



Appendix B: General Information from Selected Traders in Northern Ghana. (1996/97 trade seasons)

Jroup dumber	EXPECTED LENGTH OF STORAGE	ACTUAL LENGTH OF STORAGE	AVAILABLE STORAGE STRUCTURES	CAPACITY OF STRUCTURES	CONDI-TION OF STRUC-TURE	LOCA-TION OF STRUC-TURE	REASON FOR LOCA-TION	TRADERS FEELINGS ABOUT STRUCTURE	SUGGES-TION FOR STRUCTURE IMPRO-VEMENT	AMOUNT TRADER CAN PAY FOR REMEDY	TYPE OF TRAINING TRADER THINkS HE NEEDS
	6 month	5 month	Market shed and store	8ft by 10ft but shared by 5 others	Old open wooden structure uncemented floor, leaking low roof	Market	Fast business also has no other place	Not happy	Want block structure with high root and cemented floor	Anything reasonable	Bookkeeping and stock protection
1 il	6 months	Not disclosed	GFDC Warehouse	Very spacious but shared by other GFDC customers	Block cemented floor, high roof	GFDC offices	For treatment and better protection	Satisfied	Wants to have a block structure in the market	Willing to pay but did not mention any amount	Stock treatment and management
3	4 months	4 months	Market shed	8ft by 10ft but shared by 5 others	Old open wooden structure uncemented floor, leaking low roof	Market	Fast business also has no other place	Not happy	Want block structure with high root and cemented floor	Anything reasonable	Stock protection ! methods and type of chemical
4	4 months	Not disclosed	Market shed and store	8ft by 10ft but shared by 5 others	Structure	Market	Fast sales	Not satisfied	Want block structure with high root and cemented floor	0400,000	Stock treatment and management
5	6 months	Not disclosed	Market shed and store	12ft by 8ft but shares with others in market. Refused to show us the store	Old open wooden shed. High root, uncemented floor, dirty surroundings	Bblock store outside market	Fart business and for long storage	Not happy with condition of market shed	Wants block cemented floor high roof in market	2 (two) million	Accounting and stock ! management

Appendix B (Continued)

Group Number	EXPECTED LENGTH OF STORAGE	ACTUAL LENGTH OF STORAGE	AVAILABLE STORAGE STRUCTURES	CAPACITY OF STRUCTURE	CONDITION OF STRUCTURES	LOCATION OF STRUCTURE	REASON FOR LOCATION	TRADERS FEELING ABOUT STRUCTURE	SUGGESTION FOR STRUCTURE IMPROVEMENT	AMOUNT TRADER CAN PAY FOR REMEDY	TYPE OF TRAINING TRADER THINS HE NEEDS
6	5 months	5 months	Market shed	6ft by 6ft	Old open wooden shed. Uncemented floor low roof.	Market	Fast sales	Not happy	Block, high roof cemented floor	Whatever I can get	Pest control
7	4 mouths	8 months	Market shed	10ft by 8ft	Old open wooden shed. Uncemented floor low roof.	Market shed	Fast Sales and have no other place	Not happy	Wants block, high roof cemented floor	Can't tell, will pay be installment	Pest control
8	9 months	8 months	Market shed but demolished	12ft by 10ft	Wooden tightly built with high roof, cemented floor	Market	Fast business	Want block structure	Block structure	Cannot telL Government already building	Pest control
9	5 months	5 months	Market shed + block	Small shed + spacious block store	Market shed demolished. New stores being constructed by Government	Market + store outside market	Fast business + long storage	Indifferent	Needs block structure in market	Store already being constructed	Pest control
11	6 months always selling and buying from village traders	2 months	Block store	15ft by 12 ft	Strong block walls cemented floor, high roof	Street side	Fast business	Happy	Satisfied with store	No need	Pest control
12	6 months	2 months	Block store	18ft by 15ft + high roof	«		«	«	«		Pest control

Appendix C: Financial Results of Cowpea Trading Operations

Group Number	TOWN	TOTAL SALES (BAGS)	NET REVENUE OBTAINED	TOTAL LOSS IN REVENUE	TOTAL MARKETING COST	% OF NET REVENUE OVER TOTAL INVESTMENT	AVERAGE NET REVENUE PER BAG	AVERAGE COST PER BAG	AVERAGELOSS IN VALUE PER BAG	CAUSE OF LOSS IN REVENUE
1	Tamale	500	6,806,000	3,086,000	33,970,000	20,03%	13,612,00	67,940,00	4,172,00	Infestation and low demand
2	Tamale	50	855,000	100,000	3,645,00	23,45%	17,1000=	72,900	2,000	Infested grains but sold at time of high demand
3	Tamale	300	5,256,000	1,859,000	20,724,000	25.36%	17,520	69,080	6,196.66	Infestation and delayed sales
4	Tamale	55	8233,600	249,600	3,983,000	20.67%	14,974.54	72,418.18	4,538.18	Good quality grain but delayed sales
5	Tamale	50	586,200	566,000	3,422,000	17.1%	11,724.00	68,440.00	11,320,00	Infestation and delayed sales
6	Bolga	140	4,321,500	75,000	11,003,500	39.27%	30,867.8	78,596.42	535.7	Limited infestation in UER due to dry weather
7	Bolga	90	2,851,000	Nil	7,359,000	38.74%	31,677.78	81,766.67	Nil	Suppliers schools at high tender prices. And has regular customers
8	Bolga	230	2,937,500	NU	11,470.500	25.6%	12,771.7	49,871.7	Nil	Sells to regular customers at higher prices than market prices
9	Bawku	1,150	13,125,000	Nil	75,521,000	. 17.34%	11,413.0	65,670	NU	Dry weather and high demand

Apppendix D: Cow pea Market Integration Results.

Two-way ntegration Equation	MARKET1	Distance b/n markets. (miles)	MARKET21 P_{1M} || $P_{,,-2}$ || $P_{2,}$ || $P_{2t-,}$ || $P_{2,,-2}$ li P_{21}-3 II R^2 II R'^2 II IMC j| D.W
1.	Accra	53	Koforidua 0.71377 0.2272 0.1353 0.1115 -0.0272 -0.2175 0.9068 0.9003 6.3 . 2.0367
			(0.1012) (0.1059) (0.1254) (0.1785) (0.1794) (0.1193)
			0.00001 0.03 0.07
2.	Koforidua	53	Accra 1.0034 -0.2006 0.0849 0.1333 -0.1093 0.0482 0.9334 0.9288 7.5 1.9931
			(0.1003) (0.1019) (0.0767) (0.0964) (0.0966) (0.0807)
			0 0.05
1.	Accra	169	Kumasi 0.6409 0.1541 0.2538 0.1613 -0.2553 0.0657 0.9185 0.9129 ^{2}-5 1.9837
			(0.0983) (0.0974) (0.0967) (0.1346) (0.1325) (0.1022)
			0.00001 0.117 0.0101 0.0568
1	Kumasi	169	Accra 0.8944 -0.0949 0.2501 -0.1371 0.0402 -0.0327 0.8901 0.8825 6.5 2.07
			(0.1052) (0.1063) (0.0981) (0.1179) (0.1186) (0.0901)
			0 0.0123
I.	Accra	247	Techiman 0.6682 0.1171 0.3094 -0.3054 0.1542 0.129 0.916 0.91 $^{4-3}$ 1.9419
			(0.0994) (0.0911) (0.1102) (0.1598) (0.1606) (0.1176)
			0 0.006 0.058
)	Techiman	247	Accra 1.1027 -0.2619 0.2247 -0.1999 0.0421 0.8805 0.8875 0.8796 5.S 2.119
			(0.0956) (0.1016) (0.0857) (0.1044) (0.1045) (0.0808)
			0 0.0114 0.0101 0.0584
I.	Accra	406	Tamale 0.7167 0.1258 0.2214 -0.0413 -0.0129 0.0394 0.9046 0.8980 17-3 1.9818
			(0.1003) (0.0977) (0.0944) (0.1152) (0.1143) (0.0949)
			0 .0176
	Tamale	406	Accra 0.6615 0.0454 0.2328 -0.0502 0.0126 -0.0627 0.7694 0.7535 . 13.1' 1.9985
			(0.0993) (.0992 (0.1007) (0.1285) (0.0192) (-0.0995
			0 .0228

Appendix D (Continued)

Two-way integration Equation	MARKET1	Distance b/n markets. (miles)	MARKET2	Pin	Plt-2	Pa	P2I-1	P 2t-2	P21-3	R^2	R'^2	IMC	D.W
1.	Accra		Wa	0.7398	0.0956	0.2511	0.2901	-0.7020	0.3633	0.9112	0.9050	i 1	1.9583
				(0.0973)	(0.0976)	(0.1613)	(0.2359)	(0.2427)	(0.1701)				
				00		.12		,004	0.035				
2.	Wa		Accra	0.9943	-0.0963	0.0857	0.0152	0.0722	-0.1379	0.9333	0.9287	13.7 r	2.0967
				(0.1006)	(0.1011)	(0.0571)	(0.0707)	(0.0706	(0.0554)				
				00					0.014				
1.	Accra	506	Bolga	0.6631	0,1593	0.1981	0.1752	-0.0419	-0.1490	0.9136	0.9076	3.7	1.9930
				(0.0987)	(0.1004)	(0.1096)	(0.1548)	(0.1545	(0.1163)				
				00	.11	0.0738							
2	Bolga	506	Accra	0.9482	-0.1406	0.1752	-0.1161	0.1595	-0.1039	0.9094	0.9031	5.9	2.050
				(0.1041)	(0.1866)	(0.0867)	(0.1060)	(0.1071)	(0.0825)				
				00		0.046							
1.	Accra	18	Tema	0.5491	0.1548	0.5598	-0.2228	-0.1048	0.0312	0.9268	0.9218	2.4	2.004
				(0.1034)	(0.1085)	(0.0873)	(0.0915)	(0.1186)	(0.0815)				
				00		00	0.0576						
2.	Tema	18	Accra	0.5315	0.0829	0.5173	-0.0298	-0.0537	-0.0619	0.9357	0.9312	•" 9% ’	1.998
				(0.1002)	(0.1015)	(0.0805)	(0.1125)	(0.1121)	(0.0881)				
				00		00							
1.	Tema	71	Koforidua	0.7139	0.1485	0.27-78 - 0.1176 -0.0785 -0.2207 0.9173 0.9116 6.1 2.012							
				(0.0999)	(0.1043)	(0.1197) (0.1750) 0.1730 (0.1182)							
				00		0.0224 0.0648							
2.	Koforidua	71	Tema	1.0005	-0.2073	0.1950 -0.1578 0.1636 -0.0426 0.9342 0.9297 6.1’, 2.031							
				(0.1030)	(0.1046)	(0.0770) (0.0981 (0.0992) (0.0736)							
				00	0.0503	0.012 0.110 0.102							

Appendix *D (Continued)* ,

Two-way integration | Equation	MARKET 1	Distance b/n makets. (Miles)	MARKET2	PIM	P11-2	Pat	P21-1 P2t-2 P3t-3 R R IMC D.W
1.	Tema	187	Kumasi	0.6328	0.0595	0.2885 0.0568 -0.1480 0.1568 0.9222 0.9168 4.2-, 2.027	
				(0.0985	(0916)	(0.0958) (0.1337) (0.1320) (0.1030)	
				00		0.003 0.13	
2.	Kumasi	187	Tema	0.9107	-0.1124	0.2661	-0.1308 0.7654 -0.0264 0.8899 0.8822 ' 1.1 2.083
				(0.1020)	(0.1056)	(0.0968) (0.1185) (0.1191) (0.0875)	
				00		0.0071	
1.	Tema	293	Techiman	0.6413	0.0849	0.3140 -0.2539 -0.0167 0.3270 0.9230 0.9176 2.5 1.9998	
				(0.0969)	(0868)	(0.1078) (0.1550) (0.1561) (0.1165)	
				00		.0004 0.1047 0.0060	
2..	Techiman	293	Tema	1.0881	-0.2511	0.1976 -0.1425 0.0677 -0.0692 0.8859 0.8780 ; 7.B~J: . 2.1368	
				(0.0955)	(0.1026)	(0859) (0.1057) (0.1058) (0.0787)	
				00	0.0162	0.023	
1.	Tema	424	Tamale	0.6848	0.0594	0.1930 0.0915 -0.0595 0.1500 0.9132 0.9072 7.4 -J 1,9512	
				(0.1009)	(0.0927)	(0.0916) (0.1119) (0.1115) (0.0964)	
				00		0.037 0.12	
2.	Tamale	424	Tema	0.6611	0.04041	0.1944 0.0133 -0.0631 -0.0206 0.7620 0.7455 ■ 10.4 1.9863	
				(0.1017)	(0.1032)	(0.1045) (0.1320) (0.1315) (0.0977)	
				00		.06	
1.	Tema	463	Wa	0.7426	0.0889	0.3341 0.1216 -0.4714 0.2232 0.9099 0.9037 1.5 1.9628	
				(0.1009)	(0.0988)	(0.1679) (0.2437) (0.2495) (0.1739)	
				00		0.0493 0.0618	
2.	Wa	463	Tema	0.9635	-0.0470	0.1120 0.0353 -0.0449 -0.0814 0.9333 0.9287 21.4 2.0154	
				(0.1019)	(0.1040)	(0.0557) (0.0713) (0.0714) (0.0545)	
				00		0.04	

Appendix D (Continued)

Two-way integration Equation	MARKETI	Distance b/n markets. (Miles)	MARKET2	Pin	Pit-2	Pa	P2M	P 2t-2	P2t-3	R^2	R'^2	IMC	D.W
rr	jlema	524	Bolga	0.6759	0.1285	0.2855	0.0554	-0.1055	-0.0288	0.9131	0.9071	4.2 ~	1.9895
				(0.1017)	(0.0989)	(0.1128)	(0.1568)	(0.1577)	(0.1166)				
				00		0.013							
2.	Boiga	524	Tema	0.9521	-0.0963	0.2056	0.0466	-0.3247	0.1480	0.9155	0.9097-	.2.9	1.9745
				(0.1020)	(0.1024)	(0.0813)	(0.1027	(0.1033)	(0.0790)				
				00		0.01		0.002	0.06				
1.	kumasi	124	koforidua	0.8896	-0.0405	0.4478	-0.4050	0.1947	-.1792	0.8987	0.8917	■ 4.5 "	2.0148
				(0.006)	(0.1038)	(0.1166)	(0.1630)	(0.1677)	(0.1065)				
				00		0.002	0.014		0.095				
2.	koforidua	124	Kumasi	0.8879	-0410	0.2691	-0.0454	0.5468	-0.0639	0.9431	0,9392	1.6	, 1.9731
				(0.0991)	(0.0943)	(0.0737)	(0.1064)	(0.1030)	(0.0792)				
				0000		0.0004							
1.	Kumasi	78	Techiman	0.7454	-0.0356	0.3611	-0.1020	0.1063	-0.0616	0.9078	0.9014	7	2.0222
				(0.1008)	(0.0953)	0.01033	(0.1452)	(0.1454)	(0.1060)				
				0000		0007							
2.	Techiman	78	Kumasi	0.8909	-0.1255	0.3013	-0.0389	0.6365	-0.1253	0.9008	0.8939	• 1 . 3	2.0539
				(0.9913)	(0.1028)	(0.0858)	(0.1139)	(0.1134)	(0.0803)				
				0000		0007							
1.	Kumasi	237	Tamale	0.8691	-0.0357	0.3548	-0.1691	-0.0534	0.0161	; ,0.8968	. 0.8869	16:2	■2.0571
				(0.1033)	(0.1036)	(0.0903)	(0.1074)	(0.1083)	(0.0820)				
				000		0.0002	0.11						
2.	Tamale	237	Kumasi	0.5419	0.0989	0.3891	*****	-0.2291	0.0921	0.8125	0.7995	2.3	1.9270
				(0.0978)	(0.0947)	(0.0962)		(0.1359)	(0.0962)				
				0		.0001		0.09					

Appendix D (Continued)

Two-way integration Equation	MARKET1	Distance b/n markets. (Miles)	MARKET2	Pin	P«-2	Pa	P2M	P 2t-2	P2t-3	R^2	R^{-2}	IMC	D.W
1.	Kumasi	276	Wa	0.9644	-0.1011	0.1127	0.2141	-0.2096	-0.0185	0.8874	0.8796	. .4 '>	2.0442
				(0.0985)	(0.0988)	(0.1601)	(0.2333)	(0.2403)	(0.1639)				
				0000									
2.	Wa	276	Kumasi	1.0328	-.1214	0.0341	0.0410	0.0200	-0.0588	*o-'l0£6 0.2171* 12.2'			\^ns
				(0.1009)	(0.0997)	(0.0619)	(0.0842)	(0.0838)	(0.0602)				
				0000									
1.	Kumasi	337	Bolga	0.8484	3.8794	D.3152	0.7865	■0.0424	■0.1733	0.0.9032	0.8965	1 1.	1.9574
				(0.0970)	(0.0978)	(0998)	(0.1445)	(0.1435)	(0.1043)				
				0000		0.0021							
2.	Bolga	337	Kumasi	0.8948	-0.0421	0.3042	-0.1927	-0.0742	0.0650	0.9123	0.9062	4.6 -	1.9691
				(0.1039)	(0.1022)	(0.0895)	(0.1204)	(0.1219)	(0.0850)				
				0000		0.0010							
1.	Techiman	202	Koforidua	1.1026	0.2195	-0.0663	0.3361	-0.2504	-0.01173	0.8870	0.8791	3.2	2.0546
				(0.1031)	(1042)	(0.1112)	(0.1566)	(0.154 6)	(0.1015)			-	
				0	0.0377		0.0343	0.108					
2.	Koforidua	202	Techiman	1.0181	-0.1606	-0.0435	0.3566	-0.2285	0.0742	0.9381	0.9339	2.8-	1.9750
				(0.1007)	(0.0951)	(0.0895)	(0.1275)	(0.1300)	(0.0939)				
				000	0.0946		0.0062	0.08					
1.	Techiman	286	Tamale	1.0013	-0.1836	0.2472	-0.0275	-0.1159	0.0201	0.8914	0.8839	. 8 . 6'	2.0592
				(0.0983)	(0.1012)	(0.0807)	(0.0961)	(0.0945)	(0.0751)				
				000	0.0728	0.0028							
2.	Tamale	286	Techiman	0.5556	0.0960	0.3187	-0.1306	0.1966	-0.1255	0.7983 -	' 0.7844	2.8	■1.9984
				(0.0992)	(0.0923)	(0.1146)	(0.1631)	(0.1636)	(0.1156)				. ^
				0000		0.0065							

Appendix D (Continued)

Two-way integration | Equation	MARKET 1	Distance b/n markets. (Miles)	MARKET2	P_{IM}	P_{11-2}	P_{2t}	P2t-1	P_{2t-2}	P2t-3	R^2	R^{-2}	IMC	D.W
1.	Techiman	198	Wa	1.0841	-0.2041	0.0659	0.1538	-0.1738	0.7234	0.8823	0.8741	7	2.0836
				00.0971	(0.0983)	(0.1449)	(0.2100)	(0.2162)	(0.2435)				
				0000	0.0401								
2.	Wa	198	Techiman	1.0658	■0.1488	0.0110	■0.0604	0.1791	■0.0893	0.9305	0.9267	5.9	1.9830
				(0.1001)	(0.0971)	(0.0694)	(0.0981)	(0.0981)	(0.0687)				
				0000				0.0707					
1.	Techiman	331	Bolga	1.0379	-0.1587	0.2399	-0.0975	-0.1476	0.0421	0.8883	0.8804	7 .	2.0588
				(0.0974)	(0.0988)	(0.0952)	(0.1347)	(0.1353)	(0.0963)				
				000		0.0133							
2.	Bolga	331	Techiman	0.9411	-0.0609	0.2422	-0.1535	0.0215	-0.0125	0.9095	0.9032	43,7	1.9937
				(0.1008)	(0.0975)	(0.1001)	(0.1429)	(0.1435)	00.0994				
				000		0.017							
1.	Tamale	361	Koforidua	0.6264	0.1000	0.3144	0.0148	-0.1768	-0.0523	0.7722	0.7564	. 3.5	v 1.9270
				(0.1018)	00.1029	(0.1328)	(0.1853)	(0.1860)	(0.1217)				
				000		0.0198							
2.	Koforidua	361	Tamale	0.8937	-0.0828	0.1688	0.0746	0.0234	0.0230	0.9377	0.9333	38.1	,, 2.0378
				(0.1010)	(0.0938)	(0.0708)	(0.0865)	(0.0864)	(0.0746)				
				0000		0.0191							
1.	Tamale	195	Wa	0.6698	0.0648	0.5104	-0.2609	-0.0635	*	0.7805	0.7653	25.6	1.9756
				00.0986	(0.0971)	(0.1685)	(0.2546)	(0.2581)					
				0000		0.0031							
2.	Wa	195	Tamale	1.0406	-0.1454	0.1688	-0.1337	0.5467	0.0380	0.9334	0.9288	1,9	2.0101
				(0.10002)	(0.1004)	(0.0542)	(0.0664)	(0.0456)	(0.0522)				■s
				0000		0.0024	0.0466						

Appendix *D* (Continued)

1 Two-way integration | Equation |	MARKET1	Distance b/n markets. (Miles)	MARKET2	Pin	P_{11-2}	Pat	P_{2t-1}	P_{21-2}	P_{21-3}	R^2	R'^2	IMC	D.W
1.	Tamale	100	Bolga	0.5753	-0.0244	0.3618	-0.4146	0.2920	-0.0990	0.8258	0.8119	1.3 :	2.0002
				(0.0997)	(0.0904)	(0.1063)	(0.1541)	(0.1554)	(0.1046)				
				0000		0.0010	0.0084	0.0632					
2.	Bolga	100	Tamale	1.0276	-0.1640	0.3267	-0.2670	0.1122	-0.0537	0.9185	0.9129	3-8	1.9920
				(0.0991)	(0.0976)	(0.0762)	(0.0974)	(0.0962)	(0.0737)				
				0000	0.0960	0000	0.0073						
1.	Bolga	461	Koforidua	1.0066	-0.0537	0.0190	0.0975	-0.1759	0.0234	0.9037	0.8970	5.7	1.9826
				(0.1061)	(0.1112)	(0.1161)	(0.1622)	(0.1585)	(0.1029)				
				0000									
2.	Koforidua	461	Bolga	0.9820	-0.1283	0.0119	0.2972	-0.1226	-0.0429	0.9378	0.9335	3.3	1.9931
				(0.0982)	(0.0944)	(0.0852)	(0.1204)	(0.1242)	(0.0942)				
				0000			0.015						
1.	Bolga	171	Wa	O'.09351	-0.1385	0.4398	-0.3653	0.1125 *	0.9108	0.9047	0.25 '	2.0158	
				(0.1015)	(0.1035)	(0.1459)	(0.2073)	(0.2154)					
				0000		0.0033	0.0810						
2.	Wa	171	Bolga	0.9669	-0.1699	0.1930	-0.0467	-0.0342	0.0320	0.9377	0.9334	20.7	2.0103
				(0.0981)	(0.0982)	(0.0630)	(0.0899)	(0.0897)	(0.0662) ,				
				0000	0.0866	0.0028							
1.	Koforidua	400	Wa	1.0233	-0.1639	0.1396	-0.1086	0.0988	0.0299	0.9368	0.9258	9.4	2.0417
				(0.0995)	(0.0959)	(0.1341)	(0.1947)	(1994)	(0.1387)				
				0000	0.0906								
2.	Wa	400	Koforidua	1.0555	-0.1162	0.0759	0.0490	-0.1311	0.1154	0.9300	0.9252 .	8	2.0007
				(0.0998)	(0.1040)	(0.0731)	(0.1052)	(0.1055)	(0.0691)				
				0000									

Source: From Study

Appendix E: Groundnuts market Integration Results. [f]

two-way integration Equation	MARKET1	Distance b/n markets. (miles)	MARKET2	Pin	Pit-2	Pat	Pa-1	Pa-2	P21-3	R^2	R'^2	IMC	D.W
1.	Accra	53	Koforidua	0.9019	0.2765	0.1688	0.0594	-0.0962	-0.0302	0.9512	0.9482	9.3752	1.9678
				(0.0959)	(0.0960)	(0.1515)	(0.2365)	(0.2379)	(-0.0302)				
	Sig.T			0.000									
2.	Koforidua	53	Accra	1.1577	-.0.2194	0.0682	-0.0623	0.0622	-0.0292	0.9730	0.9713	18.5826	1.9805
				(0.0941)	(0.0943)	(0.0575)	(0.0780)	(0.0783)	(0.0578)				
				0.0000	0.0218								
1.	Accra	169	Kumasi	0.9067	-0.0592	0.0462	0.0594	0.0583	0.9467	0.9504	0.9473	15.5523	1.9617
			1	(0.0966)	(0.10180	(0.0524)	(0.0535)	(0.0523)	(0.0512)				
				0.000		A							
2.	Kumasi	169	Accra	0.1348	0.0374	0.1230	0.3049	0.0420	0.1691	0.7804	0.7670	0.4421	1.9974
				(■0^)947)	(0.0947)	(0.1664)	(0.2274)	(0.2297)	(0.1749)				
1.	Accra	247	*Tectjjfjn^fT*	0.9103	-0.0247	0.0890	0.0132	0.0477	-0.0320	0.9514	0.9484	19.0838	1.9880
				(0.0940)	(0.0974)	(0.0475)	(0.0559)	(0.0562)	(0.0483)				
Sig.T				0.000	0.063								
2.	Techiman	247	Accra	0.5234	-0.2816	0.2563	-0.0214	0.1305	0.4063	0.7951	0.7826	\ 1.2882	1.8900
				(0.0901)	(0.0886)	(0.1772)	(0.2427)	(0.2427)	(0.1810)				
		' k		0.0000	0.0019				0.0268				
1.	Accra	406	Tamale	0.2577	-0.0140	0.5179	-0.1529	-0.2353	0.1826	0.9623	0.9600	1.0951	1.9895
				(0.09311)	(0.0968)	(0.0964)	(0.1444)	(0.1435)	(0.1038)	-			
				0.000		0.000		0.103	0^3812	r-			
2.	Tamale	406	Accra	0.8504	-0.0879	0.3711	-0.7712	-0.0449	0.0449	0.9548	0.9521	1.1026	1.9986
				(0.0993)	(0.1020)	(0.0727)	(0.0993)	(0.V006)	(0.0728)				
				0.0000		0.0000	0.0874						

, Appendix E (Continued)

Two-way integration Equation	MARKET1	Distance b/n markets. (miles)	MARKET2	Pin	P«-2	Pa	P*i	Pa-2	P2t-3	R^2	R'^2	IMC	D.W
1.	Accra		Wa	0.9798	0.0184	0.8609	0.2166	-0.0146	0.0225	0.9502	0.9480	4.5235	1.9913
				(0.0943)	(0.0972)	(0.6083)	(0.3429)	0.3201	(0.4664)				
				0.000				0.0219					
2.	Wa		Accra	-.0.8415	-0.0472	-0.4313	1.5376	0.3192	0.1292	0.0.1608	0.1097	2.6362	2.0021
				(0.0933)	(0.0962)	(1.4072)	(1.9276)	(1.8941)	(1.3985)				
													*
1.	Accra	506	Bolga	0.8765	0.9238	0.1918	-0.0441	0.3065	-0.3231	0.9528	0.9499	2.8597	1.9391
				(0.0963)	(0.1003)	(0.1674)	(0.2467)	(0.24240	(0.1567)				
				0.0000					0.0415				
2	Bolga	506	Accra	1.1169	-0.2932	0.0646	0.1097	-0.0692	0.0378	0.9775	0.9761	10.1814	2.0777
				(0.0899)	(0.0868)	(0.0513)	(0.0699)	(0.0706)	00.0559				
				0.0000	0.0010		0.1194						
1.	Accra	18	Tema	0.7838	0.0685	0.5946	-0.3687	-0.2933	0.2262	0.9731	0.9715	2.1258	2.0593
				(0.0906)	0.0916	(0.0639)	(0.0895)	(0.0909	(0.0632)				
				0.0000		0.0000	0.0001	0.0016	0.0005				
2.	Tema	18	Accra	0.5509	0.2513	0.6868	-0.3229	-0.1754	0.4755	0.9616	0.9593	1.7061	1.8928
				0.0901	(0.0902)	(0.0782)	(0.1210)	(0.1199)	(0.0782)				
				0.0000	0.0062	0.0000	0.0087						
1.	Tema	71	Koforidua	0.6904	0.1029	0.4416	-0.1875	0.1158	-0.1655	0.9390	0.9353	3.6821	1.9240
				(0,0942)	(0.0980)	(0.1602)	(0.2558)	(0.2518)	(0.1608)				
				0.0000		0.0068							
2.	Koforidua	71	Tema	1.1615	-0.2519	0.1396	-0.1456	0.1443	-.0680	0.9754	0.9739	7.9773	1.9215
				(0.0940)	(0.0938)	(0.0503)	(0.0623)	(0.0640)	(0.0504)				
				0.0000	0.0083	0.0064	0.0212	0.0261					
													*

Appendix *E (Continued)*

Two-way integration Equation	MARKET1	Distance b/n makets. (Miles)	MARKET2	Pn-i	Pit-2	Pa	P21-1 *	P2t-2	P2t-3	R^2	R'^2	IMC	D.W 1
1.	Tema	187	Kumasi	0.6862	0.0899	0.1445	0.9776	0.0475	0.0415	0.9359	0.9320	0.7019	1.9413
				(0.0947)	(0.0960)	(0.0531)	(0.0561)	(0.0561)	(0.0536)				
				0.0000		0.0075							
2.	Kumasi	187	Tema	0.2043	0.1013	0.4346	0.1945	0.0481	0.0689	0.0.7699	0.7559	1.0503	2.0207
				(0.0941)	(0.0947)	(0.1539)	(0.1961)	(0.1964)	(1554)				
				0.0319		0.0056							
1.	Tema	293	Techiman	0.2669	0.0.1524	0.0390	0.0451	-0.2144	0.0489	0.9308	0.9265	1.2448	1.9774
				(0.0925)	(0.0982)	(0.0521)	(0.0616)	(0.0623)	(0.0513)				
				0.0000	0.1234								
2..	Techiman	293	Tema	0.6092	-0.1943	0.1242	0.0472	0.3556	-0.8890	0.7708	0.7568	1.7131	1.8784
				(0.0935)	(0.0905)	(0.1685)	(0.2126)	(0.2121)	(0.1744)				
				0.0000	0.0340			0.0963					
1.	Tema	424	Tamale	0.5311	0.1682	0.4531	0.0836	-0.4164	0.2290	0.9529	0.9500	1.2754	1.8917
				(0.0883)	(0.0872)	(0.0986)	(0.1498)	(0.1479)	(0.1101)				
				0.0000	0.0563	0.0000		0.0057	0.0398				
2.	Tamale	424	Tema	0.8674	0.0.0554	0.3388	-0.1376	0.0763	0.0231	0.9504	0.9474	6.3037	1.9861
				(0.1025)	(0.1061)	(0.0735)	0.0867	(0.0877)	0.0676				
				0.0000		0.0000	0.1154						
1.	Tema	463	Wa	0.7450	0.1930	0.0208	0.0461	0.0325	0.0362	0.9358	0.9318	16.1605	2.0180
				(0.0915)	(0.0905)	(0.0621)	(0.2310)	(0.0740)	(0.0217)				
				0.0000	0.0352	0.0017							
2.	Wa	463	Tema	-0.6120	1.1325	4.0135	-0.2349	0.1641	-1.1220	0.1698	0.1193	2.6053	
				(0.0933)	(0.0932)	(1.2233)	(1.5734)	(1.5837)	(1.2617)				2.0031
						0.0014							

Appendix E (Continued)

Two-way integration Equation	MARKET1	Distance b/n markets, (Miles)	MARKET2	Pn-i	P-lt-2	P2t	P 21-1	P2t-2	P2t-3	R^2	R'^2	IMC	D.W
1.	Tema	524	Bolga	0.3462	0.1578	0.4065	-0.2036	0.2541	-0.2616	0.9373	0.9334	1.3624	2.0038
				(0.0958	(0.0975	(0.1765)	(0.2645)	(0.2502)	0.1673				
				0.0000	0.1083	0.0231			0.1206				
2.	Bolga	524	Tema	0.1104	-0.2617	0.1149	0.0773	-0.0746	0.0115	0.9774	0.9760	1.4282	2.0602,
				(0.0908)	(0.0886)	(0.0466)	(0.0581)	(0.0586)	(0.0502)				
				0.0000	0.0038	0.0153							
1.	kumasi	124	koforidua	0.2902	0.1899	0.7627	-0.4805	0.0240	0.1153	0.7638	0.7494	0.603^	2.0539
				(0.0893)	(0.0896)	(0.2790)	(0.4429)	(0.4475)	(0.2837				
				0.0015	0.0363	0.0073							
2.	koforidua	124	Kumasi	1.1495	-0.2058	0.0830	-0.0240	0.2753	-.0157	0.9740	0.9724	4.1754	1.9637
				(0.0933)	(0.0931)	(0.0296)	(0.0304)	(0.0305)	(0.0294)				
				0.0000	(0.0291)	0.0060							
1.	Kumasi	78	Techiman	0.5917	0.3227	-0.1711	0.0742	0.0559	0.1062	0.7291	0.7126	7.9743	2.0717
				(0.1147)	(0.1285)	(0.1239)	0.1306)	(0.1162)	(0.0921)				
				0.0000	0.0134								
2.	Techiman	78	Kumasi	0.4946	-0.0562	-0.0341	0.6782	0.3111	-0.3680	0.8903	0.8836	0.7292	1.8732
				(0.0866)	(0.0713)	(0.0660)	(0.0679)	(0.0846)	(0.0919)				
				0.0000			0.0000	0.0040	0.0001				
1.	Kumasi	237	Tamale	0.2022	0.1167	0.3254	0.1551	-0.2095	0.3876	0.7671	0.7529	0.9651	2.0623
				(0.0935)	0.0932	(0.1992)	(0.2928)	(0.2935	(0,2147)				
				0.0327		0.1051			0.0736				
2.	Tamale	237	Kumasi	1.0204	-0.1368	0.0660	0.0384	0.0712	0.0246	0.9436	0.9401	14.3314	1.9838
				(0.0954)	0.1040	(0.0425)	(0.0439)	(0439)	(0,0422)				
				0.0000		0.1233							

Appendix E (Continued)

Two-way integration Equation	MARKET1	Distance b/n markets. (Miles)	MARKET2	P«-i	*P* 1t-2	P2t	P2t-1	P2t-2	P2t-3	R^2	R'^2	IMC	D.W
1,	Kumasi	276	Wa	0.4514	0.3421	0.2342	0.4326	0.0100	0.1520	0.7151	0.6978	1.0435	2.1493
				(0.0873)	(0.0874)	(0.0127)	(0128)	(0.0126)	(0.0125)				
				0.0000	0.0002								
2.	Wa	276	Kumasi	-0.0308	-0.0238	0.4143	0.9926	0.4175	-0.1198	0.1486	0.0967	1.6041	2.0016
	•		.	(0.0934)	(0935)	(0.7023)	(0.4175)	(0.7242)	(0.6997)				
				.									
1.	Kumasi	337	Bolga	0.2120	0.1353	0.7732	-0.2602	-1.0869	1.1674	0.7842	0.7711	0.1950	1.9446
				(0.0881)	0.0880	(0.2896)	(0.4410)	(0.4363)	(0.2804)				
				0.0178	0.1272	0.0087		0.0142	0.0001				
2.	Bolga	337	Kumasi	1.1715	-0.2931 •	0.0545	0.0519	0.0121	0.0761	0.9759	0.9745	22.5722	2.1217
				. (0.0888)	(0.0860)	(0:0276)	(0.0286)	(0.0190)	(0.0287)				
				0.0000 >	0.0009	0.0504	0.0720						
1.	Techiman	202	Koforidua	0.6843	-0.1320	0.0169	-0.0844	0.7642	-0.3181	0.7490	0.7338	0.8954	1.9078
				(0.0951)	(0.0939)	(0.3182)	(0.4981)	(0.5006)	(0.3303)				
				0.0000				0.1296					
2.	Koforidua	202	Techiman	1.1834	-0.2082	0.0672	-0.0218	0.0114	0.0156	0.9725	0.9709	54.28	1.9622
				(0.0928)	(0.0961)	(0.0279)	(0.0341)	(0.0346)	(0.0278)				
				0.0000	0.0324								
1.	Techiman	286	Tamale	0.6041	-0.2182	0.3318	-0.1496	0.3129	0.1653	0.7740	0.7602	1.9306	1.9070
				(0.0918)	(0.0906)	(0.2171)	(0.3170)	(0.3184)	(0.2292)				
				0.0000	0.0177	0.1292							
2.	Tamale	286	Techiman	01.0391	-0.1234	0.0661	0.0234	0.0574	-0.0353	0.9441	0.9407	0.6811	1.9979
				(0.0930)	(0.0987)	(0.0395)	(0.0469)	(0.0473)	(0.0393)				
				0.0000		0.0973							
							.						

Appendix E (Continued)

Two-way integration Equation	MARKET 1	Distance b/n markets. (Miles)	MARKET2	PIH	P 1t-2	Pzt	P*i	P2t-2	P2t-3	R^2	R^{*2}	IMC	D.W
1.	Techiman	198	Wa	0.8060	-0.0327	0.0155	0.0124	0.0135	0.0137	0.7094	0.6917	3.775	1.9893
				(0.0955)	(0.0957)	(0.0139)	(0.0139)	(0.0139)	(0.0139)				
				0.0000									
2.	Wa	198	Techiman	0.04188	0.1768	0.5624	0.2077	0.2179	0.40081	0.1209	0.0673	0.1921	2.0039
				(0.0933)	(0.0654)	(0.6502)	(0.8312)	(0.8354)	(0.6658)				
1.	Techiman	331	Bolga	0.6624	-0.1742	0.4717	0.2214	-0.5491	0.3379	0.7523	0.7372	1.2063	1.9538
				(0.0948)	(0.0952)	(0.3356)	(0.5210)	(0.5148)	(0.3271)				
				0.0000	0.0699								
2.	Bolga	331	Techiman	1.1940	-0.2744	0.0300	0.0336	-0.0109	0.0166	0.9749	0.9733	35.5357	2.0515
				(0.0910)	(0.0882)	(0.0261)	(0.0322)	(0.0324)	(0.0273)				
				0.0000	0.0024								
1.	Tamale	361	Koforidua	1.0220	-0.0424	0.2715	0.0926	-0.5065	0.1734	0.9482	0.9450	2.0177	1.9876
				(0.0942)	(0.1026)	(0.1227)	(0.1939)	(0.1943)	(0.1278)				
				0.0000		0.0290		0.0104					
2.	Koforidua	361	Tamale	1.1163	-0.1552	0.1502	-0.1347	0.4234	0.0856	0.9734	0.9718	2.6365	1.9500
				(0.0985)	(0.0992)	(0.0675)	(0965)	(0.0976)	(0.0712)				
				0.0000	0.1269	0.0281							
1.	Tamale	195	Wa	1.0427	-0.0762	0.0133	0.2312	0.1242	0.5543	0.9433	0.9398	4.5099	1.9791
				(0.0955)	(0.0957)	0.2156	0.4123	0.2341	0.6434				
				0.0000									
2.	Wa	195	Tamale	-0.0262	-0.0474	0.4871	2.6588	-2.1839	0.8232	0.1525	0.1010	0.0098	2.0026
				(0.0942)	(0.0950)	(1.6230)	(2.3592)	(2.3809)	(1.6598)				

Appendix E (Continued)

Two-way integration Equation	MARKET 1	Distance b/n markets. (Miles)	MARKET2	Pin	Plt-2	P_{21}	P21-1	[illegible]	P2t-3	R^2	R'^2	IMC	D.W
1.	Tamale	100	Bolga	0.9531	-0.1179	0.3035	-0.0742	-0.1458	0.0206	0.9466	0.9428	6.5370	1.9928
				(0.0975)	(0.0173)	(0.1419)	(0.2069)	(0.2053)	(0.1306)				
				0.0000		0.0346							
2.	Bolga	100	Tamale	1.0379	-0.2345	0.1288	0.0750	-0.1037	0.1073	0.9787	0.9774	10.0086	2.1055
				(0.0916)	(0.0857)	(0.0580)	(0.0848)	(0.0850)	(0.0679)				
				0.0000	0.0072	0.0283			0.1168				
1.	Bolga	461	Koforidua	1.1624	-0.2397	0.2051	-0.0220	-0.1187	0.0493	0.9765	0.9750	9.7927	2.0584
				(0.08990	(0.0898)	(0.0842)	(0.1326)	(01330)	(0.0885)				
				0.0000	0.0087	0.0165							
2.	Koforidua	461	Bolga	1.1202	-0.1648	0.2390	-0.2377	0.0243	0.4051	0.9736	0.9720	4.7126	1.9609
				(0.0960)	(0.0966)	(0.0987)	(0.1500)	(0.1496)	(0.0949)				
				0.0000	0.0908	0.0171	0.1159	0.1159					
1.	Bolga	171	Wa	1.2519	-0.2802	0.0754	0.4563	0.6542	0.3251	0.9735	0.9719	1.9136	2.0518
				(0.0897)	(-0.0892)	(0.0231)	(0.0115)	(03241)	(0.0734)				
				0.0000	0.0021								
2.	Wa	171	Bolga	0.0456	-0.0121	0.4810	2.4619	-2.7799	1.3917	0.1333	0.0805	0.0164	1.9964
				(0.0933)	(0.0934)	(2.3613)	(3.7252)	(3.6939)	(2.3448)			.	
1.	Koforidua	400	Wa	1.1855	-0.2165	0.3956	0.6548	-1.4556	1.5621	0.9734	0.9717	0.8144	1.9564
				(0.0927)	(0.0917)	0.0567	0.8831	0.6547	0.6546				
				0.0000	0.0199		0.0317						
2.	Wa	400	Koforidua	0.0367	0.0387	0.3881	0.3603	-0.2678	0.4545	0.0837	0.0279	0.1018	2.0063
				(0.0950)	(0.0951)	(2.3672	(3.7090)	(3.7050)	(2.3530)				
													J

Source: From study;

Appendix F: Indicated Types of Associations per Market Pairs

Two-way	Local Market	Reference Market	Distance (miles)		
Direction				Cowpea	Groundnuts
1	Accra	Koforidua	53	W	N
2	Koforidua	Accra	53	N	N '
1 !	Accra	Kumasi	169	W	N
2	Kumasi	Accra	169	**W**	H
1	Accra	Techiman	247	**W**	N
2	Techiman	Accra	247	**W**	H
1	Accra	Tamale	407	N	H
2	Tamale	Accra	407	N	H
1	Accra	Wa	445	H	W
2	Wa	Accra	445	N	W
1	Accra	Bolga	506	W	W
2	Bolga	Accra	506	**W**	N
1	Accra	Tema	18	**W**	W
2	Tema	Accra	18	N	W
1	Tema	Koforidua	71	**W**	**W**
2	Koforidua	Tema	71	**W**	N
1	Tema	Kumasi	187	**W**	H
2	Kumasi	Tema	187	H	H
1	Tema	Techiman	293	W	H
2	Techiman	Tema	293	N	H
1	Tema	Tamale	424	N	H
2	Tamale	Tema	424	N	W
1	Tema	Wa	463	H	N
2	Wa	Tema	463	N	W
1	Tema	Bolga	524	W	H
2	Bolga	Tema	524	W	H
1	Kumasi	Koforidua	124	**W**	H
2	Koforidua	Kumasi	124	H	W
1	Kumasi	Techiman	78	N	N
2	Techiman	Kumasi	78	H	H
1	Kumasi	Tamale	237	N	H
2	Tamale	Kumasi	237	W	N
1	Kumasi	Wa	276	W	H
2	Wa	Kumasi	276	N	H
1	Kumasi	Bolga	337	H	H
2	Bolga	Kumasi	337	W	N
1	Techiman	Koforidua	202	W	H
2	Koforidua	Techiman	202	W	N

Appendix F (Continued)

Appendix F (Continued

	Techiman	Tamale	286	N	H
	Tamale	Techiman	286	W	H
	Techiman	Wa	198	N	W
	Wa	Techiman	198	W	U
	Techiman	Bolga	331	N	H
	Bolga	Techiman	331	N	N
	Tamale	Koforidua	361	W	W
	Koforidua	Tamale	361	N	W
	Tamale	Wa	195	N	W
	Wa	Tamale	195	H	U
	Tamale	Bolga	100	H	W
	Bolga	Tamale	100	W	N
	Bolga	Koforidua	461	W	N
	Koforidua	Bolga	461	W	W
	Bolga	Wa	171	H	H
	Wa	Bolga	171	N	U
	Koforidua	Wa	400	N	U
	Wa	Kofiridua	400	N	U

H = High
W = Weak association
N = No association
U = Regression results not well defined.

Appendix G: Questionnaire

Name of crop/item..... .Date

1. Region (1) NR (2) HER (3) UWR
2. Town.....
3. Name of respondent (not compulsory).....
4. Sex (1) Male (2) Female

5. Age group
   (1) 16-30yrs.
   (2) 31-40yrs.
   (3) 40 - 50yrs.
   (4) More than 50 yrs.

Educational Status
   (1) Never been to school
   (2) Up to middle form 4
   (3) Up to J.S.S
   (4) Post elementary/ Post SSS

7. Name of target market.....
8. Frequency of market days per week
   (1) Once (2) Twice (3) Three times

Target market supply sources

Village Market	Distance away (km)	Transport fare (0) in and our	Frequency of Market days.
Bimbilla Karaga Yendi Gushiegu			

10. What category of trader are you?

(1) Wholesaler (sells in bags)

(2) Retailer (sells in bowls)

11. Since when did you start selling this crop.....

12. Do you sell here permanently (1) Yes (2) No If not, name the other markets you trade in .....

13. List all the different categories of people or groups of people (including government and non-government organisations) engaged in selling this grain in this area/market.

(1) (2) (3)

(4) (5) (6)

14. List all others who come to buy the crop from this area/market (e.g. Housewives, matrons other traders etc.)

(1) (2) (3)

(4) (5) (6)

15. What is the largest quantity of stock you are able to store in the year?

16. What is the quantity of grain that passed through your hands?

(1)1994..... (2) 1995.....

17. Among the other traders of this crop how many can be considered large scale traders (handling over 50 bags at a time)

18. Do traders in this area constitute themselves into associations (1) Yes

(3) No.

19. If YES, how many different associations are operating and how many members are in each group

(1) No. of groups..... (2) Membership/Groups.....

20. Are associations specific for specific communities? eg. cowpea sellers association or groundnuts sellers association

21. What is the name of the group you belong to?.

22. Name the town/village where you buy your sock/goods from

Town/ Village of purchase	Dist (Km)	Price Per bag	Price per bowl	No. of bags bought per trip	No. of trips per month	Lorry Fare in and out	Charge per bag	Loading and off loading charges	Other expenses (tax eontariner feeding)
1. Bimbilla									
2. Karaga									
3. Yendi									
4. Gushiegu									
6.									
7.									
8.									
9.									

23. From which sources do you buy your stock?

1) Farmers.....2) Other traders,

24. Which sources do you get good quality grains?

1) Farmers.....2) Other traders

25. Do you consider quality in buying grains?

1) Yes..... 2) No.....

26. If Yes what do you expect to see in the grain to consider it good quality

27. Where do you prefer to buy your grains from?

1) At farmers home

2) On the market route on a market day

3) In the market

28. What are the advantages in your choice of place of purchase?.....

29. Do you buy stock throughout the year ?.....

30. In which months do you buy the largest quantities?.....

31. In what measurers do you buy your stock?.....

32. Do you use a similar measure to sell?.....

33. Sales purchase schedule in quantities per month (From time of Harvest, July

Month	July	Aug.	Sep.	Oct.	Nov.	Dec/	Jan	Feb	Mar	Apr	May	June
Quantity bought												
Price per bag												
Price per bowl												
Quantity sold												

Price per bag												
Price per bowl												

34. What quantity of grain did you carry over from

1) 1994 (My)..... (2) 1996 (July).....

35. What was the quality of the carry overt stock?

1) Weeviled 2) Powdered 3) Good

36. Spoilage percentage of carry over stock.

1) 5% 2) 10% 3)15% 4) 20% per bag 5) >20% (Good)

37. Do you sell at the same place where you buy your stock

1) Yes 2) No If No Name the other markets/town or villages

38. Do you have your own means of transport?.....

39. If No how do you transport your sock to your storage place

40. What problems do you face during transportation.

41. Has any government official ever examined your measures?

1) YES..... 2) NO.....

42. If yes what was their reason.....

Pest/Infestation Control

43. Where do you normally store your stock.....

(1) Home (2) Market.....

44. What is your reason.....

45. In what structure do you store it?

(1) Mud silo (2) Sacks (3) Other (specify)

46. Do you pay rent for storage?.....

47. If Yes how much per month/per bag?.....

48. How long do you store before selling?.....

49. What margin do you make at the time of sale?.....

50. Do you treat tour stock before storage?.....

51. If yes what chemical do you use?.....

52. How do you apply the chemical?.....

53. What other method of control do you use?

(1) Herbs (2) smoke (3) Ash (4) Other (specify)

54. Have you ever been trained in the treatment of stocks?.....

55. If Yes, by whom?.....

56. Do you think the Ministry of Agric should come periodically to treat your stocks for you?

57. What problems do you encounter while storing

58. What are the causes of stock spoilage

(1) Weevils (2) Moulding (3) Powdering (4) Other (specify)

59. Do some customers return grains which are bad?

(1) Yes (2) No

60. If yes do you collect them back?

(1) Yes (2) No

61. If yes, what do you do with it? We keep it, or transfer to someone who prefers it.

62. Quantity of Spoilage declared

Month	July	Aug.	Sep.	Oct.	Nov.	Dec/	Jan.	Feb.	Mar.	April	May	June
Quantity stored	4	4										9
Quantity sold	4	4										9
Spoilage sold												

63. Which varieties spoil more quickly in storage (Local names).In order of importance, give reasons.

Local Name	Reason
1. Black millet	More palatable
2. White	
3. Nara	
4.	
5.	

64. Storing Period

Variety (Local Name	Length of Storage Without treatment	Length of Storage with treatment	Reason
1. 2. 3. 4. 5. 6.			

65. How many times do you treat your stored stocks in a year/season?.....

66. At how many months interval.....

67. What time after purchase do you do the first treatment?.

Source of Capital

68. Where do you get money to start trading in this crop?

(1) Self [ ] (2) Husband [] (3) Loan from bank [ ]

(4) Loan from money Lender [ ]

(5) Grain credit from farmers [ ]

(6) Cash Asst, from relatives [ ]

(7) Grain credit from larger traders [ ]

69. If loan from bank or money lender, what is the interest rate

(1) Bank.....

(2) Money Lender.....

(3) Other source of loan or credit condition.....

Pricing and Competition

70. Who sets the price for a produce per unit measure

(1) Farmer (2) Trader

71. How is the price normally determined.....

72. Do you relate price of purchase to the

(1) Selling price..... (2) Transport cost.....

73. Do you experience any competition during?

(a) Buying (1) Yes (2) No

(b) Selling (1) Yes (2) No

74. If Yes who are your competitors

(a) Buying competitors.....

(b) Selling competitors.....

75. If one decides to go into the trading of this crop what problems is the newcomer likely to face.....

76. Do you have a market queen/king for this crbp?.....

77. If yes what are your obligations to him /her.....

78. When do you pay the least price for a bag or bowl?

(1) Month.....

(2) What was the price?

(1) 1994..... (2) 1995.....

79. At what month did you pay the highest price per bag/bowl

(1) Month.....

80. What was the highest price for?

(1) 1994..... (2) 1995.....

Variety Preference/customer type

81. List the varieties of this crop which you normally sell (Local name)

1) 2) 3)

4) 5) 6)

82. Which customer buys what variety.

Customer	Variety	No. Of bags or bowls per visit.	Who is your main customer (Rank)
Other traders House Wives School factories Others(Specify)			

83. Do you sometimes experience low sales:.....

84. If yes what period is that (months) December, January

85. Do you sometimes find it difficult to get supplies? Yes

86. If yes, what month (s) is the October, November?

87. Do you offer credit sales.....

88. If yes, at what condition.....

89. Do your creditor pay back.....

90. If not what do you do.....

91. Any bad experience since.....

92. What other crops/produce do you sell?.....

93. List the problems you encounter as a trader in this crop

1.
2.
3.
4.
5.
6.
7.
8.

94. Do you have adequate sales facilities in the market for your trading?.....

95. If No what do you suggest should be done to improve facilities in the market?