Gasper Ashimogo

Peasant Grain Storage and Marketing in Tanzania: A Case Study of Maize in Sumbawanga District

Verlag Dr. Köster

Berlin

Schriften zur internationalen Agrarentwicklung
Band 15

D 11

Die Deutsche Bibliothek - CIP-Einheitsaufnahme

Ashimogo, Gasper:
Peasant grain storage and marketing in Tanzania : a case study of Maize in Sumbawanga district / Gasper Ashimogo. - 1. Aufl. - Berlin : Köster, 1995
(Schriften zur internationalen Agrarentwicklung ; Bd. 15)
Zugl.: Berlin, Humboldt-Univ., Diss., 1995
ISBN 3-89574-069-1
NE: GT

"Gedruckt mit Unterstützung des Deutschen Akademischen Austauschdienstes"

1. Auflage Mai 1995

Druck: **multiprint**, Hans-Jürgen Will, Behaimstr. 10, 10585 Berlin
Verlag: Dr. Hans-Joachim **Köster**, Hilbertstr. 9, 12307 Berlin
Tel.: 030/ 7447168 Fax: 030/ 7449052

ISBN 3 - 89574 - 069 - 1

PEASANT GRAIN STORAGE AND MARKETING IN TANZANIA:

A CASE STUDY OF MAIZE IN SUMBAWANGA DISTRICT

Von der Landwirtschaftlich-Gärtnerischen Fakultät
der Humboldt-Universität zu Berlin
zur Verleihung des akademischen Grades
Doctor rerum agriculturarum (Dr.rer.agr.)
genehmigte Dissertation

Vorgelegt von
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Berlin 1994

Promotionskommission:

Vorsitzender:	Prof. Dr. E. Thomas
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Datum der Disputation: 04. April 1995

Gedruckt mit Unterstützung des Deutschen Akademischen Austauschdienstes

ACKNOWLEDGEMENTS

This work would not have been possible without the constructive suggestions, assistance and encouragement that I received from several people. I would first like to express my sincere gratitude to Professor Günter Lorenzl, my supervisor, for offering expert advice on the work based on years of professional experience. His quest for perfect organisation, thoughtfulness and attention to detail were greatly instrumental in bringing this work to its present form. I am also grateful for something I will always treasure - his understanding. In recognition of the relatively short time I had to complete my work, he ensured minimum interruptions throughout my study period.

I am thankful to Professor Hartmut Brandt of the German Development Institute for his constructive suggestions on this research. I also extend my thanks to Professor Erhard Thomas from the Humboldt University of Berlin for presiding over my examination committee.

Initial preparation for this research was undertaken during my doctoral course work period at the University of Hohenheim and I am grateful to Professors Werner Doppler and Mathias von Oppen and fellow doctoral candidates for their valuable suggestions in our seminars. I am thankful to the German Academic Exchange Service (DAAD) for the financial assistance and to Sokoine University of Agriculture for granting me a study leave. Dr. W. Maro, of the Economic Research Bureau, University of Dar-es-Salaam supervised my fieldwork in Tanzania. Based on his research experience he started his job by turning my otherwise theoretical research proposal into practical reality. At the end he offered facilities and organised very useful seminars for initial discussion of my field findings.

A special statement of appreciation goes to Hartmut Müller, of the Integrated Food Security Programme in Rukwa Region, whose commitment to this work went beyond any of my expectations. He was the key person in organising the field work and offered a lot of advice and background material during my stay in Sumbawanga and long after I came back to Berlin. For their assistance in data collection I would like to thank Richard Herman, Emmanuel Ndaga and David Zambe. The assistance of S. Soza in co-ordinating the price data collection and Zakaria Mkoga, N. Nsemwa and Richard Shetto in the laboratory loss assessments at the Uyole Agricultural Centre is highly appreciated. I would also like to thank the village leaders for their valuable co-operation and farmers and traders in the surveyed areas for their eagerness to answer our questions.

For the assistance enjoyed at the institute I am thankful to my colleagues Eldaw Ahmad Mohamed, Wolday Amha, Jeanette Bacha, Birgit Huy, Birgitte Klein, Festus Limbu, Daniel Wahby and Chang-Ju Huang-Tzeng. I am especially thankful to Florens Turuka and Nyamajeje Weggoro who commented on the entire manuscript. Gratitude is expressed to Donald Baerg for his careful editing and proof-reading and Hannelore Menzel for expertly drawing the figures. Regina Schiffner did a commendable job in improving the lay-out of the dissertation. The helping hand of Walter Blodig, Martina Drescher and Pitti Müller is highly acknowledged.

Life in Berlin was easier because of help received from a number of friends. In this respect I would like to acknowledge John Kabudi, Roswitha Paul-Walz, Annete Reck, Fanuel Shechambo and the family of Cyprian Millanzi.

Finally, I am most grateful and indebted to my wife Grace and our Berlin-born son, Alexander who, aside from facing some difficult situations, remained to be a constant inspiration throughout the duration of the studies.

All errors in content and interpretation in this work are the responsibility of the author.

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LIST OF ABBREVIATIONS

ADIS	Agricultural Diversification and Intensification Study
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo
FAO	Food and Agriculture Organisation of the United Nations
FSD	Food Security Department
FSG	Food Studies Group
FSU	Food Security Unit
GDP	Gross Domestic Product
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
IDS	Institute of Development Studies
MALDC	Ministry of Agriculture and Livestock Development and Co-operatives
MDB	Marketing Development Bureau
MSU	Michigan State University
NMC	National Milling Corporation
OPVs	Open pollinated varieties
PCs	Primary Co-operative Societies
SADC	Southern African Development Community
SGR	Strategic Grain Reserve
SFMU	Statistics and Farm Management Unit
SUA	Sokoine University of Agriculture
TDRI	Tropical Development and Research Institute
TET	Tanzania Economic Trends
TFNC	Tanzania Food and Nutrition Centre
TSh	Tanzania Shilling
UAC	Uyole Agricultural Centre
UNDP	United Nations Development Programme
URT	United Republic of Tanzania

SUMMARY

Maize is the major staple cereal grain in Tanzania and it plays an important role in the country's food security and income to smallholder farmers. In response to the crisis which has faced the agricultural sector since independence in 1961, reforms in grain marketing were instituted as part of broader macroeconomic changes beginning in 1984. These liberalisation policies also affected the smallholder farmers' grain storage and marketing patterns. The main objective of this research was to investigate peasants' patterns of maize storage and marketing and the consequent effects of these patterns on spatial and seasonal efficiency as well as food security and income distribution under the auspices of liberalisation. The study builds on the concepts of spatial and temporal efficiency as well as the agricultural household models and uses Sumbawanga, a maize surplus district, as a case study. Analyses are based on questionnaire surveys conducted among 120 farmers and 14 traders, weekly price data from four villages and the main Sumbawanga town market, and monthly loss assessments of grain stored by 20 farmers in the 1992/93 marketing season.

The study reveals that maize production and storage are mainly undertaken to meet household consumption and cash needs. Quantity of maize harvested and household size are the main factors which influence the allocation of maize between sales and consumption. Due to lack of storage facilities for large-scale farmers, unreliable market outlets, and liquidity constraints maize sales are concentrated in the low-price harvest period. Traders play a minimal role in grain storage due to a lack of capital. The market efficiency analysis revealed three main aspects: (1) Rural markets in Sumbawanga district are well integrated into the Sumbawanga town market. However, the degree of integration differs between villages mainly due to differences in accessibility and distance from the central markets. (2) Although spatial price differences are largely a function of the transfer costs there is little possibility for profit maximisation from maize trade within the district. (3) The temporal price efficiency is generally low and is lower at nominal interest rates of below 50 %.

Consequent of the existing storage and marketing patterns one third of the sample farmers did not have enough consumption maize to last until the next harvest. These were forced to buy from the market during the high-price pre-harvest season. Policy interventions to increase maize production could assist in reducing poverty and food insecurity in the district.

ZUSAMMENFASSUNG

Mais stellt das Hauptnahrungsmittel und die wichtigste Einkommensquelle für die meisten Kleinbauern in Tansania dar. Seit Mitte der 80er Jahre hat die tansanische Regierung die Getreidemärkte dereguliert. Dabei geht man davon aus, daß diese Liberalisierungspolitik auch zu Veränderungen der ländlichen Maislagerungs- und Vermarktungseffizienz führt und der Nahrungsmittelsicherung dienlich ist. Das Ziel der vorliegende Arbeit ist es, die Auswirkungen des Liberalisierungspolitik auf Einkommen, räumliche und zeitliche Effizienz sowie auf die Nahrungsmittelausgaben auf der Mikroebene zu beschreiben und die wichtigsten Einflußfaktoren zu identifizieren. Den theoretischen Hintergrund der Untersuchung bilden die Ansätze zur zeitlichen und räumlichen Effizienz und landwirtschaftliche Haushaltsmodelle. Diese Untersuchung nimmt das Maisüberschußgebiet Sumbawanga Distrikt als Fallstudie. Hierzu wurden während eines 9-monatigen Forschungsaufenthaltes 120 Bauern und 14 Privathändler befragt und wöchentliche Preisdaten von 4 ländlichen Märkten und einem Hauptmarkt erhoben. Außerdem wurden die monatlichen Verlustdaten von 20 bäuerlichen Getreidesilos untersucht.

Die Studie zeigt, daß die Produktion und die Lagerung von Mais vor allem dem Verkauf und dem häuslichen Konsum dienen. Diese Maisverwendung wird durch die Familiengröße und die Maismenge beeinflußt. Aufgrund fehlender zuverlässiger Absatzmärkte und unzureichender Lagerfazilitäten für die Großbauern, konzentrieren sich die Verkäufe auf die Niedrigpreisperiode. Händler lagern nicht aufgrund von Kapitalmangel. Die Markteffizienzanalyse zeigt drei wesentliche Aspekte: (1) Auch wenn die lokalen Märkte innerhalb des Sumbawangadistriktes mit den Stadtmärkten integriert sind, so gibt es doch erhebliche Unterschiede zwischen den Dörfern. Die Höhe der Integration wird durch den unterschiedlichen Zugang zur Straße und der Entfernung zum Stadtmarkt beeinflußt. (2) Auch wenn die räumlichen Preisdifferenzen die Transferkosten decken, so gibt es doch wenig Spielraum für Profitmaximierung. (3) Die zeitliche Preisineffizienz ist nur dann hocher, wenn die nominale

Zinsrate unter 50 % liegt. Das Lager- und Vermarktungsverhalten der Kleinbauern führt dazu, daß ein Drittel der betrachteten Bauern nicht über genügend Mais verfügt, um seinen Konsumbedarf zu decken und statt dessen Mais, meist in der Hochpreisperiode, hinzukaufen muß. Politische Interventionen könnten dazu beitragen, eine erhöhte Maisproduktion zu sichern und die Armut innerhalb des Distriktes zu verringern.

CHAPTER 1

INTRODUCTION

1.1 Overview

Since colonial times and after independence in 1961 food grain marketing in Tanzania has come increasingly under government intervention. Dissatisfaction with the dismal performance of grain markets and with the increasing costs to the government in the 1960s and the 1970s has spurred discussions and policy reforms to improve the performance of grain markets and to assure increased participation of the private sector in grain marketing. The liberalisation policy, instituted in the mid-1980s, is an outcome of these debates and policy changes. The grain market reforms are being undertaken as part of a general structural adjustment programme.

The liberalisation policy changes have been in effect for nearly a decade, and a preliminary appraisal can be made. Recent discussion, for example, Bryceson (1993:184), Coulter and Golob (1992:420) and Santorum and Tibaijuka (1992:431) on the process of these policy changes has tended to imply that the reform has been successful towards greater private sector involvement in agricultural marketing despite a number of structural constraints such as poor roads, weak extension services and lack of credit. Because of these constraints, it is stressed (Staatz et al. 1989:703) that even where the principles and purpose of liberalisation may appear to be reasonably well agreed, articulate care must be taken to understand the ability of different types of farmers and other market participants to respond to opportunities created by the liberalisation, given the differences in their access to productive resources, improved technology, information and credit.

Considering the facts that about 80% of the agricultural sector's output in Tanzania is produced by smallholders and that, for example, between 75 and 80% of maize produced in Tanzania is retained at farm level (FAO, 1993:10, 30) the role of the performance of household storage and marketing needs to be understood as a prerequisite for evaluation of the food grain market liberalisation reforms.

This work presents such an attempt and it reports on an empirical study of the post-harvest food system at the farm level. The study has a particular emphasis, which is the storage and marketing behaviour of peasant farmers in Sumbawanga District of rural Tanzania. The maize subsector, purposely chosen due to its fundamental contribution to food supply and farm incomes, is the focus of the study. It is our conviction, however, that many of the issues examined in this work may be applicable to most of the other food grains and to most other grain-producing areas of the country. This chapter outlines the research problems, the objectives of the study, the research questions and the hypotheses to be tested.

1.2 Problem statement

1.2.1 Grain supply variability

Agricultural production in Tanzania is predominantly rainfed. In 1988/89, for example, about 98 % of the nearly 7 mill. ha of land cultivated was rainfed (FAO, 1993:10). Variability in rainfall is, therefore, the major source of supply variability for agricultural commodities. An analysis by the Ministry of Agriculture (URT MALDC, 1992:18-21) shows that in all regions of the country maize is planted in the rainy season between October and February while harvesting coincides with the dry season between April and August[1]. The rainfall varies considerably between and within seasons throughout the country[2].

Even though rainfall and other climatic factors are given exogenously, Sahn (1989:12) argues that farmers can respond to climatic events by adjusting production technologies and management practices to ensure stable incomes and a constant availability of food between seasons. Therefore, regardless of when crops are harvested, the ability to store inter-temporally can balance out seasonal food availability. This suggests that the availability of storage infrastructure and the functioning of markets in terms of efficiency and competitiveness of inter-period arbitrage, are essential components in reducing seasonal fluctuations in food availability and income (Sahn, 1989:13). A further dimension of the storage issue concerns the role of institutions in promoting temporal arbitrage.

Under rural conditions lack of storage at farm level can affect the smallholders in two ways. First, when they decide to sell their grain immediately after harvest when prices are relatively low due to increased market arrivals. Second, when they repurchase the product for home consumption at relatively higher prices in the lean season. Aggregate data from a survey in Burkina Faso, for example, showed some concentration of sales in the low-price, post-harvest periods and a concentration of purchases in the high-price, pre-harvest seasons even though the pattern was not extreme (Ellsworth and Shapiro, 1989:204).

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1 As a result of the seasonality in production there is also a marked seasonal fluctuation in grain supply - a situation which necessitates storage operations.

2 See section 2.2.2 of chapter two for information on annual average rainfall distribution in the country. For an understanding of the influence of rainfall and other factors on maize production in different regions of the country see chapters two and three.

Variability in grain supply can also arise from variability in price expectations of a stored product (Bressler and King, 1970:211-212; Newberry and Stiglitz, 1981:50; Tomek and Robinson, 1991:160). This could in turn depend on the storage costs. Thus, food security requirements and storage costs are important in determining the size of the product sold and hence the extent to which temporal commodity supply and price can be balanced out.

1.2.2 Low government storage capacity

The available government storage capacity[3] is probably below the optimal capacity in terms of food security requirements for the nation. Even though estimates show that between 1970/71 and 1987/88 the open market traded between 64 and 75 % of the marketed maize surplus (Mlay, 1988:4), the denial - until the time of the liberalisation - of legal access to transportation and storage by private traders has led to accumulation of large grain stocks in major produzing areas of the country. For example, following the good maize harvests of 1987/88 there were by January 1989 some 23,000 t of maize accumulated above Rukwa region's available storage space[4] (Tibaijuka, 1989/90:13). Similarly, large stockpiles accumulated in Arusha, Songea and Iringa regions.

Moreover, the Ministry of Agriculture and Livestock Development (URT, 1984:43) estimated a 39% nation-wide maize production increase and an annual increase in demand of 3.4% in the long run up to the year 2000. Indeed, increases in maize yields associated with the adoption of improved varieties and modernisation of peasant agriculture through the use of improved production technology have been documented. Plucknett's (1991:133) review of maize yields[5] in the country over the past 40 years shows that until 1960 annual yield

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[3] Capacity in this respect does not strictly refer to aggregate space available but also to location of facilities with respect to food production potential across regions.

[4] For details about off-farm storage capacity in Sumbawanga district see Table 6.2 under chapter six.

[5] For further details on selected maize statistics see chapter two and Appendix 2.1.

gains averaged about 11 kg/ha/annum but from then on were higher, reaching 71 kg/ha/annum during 1970-75. Then, after levelling off for about 10 years, maize yields began to increase again in 1985 and have continued to rise at a rate of 75 kg/ha/annum.

The increased grain yields must have contributed to the storage bottlenecks. Thus, while technologies are available for raising yields dramatically, an unacceptable share of the increased production will be lost if problems of local storage are not taken care of. This implies that government and private storage, including that of traders, need to complement each other, in which case private sector assistance in the storage operations would definitely ease public stock management problems.

Under liberalisation it is assumed that the private sector will invest to increase its capacity to store grain and hence establish an effective link between producers, the government and consumers. However, due to past policies traders might lack confidence in the new policy changes. Moreover, they may be faced with problems of lack of capital and good infrastructure for efficient storage and marketing operations.

1.2.3 Households trade-off between food sufficiency and cash needs

Newbery and Stiglitz (1981:51) point out that although producers and consumers are the two primary participants in agricultural markets, two other participants: arbitrageurs and the government, do have a marked effect both on the degree of price variability and the success of any commodity price stabilisation scheme.

Peasant farmers in Tanzania, as in many of the developing countries, are both producers and consumers of the staple grains they produce. Therefore, policy and storage practices affect them directly. Furthermore, smallholder food grain harvests are subjected to three separate household's demand for family food, for immediate cash and/or exchange requirements, and for speculative purposes. Therefore, farmers are holding stocks for later sale as well as for later consumption. Pinckney (1989:66) argues that *a priori* determination of how much of the private storage is held for each of these purposes is not possible both because of lack of micro-level data and because the farmers themselves may shift their intended use depending on changes in factors as prices of agricultural and other consumer goods.

Thus, the consequences of commodity storage depend on the actions taken by all storing agents. Following liberalisation traders were not restricted to buying grain directly from farmers. We assume, therefore, that in areas where trader participation in buying grain increased market outlets liberalisation has increased the farmers' marginal propensity to sell out grain at the expense of household food self-sufficiency. However, the magnitude of the effects of the changing marketing patterns to individual farmers will vary with prevailing specific conditions like the level of total grain production and access to the major demand markets.

1.2.4 Lack of information

Available literature indicate that rather than using scientifically-derived information, many previous policy decisions in Tanzania have been based on reviews by committees and commissions following a crisis situation. For example, following the 1987/88 bumper maize harvests cited above the government launched a campaign in November 1989 to mobilise the NMC capacity to buy and move maize from primary Co-operative Societies (PCs) to regional transit NMC godowns and to haul surplus stocks from NMC godowns to final consuming centres (Tibaijuka, 1989/90:13-14). In a recent study on efficiency of the rice marketing system in Tanzania Limbu (1993:19) cites evidence which emphasise that many of these policy changes have concerned mainly the food crops consumed by the majority of the population.

This *ad hoc* situation has often led to too frequent policy changes with a lesser regard to socio-economic justification. Indeed, Biseko (1989:52-53) reports that the most recent decision to form the Food Security Department (FSD) is a result of an FAO Food Security Mission review of the country's food situation in 1986. Accordingly, in 1988 the government issued orders to set up a Board of Trustees to exercise 'final control' over the Strategic Grain Reserve (SGR) and the Food Security Unit (FSU).

At micro level the situation was exacerbated and this is not only limited to Tanzania. More than 20 years ago Lipton (1971:1) lamented about the extreme paucity of data relevant to economic decision on crop storage in developing countries. To date the situation has not significantly improved. Instead, there are plenty of good technical discussions of factors accelerating and impeding crop spoilage of various sorts, and of particular storage systems (Lipton, 1971:3). In Tanzania opportunities for improving the availability of post-harvest data reported by Tyler (1985) have also been limited to losses of stored grain. Under the auspices of liberalisation in Tanzania there has been very little micro-level data of economic importance on the impacts of these policy changes on the rural farming population.

1.3 Objectives of the study

The overall objective of this study is to describe the storage and marketing implications of the grain markets liberalisation process for maize in Tanzania. The specific objectives are:

(a) To identify the patterns of household maize storage and marketing in terms of storage technologies used, amount stored, purpose of storage, duration of storage, quantities marketed and purchased, and the seasonal organisation and timing of marketing transactions.

(b) To evaluate how specific farm characteristics such as total production, prices and market accessibility and family characteristics such as mean size of household influence these patterns.

(c) To describe the market channels for maize in the study area and to analyse typical features including trader arbitrage activities and the reasons which limit traders' participation in seasonal maize storage.

(d) To study seasonal and spatial marketing efficiency in terms of the relationship between storage investment and running costs of different storage technologies and seasonal price variations, and the relationship between transfer and marketing costs and spatial price differences.

(e) To evaluate the implications of the smallholder farmers storage and marketing patterns on food self-sufficiency.

1.4 Research questions

To effectuate the above-stated research problems and objectives requires carrying out an empirical analysis, the results of which should provide answers to the following questions:

(1) Household storage patterns

- What are the household maize storage patterns in the survey villages in terms of amount of grain stored, purpose of storage, and duration of storage?
- What factors significantly influence these storage patterns?
- What is the present household technical, space, managerial and economic maize storage capacity?

(2) Marketing patterns and role of traders

- How is maize marketing organised, that is, what are the major seasonal patterns and methods of marketing transactions in the survey villages?

- What influence does price, quantity of output harvested, household size and market accessibility have on the allocation of grain between sales and household consumption?
- Which are the main market channels for maize and what quantities of grain flow through the different channels?
- What role does storage play in traders' maize marketing activities and what are the most important barriers which limit participation of traders in storage operations?

(3) Seasonal marketing efficiency

- What are the key farm storage cost components for different storage technologies?
- How do storage costs relate to seasonal price changes? Do prices rise significantly over and above the storage cost between the immediate post-harvest period and the off-season?
- What are the most important grain marketing and transfer costs?
- How are spatial price differences between markets related to marketing and transfer costs?

(4) Food sufficiency and farm income

- Given the households marginal propensity to sell maize, is the grain retained for home use enough to feed the family during the lean season up to the next harvest? If not what strategies do families adopt to supplement consumption of own produced maize?
- What are the relative impacts of wealth and/or income and household size in demand for maize?

1.5 Hypotheses

Three general hypotheses are tested in this study. Specific arguments about each of the hypotheses are given in the appropriate subsections. These hypotheses are:

1.5.1 The main factors which determine the size of household storage and marketing is the trade-off between the families food self-sufficiency and sales. Moreover, home consumption increases less than proportionally and the marketed surplus increases more than proportionally with increases in output.

This hypotheses stems from the fact that since maize is a basic subsistence food in Tanzania in general and in the study area in particular, it has to be satisfied first in consumption. This implies, as Haessel (1975:111) notes, that the cultivators' short run decision is to allocate the total production (supply) of foodgrains between consumption and sales net of other disposals which consist of payments in kind for wages and other payments. With necessary adjustments for the influence of household size on consumption, it is expected that smaller farmers will market a smaller proportion of their total harvest relative to bigger farmers. On the other hand, Pinckney (1989:66) assumes that since the motive for traders participation in the marketing system is speculation they are likely to increase their participation in grain marketing after liberalisation. Farmers might respond by increasing the proportion of grain sales out of total production at the expense of their food security objectives.

1.5.2 Traders are not an important factor in seasonal maize storage due to the high costs of investment in storage operations and due to lack of credit and lack of good market infrastructure.

Historically, Tanzanian domestic grain markets consisted of two main channels; firstly, government[6] and quasi-government companies and secondly, private traders and local markets (Lele and Candler, 1984:208-209). To meet the national storage demand more traders may be necessary to complement government storage. However, the participation of traders in storage measures in the past has been very low. It is assumed that under liberalisation traders could assist in storage operations on contract basis with the governments. Furthermore, most of the farm commodities collected by village level middlemen are also purchased by a number of town traders who engage in transshipment activities to other distant regions. It is hypothesised that one factor which limits participation of village based middlemen in grain marketing is lack of capital. Weaker competition of village middlemen is likely to be associated with high profit of town traders relative to local middlemen.

1.5.3 Storage and marketing efficiency in rural markets for maize is low and is significantly lower in the relatively maize-deficit and remote villages than in the maize-surplus and accessible villages.

In an efficient market, costs of storage and transportation must equal the seasonal price increases and spatial price differences for markets which are geographically isolated, with allowances made for 'normal' profits (Scarborough and Kydd, 1992:83-102). In this hypotheses it is assumed that seasonal price increases are significantly higher than expected price increases which incorporates storage costs and that marketing margins exceed transfer costs, respectively. It is assumed further that farmers in relatively maize-deficit and remote areas which are underdeveloped in terms of road infrastructure incur more transportation, storage and transaction costs per unit of stored and/ marketed

[6] In the context of this work the words "government," "official," and "formal" markets on the one hand and "private," "open," "unofficial" and "parallel" markets on the other hand are used synonymously.

produce relative to farmers in surplus and accessible areas. The later may enjoy lower per unit costs of marketing as a result of economies of scale in storage and marketing operations.

1.6 Data base

At national level a reliable assessment of maize production and marketing performance in Tanzania is hindered by lack of reliable data on production and open market activities. For example, Raikes (1986:116) purports that no one knows with any degree of certainty either the level or the trend in per capita food production in the country. The Ministry of Agriculture, Livestock Development and Co-operatives (MALDC) henceforth the Ministry of Agriculture has two units which estimate production of food crops in Mainland Tanzania. These are the Food Security Unit (FSU) and the Statistics and Farm Management Unit (SFMU) which fall under the Directorate of Food Security and the Planning and Marketing Division respectively (URT MDB, 1992b:2).

Although the two organs assemble production estimates separately, each of them depends very much on the Ministry of Agriculture extension staff at village level and district levels for basic data on the area under crop and yields per unit area planted. The Marketing Development Bureau (MDB) of the Ministry of Agriculture casts doubt on the reliability of these data and notes that the method employed at the source relies on the subjective evaluation of the extension officer (URT MDB, 1992b:23). Moreover, the FSU figures are mere forecasts which attempt to provide the probable food situation during the following twelve months.

For purposes of analysis in this study production, marketing and price data summarised by the MDB mainly from the sources described above is utilised despite their shortcomings. Established in the Ministry of Agriculture with FAO/UNDP assistance in 1970 and subsequently supported by World Bank funds the MDB, among other duties, summarises and issues marketing intelligence bulletins, provides advice on pricing policies and reviews the operations of parastatal marketing boards (Siedler, 1993:273).

It is also worth noting that even though several efforts have been made to classify Tanzania into agroecological zones the Ministry of Agriculture collects all agricultural production and marketing data on the basis of administrative regional boundaries. Since these data were readily available most of the analysis in this work is based on the regional data.

1.7 Organisation of the study

This case study is divided into nine chapters including this introduction.

Chapter two explains the setting of the maize sector in Tanzania. The chapter opens up with a brief summary of recent economic and agricultural trends in the country. It then proceeds by elucidating the structure of and trends in maize production and government procurements. Finally, it highlights the overall importance of the maize sector in the Tanzanian economy.

Chapter three summarises the evolution of the institutional, organisational and pricing policies that influenced the marketing of maize in the country since independence in 1961. A brief review of the effects of these policies in the maize economy is also provided.

Chapter four presents the theory, and the methodological and conceptual framework. It reviews economic theory of marketing efficiency with particular emphasis on grain storage. The chapter also points out the implications of the theory of the agricultural household models for a semi-subsistence economy. At the end this section points out the conceptual limitations of economic analysis of farm storage in a semi- subsistence economy.

Chapter five reviews the literature related to grain storage in sub-Saharan Africa and gives a summary of the salient features of grain production and storage in the region.

Chapter six presents a description of the study area and the methods of data collection.

Chapter seven gives the major findings of the case study. Patterns of household storage and marketing activities and the factors which dictate these patterns are discussed. The chapter also discusses the different marketing channels and market organisation in relation to the role of traders and the government in grain marketing after liberalisation.

Chapter eight evaluates the implications of the smallholder farmers' storage and marketing practices on marketing efficiency and on food self-sufficiency in view of the fact that maize serves as both a food as well as a cash crop in the study area.

Chapter nine provides a summary of the study and highlights areas which merit further research.

CHAPTER 2

THE SETTING OF THE MAIZE SECTOR IN TANZANIA

In order to appreciate the need for on-farm maize storage and marketing in Tanzania it is necessary to understand the aggregate dynamics of the maize sub-sector in the country. This chapter starts with a summary of the recent general economic and agricultural trends in the country in section 2.1. Section 2.2 describes the structure of maize production followed by an account of the production and marketing trends in section 2.3. Section 2.4 underscores the importance of maize as a staple grain in the country and section 2.5 summarises the main features of the chapter.

2.1 Recent economic and agricultural trends

Tanzania's economy depends to a large extent on agricultural production. Recent statistics indicate that between 1975 and 1992 the sector employed about 81% of the total population (FAO, 1992:25). About 80% of the agricultural sector's output is produced by smallholder farmers with the mean farm size of 2 ha. Most of the remaining 20% is derived from a significant large-scale commercial estates sector (FAO, 1993:10). On average agriculture contributes about 60% of total Gross Domestic Product (GDP) in the country (FAO, 1993:10). The major cash crops are cotton, coffee, tea, sisal cashew nut and cocoa, which on average account for more than 50% of national foreign exchange earnings (Quiñones et al., 1992:27).

However, growth of the agricultural sector is occasionally affected by unfavourable weather conditions. For example, insufficient rainfall in 1991 resulted in a decline of the sector's relative contribution to GDP from 80% in 1990 to 55% in that year (URT TET, 1992:1).

Table 2.1 summarises the structure of production for the 1988/89 cropping season. The data highlight the importance of cereals and pulses, oil seeds and bananas in the agricultural sector, with 37% and 42% respectively of total crop production. Cash crop accounted for approximately 13% and 4% of total cropped area and production, respectively.

Table 2.1 Crop area and production statistics, Tanzania, 1988/89

Crop category	Area (000 ha)	Production (000 t)
Cereals[a]	2,861	3,810
Root crops[b]	1,069	1,826
Other food crops[c]	1,230	4,369
Cash crops[d]	741	397
Total	5,901	10,402

[a] Maize, sorghum, millet, paddy and wheat.
[b] Cassava and sweet potatoes.
[c] Pulses, oil seeds, nuts and bananas.
[d] Cotton, sisal, coffee, tea, tobacco, pyrethrum and cashew nuts.

Source: FAO (1993) United Republic of Tanzania: Comprehensive Food Security Programme. Vol. 1, Main report:12.

2.2 Structure of maize production

2.2.1 Aggregate national production

In terms of quantity produced, maize is the most important of all cereal grains grown in Tanzania followed by paddy, sorghum, millet and wheat. As shown in Appendix 2.1 for the period between 1961/62 and 1992/93 nation-wide, maize accounted for approximately 79% of estimated preferred staple grain production (maize, paddy and wheat) and 60% of estimated total grain (maize, paddy, wheat, sorghum and millet). Estimates by the Ministry of Agriculture show that maize also accounted for about 28% of total human energy supply between 1970 and 1987 (Mlay, 1988:1). Maize is a preferred staple food grain throughout most of the country.

FAO (1993:11) attributes the dominance of maize in the country's grain economy to favourable seasons during some periods coupled with government support for the maize sector. The National Maize Project briefly discussed in section 2.2.3 below is an example of concerted government efforts to increase maize production. Selected maize statistics collected by the International Maize and Wheat Improvement Centre (CIMMYT) show that the growth rate of yield of maize was higher than that for all cereals between the periods from 1962-66 to 1973-77 and between 1973-77 to 1984-88 (Appendix 2.1). The average growth rates for maize were 4.3 and 6.5% against rates of merely 1.4 and 3.0% for all cereals for the respective periods.

2.2.2 Regional production

At regional level the outlook of maize production is not uniform. As noted earlier, several methods have been undertaken to classify Tanzania into agricultural ecological zones. However, the Agricultural Diversification and Intensification Study (ADIS) conducted jointly by the Food Studies Group (FSG) and the Sokoine University of Agriculture (SUA) acknowledges that the country is so vast and complex in terms of climate, soils and topography. It is therefore difficult to classify it exactly into its agricultural zones in the absence of soil surveys and detailed mapping of the physical environment (FSG and SUA, 1992:25). Even under accurate country zonation it may be difficult to generalise the suitability of a particular area for all crops because climatic requirements differ for each crop. With these differences in climatic factors maize output varies accordingly.

As mentioned above, agriculture in Tanzania depends predominantly on rainfall. Irrigation is limited and is mostly under traditional production. Given the problems outlined above on climatic classification of the country, Gill's (1991:31) argument that rainfall variability in amount, intensity and seasonal distribution is the usual basis for most systems of climatic classification in the tropics appears to be of particular importance for Tanzania.

Annual rainfall averages in Tanzania range from just over 7,000 mm at Bukoba in the far west to less than 600 mm at Dodoma in the dry central area of the country (Map 2.1). The annual distribution is bi-modal in the higher rainfall areas with a short rainy period in October-November followed by slightly more reliable long rains in March-May, and mono-modal (wet season from November to April) in the rest of the country (FAO, 1993:11). Annual variability is quite high resulting in a considerable drought risk which, because domestic grain supply nearly balances demand in average seasons, causes a real danger of food shortages in some years at both national and regional levels.

Table 2.2 and Figure 2.1 show the summary of regional maize production in the country and which areas have relatively more important maize supplies. It is worth noting that as a result of the rainfall regime much of the production tends to concentrate around the periphery. This stresses the importance of transportation links and other infrastructural facilities for such functions as marketing, communication and storage of maize.

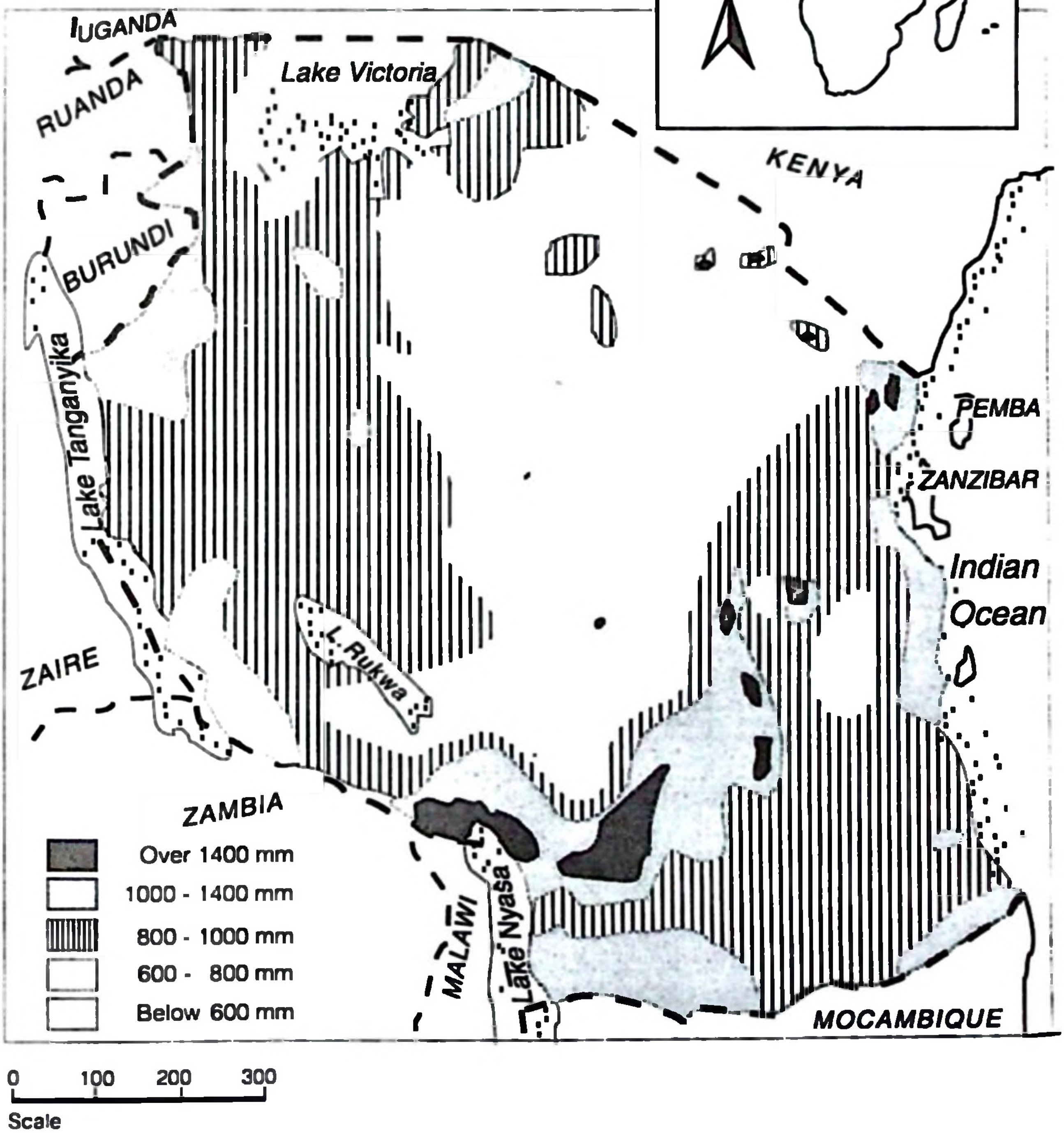
The major producing regions of Arusha, Iringa, Mbeya, Rukwa, Ruvuma, Shinyanga, Tabora and Mwanza yielded on average over 70% of total maize production between 1985/86 and 1991/92. In contrast, the coastal regions of Coast (including Dar-es-Salaam), Lindi, Mtwara and Tanga together with the semi-arid central regions of Dodoma and Singida produced only 11% of the national total (Table 2.2 and Figure 2.1).

During the same period an average of about 1.7 mill. ha were planted to maize in Tanzania; more than 60% of the area was in Arusha, Iringa, Mbeya, Mwanza, Ruvuma, Shinyanga and Tabora (Table 2.2). Although regional levels of maize production coincide to a large extent with the respective areas under maize cultivation, it is eminent from Table 2.2 that differences in production

Map 2.1

Average annual rainfall, Tanzania

1978 - 1986



Source: Boesen et al. (1986) Tanzania: Crisis and Struggle for Survival. Uppsala: 17.

levels between regions can also be attributed to differences in productivity or yield levels. Furthermore, Table 2.2 reveals that Arusha region and the 'big four' maize-producing regions of Iringa, Mbeya, Rukwa and Ruvuma have relatively the highest per capita maize production figures.

The regional level maize production is reflected on maize adequacy in Table 2.2. Data for the period between 1985/86-1991/92, imply that 63% of the Tanzanian population lives in maize deficit regions, that is, in regions producing less maize than they actually require to feed their populations[7]. The main maize deficit regions are Dar-es-Salaam, Coast, Dodoma, Kagera, Kigoma, Lindi, Mara, Mtwara, Mwanza, Singida and Tanga with a production of less than 80% of their maize requirements.

[7] This analysis should be interpreted with caution because although maize is the most important staple crop in Tanzania there are wide differences in consumer preferences in the country. For example, regional food balance sheets cited by FAO (1993:14) show that in terms of total food production the population in Kagera region, where production and consumption of bananas and cassava is more predominant, had an overall food adequacy of over 200 % in the 1989/90 marketing year. In contrast, the region's maize adequacy for 1985/86-1991/92 was less than 40 % (Table 2.2).

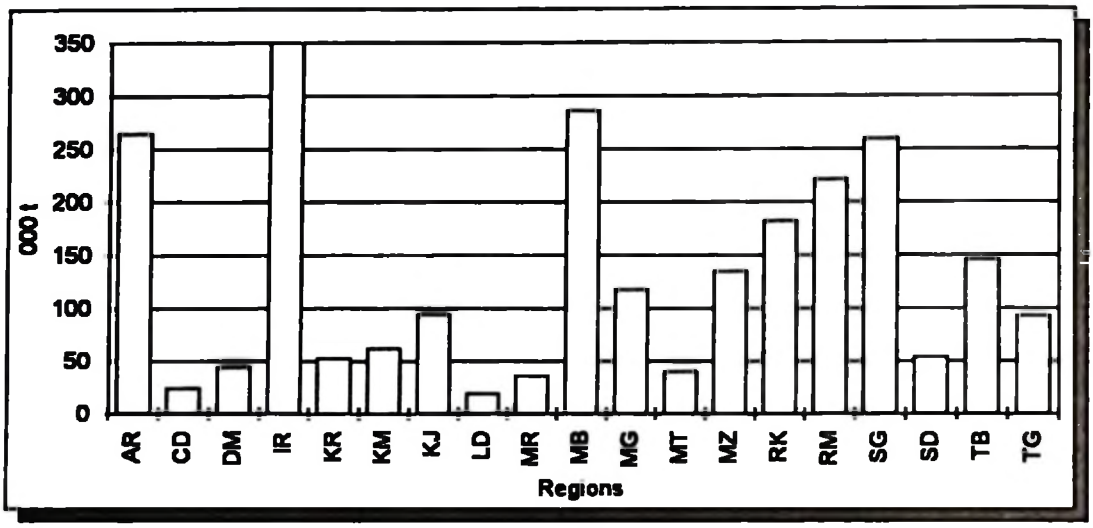
Table 2.2 **Mean area, production and yield of maize by region, Tanzania, 1985/86-1991/92**

Region	Production (000 t)	Area (000 ha)	Yield (kg/ha)	Population[a1] (000)	Per capita production (kg)	Production sufficiency[b] (%)
Arusha	265	139	1906	1456	182	184
Coast/DSM	24	19	1263	2160	11	11
Dodoma	44	42	1048	1296	34	34
Iringa	350	219	1598	1273	275	278
Kagera	53	45	1178	1434	37	37
Kigoma	62	45	1378	907	68	69
Kilimanjaro	94	63	1492	1153	82	83
Lindi	19	22	864	671	28	28
Mara	36	27	1333	1026	35	35
Mbeya	286	157	1822	1567	183	185
Morogoro	118	90	1311	1326	89	90
Mtwara	40	34	1176	912	44	44
Mwanza	135	127	1063	1974	68	67
Rukwa	182	88	2068	756	241	243
Ruvuma	221	125	1768	837	264	267
Shinyanga	260	233	1116	1874	139	140
Singida	54	44	1227	830	65	66
Tabora	146	108	1352	1085	136	137
Tanga	93	85	1094	1363	68	67
Total	2,482	1,712	-	23,900	-	-
Mean	-	-	1,371	-	108[c]	109

[a] Calculated as mean for the period between 1988 and 1992 to cover population increases estimated at 3.4% at national level (Appendix 2.1).
[b] Based on the national per capita maize utilisation of 99 kg per annum reported by CIMMYT (1990:47) for the period between 1986-88.
[c] This is slightly higher than the per capita total maize utilisation of 99 kg/a. reported by CIMMYT (1990:47). The difference could be attributed to exports or differences in data used for the calculations.

Source: Appendices 2.3 and 2.4.
[1] URT TET (1993) Tanzania Economic Trends: A Quarterly Review of the Economy 6 (1/2):123.

Figure 2.1 Average maize production by region, Tanzania, 1985/86 - 1991/92



Regions are:
Arusha (AR), Coast/Dar-es-Salaam (CD), Dodoma (DM), Iringa (IR), Kagera (KR), Kigoma (KG), Kilimanjaro (KJ), Lindi (LD), Mara (MR), Mbeya (MB), Morogoro (MG), Mtwara (MT), Mwanza (MZ), Rukwa (RK), Ruvuma (RM), Shinyanga (SG), Singida (SD), Tabora (TB) and Tanga (TG).

Source: Table 2.2.

2.2.3 The National Maize Project

The concentration of maize in the southern regions and other high potential areas is, to a large extent, attributed to national efforts to increase maize production. Bryceson (1993:64) reports that these efforts started just before the majority of the rural population was resettled in villages through the villagisation process. In 1971/72 some villages in Iringa region received free agricultural inputs and tractor ploughing services from the government to increase maize production under communal arrangements.

After the villagisation process the government launched the National Maize Programme covering some 13 regions. The project's poor performance resulting from both a technical and financial crisis led to its replacement by a World Bank-funded National Maize Project in 1975. According to Bryceson (1993:66) the projects visible impact was concentrated in Mbeya, Rukwa and Ruvuma where marketed maize more than doubled. Yields as high as 4 t/ha were recorded in Rukwa region.

Besides such a success of the project in selected areas the financial problems still persisted. At the conclusion of the project in 1982 nearly 50% of the TSh 51 million loans which accumulated between 1975 and 1980 were unpaid (Bryceson, 1993:65). Even though these programmes failed to bear the expected results, Rasmussen (1986:194) argues that their long-term advantages were apparent because many peasants had learned how to grow hybrid maize with relatively better technology.

2.3 Production and marketing trends

In the following discussion and for the purpose of a subsequent link between performance indicators and policies that have affected maize production and marketing trends, the period of assessment is divided into three sub-periods; 1961/62 to 1973/74; 1974/75 to 1983/84; and 1984/85 to 1991/92. The reason that we chose these periods is because they are closely linked with the time periods of two major policy changes in the country: the villagisation policy which started in 1973 and the market liberalisation policies which were initiated in 1984. In 1973 the NAPB was also disbanded and the NMC was elevated to the status of a single-channel state marketing agent for staple food stuffs (Bryceson, 1992:85).

2.3.1 Production trends

Table 2.3 and Figure 2.2 show that aggregate national maize production grew at an annual rate of 6.5% between 1961/62 and 1973/74; 3.8% between 1974/75 and 1983/84; and -1.1% between 1984/85 and 1992/93. Over the entire period, maize production is estimated to have grown at an annual rate of 5.1%. Except for the sub-period 1984/85-1992/93, annual growth rate in maize production has exceeded population growth rate estimated at 3.4% (Appendix 2.1). Indeed this is reflected in the positive growth rates of per capita maize utilisation which stood at 1.8% per annum for the period between 1961/62 and 1976/77 and 2.1% per annum for the period between 1973/74 and 1987/88 (Appendix 2.1).

Table 2.3 Average annual maize production, government purchases and imports, Tanzania, 1961/62 - 1992/93

Period	Production growth rate[a] (%/annum)	Production (000 t)	Purchase (000 t)	Purchase[b] (%)	Imports[c] (000 t)	Sufficiency ratio[d] (%)
1961/62-1973/74	6.5	657	94	14.3	37	95.7
1974/75-1983/84	3.8	1,653	119	7.2	119	93.5
1984/85-1992/93	-1.1	2,471	126	5.1	4	99.9
Entire period	5.1	1,480	111	7.5	55	96.4

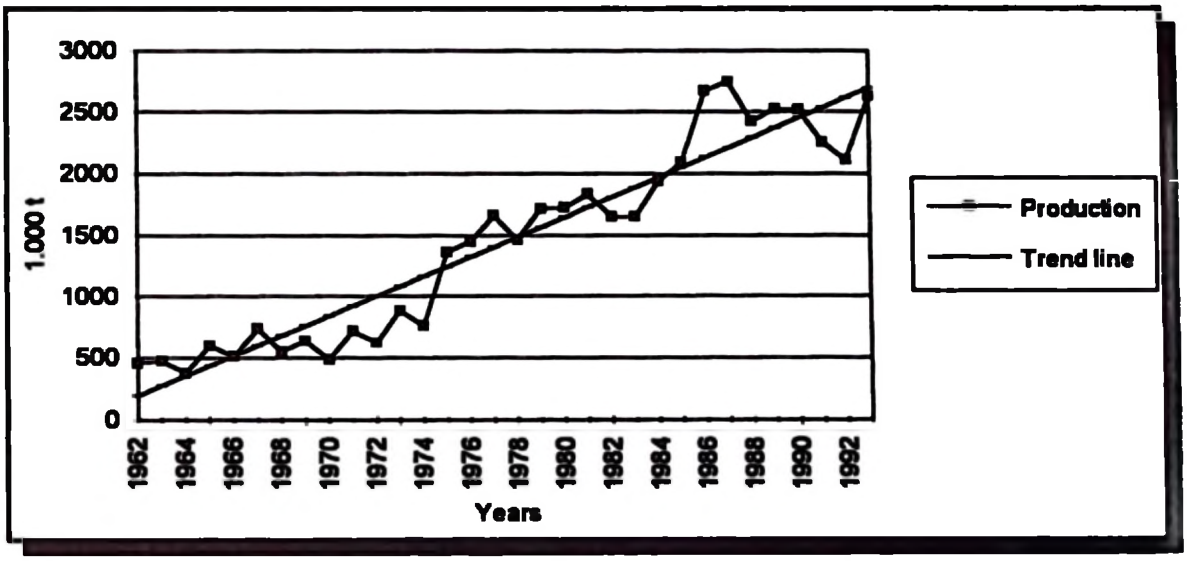
[a] Growth rates were calculated using the standard formula for annual percentage compound growth as follows (CIMMYT, 1990:44): $X_t = X_o\,[1+(g/100)]^t$. Where: X_t = three-year moving average of data for ending period; X_o = three-year moving average of data for base year; t = number of years from the midpoint of base period to that of ending period; g = three year moving average annual percent growth rate.
[b] As percent of total production.
[c] Imports (including food aid) less exports.
[d] Domestic production/(Domestic production + imports - exports).

Source: Appendix 2.5.

2.3.2 Marketing trends

Maize marketing in Tanzania has usually been conducted by the government (through the National Milling Corporation-NMC and Co-operative Unions) and by private traders. Data on actual volumes handled by the private markets are hard to obtain. Rough estimates, however, show that the official markets handled between 25 and 36% of the marketed surplus of maize or between 5-10% of estimated maize production. The remaining proportion was handled by the open markets (Table 2.4). The official sources of purchased maize was concentrated in Arusha, Dodoma, Iringa, Mbeya, Rukwa, Ruvuma, and regions (Appendix 2.6).

Figure 2.2 Maize production trend, Tanzania, 1961/62 - 1992/93



Trend function:

Production = 115.14 + 80.67 x time;
t-test = 16.85 (significant, $p < 0.05$)
$R^2 = 0.90$ $n = 32$

Source: Appendix 2.2.

While official maize purchases are concentrated in the above-mentioned peripheral regions official sales have been concentrated in Dar-es-Salaam. For example, the NMC made about 68% of its total maize flour sales in 1983/84 and some 64% of its maize and maize flour sales for the year 1989/90 in Dar-es-Salaam alone (FAO, 1986:21; URT MDB, 1992a:2).

At present private traders are estimated to handle between 80-90% of marketed food grains and are operating freely in the market (URT MDB, 1992a:2).

Table 2.4 Share of marketed surplus of maize going through the official and open markets, Tanzania, 1970/71-1991/92 (%)

Marketing year [a]	Marketed surplus as share of total production	Share of market supply	
		Official market	Private market
1970-1983/84[1]	20	25	75
1984/85[1]	25	25	75
1985/86[1]	25	36	64
1986/87[1]	25	36	64
1987/88-91/92[2]	N.A.	10-20	80-90
[a] July-June year.			

Source: [1] Amani et al. (1988) Effect of market liberalisation on food security in Tanzania. In:Rukuni and Bernsten (eds.): Southern Africa : Food security policy options:87.
[2] URT MDB (1992a) The wholesale trade in grains and beans in Tanzania:2

In terms of maize purchases through the official channel we observe that the absolute quantities bought increased throughout and reached an average peak of 126 000 t in the 1984/85-1991/92 period. There was, however, a marked decrease in the proportion of marketed maize out of total production from around 14% during the 1961/62-1973/74 period to a mere 5% in the 1984/85-1991/92 period (Table 2.3). Overall the official channel handled about 8% of the total maize production (Table 2.4).

2.3.3 Constraints to maize production and marketing

Although the foregoing description shows that the overall maize production trend is positive, farmers' efforts to increase production are confronted by a number of constraints. These include mainly low production technologies and low prices and uncertain access to markets. Here, we summarise these problems.

Tanzania has enough land resources to sustain a much higher level of crop productivity than that which exists at present. According to a recent estimate (FAO, 1993:10) the country has 3.0 mill. ha suitable for maize production at low levels of inputs, 6.0 mill. ha suitable at intermediate levels and 6.5 mill. ha at high levels compared, for example, with approximately 2.0 mill. ha cultivated in 1988/89 for about 2.5 million tons.

The adoption of improved germplasm has been limited, and crop yields remain quite low. In 1988, only about 17% of the maize area was planted to improved open pollinated varieties (OPVs) and hybrids and only 70 kg of fertiliser nutrients were applied per hectare of maize cropland (CIMMYT, 1990:47). The use of draft power is also very limited. For example for the years 1989 and 1990 the number of tractor ploughs distributed nation-wide were respectively only 462 and 230 which was about 26 and 13% of the respective national demand of 1,800 ploughs (URT MALDC, 1992:98).

We have observed in this section that the main feature of the produced and marketed surplus of maize in Tanzania is the highly erratic trend through time. There could be several explanations for this; first, maize like other staple grains is far more susceptible to annual climatic variability than perennial crops like coffee or tea. Second, the extent of the retention of staple grains like maize by peasants at harvest depend, among other things, on the availability of substitute foods, on the prospect of purchasing back staple grains in the lean season, and on the alternatives available for obtaining cash income.

To a large extent, however, a lack of pricing incentives and ineffective marketing policies have contributed substantially to both unstable production and marketing patterns. An account of the pricing and marketing policies and their effects on maize marketing is the subject of the next chapter.

2.4 Maize as a staple grain

According to Miracle (1966:143-144) maize was introduced in Tanzania as early as in the seventeenth century even though its production and use were confined to the coastal areas until the mid-nineteenth century. The crop only became widely accepted as a staple in the upcountry areas in the early twentieth century. As noted above, maize at present is the dietary staple of the majority of the Tanzanian population and therefore plays a crucial role both in rural subsistence consumption and the realisation of marketable surplus to feed the growing urban population.

Due to this fact nearly all maize grown in Tanzania is used for human food, with the exception of a small amount of less than 10% used for other purposes like feeding livestock (Appendix 2.1). Some maize is consumed green as a snack food, either roasted or boiled. More often dried maize grain is processed into stiff porridge and consumed together with relish made mostly from vegetables, grain legumes or meat.

CHAPTER 3

GOVERNMENT MAIZE POLICY

3.1 Background

The grain handling industry in Tanzania has been dominated by statutory monopolies for the past three decades. As a result the problems which beset grain economies in the country are often viewed as arising from government policy failures, particularly a lack of effective pricing and marketing arrangements. These problems and concerns have given rise to a number of analytical studies to consider whether the policies adopted by the government are conducive to efficiency. Some typical studies are those by Amani et al. (1988 and 1989); Amani and Kapunda (1990); Amani and Maro (1992a and 1992b); Booth (1991); Bryceson (1985, 1992 and 1993); Ellis (1982, 1983, 1984, and 1988a); Gerrard and Roe (1983); Johnson (1989); Kriesel et al. (1970); Lofchie (1978, 1988 and 1989); Mhina and Munishi (1990) and Nindi (1990). A few studies have specifically focused on the evolution of policies affecting the maize sector. These include work by Temu (1977); Gordon and de Greve (1988); Tibaijuka (1989/90); Mlay (1988) and Minde (1989).

To a large extent the consensus of most published work is that the Arusha Declaration of 1967 - which set the country to a policy of socialism and self-reliance - has provided the basis for most policy decisions affecting agricultural production, marketing and food consumption. A concise summary of this view is given by Mlay (1988:8) and Hyden and Kalstron (1993:1396) who point out that as a result of the declaration, the state assumed control over major means of production and service institutions. Communal production and service activities strengthened and/or started, and individual activities were discouraged by limiting political and institutional support. It is therefore argued that there are a few countries, at least in Africa, where the notion of development as a form of

Even though maize imports have been recorded intermittently, Tanzania is almost self sufficient in maize with an average self-sufficiency ratio of 96% between 1961/62 and 1992/93 (Table 2.3; Appendix 2.5). This compares very closely with Ahmad's (1988:60) estimation of a 97% degree of self-sufficiency in all food grains for the country for the 1976-80 period.

2.5 Conclusions

From the discussion and statistics presented in this chapter the following deductions can be made:

(a) Maize is the main staple grain in terms of production, consumption and cash requirements. Therefore, it plays an important role in Tanzania's food security and income.

(b) The grain is produced mainly by smallholder farmers who retain most of the harvest for household utilisation.

(c) The potential for increased maize production varies across regions in the country. However, production among small-holder farmers is largely limited by low levels of production technology.

(d) In terms of marketed surplus of maize, the official marketing channel has been significantly overshadowed by the open market. This trend has been more apparent after the markets were liberalised some 10 years ago.

It should be emphasised that the trends discussed in this chapter have been, to a large extent, a result of government policy towards maize in particular and the grain sector in general. This is the subject of the following chapter.

social engineering was more deeply entrenched in public policy circles than in Tanzania in the first two decades of independence (Hyden and Kalstron, 1993:1396).

Following Mlay (1988:8), the policies that affect maize production and marketing can be categorised into (a) institutional and organisational policies, (b) pricing policies, (c) trade policies, (d) wage and income policies, and (e) exchange rate policies. In addition, indirect effects arising from monetary and fiscal policies can also be considerable. In this chapter focus is limited to the institutional and organisational policies, pricing policies and grain storage policies. The last part of the chapter summarises the main features of the liberalisation policies.

3.2 Marketing institutional and organisational policies

3.2.1 Marketing arrangements between 1961/62 and 1973/74

Kriesel et al. (1970:19-20) and Bryceson (1993:36-60) offer enough evidence to support the fact that official maize control in Tanzania dates back to the time of the second world war when a statutory Cereal Board to ensure bulk purchases of food grains was set up. The enactment of the Agricultural Products Act (Control and Marketing) in October 1962 and the subsequent establishment of the National Agriculture Products Board (NAPB) (under authority of this Act) in March 1963 was one of the first manifestations of the post-independence agricultural policies in Tanzania (Kriesel et al., 1970:19-20). The Agricultural Products Act led to the institution of a three-tier, single-channel marketing system.

With respect to grain marketing, the NAPB became the apex of the system and had monopoly power on commercial purchases of grain. The functions of the NAPB were limited to purchases from Co-operative Unions or local Co-operative Societies and sales to licensed grain millers. Under this arrangement Co-operative Unions were, either directly or through their Primary Societies, appointed as agents of NABP. Mlay (1988:12) argues that the elimination of middlemen in grain trading appeared to be the main objective of NAPB. Private marketing was legally reduced significantly since sales outside the official channel was only permitted in the case of direct sales from producers to consumers. As a further control, no transportation of significant quantities of grain was allowed without the approval of the NAPB. By 1966 almost all purchases of maize acquired by the NAPB came through the co-operatives (Bryceson, 1985:56; Johnson, 1989:219; Mlay, 1988:12).

In 1967 the major grain-milling companies had been nationalised and a National Milling Corporation (NMC) was established. In 1973, the activities of NAPB were taken over by the NMC. It is, however, worth noting that in the period prior to 1973 the main emphasis of government intervention in agricultural markets was the consolidation of the three-tier crop marketing system consisting of Primary Co-operative Unions, Regional Co-operatives and Marketing Boards. By 1973 some 2,300 Primary Societies had been formed, affiliated to 20 Regional Co-operatives, and there were 8 other Marketing Boards (Ellis, 1988a:69).

The role of the co-operatives in agricultural marketing was, in the early 1970s, associated to a large extent, with the villagisation programme that started in 1973. By 1976, 13 million people had been moved into villages (Mlay, 1988:9). In 1976 the Villagisation Act was enacted and a legal framework for villages to operate as production and marketing co-operatives was provided (Ellis, 1988a:70). An account of the institutional setting and the role of villages in food security, among other aspects, after the villagisation programme is given by Hyden (1990).

Between 1973 and 1975 the agricultural Marketing Boards were reorganised into semi-autonomous state institutions - the parastatal Crop Authorities. According to Bryceson (1992:82) these changes arose out of official dissatisfaction with the marketing performance of the NAPB and Co-operatives as well as out of preoccupation with achieving food security and ensuring stable producer and consumer prices.

These institutional and organisational changes had significant implications on crop marketing efficiency. To operate such a marketing system efficiently meant that massive infrastructure and co-ordination abilities were required. Available evidence, for example, see Ellis (1988a) and Bryceson (1993), however, implies that both were lacking at the time the system was instituted.

In May 1976, a Government Task Force recommended the abolishment of the Co-operatives on the grounds that they have failed to provide adequate crop purchasing services. Some of the co-operatives specific problems are summarised as follows (FAO, 1986:13):

- the loss of farmer confidence due to the inability to pay cash on receipt of produce;
- poor control over cash advances made to societies and mounting debts and bankruptcy;
- inadequate procurement arrangements, causing crops to be left uncollected from farmers and/or from societies; and
- poor stock control, leading to excessive losses and low quality control.

Besides economic/financial critique, the Task Force also agreed that the changes then being recommended in Tanzania's rural society had rendered the traditional co-operative structure inappropriate. As a result of these problems a new marketing structure for food grain marketing was devised (FAO, 1986:13).

In particular, the marketing arrangements proposed in 1976 emphasised the role of a single marketing system for the country with slightly different distribution procedures for Dar-es-Salaam and other regions. Accordingly, after the Co-operatives were abolished in 1976 the NMC (which assumed crop authority functions in 1973) became the sole authorised agency responsible for grain marketing from the national to the village level. The NMC therefore enjoyed the status of a single channel marketing agent buying grain directly from producers (Amani et al., 1988:75).

3.2.2 Marketing arrangements between 1976/77 and 1983/84

Despite the fact that policy changes were centred only on the official marketing system, a parallel market operated by the private sector also developed simultaneously. During this period, however, the open market was not official although its operations were not restricted in some parts of the country. As noted in chapter two, official grain and flour supplies were concentrated in Dar-es-Salaam city. These supplies were channelled through the NMC, which in turn distributed it to consumers through the Regional Trading Companies (RTCs) and other institutions like schools and the army (FAO, 1986:15). The NMC supplies in turn were secured from the NMC regional branches, imports and Strategic Grain Reserve (SGR). The above explanation implies that NMC was by far the largest parastatal institution which undertook marketing of maize and other food grains. The NMC and RTCs constituted the official or legal marketing channels while private traders and the local markets formed the parallel or unofficial channel.

In areas outside Dar-es-Salaam the major participants in the marketing system were the farmers, the NMC regional branches, and the RTCs. As elaborated by Ngowi, (1984:75) the NMC and RTC branches operated in regional and district centres with a central administration at the national level. While the NMC had a legal monopoly of buying and selling food grains domestically as well as to import and export food, the RTCs and Co-operative Unions operated exclusively in the domestic markets. The private and village level/local markets operate independently. The interaction of the official and parallel marketing outlets formed a complex grain management institutional system.

Essentially, the grain produced by farmers could reach consumers through the two major channels which operated within the same market structure. Grain could either reach consumers through the parallel markets or through official channels. While the NMC and RTCs catered mainly to a portion of the urban food consumers, the remaining portion of the urban and most of the rural areas have been served by the parallel market. Due to limited supplies, the official markets were unable to satisfy all the food demand of the urban population. The parallel markets, therefore, played an important role in serving both the urban and rural consumers.

Mlay (1988:13) concludes that the multiple roles of NMC in processing, marketing, importing and exporting of grain and serving as the agent of the government in handling SGR stocks strained its ability both financially and in terms of skilled manpower and facilities. The result was inability of the NMC to respond promptly in its grain marketing functions. Delay in paying farmers and inability to move grain promptly after purchase became the chronic problems facing NMC. The effects of these marketing inefficiencies was a discouragement of producers to market grain through the official channel.

3.3 Pricing policy

FAO (1986:16) asserts that the most important reason for the poor performance of the official channels was perhaps the existence of low official prices compared to the unofficial prices. Farm output prices play an important role in the economic system. These are: (1) to allocate farm resources, (2) to distribute incomes, and (3) to encourage or retard investment and capital formation in agriculture (Mellor, 1968:23). Streeten (1987:11) describes these functions as the signals, incentives, and instruments for the allocation of resources and incomes. Therefore, state policies on pricing need to address three issues (Mlay, 1988:14): determination of the absolute levels of prices to induce increased agricultural production, setting of relative prices to influence the composition of agricultural output, and pricing over time, space and form to reflect storage, transport and processing costs.

Prior to 1974/75 period, pricing was never used as a policy instrument to influence agricultural production. Government concern was in maintaining price stability. State intervention in pricing was in fixing into-store price. Producer price was determined mainly as a residual after deduction of estimated marketing costs of co-operatives. As a result of neglecting agricultural pricing as an instrument of policy, prices of crops declined sharply in real terms (Table 3.1).

Following two consecutive crop failures in 1973/74 and 1974/75 periods with consequent large food imports, there was a change in priority to food self-sufficiency. A large increase in producer prices was instituted in favour of food crops. As a result food crops experienced a positive increase in producer prices in real terms (Table 3.1). The decline in maize imports over the 1973/74-1978/79 period with exports of 49,000 t in 1978/79, meant that producers responded positively to the price changes.

Table 3.1 **Evolution of official producer prices for maize, paddy and wheat, Tanzania, 1969/70-1991/92**

Crops	Producer price (TSh/kg)		Increase/decrease (%)	
	1969/70-1973/74			
	1969/70	1973/74	Current terms	Real terms[a]
Maize	0.28	0.33	17.9	-16.7
Paddy	0.52	0.57	9.6	-22.4
Wheat	0.57	0.57	0	-29.2
	1973/74-1978/79			
	1973/74	1978/79	Current terms	Real terms[a]
Maize	0.33	0.85	157.6	32.4
Paddy	0.57	2.20	110.5	8.2
Wheat	0.57	1.25	119.3	12.7
	1978/79-1983/84			
	1978/79	1983/84	Current terms	Real terms[a]
Maize	0.85	2.20	158.0	-22.5
Paddy	1.20	4.00	233.3	-1.7
Wheat	1.25	3.00	140.0	-28.1
	1983/84-1986/87			
	1983/84	1986/87	Current terms	Real terms[a]
Maize	2.20	6.30	186.4	49.0
Paddy	4.00	9.60	140.0	22.3
Wheat	3.00	9.00	200.0	54.1
	1986/87-1991/92			
	1986/87	1991/92[1]	Current terms	Real terms[a]
Maize	6.30	15.40	144.4	-5.4
Paddy	9.60	31.40	227.1	29.3
Wheat	9.00	38.40	326.7	65.2

[a] Nominal prices were deflated using the National Consumer Price Indices (NCPI) for foodstuffs. For example, the Indices for 1986/87 and 1991/92 (Base: 1977 = 100) were 920 and 2377 respectively (See URT TET, 1992:65).

Source: Mlay, G.I. (1988) Analysis of Policies Affecting Maize Production and Consumption in Tanzania. FAO. Rome:14-20.

[1] URT TET (1992) Tanzania Economic Trends. A Quarterly Review of the Economy. 5(1/2):73.

In order to protect consumers from the effects of large producer prices, the government fixed consumer prices below ex-store costs of NMC. The result was a large financial loss to NMC. For example, Nindi (1990:17) reports that in 1980/81 NMC losses amounted to 31 % of its total sales, or about 8 % of the governments current expenditure. The absolute debt figures are put at TSh 2,820 and 2,350 billion by December 1980 and by September 1984 respectively (Ellis, 1988a:80). In most cases these losses were covered by subsidies from the government budget.

With the dissolution of Co-operatives in 1976, and the institution of a two-tier, single-channel marketing system, state intervention in pricing changed from fixing into-store prices to fixing producer prices. This move effected the pan-territorial pricing system that was instituted in 1974. Pan-territorial pricing was motivated by two main objectives, namely to equalise income differentials between farmers living in different regions and to increase the country's agricultural output by stimulating production in remote areas through price incentives (Mlay, 1988:17). He observes that the consequences of pan-territorial pricing were:

(a) An increase in transport costs for procuring increased output from remote regions; and
(b) The development of a systematic bias against high-value/ low-weight crops in remote regions. For example, production of tobacco in Ruvuma became relatively unattractive as a result of rapid increase in maize price through regional crop subsidisation.

This implies that the move to pan-territorial pricing based on its appeal to equalising regional incomes had a detrimental effect on resource allocation efficiency.

The upward adjustment of real producer prices ended in 1978/79 period. The period between 1978/79 and 1983/84 saw a decline in real producer prices for preferred staple grains despite a large price increase in nominal terms (Table 3.1). These findings are in line with observations by Ellis (1984:33) that between 1970 and 1980 the indices for price, income and output terms of trade declined by 36, 39 and 5 % respectively.

In order to boost food grain production, pan-territorial pricing was replaced by regional pricing for some domestic food crops in 1982. According to Ellis (1988a:72) the basis of these price differences was comparative advantage in production, with high production regions given premium regional prices and low production regions given lower fixed prices. For example, for maize in 1985/86, the premium price was TSh 5.25/kg., while the lower price was TSh 3.50/kg.

Mlay (1988:18) views the aim of this policy as the attainment of self-sufficiency in food supply irrespective of the resource cost for producing it. Furthermore, as Ellis (1988a:72-73) points out, this approach, while in theory it reduced marketing costs to some degree by encouraging regional specialisation in marketed supply, it did not meet one of the major criticisms of pan-territorial pricing which was its neglect of transport cost differences between regions. In practice the comparative advantage principle adopted by the government favoured high transport cost, high production regions like Ruvuma and Rukwa at the expense of low transport cost, low production regions (URT MDB, 1992a:2).

3.4 Grain storage policy

3.4.1 Policy development

The agricultural policy document of 1983 emphasised the need to increase storage capacity especially in areas where transportation services are poorest at village, district and regional levels (URT Ministry of Agriculture, 1983:28). According to this policy document, government storage policy storage at village level is to be the responsibility of the individual farmers and the village Government and/or primary Co-operative Societies. The need for training and extension services for improved storage is also emphasised. At Co-operative Union level and below, crop and input storage facilities are to be owned by the Co-operatives themselves. The policy document stipulates further that at regional and national level storage facilities are to be owned by the Crop Authorities and Marketing Boards.

Through the agency of the NMC, the Government envisaged the building up (within 5 years up to 1988) a scattered storage capacity sufficient for a National Strategic Food Reserve of 400,000 t (URT Ministry of Agriculture, 1983:28). The then Ministry of Agriculture was supposed to review the storage capacity owned or controlled by various institutions in the country, so as to assess the national storage capacity. The Ministry of Agriculture was also vested with a co-ordinating role for storage, so as to reduce the under-utilisation of created capacity and avoid unnecessary duplication.

Intermittent crop surpluses resulting from a combination of good weather and policy changes in favour of the agricultural sector have been undermined by poor transport and marketing infrastructure. In recognition of this chronic problem and in line with the 1983 Agricultural Policy, the Government established an Inter-Ministerial Technical Advisory Committee on Agricultural Storage in 1987. The Committee had representatives from the concerned Ministries as MALDC, Ministry of Finance, and the Planning Commission. The main task of the Committee was to address the issue of crop storage with a national co-ordination committee and approve, chart out and execute a comprehensive national crop storage policy (FAO, 1993:36).

The outcome of the deliberations of the committee was the issuing of a provisional policy on village level storage (URT, 1990). This document highlights the need to provide household-level storage, temporary storage for surplus produce, and village stores. Issues such as ownership of the village store, charges to be levied for storage services, size and design of store, community participation in construction of the store and optimal utilisation have been studied. Recommendations on how to establish priorities for the construction and management of stores, maintain adequate quality control as well as train technicians in store construction and maintenance have been included. Use of the village store as a focal point for distribution of farm inputs is also dealt with, and the impact of transport facilities and road conditions on storage requirements has been recognised.

Following the recommendations of the Inter-Ministerial Committee the MALDC published a National Village and Household Level Storage Programme (URT MALDC, 1991). The objective of programme is based on the National Food Strategy and Food Security Objectives. More specifically the programme objectives, among others, are (URT MALDC, 1991:4-5):

1. *Long-term objectives:*
   - (a) To improve nutritional status for the disadvantaged groups in particular and overall improved nutritional status of the nation; and
   - (b) To ensure secured availability of food for all and at all times.

2. *Short- and medium-term objectives:*
   - (c) To facilitate greater safety of stored food and cash crops from contamination by poisonous substances;
   - (d) To improve accessibility to food at affordable prices;
   - (e) To stabilise intra-seasonal and intra-regional producer and consumer prices;
   - (f) To improve farm income by reducing post-harvest losses; and
   - (g) To diversify export base to include food crops in the national export basket.

It remains to be seen whether these objectives can be achieved, given past history on storage policy. Evidence suggests that past government's concern on storage has been closely linked to crisis situations. The storage programme document (URT MALDC, 1991:10) recorded that in 1949 the colonial government formed the Grain Storage Department (GSD) to facilitate the marketing of subsistence crops. In the early 1950s the Native Authorities got involved in large-scale storage of grains in certain areas whose populations were threatened by famine. The food crises of 1973/74 (food shortages) and 1978/79 (huge food surpluses) also reactivated government's interest on storage, but the interest faded soon after. Again the food surpluses experienced in 1986/87 rekindled government's interest in storage. Amani and Maro (1992b:193) add up to this scepticism by acknowledging that although climatic variability led to these government responses other contributing factors were poor stock control, rapid depletion of commercial stocks, the instability of the commercial market and the expansion of the unofficial market.

3.4.2 Storage capacity

Available data show that there is sufficient total storage capacity in Tanzania. Ngondo and Kottering (1991:7) argue that the problem lies with the management of existing capacities and especially at the present time when, as a result of the liberalisation policies, public marketing authorities are unlikely to play a dominant storage role in the future. They point out that NMC and Co-operative Unions stores are effectively out of action and public marketing organisations may in fact withdraw from provision of storage services altogether.

As noted earlier storage of staple crops in Tanzania is undertaken largely at the household level (between 70 and 80% of output). In addition, there are village stores, Co-operative Union stores, NMC stores, SGR stores and private stores. The main features of the various storage types are provided in Table 3.2. To meet annual food security demand Ngondo and Kottering (1991:7) estimate that about 500,000-700,000 t of maize, in addition to other crops, need to be stored as government stocks. This will supplement maize stored at household level, the total capacity of which is estimated to be well over three times that level.

During the preparation of the village storage programme the MALDC estimated the regional distribution of storage space in the country as a basis for identifying excess (deficit) capacity. A summary of the data obtained show that nation-wide a storage demand of about 800,000 t[8] is available, its distribution between regions is not optimal (URT MALDC, 1991:60-94). The biggest shortages of storage capacity are recorded in the maize surplus regions of Mbeya (33,000 t), Rukwa (24,000 t) and Ruvuma (23,000 t). In contrast, a maize deficit region of Lindi has a storage capacity of 20, 000 t compared to its requirement of 5,000 t.

[8] The MALDC cautions however that these figures are an underestimate of actual figures because about 25% of the districts could not furnish information for the storage capacity compilation exercise. Furthermore, some of about 700 stores which were either being constructed or being repaired by an FAO assistance during the survey time were not included in the survey (URT MALDC, 1991:60).

Table 3.2 Main features of various storage types, Tanzania, 1991

Type of storage	On farm	Village	Co-operative	NMC[a]	SGR[a]
Ownership	Household	Village council	Co-operative	NMC	(a) FSU (b) NMC
Management	Household	Co-operative and/or village	Co-operative (RCU+PCs)	NMC	(a) FSU (b) NMC staff
Size	< 5 t	100 - 500 t; Total: 700,000 t	500-1500 t. total: 700,000 t (PCs level)+ 250,000 t (RCU level)	Total: 550,000 t	(a) 10,000 -30,000 t; Total: 80,000 t (b) 8,000 -46,000 t Total: 69,000 t
Condition[b]	Basic; < 5% losses	Variable	Not well maintained	Bad	Very good
Utilisation	Decreasingly after harvest peak, most of the stock is out after 6 months	Decreasingly after harvest peak with empty stores for several months	-	Not at all in 1990/91	Constantly with regular stock rotation
Location	Household	In about half of all villages	-	Mainly in Dar-es-Salaam	(a) Arusha, Makambako, Dodoma, Shinyanga, and DSM (b) DSM, Mkm & TNG

[a] The NMC serves as agents of the SGR.
[b] Refers to sanitation and maintenance to minimise losses.

The abbreviations stand for SGR (Strategic Grain Reserve); NMC (National Milling Corporation); DSM (Dar-es Salaam); FSU (Food Security Unit); RCU (Regional Co-operative Union); PCs (Primary Co-operative Society); Mkm (Makambako); TNG (Tanga).

Source: Ngondo A. and Kottering A. (1991) Tanzania: Comprehensive Food Security Programme, Phase 1-Marketing (Draft):8-9.

3.4.3 The Strategic Grain Reserve (SGR)

The stocks held by SGR comprise a quantity of grain owned by the government and kept in addition to the commercial stocks of the Co-operative Unions and the NMC. The SGR was transferred from the NMC to the Food Security Unit within the MALDC in 1990 as one of the moves towards the market reforms instituted since 1984 (Amani and Maro, 1992b:192). The SGR was initiated by the government (following an FAO recommendation) as one of its food security instruments during production shortfalls.

Storage facilities for the SGR were constructed in Arusha, Dar-es-Salaam, Dodoma, Makambako and Dodoma (Table 3.3). It is clear from this location strategy that major supply and demand potentials were given priority. The initial stock of 100,000 t of food grains in 1978 was provided by donors. As noted by Amani and Maro (1992b:193-194) the SGR was intended, at that time, to address the food security needs of urban areas with the following justifications: (1) the degree of climate variability plus the relatively small proportion of national grain production traded through the official channels can shift the domestic market rapidly from surplus to deficit position, (2) shortage of foreign exchange may not make it possible to have imports at the required times, and (3) processing imports requires between 3 and 6 months and during this time domestic stocks can be used in case they are needed.

Table 3.3 Construction of godowns for the Strategic Grain Reserve, Tanzania, 1986

Location	Capacity (000 t)	Financed by
Arusha	20	Netherlands
Makambako	10	Netherlands
Dodoma	30	UK.
Shinyanga	10	UK.
Kipawa (DSM)	10	Tanzanian government
Total	80	---

Source: FAO (1986) Food Security Review Mission Report to Tanzania. Rome:11.

The drought induced food shortages during the early 1980s also affected rural areas stretching the SGR to its limits. These shortages coupled with financial limitations due to SGR's non-commercial mode of operations rendered its (SGR) non-existent between 1981 and 1986 (Amani and Maro, 1992b:193). A follow-up FAO Food Security Mission in 1986 reviewed the SGR situation and came up with a number of proposals to rebuild and manage the SGR. These recommendations were (FAO, 1986:25-28):

- the government be the owner of the SGR;
- the SGR be used only during emergency;
- an emergency is to be identified by the FSU;
- only the FSU should authorise the release of SGR stocks;
- SGR should be established within the MALDC;
- NMC continue to manage the SGR on behalf of the government in return for a reimbursement of all expenses resulting from the SGR operations; and
- a Food Security Reserve Fund be established within government account.

During the 1988/89 marketing year, the SGR was re-established by purchasing 112,000 t of domestic maize. In addition 29,000 t of maize were purchased during the 1989/90 marketing season bringing the total close to its target level of 150,000 tons (Amani and Maro, 1992b:194).

Coulter and Golob (1992:421) note that the SGR was not designed as a buffer stock, and as a result it has no formal mechanism to avoid large inter-seasonal fluctuations of prices. As data in Table 3.4 suggest the SGR has also been used as an income support mechanism in surplus regions, particularly the Southern Highland regions of Rukwa and Ruvuma where the private sector has been most reluctant to buy grains. Each of the two regions contributed 30 and 24% respectively of the 75,000 t bought by the SGR in the 1990/91 marketing year.

Table 3.4 Regional sources of maize for Strategic Grain Reserve, Tanzania, 1990/91

Region	Quantity (tons)	Contribution to total (%)
Rukwa	22,217	27.7
Ruvuma	17,867	23.9
Iringa	17,619	23.5
Mbeya	6,970	9.3
Arusha	4,000	5.3
Singida	3,124	4.2
Dodoma	1,600	2.1
Shinyanga	1,486	2.0
Total	74,883	100.0

Source: Amani and Maro ((1992b) Stock management: Problems and policy under market liberalisation for grains in Tanzania. In: Wyckoff, J.B. and Rukuni, M. (eds.). Food security research in Southern Africa: Policy implications. Harare:196.

The above analysis underlines the fact that the SGR is still urban biased and does not have the financial and management capacity to cater for the rural areas. Furthermore, Amani and Maro (1992b:197) conclude that the rules governing the SGR do not specify what the composition of the stocks should be. This implies that for a long time in the future more reliance will still be put on farm storage as the major source of food security reserves for the majority of the rural population.

3.5 Market liberalisation

3.5.1 Meaning and concepts

During the last two decades, many developing countries, especially those in sub-Saharan Africa, adopted the World Bank and International Monetary Fund (IMF) supported structural adjustment programmes in response to acute macro-economic disequilibria. These crises were manifested by high rates of inflation, overvalued exchange rates, and unsustainable deficits in the balance of payments and budget. The adjustment policies dominated policy making in the region to an extent that between 1980 and 1988, thirty-three countries had stand-by agreements with the IMF and 12 had extended Fund facilities, while 15 had structural adjustment loans with the World Bank (ECA, 1989:16).

Domestic market liberalisation has been one of the most important, and widely implemented, of the structural adjustment policies because it was recognised that (Scarborough and Kydd, 1992:1): (a) pre-liberalisation marketing practices may have constrained agricultural production, producer incomes and consumer welfare, and (b) there has been a bias in development economics towards production and a consequent underestimation of the role of marketing. In addition Duncan and Jones (1993:1497) identify three main reasons for marketing reform, namely (i) the economic costs to the agricultural and other sectors resulting from pricing and marketing intervention, (ii) unsustainable financial losses for parastatal marketing agencies and, (iii) the failure of traditional forms of intervention to achieve their objectives.

Market liberalisation implies increased private sector participation in domestic markets coupled with a simultaneous reduction of the role of marketing parastatals and co-operatives (Reusse, 1987:299; Lorenzl, 1992:27; Scarborough and Kydd, 1992:1). The key objectives to market liberalisation has been to increase the economic efficiency of marketing and price structures. According to neo-classical theory (e.g. Ellis, 1992:19) this 'getting prices right' policy will increase allocative efficiency of available resources. Lorenzl (1992:36) however, recommends that 'get the rules right' should become a strategic programme arriving at protection of the market itself as well as protection against market forces seriously affecting the marginalised population section.

It is often pointed out (Ruesse, 1987:299) that, given the strong emphasis on the role of the private sector in liberalised markets, a major risk could arise from government's frequent lack of knowledge and working liaison with the private sector at a time when major decisions about decontrol are being taken. Furthermore, the increased reliance on the private sector in many developing countries is challenged by those who doubt that the private sector could actually fill the vacuum created by a withdrawal of public marketing activities, come up with improved technologies and most importantly, the capital to finance them. It is rather claimed that there is a continued role for public action where private markets are slow to develop.

While the need for market reform is widely acknowledged, the debate centres on its complexity emanating from a number of facts (Valdés, 1993:272). First, historically, agriculture is a sector which has been subject to extensive government interventions in both output and factor markets. Second, agriculture is a sector whose structure of costs and returns depends substantially on the performance of other sectors (such as transport and communications) and related markets (such as the financial and foreign exchange markets). Third, agriculture in developing countries is comprised of many small farmers exercising independent production and consumption decisions. This implies that the magnitude and sequence of liberalisation measures must consider the interaction between the macroeconomic process and the response to the reforms by the agricultural sector.

3.5.2 Cereal market liberalisation in Tanzania

3.5.2.1 Reasons for reform

Mounting budget deficits and inefficiency of the public marketing system has been mentioned as the primary reason which led to the market reforms instituted in Tanzania since 1984 (Nindi, 1990:3). Market liberalisation was, therefore, undertaken as part of a broader structural adjustment programme. As noted earlier there was a substantial deterioration of real prices and income from crop sales in the 1970s. When taken in conjunction with a concomitant deterioration in the efficiency of agricultural marketing an analysis by Ellis (1982:263) suggested, for example, that price policy has had a major adverse impact both on peasant living standards and on the economic performance of Tanzania since the 1960s.

Based on a partial equilibrium model to determine the welfare effects of state pricing policies on maize producers and consumers, Mlay (1988:39-40) showed that significant price distortions have been created as a result of government market intervention. His results also showed that consequent to these distortions, welfare losses to both producers and consumers had occurred, and that consumption and production levels of maize have been maintained at a lower level than would have been in the absence of distortions.

3.5.2.2 Donor pressure for reform

The macroeconomic problems which faced the country necessitated adoption of policy measures to correct the imbalances in the economy. As a result in 1978 and 1979 the IMF and the World Bank began detailed discussions with the Tanzanian government about the need to modify the rigid domestic price system and exchange rate policy, and the marketing policy in the agricultural sector (Hyden and Kalstron, 1993:1397). However, failure of the government to meet the conditions put forward by the IMF and the World Bank stalled the negotiations. Instead the government devised and launched a Structural Adjustment Programme (SAP) in 1982 (Bryceson, 1993:22). Since SAP depended heavily on foreign financing its objectives failed due to lack of funds.

At the same time, a series of negative external shocks (like a fall in coffee prices) resulted into a dramatic decline in Tanzanian terms of trade, by 40% during 1978 and 1982, and an eventual launching of the three-year Economic Recovery Programme (ERP) in 1986 (Hyden and Kalstron, 1993:1398). Devaluation and a decrease in government expenditure led to the signing of an agreement with the IMF in September 1986 (Bryceson, 1993:28). This opened the way for standby credit facilities and grants. The thrust of policy conditionality required by the IMF and World Bank has placed greater emphasis on agriculture.

3.5.2.3 Specific objectives and measures of the reform

Significant policy changes were introduced in 1984 and 1986. The policy changes introduced in 1984 included (Mlay, 1988:19; Amani and Kapunda, 1990:76-77):

- substantial increase in producer prices of major export and food crops;
- removal of consumer subsidies;
- imposition of import tax on rice;
- allowing individuals to import goods and sell them at market clearing prices; and
- devaluation of the TSh by 26 % in US$ terms.

The policy measures started in 1984 were re-inforced following the adoption of the (Economic Recovery Programme) ERP in June 1986 and the signing of the agreement with the IMF in the same year. Under the programme the following policy measures were taken (Mlay, 1988:19-20):

- further devaluation of the TSh and adoption of a crawling peg;
- raising of producer prices by 5% in real terms annually or paying 60-70% of fob price whichever is higher;
- further liberalisation of trade, and reduction of items under price control; and
- an imposition of a ceiling on government expenditure.

3.5.2.4 Preliminary achievements of liberalisation

Initial results of the market reforms portray a positive response from market participants despite a number of policy and implementation problems. The country's GDP (at 1976 factor cost) grew from around TSh 23,700 mill in 1984 to TSh 30,500 mill by 1991 (URT TET, 1992:64).

In the grain marketing system NMC and Co-operative Unions only ceased to be a significant force in the market in 1990/91, as credit restriction reduced official purchases. We noted earlier that NMC was consistently purchasing 5-10% of estimated maize production. Since the 1990s NMC is playing a minor role as an agent of the SGR and is being nationalised. A recent MDB study speculates that in the future the NMC is likely to become a purely milling operation with little or no role in grain trading (URT MDB, 1992a:2). Co-operative Unions had also a number of their own problems besides the several measures which were taken with the aim of improving their performance. FAO (1993:7) noted that all these measures did not address the fundamental problem of the sector, which is lack of membership control. To address this problem the new Co-operative Act 1991 was enacted in April, 1991. Under the new Act agricultural Co-operatives are designed to deal with purchasing, processing, marketing and distribution of single or multiple crops (URT, 1991:60).

Traders response into trading has also been generally positive. It is, however, difficult, as also noted by Staatz et al. (1989:709) in Mali, to establish with precision the impact of the liberalisation on private trade due to the absence of reliable data on the structure of this trade prior to liberalisation. Recent reports, however, give the impression that the liberalisation stimulated entry of private traders into grain marketing. A survey of 196 grain traders in five regional towns in 1988 revealed that 60% had entered the trade since the liberalisation started in 1984 (Bryceson, 1993:119). Another study conducted by the MALDC mentions inflexible transport system, production shifts, absence of seasonal stockholding, lack of credit and government interventions as persisting problems, even under liberalisation (URT MDB, 1992a:36-41).

On the price development we recall (Table 3.1) that Mlay (1988:20) provided data which show that the policy objective of raising producer prices in real terms was achieved since real prices between 1984/85 and 1986/87 increased by 49, 22 and 54% for maize, paddy and wheat respectively. This trend continued up to the beginning of the 1990s except for maize. While real producer prices for Paddy and wheat increased respectively by 29 and 65 %, between 1986/87 and 1991/92, maize prices declined by 5 % (Table 3.1).

CHAPTER 4

THEORETICAL AND CONCEPTUAL FRAMEWORK

This chapter seeks to clarify the theories and concepts on which the analytical part of this research is based. Section 4.1 presents the different schools of thought on economic analysis of agricultural markets. Section 4.2 describes the specific measures used to assess marketing efficiency in general while section 4.3 discusses specific measures of efficiency in storage commodity. Section 4.4 explains the farm household models. The conceptual framework is presented in section 4.5 and section 4.6 summarises the main practical limitations of the different theories and concepts.

4.1 Models for evaluating economic analysis of markets

The need to evaluate the performance of agricultural markets stems from their fundamental role in the development process. Lorenzl (1978:A4) summarises the dynamic role of agricultural marketing in the development process as follows:

(a) Marketing systems channel the net capital surplus out of the agricultural sector which could be used to accentuate the development of industry, infrastructure, and social services.

(b) Marketing integrates the farming community into the market economy through communication and exchange, and the provision of secured markets which encourages producers to increase marketed surplus and diversify production in cash crops. This integration created along marketing channels open the way to speed up the diffusion of modernisation to traditional rural areas.

(c) Marketing becomes and remains as one of the most important economic sub-sectors during the whole process of development by encouraging the development of industries which provide inputs and raw materials necessary for agricultural production.

Reviewing the historical evolution of the economic analysis of markets and marketing, Scarborough and Kydd (1992:24-25) identify three main schools of marketing economics. These are, (a) the internal productive efficiency of marketing enterprises, (b) the structure-conduct-performance school, and (c) the food systems framework. A brief review of each of these schools of thought is given below.

4.1.1 Internal productive efficiency of marketing enterprises

In the 1940s and 1950s the main emphasis in marketing economics was on the internal technical and operational efficiency of marketing firms. French (1977:160) divides approaches to estimating firm-level economic efficiency and cost relationships aimed at improving technical and operational efficiency into three groups; (i) descriptive analysis of accounting data, (ii) statistical analysis of the same data, using econometric methods to estimate production function relationships, and (iii) analysis which combine physical production and cost relationships, using, for example, data on inputs and outputs of the production function.

In the case of (i), for example, accounts data are used to calculate average costs which could be used to test various hypotheses. Scarborough and Kydd (1992:26) warn, however, that there is a danger in attempting to make generalisations about, and postulating causality, between the relationships between costs and firm characteristics because there are so many factors which affect costs.

4.1.2 The structure-conduct-performance (SCP) model

The major proponents of the SCP model are Bain (1968), Marion (1986), Reid (1987) and Shaffer (1983). The analytical core of this model is the assessment of markets on the assumption of a two-way causal and feedback relationship between its three major components; structure, conduct and performance. The model claims to explain the relationships between functionally similar firms, and their market behaviour as a group. It is assumed that, (Scarborough and Kydd, 1992:26) given certain basic conditions, the performance of particular industries depends on the conduct of its sellers and buyers, which in turn is strongly influenced by the structure of the relevant market.

According to Bain (1968:7) the structure of a market entails the organisational characteristics of a market that appears to exercise a strategic influence on the nature of competition and pricing within the market. The most important measures of market structure are (a) the degree of seller's and buyers' concentration, (b) the degree of product differentiation, and (c) barriers to entry.

Market conduct refers to firm behaviour in adopting or adjusting to the markets in which they buy or sell. These include things like (Reid, 1987:12) pricing and selling policies and tactics, overt and tacit inter-firm co-operation, or rivalry, and research and development activities.

Market performance is the end result of a firms' objectives. The traditional yardstick for measuring efficiency focus on productive and allocative efficiency, progressiveness and equity (Scarborough and Kydd, 1992:26). The SCP model has been widely criticised mainly because it lacks substantial inferences concerning behavioural and performance characteristics, and the type of indicators used to assess performance. Besides these shortcomings, Marion and Müller (1983:17) argue that the model provides the only well developed framework for examining behaviour of imperfectly competitive markets.

4.1.3 The food systems framework

Work by Shaffer (1983) emphasises that the food systems framework emerged from the concern that the internal productive efficiency model and the SCP model could not jointly examine the nature of the vertical, as well as horizontal, relationships between firms in assessing market performance. Furthermore, it fails to identify binding constraints on, or in, the system, and opportunities for enhancing its productivity and performance. As a result the food systems framework combines elements of both the two previous models. A further advantage of this approach is that it recognises the importance of the complimentary nature of farm resources in both production and consumption.

Its broad approach does not consider such aspects as the economic, infrastructural and institutional environments in which markets operate as given, but are studied in terms of (a) their impact on market performance, and (b) the constraints on and opportunities for markets to contribute to improved economic performance (Scarborough and Kydd, 1992:28). Such constraints and opportunities are defined either through interviews with market participants, or through classical market analysis tools.

4.2 Measures of marketing efficiency

Having discussed the general schools of thought we now discuss the specific tools which are commonly employed in assessing marketing efficiency. But, what exactly is marketing efficiency? Fisk (1969:713-715) warns that since marketing efficiency, in general, concerns changes in output relative to inputs, efficiency in itself is an ambiguous notion. First, there are problems in what is meant by efficiency; second, there are problems in relating a given unit of output to inputs made at some previous time; third, there are problems concerned with variability in the units of measurement; and finally, the construction of yardsticks to measure efficiency presents formidable obstacles to rational judgement. In addition, distinction between social and personal efficiency has to be observed in marketing. The return to individual business for its inputs of time, effort, and money may or may not be consistent with the long-run interests of society.

On the assumption that most analyses of markets in developing countries will be concerned with assessing and determining ways of enhancing economic performance, French 1977:95) and Scarborough and Kydd (1992:10) define market performance as the way in which markets and marketing contribute to various aspects of economic performance. They argue that a market system, or parts of it, can be said to be economically efficient if:

- all firms are productively efficient;
- the spatial distribution of firms, plant and infrastructure is organised to take advantage of scale and locational economies, and
- the operation of exchange generates prices which conform to a competitive standard.

The above authors divide performance criteria into two categories, those related to economic efficiency and other performance objectives. The former includes technical, pricing and exchange efficiency and the later includes innovation, inter-sectoral resource transfers, equity, employment, food security and co-ordination efficiency. In the following sections we describe aspects of technical efficiency, pricing efficiency, equity and income distribution, and food security.

4.2.1 Technical efficiency

Technical efficiency refers to the performance with which resources are used in marketing, in terms of physical output and input ratios. A technically efficient firm, or market, produces the maximum possible output from the inputs used, given locational and environmental constraints (Scarborough and

Kydd, 1992:12). Deviations from technical efficiency can stem from a variety of sources, including a lack of knowledge of available technologies or inadequate management due to lack of motivation, skills and/or personnel. They argue further that in order to measure technical efficiency inputs used and outputs realised must be identified and measured.

Examples of measures of technical efficiency in marketing are provided by the rate at which raw materials are transformed into end- and by-products in processing and the extent of qualitative and quantitative crop losses in handling, transport and storage.

4.2.2 Pricing efficiency

This is also often referred to as operational or allocative efficiency. As much as pricing efficiency is related to technical efficiency, one fundamental difference between the two is that the latter caters for an engineering optima of output maximisation regardless of magnitude of the incremental costs of production. For pricing efficiency, however, maximisation of output is only a sufficient but not a necessary condition of optimality. Colman and Young (1989:51) stress that allocative efficiency presumes that the entrepreneurs' objective function is one of profit maximisation and will, therefore, provide goods and/or services at a level of output which ensures that the value of marginal product (VMP) equals the marginal factor costs (MFC).

Pricing efficiency is evaluated in terms of (a) price trends, (b) market integration which evaluates the relative movement of prices in geographically separated markets, and (c) marketing margins of prices at different nodes of the marketing chain. Details regarding these measurements are elaborated in chapter eight.

Potential sources of pricing inefficiency are lack of information and lack of standard and weights and measures. Efficiency in this case is taken to be a function of the accuracy, timeliness, and availability of price information (Ellis, 1992:109).

4.2.3 Equity and income distribution

Equity refers to the equal distribution of income between individuals. One way of measuring how markets affect income distribution is to examine the differences in prices received, or paid, by various categories of market participants. With reference to food prices (Scarborough and Kydd, 1992:19) note that poor consumers may pay higher prices for their food because they purchase in smaller quantities than wealthier ones. Similarly, poor farmers may receive lower prices for their output because they sell in smaller quantities, they are unable to store their produce, and/or because they are locked into debt relationships with their buyers. Furthermore, Adams (1994:111) has demonstrated that it is important to pinpoint the relative contribution of different sources of rural income to total farm income and its variability. This will assist in identifying where efforts to improve income distribution should focus.

4.2.4 Food security

Markets have an influence on incomes, prices and commodity flow. As a result they play a determining role in production and consumption at both farm and national level. Indicators of the effects of markets on consumption can be provided through analysing (Scarborough and Kydd, 1992:21) (a) the stability of volumes of food flowing through consumer markets; (b) the levels and stability of consumer market prices, particularly those paid by poor consumers; and (c) the ratios between various consumer incomes and food prices. On the other hand, the relationship between food markets and food security can be assessed through (a) the stability of volumes of food flowing through producer markets; (b) the level and stability of prices particularly those received by small farmers; and (c) the ratio between input costs and output revenues.

At household level the ability to obtain food is also determined by inter-temporal savings behaviour which includes (Sahn, 1989:7-8) savings in the form of money, assets, and food. Seasonality of earnings is, in turn, conditioned by the pattern of income from a variety of sources, including agricultural sales, wages, business profits, remittances, and transfer payments.

In addition to these types of efficiency the role of physical infrastructures and institutional organisation to overall process of exchange and their contribution to efficient functioning of markets must be considered.

4.3 Efficiency in agricultural commodity storage

4.3.1 Theory of storage

4.3.1.1 Supply of storage

The theory regarding inter-temporal price relationships is largely attributed to Brennan (1958), Telser (1958) and Working (1949 and 1958). According to Sexauer (1977:220) these authors established that the difference between the current price and the expected price of a storable commodity must be equal to the marginal cost of storage. The marginal cost of storage is defined as the change in the total cost of storage per unit change in the quantity of stocks held. The relationship between the amount of a commodity held in storage and the equality of the marginal cost of storage with the temporal price spread gives rise to a supply of storage curve. This supply of storage curve slopes upward to the right. More storage will be supplied at a high return per unit and less storage at a low return per unit stored (Sexauer, 1977:220). Accordingly, the supply of storage refers, therefore, not to the supply of storage space but to the supply of commodities as inventories. The basic supply of storage relationship is (Sexauer, 1977:220):

$$(P_{t+1} - P_t) = f(S_t) \text{------------------------------} (1)$$

where P_t = price in period t,

P_{t+1} = in period t, the price expected to exist in period t + 1; and

S_t = inventory (value) of the stored commodity

This model implies that inter-temporal price relations at a given time between prices applicable to different times and that relations between prices for delivery at two different dates are commonly regarded as dependent on the cost of carrying the stocks.

4.3.1.2 Demand for storage

The theory of storage has originally linked the supply and demand sides of commodity storage. According to Brennan (1958:51-52) the demand for storage of a commodity can be derived from the demand for its consumption. If we assume that consumption during any period depends only upon the price in that period, then the demand in period t can be written as:

$$P_t = f(C_t) \text{------------------------------} (2)$$

where P_t = price in period t

C_t = consumption during t

Consumption in any period equals stocks carried into the period plus current production minus stocks carried out of the period.

$$P_t = f(S_{t-1} + X_t - S_t) \text{------------------------------} (3)$$

where P_t = price in period t

S_{t-1} = stocks at the end of period t-1

X_t = production during t, and

S_t = stocks at the end of t

If P_t increases less will be consumed (theory of demand with respect to price) and P_{t+1} will decrease. In general, price in the next period minus price in the current period may be expressed as a decreasing function of stocks carried out of the current period.

4.3.1.3 Equilibrium in storage supply and demand

The supply of and demand for storage can be used to determine the equilibrium quantity of stocks carried out at time (t) as a function of the price spread. As Brennan (1958:56) shows the equilibrium quantity of stocks is determined by the equality of the supply of and demand for stocks as:

$$U'_t = E(P_{t+1} - P_t) \qquad (4)$$

where U'_t = marginal cost of storage

$E(p_{t+1})$ = the price expected in period t+1 and P_t is assumed known,

and P_t = price in period t

In the absence of more specific information, Brennan (1958:58) argues that it seems reasonable to suppose that the sequence of prices expected to prevail within one planning interval, for example one production year, depends in some way on past prices. However, Working (1958:198) cautions that the nature and the behaviour of the expectations included in the model depend on the kinds of people supposed to be in the market. These may include producers and consumers as well as speculators.

4.3.2 Recent developments in theory of storage

Since the establishment of the theory of storage described above, a lot of modifications and challenges have been advanced to suite its applicability to specific conditions. Paul (1970:1) challenges that the short-run price of storage includes more than the cost of storing commodities. He observes further that the supply of storage curve usually pertains to one commodity independent of another - an assumption which may not be realistic in some cases.

Pliska (1973:658) showed that the concept of stochastic commodity production can be combined with the supply of storage theory to yield a satisfactory model of commodity price levels and differences. He points out that this modification will correct the problems associated with the supply of storage theory which only explains price differences but not absolute price levels.

Some literature stresses the need to incorporate welfare impacts of commodity storage under uncertainty. It is suggested, for example, that a common approach to deduce the welfare implications of stabilisation for producers, consumers, and society as a whole is to compare market performance with no storage with performance when storage is used to stabilise prices or some other variables (Helmberger and Weaver, 1977:639). However, Helmberger et al. (1982:266) challenge that the Helmberger-Weaver assumptions are consistent with rational expectations only under restrictive assumptions that producers and arbitrageurs are guided by rational expectations. Furthermore, Sharples and Holland (1981:538) proposed that since stocks are held for both, convenience and speculative purposes and since speculative stocks are held with the expectation of positive return from storage, they (speculative stocks) are more responsive to the expected return from storage than pipeline or working stocks.

Tomek and Robinson (1991:228) conclude that historically the supply of storage was thought to be stable relative to the demand for storage. They extend their argument further that the failure of this assumption is explained by the fact that some quantity of the commodity will be held even if the future price is less than current cash price, because of the need for working stocks.

Helmberger and Akinyosoye (1984:119) relate the behaviour of storage under price uncertainty on relative scarcity and abundance of the stored commodity. They argue that in a period of sufficient scarcity, the price of an agricultural commodity is determined by stochastic supply of and stochastic demand for current consumption or processing. In the period of sufficient abundance, on the other hand, price is determined by supply and total demand, the later representing the demand for speculative storage as well as for consumption.

More recently, Miranda and Glauber (1993:110) attest that stockholding allows the impact of exogenous market shocks to be distributed over the remainder of the marketing year, moderating the shock's immediate effect on market price. As the end of marketing year approaches, shocks must be observed over shorter time horizons and thus have an increasingly more pronounced effect on market prices.

4.3.3 Role of storage

When a product can be stored, market clearing is facilitated not only by adjustments in price but also by changes in the level of stocks or inventories. This role of storage is particularly important in many agricultural product markets, since it permits supply, which becomes available at a specific point in the year, to be matched to a more or less regular pattern of demand throughout the year (Siamwalla, 1988:82; Colman and Young, 1989:147-148).

The explicit explanation of the different types of storage follows a lot from work by Siamwalla (1988) and Pinckney (1989) even though their description of different types of storage refer, to a large extent, to public or government storage systems. The three reasons for government stockholding are: to move agricultural products from surplus to deficit years; to move produce from surplus to deficit seasons; and to ensure a smooth flow of supplies at all times, especially when imports are in order but not yet available domestically (Pinckney, 1989:9-12). These three components of storage policy can be termed inter-annual supply stabilisation stocks, seasonal stocks and import buffer stocks.

In the context of this study the seasonal storage component is the most relevant since it is also the most commonly practised by small farmers in Tanzania. Pinckney (1989:15) justifies the need for the government to hold seasonal stocks, even if it holds no inter-annual stocks, if the seasonal price variability in the absence of intervention is undesirably high - a situation quite phenomenal in the Tanzanian grain production systems.

If time period t is considered to be, say, quarters or months of the marketing/production year and by isolating consumption on the right hand side we obtain the identity (Pinckney, 1989:15):

$$Q_t + (Sg_{t-1} - Sg_t) + (Sp_{t-1} - Sp_t) + (M_t - X_t) = C_t \text{ ——————— } (5)$$

where t = quarter (or month)

$Q_t < Q_1$ if $t = 2, 3,$ or 4, defining quarter 1 as the harvest quarter

SG = government stocks

SP = private stocks

M = imports

X = exports; and

C = consumption

The equation shows that consumption equals this quarter's production plus net decline in government stocks plus net decline in private stocks plus net imports. The equation provides three important insights (Pinckney 1989:15-16): First, stock variability and trade variability are substitutes. Second, there exists a trade-off between private and public stocks: if private agents do not store grain, all seasonal storage will have to be conducted by the government. Finally, since stocks of a storable agricultural commodity are biggest at harvest and decrease thereafter up to the next harvest seasonal storage demand is seasonal. The peak for this type of storage is immediately after the harvest, while the minimum is virtually zero immediately prior to the harvest. As will be explained in chapter five these seasonal storage issues have the potential to be extremely costly for the government in terms of operating costs and storage space requirements.

Newberry and Stiglitz (1981:52) explain that since farmers and speculators engage in a limited amount of speculative storage the total expenditure of price stabilisation programmes may depend critically on the extent to which a public storage programme will serve as a substitute for a private storage programme. Given the complimentarity of private and public storage, Peck (1978:125), insists that the role and performance of private storage needs to be understood as a pre-requisite to evaluation of any proposed public role. Siamwalla (1988:84) on the other hand notes that the general perception is that if seasonal storage is left to private traders, farmers will receive less for their grain at harvest time than consumers pay in the lean season. This implies that farmers have less incentive to produce since income is transferred from them to traders. He reports that other research show that, on average, the return to holders of grain just compensates them for the costs of storage, with relatively little left over for profit. By these arguments, Siamwalla, therefore, concurs with Pinckney's argument that public and private storage ought to be perfect substitutes. Since it is difficult to control private storage, the public agency must pursue a credible price policy that leads stockholders or potential stockholders to expect prices in the future to move in line with what the government projects.

Furthermore, Newberry and Stiglitz (1981:195) argue that, of all agents practising storage, the agent with the comparative advantage in carrying stocks will be the one for whom the price increases are greatest than the storage costs.

4.3.4 Data requirements for assessment of storage efficiency

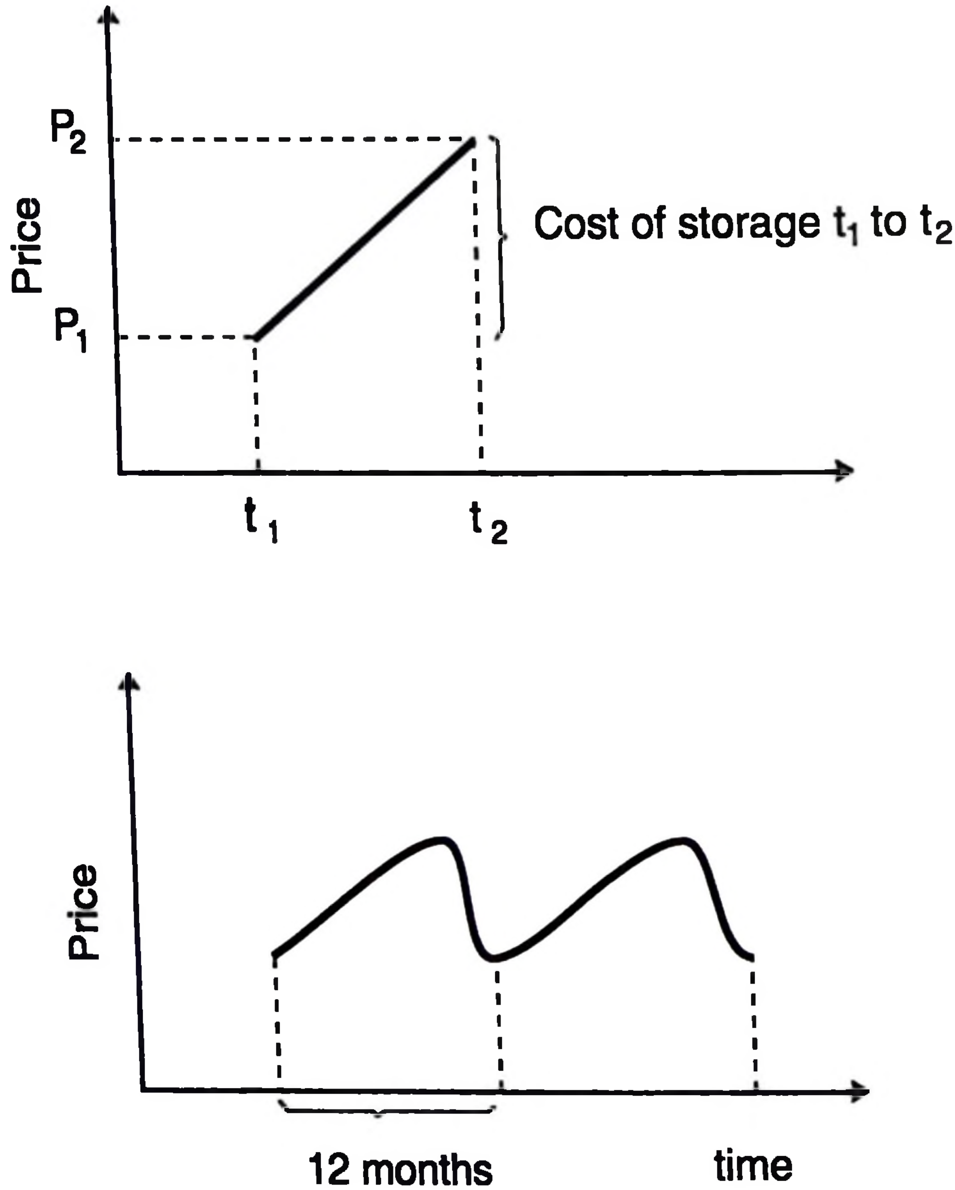
If efficiency means profit maximisation and/or least cost, so efficiency in commodity storage means highest possible returns to and/or least cost of storage. This argument leads Gardner (1987:274) to consider two different definitions of efficiency in storage: (1) the (opportunity) costs of resources used in the physical activity of storage, and (2) the optimal management of quantities held in storage so that the benefits of the stored grain are maximised given the costs of storage. Storage benefits on the other hand are also a subject of the price of the stored commodity over the storage period. In this section we first separately summarise the nature of seasonal price changes and the main storage cost components. In the final section seasonal price and storage cost changes are overlapped to elucidate the concept of storage efficiency.

4.3.4.1 Seasonal price patterns

The basic aspects regarding seasonal patterns of price, sales, and stocks are well summarised by Bressler and King (1970:211-215); Colman and Young (1989:147-149); and Tomek and Robinson (1991:157-164). Practical examples of the relationship between storage costs and price changes are detailed by Goetz and Weber (1986:99-105), Homann et al. (1979:43-60), and Lorenzl, (1993:37-48). Most agricultural products are characterised by seasonality in production and marketing patterns. For crops, seasonality arises from climatic factors and the biological growth process of plants. Many crops are harvested once a year and, depending on perishability, may be stored for sale through a marketing season. A 'typical seasonal' price pattern for a crop which is harvested once a year is illustrated in Figure 4.1.

The market price is low at the harvest time (since supply is large relative to demand) and rises, as a function of the cost of storage, to a peak prior to the next harvest. As the market anticipates the increased quantity and lower prices which the new harvest will bring, price tends to fall quite rapidly in the month or so before the next harvest. In the course of the harvest year, the change in prices should be sufficient to induce a steady release of the product from storage. Producers' stocks would also exhibit a seasonal pattern in which inventories would be highest at harvest but would be depleted during the crop year (Bressler and King, 1970:212-215; Colman and Young, 1989:148-149; Tomek and Robinson, 1991:160-162; Lorenzl, 1993:40).

Figure 4.1 Theoretical seasonal price behaviour



Source: Tomek and Robinson (1991) Agricultural Product Prices. Ithaca: 161.

4.3.4.2 Storage costs

Production and consumption are usually separated in time and the creation of time utility in bridging this gap is a productive activity that can be accomplished only at a cost in terms of resources. Scarborough and Kydd (1992:86) point out that if data on storage costs are available, further insight can be gained into the technical, operational and economic efficiency of storage, and the role storage costs play in marketing decision making.

Storage costs can be classified in different ways. Scarborough and Kydd (1992:86) gives the following classification: (1) costs that vary with the volume of stocks and/or length of storage time and those that are relatively independent of these; (2) operational costs; and (3) costs associated with quantity and quality of product losses. If all costs are only classified as either fixed or variable then these cost categories are exemplified as:

(a) Fixed costs

The costs of store maintenance or rental, salaries of permanent employees and of obtaining market information will not vary with the size of stocks except for those on a per unit basis. Similarly, handling (e.g. filling of store) and overhead expenses will not vary with the length of storage.

(b) Variable costs

These include direct costs like interest rates on capital tied up in the stored grain and indirect costs due to losses caused by pests, rodents and other sources of losses.

On the basis of these cost categories, Timmer et al. (1983:174) suggests that the opportunity cost of tied-up capital; interest on loans; commodity losses; payment for labour and facilities used; and normal profits, including payment for risk bearing, are the most important cost elements in storage. This implies that data are required on the following costs (Table 4.1).

Table 4.1 Classification of storage costs

Type of cost	Classification (Fixed/variable)
- Compound interest on loans	fixed
- Opportunity cost of capital tied in inventories	fixed
- Weight losses e.g. due to pest attack (or drying)	variable
- Rates of quality deterioration	variable
- Warehouse rental, or depreciation, rates	fixed
- Depreciation on bags if reused; costs of bags if used only once	fixed
Labour costs: - carrying and stacking	variable
- permanent employees	fixed
- Price and rate of application of pesticides and other chemicals, if used	variable

Source: Scarborough, V. and Kydd J. (1992). Economic Analysis of Agricultural Markets: A manual, UK: Natural Resources Institute:86.

Equations for the calculation of the different unitary storage costs are summarised as follows (Homann et al., 1979:54; Scarborough and Kydd, 1992:87-88):

(a) Store depreciation/commodity unit (e.g. a bag) /month:

$$\frac{\text{Original price of building}}{\text{Life expectancy} \times \text{No. of units stored} \times \text{No. of months stored}} \qquad (6)$$

For rented stores, the unitary costs of renting storage facilities per commodity unit per month are:

$$\frac{\text{Annual rate of rent}}{\text{No. of units stored} \times \text{No. of months stored}} \qquad (7)$$

(b) Interest of investing in a store, or the opportunity cost of investment capital, per commodity unit per month:

$$\frac{\text{Value of investment} \times \text{Participant's annual interest rate}}{\text{No. of units stored} \times \text{No. of months stored}} \qquad (8)$$

(c) Interest on borrowed and/or the opportunity cost of own working capital per unit per month:

$$\frac{(\text{Unitary harvest price} + \text{Handling costs}) \times \text{Annual interest rate}}{12} \qquad (9)$$

(d) Handling and treatment costs per unit per month:

$$\frac{\text{Total handling and treatment costs per year}}{\text{No. of commodity units stored} \times \text{No. of months stored}} \qquad (10)$$

(e) The value of quantitative and qualitative crop losses per unit storage period:

= Release price × (% weight loss + % quality loss)/100

Goetz and Weber (1986:125) suggest that the following summary can be used to calculate total per unit storage costs:

$$C = \frac{[(r * i)Ph]}{12} + s \text{------------------------------} (11)$$

where C = monthly cost of storing one unit of crop

r = rate of crop loss in storage over a year

i = the annual rate of interest

P_h = the unit market price at harvest time (including handling costs)

s = unit operating costs of storage per month

It should be emphasised that costs of storage are likely to vary with types and sizes of storage facilities. In stressing this aspect Homann et al. (1979:43) point out, for example, that operating costs increase with a higher level of technology due to higher fixed costs for depreciation and interest on investment for a more sophisticated system. Sparks (1975:90) however, observed that some of the differences in initial investments may be offset by differences in the length of life and annual maintenance requirements associated with both the size and type of storage facility.

4.3.5 Assessment of temporal efficiency

Goetz and Weber (1986: 99-105) summarises the cost relationships spelled out above as shown in Figure 4.2. The diagram shows that the fixed costs (FC) are constant over the storage period, while the variable costs (VC) slopes upwards in a linear fashion. Price is shown as curve xy and is assumed to increase to a maximum at time T_m and then begins to decrease as the subsequent harvest period (H_1) approaches.

The optimal storage period in the diagram is given by T^*, which yields net maximum returns to storage of ab. At this length of storage, the difference between the price and the total cost of storage is maximised, as indicated by the equality of the slopes of the cost and price lines.

To determine whether storage is profitable, the following expression is used (Goetz and Weber, 1986:125):

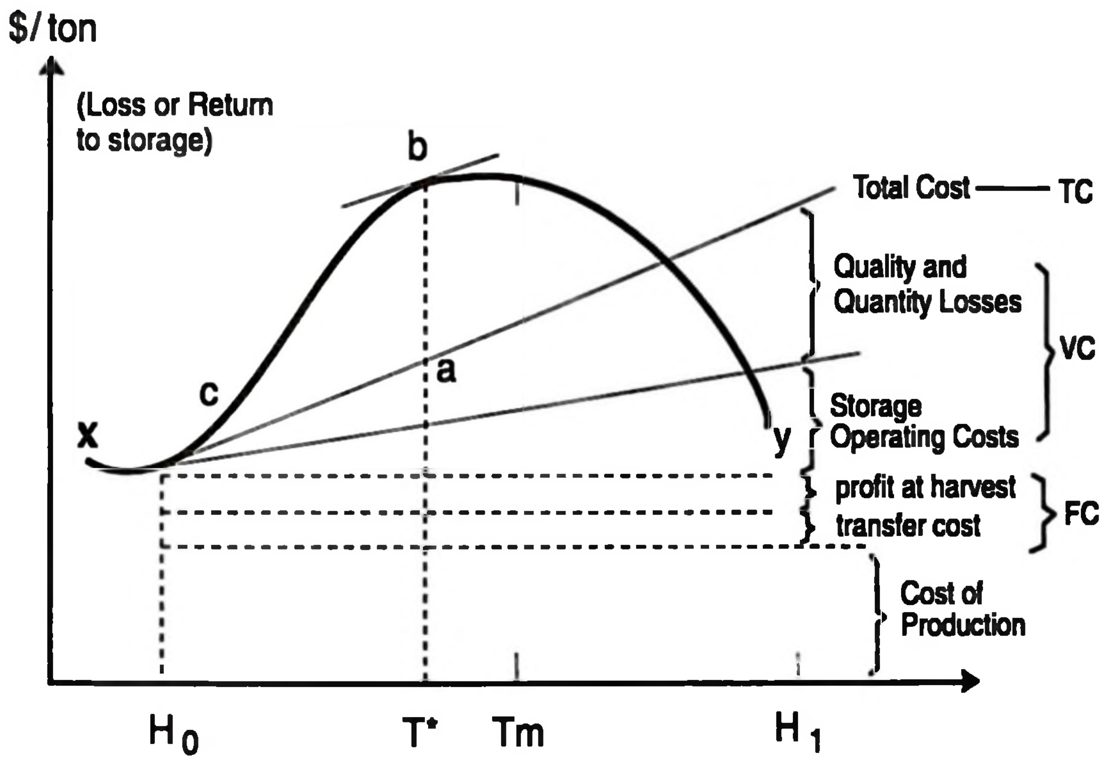
$$\frac{Pm}{Ph+Cm} = 1 \text{--} (12)$$

where P_m = post harvest release price

P_h = harvest price, and

C_m = costs of storage till release

Figure 4.2 Economic costs and benefits of storage



Source: Goetz and Weber (1986). Fundamentals of price analysis in developing countries' food systems: A training manual to accompany the micro computer software programme' MSTAT'. Working paper No. 29: 101.

If the left hand side of the equation is greater than 1, a storage gain has been obtained and vice versa. Along the same line Hays and McCoy (1978:187) explain that in a perfectly competitive market, economic theory suggests that the post-harvest price rise will equal the cost of storing grain. A price rise greater than costs of storing grain provides the opportunity for speculative storers to make more than normal profits. The expected seasonal price increase consistent with a perfect market may be calculated as:

$$E(P_{ti}) = P_{to} + t(L + I + L + D) \text{------------------------------} (13)$$

where
$E(P_{ti})$ = expected price per ton of stored grain in i^{th} month
t = time in months: 1 = 0...11 months
P_{to} = price of one unit of grain stored at harvest, i.e., t = 0
R = rent per month per unit of grain stored
I = interest on capital needed for one unit of grain per month
L = amount of grain losses over time
D = depreciation on sacks used in storing one unit of grain

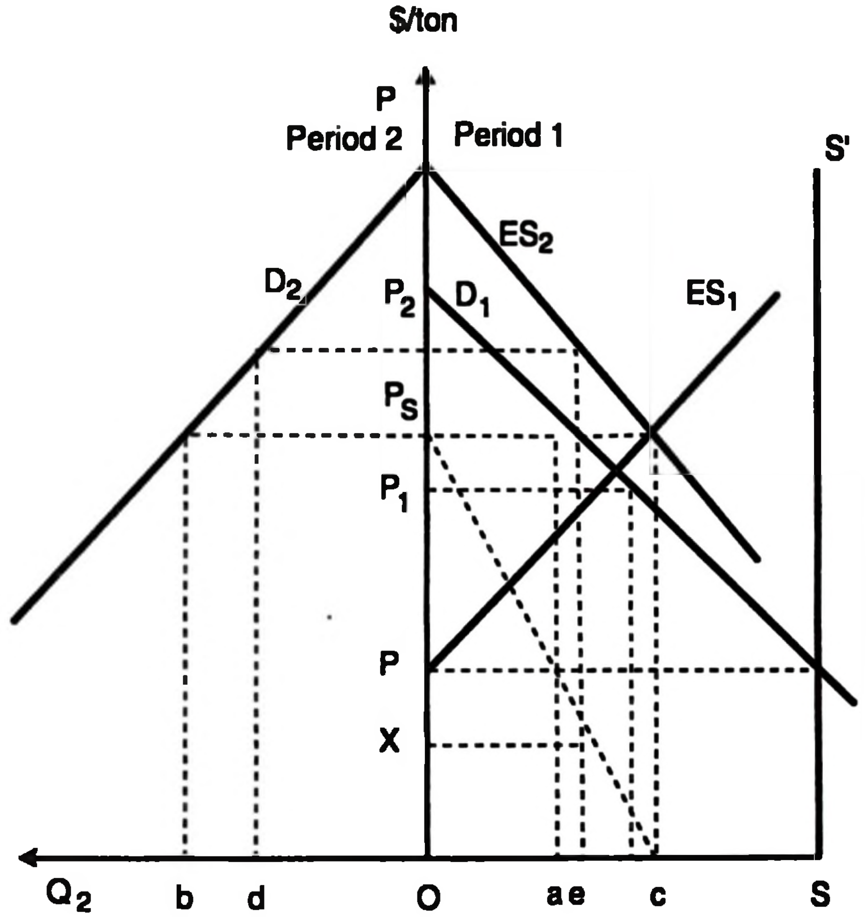
The net seasonal rise in price ($NSRP_{t1}$), the rise above that considered consistent with storage costs, for any period would be:

$$NSRP_{ti} = P_{ti} - E(P_{ti}) \text{------------------------------} (14)$$

Assuming perfectly competitive conditions, the net seasonal increase in prices will equal zero, which means seasonal price rises equal to the computed storage cost.

A diagrammatic explanation of the equilibrium situation with storage is well illustrated by Bressler and King (1970:208) in Figure 4.3. The horizontal axis OS and vertical axis OP represent the quantities available during the season and prices, respectively. Two time periods are considered for illustration. D_1 and D_2 are the demand curves for time period 1 and time period 2, respectively. In absence of storage, the supply curve SS' intersects the demand curve D_1 at price P, and all the available quantity OS is consumed in period 1.

Figure 4.3 Equilibrium with storage costs for two periods



Source: Bressler,R.G. and King, R.A. (1970) Markets, Prices and Interregnal Trade. New York: 208.

With the introduction of storage at a unit cost of OX = $P_2 - P_1$, Oc is consumed in period 1 at price P_1 and Od = cS is stored for consumption in period 2 at price P_2. Reducing storage costs to zero results in a price Ps for both time periods, with Oa consumed in the first period and Ob consumed in the second period. Thus, reducing storage costs raises prices at harvest time, lowers them in the post-harvest period, with consequent reductions and increases in the quantities consumed in the two periods, respectively.

4.4 Theory of the agricultural household

4.4.1 Basis of the theory

Development economists are interested in the analysis of the family farm household which, according to Colman and Young (1989:152), Doppler (1991:14-17) and Manig (1993:20) is the main form of economic organisation in developing countries. As the name suggests, the family farm household consists of three subsystems, family, farm and household. The activities of its members are co-ordinated in the form of simultaneous decisions and activities performed regarding, among other things, production and consumption. The analysis of the agricultural household, therefore, requires a synthesis of consumer theory and the theory of production economics. In Tanzania, the family as a unit of production depend, to a large extent, on family labour. The family has a proprietary relationship to the land. As noted in chapter 2 production technology is still very simple and agricultural production is characterised by a mixed economy for own consumption and for marketed surplus. More often rural households in the country are partially proletarianised, that is, with some family members who are engaged in wage employment. These characteristics, according to Lofchie (1978:469-470) qualifies the classification of Tanzania as a country with a semi-subsistence economy.

4.4.2 Trade model of peasant behaviour

The most recent and direct approach to the trade model of peasant behaviour is provided by Antel and Gregory (1994:377-379), Colman and Young (1989:159-160) and Ellis (1988b:128-131). In this section we elaborate on both the graphical and numerical presentations of the model.

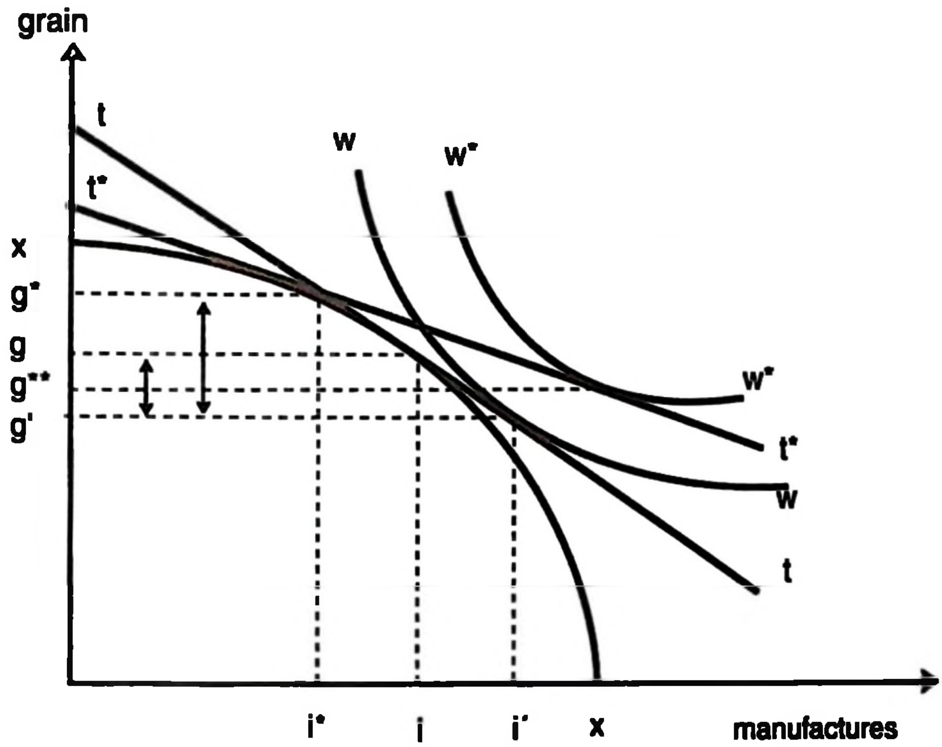
4.4.2.1 Graphical presentation

The graphical presentation of the model is depicted in Figure 4.4. In this figure it is assumed that the peasant economy is faced with an opportunity locus (production possibility frontier) XX that describes its opportunities for transforming agricultural goods (grain) into non-agricultural manufactured (handicraft) goods. The opportunity locus is shaped to show peasant agriculture's comparative advantage in grain (a high and rising opportunity cost of transforming grain into manufactured goods). Peasant agriculture trades with the city at the terms of trade denoted by tt. Peasant agriculture produces at the tangency of tt and XX, producing g of grain and i of manufactured goods. It then trades with the city along tt. Peasant agriculture maximises its welfare at the tangency of its social indifference curve WW and tt. At this optimum, peasants consume g' grain and i' industrial goods. Peasant grain marketings are represented by g - g'.

An improvement in peasant agriculture's terms of trade is represented by a flattening of the terms-of-trade line (t*, t*). The increase in the relative price of grain, as shown, has a number of effects. First, production of grain increases (from g to g*). Second, the increase in income due to the improvement in the terms of trade generates an income effect which causes peasant consumption of grain to increase. Third, the increase in grain's relative price generates a substitution effect that, *ceteris paribus*, depresses grain consumption. The net effect of the income and substitution effect is shown by g^{**}-agriculture's consumption of grain with trade. With the improved terms of trade, agriculture markets $g^{*} - g^{**}$.

The net effect of grain marketings ($g^{*} - g^{**}$) versus ($g - g'$) of an improvement in the terms of trade is determined by the relative strengths of the production effect, the income effect, and the substitution effects. The stronger the production effects and the substitution effects. the more positive the effect on marketings; the stronger the income effect, the more negative the effect of terms of trade on marketings.

Figure 4.4 Trade model of peasant behaviour



Source: Antel and Gregory (1994). Agricultural surplus models and peasant behaviour: Soviet agrculture in the 1920s. Economic Development and Cultural Change. 42(2): 377.

4.4.2.2 Numerical presentation

Barnum and Squire (1979:79-102), Colman and Young (1989:159-160) and Ellis (1988b:128-131) present the farm household model on the assumption that the household wishes to maximise the satisfaction arising from consumption of its agricultural output (Q_a), of a purchased market good (Q_m) and of leisure (Q_r). The utility function than takes the form:

$$U = U(Q_a, Q_m, Q_r) \text{ --------------------------------- } (15)$$

The household faces, however, a budget constraint, a time constraint and a production constraint. The budget constraint; which states that expenditure on the market good must equal net cash income, can be written as:

$$P_mQ_m = P_a(Q - Q_a) - w(L - F) \text{ --------------------------------- } (16)$$

where: P_m and P_a are the prices of the market good and the agricultural product respectively

w = the wage rate

Q = total farm output

L = total labour input

F = family labour input

The term ($Q - Q_a$) denotes the household's marketed surplus and the term (L-F) will be positive if labour is hired, and negative if the household supplies labour.

The time constraint is written as:

$$Q_r + F = T \text{ --------------------------------- } (17)$$

where: T = the total amount of household time which is available.

The production function imposes a constraint on farm production.

$$Q = f(L/A) \text{------------------} (18)$$

where A = the household's fixed land resource.

According to Colman and Young (1989:159) the constraints (16,17 and 18) can be collapsed into a single constraint:

$$P_m Q_m + P_a Q_a + wQ_r = wT + \Pi \text{------------------} (19)$$

where: Π = $[P_a f(L/A) - wL]$, a measure of farm profits.

The right hand side of the equation represents farm profits and total time available. On the left hand side we have household expenditure on the market good, on-farm consumption of farm output and on leisure. The household will thus seek to maximise the utility function (15), subject to the full income constraint (19). The first order conditions for optimisation will yield demand functions of the standard form, for the three consumption items-the agricultural output (Q_a), the purchased market good (Q_m) and leisure (Q_r):

$$Q_a = f_a(P_a, pm, w, Y^*) \text{------------------} (20)$$

$$Q_r = f_r(P_a, P_m, w, Y^*) \text{------------------} (21)$$

$$Q_m = f_m(P_a, P_m, w, Y^*) \text{------------------} (22)$$

where Y^* = the value full income associated with profit maximisation.

4.5 Conceptual framework

Conceptual or analytical frameworks of market performance, and of the way in which markets are structured, are essential as a guideline in identifying important variables and for effective and efficient data collection. Scarborough and Kydd (1992:9) stress that such frameworks should help indicate the most useful area(s) in which to focus limited research resources, and ensure that data collected is relevant to the objectives of the research. This section presents a brief outline of the conceptual framework used for information generation through the field work in Tanzania and through literature search. In general, the choice of variables for information generation depended very much on the objectives of the study and the resource constraints for data collection.

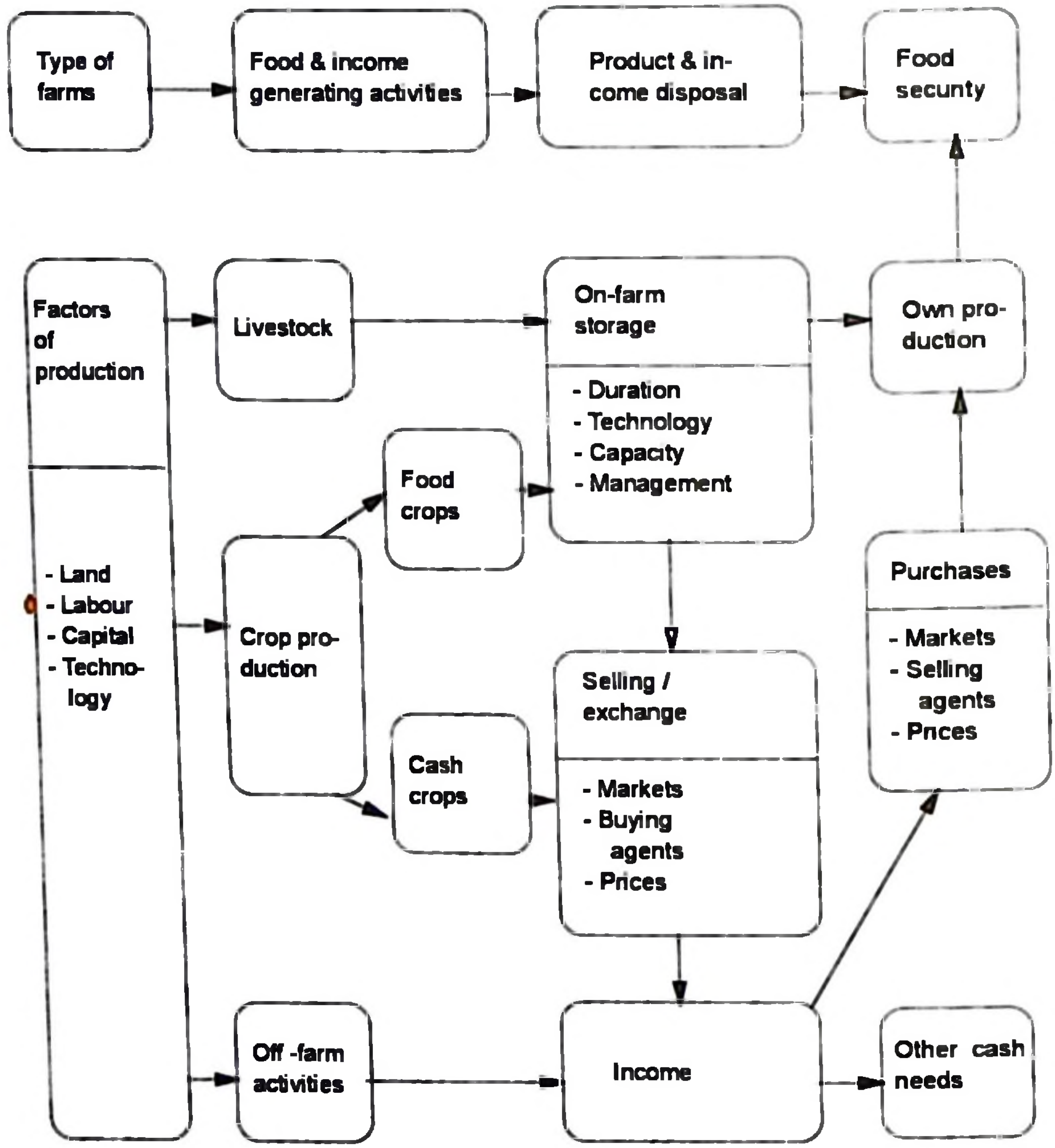
As stated in chapter one the general objective of the study was to describe the storage and marketing implications of the grain market liberalisation policies in Tanzania. The specific objectives were: to identify the patterns of household maize storage and marketing; to describe the market channels for maize in a the study area; to assess market efficiency; and to evaluate the implications of household maize storage and marketing practices on household food security and farm income.

To meet the information needs of these objectives and to identify the variables for data collection, a conceptual framework for selecting variables and respondents in maize storage and marketing was developed (Figure 4.5). The main important factor which determines the households grain storage and marketing pattern is its ability to produce. This in turn is, to a great extent, influenced by the households endowment of the factors of production, mainly land, labour and capital which jointly play a central role in agricultural production in Tanzania. Where land, for example, is limited families will be forced to depend on labour selling to be able to acquire food. Access to production technology in terms of fertiliser, improved seeds and pesticides will also determine the level of productivity of the various factors of production.

Access to credit facilities may also ease off rural households capital constraints. The food and income generation in a household involves a trade-off between a diversified set of objectives. Farm households may engage in either growing field crops, raising livestock and/or earn income and food from off-farm activities like masonry or trade. In crop production a further trade-off exists between the growing of food and/or cash crops. However, given the complimentary nature of rural production, households may jointly undertake a number of activities simultaneously.

After income and food are generated, the households' disposal pattern also reflects a trade-off between different end uses. Storable food products can be preserved to take care of household food needs in the lean season. The stored product can also be sold to earn cash which could be used to buy other food or non-food family requirements. Sales from storable food products supplement income from cash crops sales or from non-farm activities. The money can also be stored in the form of cash deposits.

Figure 4.5 Conceptual framework for analysing peasant storage and marketing



It is at this income and product disposal stage that storage becomes an important part in the whole subsystem. Individual storage operations and their interactions must be designed with regard to constraints imposed by the nature of the stored product and the environment. Perishability of the stored product is an important factor in choosing the type of storage. While the storage of grains is relatively easy the storage of perishable products like fish or vegetables may need more technically sophisticated systems. The major constraints include (Bengtsson, 1987:1-2): (a) economic factors like costs and benefits of storage, organisation of markets and price structure, and labour availability for store construction, (b) social and cultural values like ecological features and its relation to the distribution and level of occurrence of pests and disease, (c) knowledge on storage technology, and (d) institutional constraints like availability of extension services. In general, households' technical, space, managerial and economic aspects of produce storage must be taken into consideration.

The implications of the production, storage and marketing activities are the households' food security status. Food security can be derived by either consuming food produced by the household or purchased/received from the market or both. For the amount of food bought from the market two key issues are important. First, selling markets must be reliable in terms of food availability. Second, prices should be affordable. The later emphasises the importance of income for farm households and explains why households also participate in other non-farm employment activities. Income generated through such activities enables households to purchase or obtain more food to meet their requirements. Other coping strategies include exchange of crops, changing crop combination and cropping calendar and borrowing food and cash. Babu and Mthindi (1994:274-276) maintain that to understand the influence of food markets on household food security, it is important to study the existing structure and availability of markets for the selling and buying of food commodities.

Information collected based on this conceptual framework is used in the empirical analysis of this work.

4.6 Data limitations and conceptual problems

4.6.1 Data limitations

Past work on storage has been unbalanced with a wide variation in content. According to Lipton (1971:3) the technical features of grain storage systems have been studied in great detail and in most of the developing countries including sub-Saharan Africa there are already plenty of good technical discussions of these systems. Hall (1973:3) also reports that considerable efforts in both anglophone and francophone countries has been taken to direct attention to the existing problems of dealing with grain storage, to gauge the magnitude of these problems, to identify solutions by acquiring of technical data and to implement relevant solutions within a social and economic complex.

To date there have been few publications on the economic activities of grain storage in sub-Saharan Africa even though the economic implications of storage has been repeatedly mentioned in much of the literature cited above. An evaluation of the relationship between seasonal price changes and the storage costs involved have been limited by the absence of household data at the village level where storage and marketing activities take place. The most comprehensive studies of economic significance on grain storage at farm level were conducted in India by Boxal et al. (1977), Greeley (1978 and 1982) and Tyagi (1982).

While much has been achieved through national programmes to promote storage and marketing patterns which meet the needs for urban areas and export policies, Lipton (1971:3) implores the need for a better interchange of information within and between countries about storage research findings. He proposes that this could, for example, be achieved by setting up of an African Rural Storage Unit or Centre to stimulate the promotion of national extension programmes, disseminate information and assist with training and technical seminars. Such efforts have been attempted in the region. For example, under the support of the United Nations Development Programme (UNDP) the countries of the Eastern and Southern Africa recently established a joint programme on agricultural operations technology for smallholder farmers in the region. Centred in Harare, Zimbabwe, the centre is, however, more inclined to solve technical storage problems than issues related to economic aspects.

4.6.2 Conceptual problems

Perhaps the biggest controversy on all storage-related studies lies on the flaws in methodology and misinterpretation of concepts. The theoretical models presented in this chapter, and on the basis of which temporal sufficiency is undertaken, are applicable to situations where the market structure is conducive to competitive conditions so that prices of commodities over time are equal to the costs incurred in storage. Departure from these theoretical situations in developing countries may occur as a result of poor market intelligence, monopolistic conditions or government intervention to regulate markets (Idris et al., 1990:103). This implies that however relevant the models may be for developed countries, they may not be relevant for drawing meaningful inferences about storage situations in the developing countries. Some elaborating examples follow.

4.6.2.1 Labour and material costs

Most of the existing empirical studies, especially on technical aspects are at research station level where, according to Lipton (1971:4), the researchers knowledge on storage technology is quite different from that of the farmer. On the other hand, research station calculations of running costs in storage practices evaluate labour at the going wage rate. He cautions that this is a wrong approach because farmers will often employ family labour that would otherwise stand idle, so that the true cost to the farm unit, especially during the slack season, is far below the research station estimates. In other cases, for example Hays and McCoy (1978), the contribution of labour to the total storage costs is not explicitly detailed.

The same can be said regarding the costs of the materials which are used to construct storage facilities at the farm level. Farmers, in most cases, make use of locally available material like grass, mud bricks and stakes whose costs are lower when compared to those of modern building materials such as cement and corrugated iron sheets. We shall observe in the next chapter that this was evident in some Nigerian and Tanzanian situations. This implies that labour and building materials may be cheaper in rural areas than implied and thus returns to storage could be far higher than previously thought. Moreover, Scarborough and Kydd (1992:86) suggest that in understanding storage incentives, and assessing the efficiency of storage at different points in the marketing chain, it is crucial that costs are calculated according to where, when and by whom storage is undertaken.

4.6.2.2 Interest rates

As well as protecting the physical quality of grain, a sound storage facility also protects the owners' investment in the grain. Bourne (1984:332) notes that foodstuffs have a monetary value and therefore its storage is the major asset of most subsistence farmers; it is their equivalent of money in the bank. It is then a common feature that opportunity costs of capital tied up in inventories are included in calculating unitary storage costs. Scarborough and Kydd (1992:87) caution that the costs of storage, and hence the relationship between seasonal price rises and storage costs, are very sensitive to the interest rate used, and those chosen must be justified. There is still a big controversy on the procedure for selection of interest rates. Ideally, this rate should really reflect the store's or the community's rate of time preference, that is, an interest rate that reflects the real scarcity of capital (Lipton, 1971:6; Bhatt, 1979:97). Bottomley (1975:280) acknowledges, however, that this cost will actually be hard to determine.

A framework for determining the rate of interest requires an examination of four components of rural interest rates (Bottomley, 1975:279): (a) the opportunity cost of the money involved, (b) the premium for administering the loan, (c) the premium for risk, and (c) monopoly profit. He cautions, however, that this procedure is particularly difficult because of the difficulties involved in accurately defining and measuring these components in a rural setting. Due to the lack of interest rate data in rural finance markets reliance has been more often put on interest rates used by commercial banks in short-term advances to appraise storage efficiency. This is an abstract phenomena for a number of reasons.

First, in most developing countries there are high rates of inflation, and corrective measures are necessary to determine real interest rates. A corrective measure requires a deflation of the nominal interest rate to reflect the inflation rate embedded in it. Therefore, a pure rate of interest will always incorporate inflationary premiums as a compensation for any expected decline in the purchasing power of the means of repayment. In practice, however, negative real rates are not uncommon, particularly in developing countries. If the government lends at 20% during a period when the cost of living rises by 30 %, than it is paying the borrower 10 % to take its credit.[9]

Second, as demonstrated by Amani et al. (1987a) and Kashuliza (1993) in the case of Tanzania, formal credit institutions have not been able to meet the prevailing demand for finances for families, and credit institutions have

[9] The 1992 official lending rates in Tanzania were between 20-31% for both short-term and long-term advances (URT TET, 1993:106). In contrast, the 1991-1992 National Consumer Price Index (NCPI) for foodstuffs show a year to year rise of 23% (URT TET, 1993:97). These figures reflect real interest rates of between minus 3 and 8 percent.

discriminated against small farmers in the provision of credit because of their lack of collateral. Thus for these reasons small farmers continue to seek their finances from informal sources, especially from relatives, neighbours and friends (Table 4.2).

Table 4.2 Estimates of credit value and interest charges by source, Tanzania, 1989/90

Source	Credit value[a] (TSh)	Nominal interest rates[b] (%)
Relatives[c]	100 - 5,000	0 - 10
Shop owners	1,000 - 10,000	25 - 100
Businessmen[d]	10,000 - 30,000	20 - 30
Large farmers[e]	5,000 - 8,000	25 - 50
Formal credit	1,500 - 6,000	20 - 30[f]

[a] 1 U.S. dollar = TSh 200.
[b] Calculation of annual interest rates is approximate because some of the loans are usually paid back after a few months.
[c] Includes relatives, neighbours and friends.
[d] Refer to the Iringa town lenders.
[e] Includes medium- and large-scale farmers.
[f] 20-31 % for 1992. See Footnote 9.

Source: Kashuliza, A.K. (1993) Perception and role of informal rural finance in developing countries: the example of Tanzania. Journal of Rural Studies, 9(2):167.

Third, as a result of the lack of institutional lending, and as Table 4.2 demonstrates, larger landowners play a substantial role as do friends and relatives. Inevitably interest rate charges differ by source and size of credit. Merchants and larger landowners will have a cost for their money which corresponds to opportunities foregone in terms of alternative investments or liquidity preference, and they will charge accordingly. Relatives and friends, while also experiencing a sacrifice of these opportunities, they are likely to be imputed rather than actually charged for, as interest is rarely levied on these transactions. Furthermore, Bottomley (1975:281) argues that the formality of lending for an urban bank means that the administrative premium on each unit loaned is higher in the formal than in the informal money market.

4.6.2.3 Storage losses

Another area of controversy lies in calculation of storage losses which could be realistically translated into economic terms. Therefore, the primary purpose for estimating losses during storage with a fair degree of accuracy will be to get reliable figures of the economic and nutritional wastage being sustained and to be able to assess economic worthwhileness of possible improvement schemes (Adams, 1976:5). To date consensus is lacking both on the definition of losses and on methodologies for loss determination. The seriousness of this problem is brought out clearly in the following:

> ..."Figures about food losses tend to be bandied around carelessly without discussion of the loss assessment methods employed. Commonly no definition of loss is provided and the post-harvest operations included in the estimate are frequently omitted. ...The loss assessment methods for storage are the most complex of all the operations. This is because the estimation of insect losses require laboratory analysis of samples" (Greeley, 1982: 51-54).

Although Adams (1976:6) lists four types of losses, that is, quantitative, qualitative, nutritional, and seed losses, the only real loss that can be measured to some degree of accuracy is the weight loss. Furthermore, it is difficult to incorporate the different types of loss into a single index of food loss. Different methods of assessing weight losses in store have been developed in the past. Among the most comprehensive ones are the Thousand Grain Mass (TGM) and the Standard Volume Weight (SVW) well described by Reed (1987). However, some obstacles to their use are commonly recognised, such as, lack of equipment and materials, shortage of technically trained staff or lack of transport. As a result many survey work have frequently encountered major delays and have been extremely costly (Candler and Slade, 1981:66; Hindmarsh and McFarlane, 1983:3-4).

In general losses in any type of store increase - not in a linear fashion - with the period of storage, exposure to pests per unit of time, the quantity of crop stored and the poorness of quality of crop at time of storage (Lipton, 1971:8). Losses in traditional stores may also vary considerably by rainfall, type of grain, and type of storage. For example, losses tend to be higher in humid areas and when grain is stored in houses rather than in separate granaries. The destruction of a crop is much more than proportional to these parameters. The linear fashion, e.g., Hays and McCoy (1978) is purely adopted for analytical convenience.

Bengtsson (1991:2) attributes the great variability in weight loss figures in Tanzania to the fact that in other cases, e.g., Mphuru and Maro (1975:37), figures for percent damaged grains have, in general debate, been taken as figures for actual weight loss. Therefore, losses are to be distinguished from damage, with the latter being a measure of the proportion of grain having been infested, broken, and moulded.

4.6.2.4 Prices and other socio-economic aspects

One other area of concern is the lack of the integration, in the minds of social scientists and experts who provide advice to farmers, national policy makers, and others in between, of the diverse interrelationships between socio-economic factors and farm storage systems. Norgaard (1976:45) contends that insufficient consideration is given to the farmers' economics and technological limitations of storage in relation to the total post-harvest system. He argues, for example, that investment in pest control for farm-stored grain may not be cost-effective for many farmers. On top of this, selection of a treatment method is highly dependent, among other things, on length of storage and on economic limitations.

Farmers perception of losses is also rarely taken into account. Reed et al. (1989:1254) inform that economic consequences of insect infestation in grain stored on farms depend, in part, on the value of the price discounts levied at the point of first sale. This aspect might not be well translated in a situation where farmers could use the damaged grain for other purposes like brewing. Along the same line of argument Reusse (1976:2) informs that even though consumer price increases in the tropics are correspondingly pronounced, statistical evidence of this, however, needs interpretation, since the probability of purchases at peak prices is negligible and since there is a considerable difference in marginal cost between grain sold at, or shortly after harvest time and that sold towards the end of the storage season. He reports that for instance in Ghana processors of *Kenkey* (fermented maize dough) recognise this fact by paying preferential prices for old maize when the new crop enters the market. This argument is reinforced by McFarlane's (1988:122) speculation that weight loss figures around 3% appear to be customarily acceptable to farmers in many African countries and which do not in the farmers view warrant additional efforts to achieve unproved pest control in existing circumstances. Given these circumstances Mumford and Norton (1984:157) recommend that when research and extension programs in pest control are being developed it is important that an early attempt is made to obtain information on farmers perceptions, on constraints affecting certain options, and on farmers objectives.

4.6.2.5 Practical implications of the household model

A major focus of past research on farm household models has been measuring the response of marketed surplus to changes in prices and other exogenous variables. The big problem of past work on semi-subsistence households lies in the omission of household storage of staple foods (Renkow, 1990:664). All work to date has assumed that households costlessly store exactly the quantity allocated to home consumption over the period between harvests. Renkow notes further that a more serious conceptual problem, however, is that existing models take consumption, output, and sales as occurring simultaneously, an assumption which is often not realistic.

Hindreth (1977:899) observed that financial gain is not the only incentive shaping farmers behaviour. Social status, religious values, domestic tranquillity, leisure and aesthetic enjoyments might immediately be cited in the case of producers. This argument emphasises the fallacy of putting profit maximisation as the analytical point of reference in the study of the behaviour of rural farm households. Chernichovsky and Zangwill (1990:36) note that as a result of the focus of the household model on the extreme factors (largely income and prices) it ignores such internal issues (such as these psychological and cultural issues), that may be crucial to resource mobilisation and allocation.

Indeed many of the familiar results from models of output price uncertainty may not hold when producers consume a significant share of their own output (Finkelshtain and Chalfant, 1991:566). For example, Toquero et al. (1975:709) observed the allocation of rice output between home consumption and market sale within producers households in the Philippines not to be sensitive to price changes. It has also been observed that under intense shortages of consumer goods increased market arrivals may be stimulated by factors other than price increases (Azam, 1994:369).

Goetz (1992:444) reports that recent empirical findings in sub-Saharan Africa show that some agricultural households are net purchasers of food even in years of average rainfall while others fail to participate in cash markets altogether. He emphasises that the household trichotomy-net buyers, net sellers, and non-participants be seriously considered when assessing farmers responses to changing farm output prices. Indeed, Haesel (1975:114) stressed earlier that all the price and income elasticities of home consumption and marketed surplus of food grains for the larger farmers were somewhat greater in absolute value than for the entire sample suggesting that larger farmers are relatively more income responsive than smaller farmers. Strauss (1982:329) and Strauss (1984:330) on the other hand, recorded positive own price elasticities of marketed surplus in Sierra Leone without a marked difference between expenditure groups.

CHAPTER 5

GRAIN STORAGE IN SUB-SAHARAN AFRICA

This chapter reviews and summarises empirical work on the storage of agricultural products in sub-Saharan Africa. The review, in line with the broader objectives of this study, is mainly limited to grain storage and focuses specifically on economic and, to some extent, technical aspects because these factors have the biggest impact on storage efficiency.

5.1 Storage as part of the production process

In chapter four we underlined that storage is the marketing function that matches production with consumption patterns over time. A notable feature of nearly all countries in sub-Saharan Africa is that most agricultural households produce a significant portion of the staple food that they consume. If production (and harvesting) takes place at one time of the year against food demand for the entire year, as is usually the case, storage becomes necessary. Storage requirements are even more pronounced in those regions where there is only one main crop a year and where, as a result, wide variations in seasonal food availability are more erratic.

Agriculture in tropical Africa is 95% rainfed and small scale with the average farm size being 1.25-2.0 ha per family (Due, 1986:23-24). Agriculture is labour intensive with little capital employed except on large estates or state farms which account for less than 5% of the crop acreage. The demographic and economic structure of most countries in sub-Saharan Africa is such that the majority of their population live in rural areas and earn their living from agriculture. It is estimated, for example, that about 80% of the population in the

Southern African Development Co-ordination Conference (SADCC)[10] member states is based on agriculture. Due to this phenomena around 60% of the food grain produced is retained on-farm for domestic consumption or local trading (Rukuni, 1988:37). In Africa as a whole some 85% of the population depends upon agriculture for a livelihood and a similar percentage of food grains remain in farm storage (Hall, 1973:1). To date this pattern has not changed much and the fact that storage is meant to cover food needs between harvests justifies McCloskey and Nash's (1983:2) clasification of such economy as a storage economy. This implies that storage capacity at farm level is higher than-off farm storage capacity.

As Renkow (1990:664) points out, how these semi-subsistence households allocate output of staple foods between home consumption and market sales is an issue that has received considerable attention from economists because of its important implications for aggregate market supply, food disappearance patterns, and the attendant nutritional consequences for rural and urban dwellers. Furthermore, with strong market influences Reusse (1976:1) argues that even as the semi-subsistence farmer decides what portion of his crop to store for his household needs, he is taking marketing opportunities into consideration.

[10] In 1980, nine African countries agreed to form the Southern African Development Co-ordination Conference (SADCC) primarily to explore ways of becoming economically independent of developed countries, particularly the Republic of South Africa. The SADCC countries, which originally included Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia, and Zimbabwe aimed also at integrating their agricultural markets. For details about the nature of SADCC's co-operation to improve food security in the region see Koester (1986). Namibia and the Republic of South Africa later joined the SADCC to bring the total number of member countries to eleven. SADCC was transformed into the Southern African Development Community (SADC) in Windhoek, Namibia in August 1994.

5.2 Review of grain storage systems

5.2.1 On-farm storage

Storage facilities can be located either on-farm or off-farm. The implications of the structure of agricultural production in much of sub-Saharan Africa is a strong concentration of grain storage in the hands of smallholder farmers. As a result, governments and traders play a relatively small role in absolute storage requirements in the sub-continent. However, Reusse (1987:310), informs that by managing well-stocked on-farm granaries, farmers in most semi-arid grain producing areas finance the gradual release of their surplus into the marketing system, thereby moderating seasonal price rises, market congestion and shortages. Farmers reserves constitute part of the effective national buffer stocks against drastic market effects in drought seasons. On-farm storage encompasses many indigenous storage systems, developed in a remarkable diversity of socio-economic, climatic and cultural environments throughout sub-Saharan Africa. Traditional storage methods used in the region, for example storage in trees, in pits in the ground, gourds, pots, skin bags, woven baskets or bags, are often those that have been used for centuries, since the change from the nomadic way of life (Patel and Adesuyi, 1975:33).

Detailed storage studies of economic relevance are limited in sub-Saharan Africa. The study by Hays and McCoy (1978) in Northern Nigeria is among the first of such studies in the region. The authors analysed spatial and temporal efficiency of food grain markets and, short of some rigid assumptions, for example the linear increases of storage losses over time, this study, until recently, stood alone in providing more concrete facts on the subject. Anthonio's (1973) earlier paper on the economics of storage of agricultural products, provides a brief account of the functions of storage but falls short of empirical evidence. Ejiga (1977) in a Ph.D. work studied the storage, distribution and consumption of cowpeas in Northern Nigeria. Southworth et al.

(1979) published an exhaustive study on food crop marketing in Atebubu district in Ghana, partly covering issues related to seasonality and storage of both perishable and non-perishable products (Southworth et al., 1979:178-183).

In a study conducted by Albert (1991) the post-harvest system for maize in Togo is analysed by a detailed study of quantities flowing through various channels from production to final consumption. Surveys and investigations carried out in 1986 are used to determine the amounts and causes of losses under various types of on farm storage used by peasant farmers. A model study is used to compare the economic benefits of 13 different types of chemical or traditional crop protection with those of storage without protective measures. Finally, recommendations are drawn up on appropriate methods of storage and crop protection under various different conditions. A study by Christiansen (1993) about efficiency of maize marketing systems in Benin contains a section on storage efficiency at farm and trader levels.

Two studies by Stanning (1987; 1988) in Zimbabwe focus on two related issues, the nature and seasonality of farm household grain transactions and seasonality of farm household sources of income. In a broader study of grain markets in Ethiopia, Alemayehu Lirenso (1993:248-251) relates seasonal price spread and returns to grain storage. Using an approach related to that of Hays and McCoy, Idris et al. (1990) studied the spatial and temporal efficiency of sorghum markets in the Sudan.

For East Africa economic studies are concentrated in Kenya. Schmidt's (1979) study on the interaction of official and parallel markets for maize and beans in that country contains a brief section on grain storage efficiency (Schmidt, 1979:81-89). Recently Some et al. (1993) gave a brief account of the nature of food inventory at farm level in Kenya in an economy where there is a marked shift from production of sorghum and millet to maize production. These trends required considerable changes in storage structures and storage activities. It is reported (Some et al., 1993:329) that whereas sorghum/millet could be stored successfully in traditional structures, the transition to other crops, notably maize, wheat, and rice will necessitate adoption of different storage techniques and more expensive storage structures.

In Tanzania a study by Ashimogo (1988) in Kilosa district contains some useful information about storage behaviour in rural Tanzania. Another recent study conducted by Amani and Maro (1992b) is very helpful in highlighting important issues concerning parastatal and household storage systems in the wake of the ongoing grain market liberalisation policies.

5.2.2 Off-farm storage

As noted in the chapter four, cereals are stored in off-farm facilities for inter-seasonal storage and to stabilise intra-annual supplies and prices. Buffer stocks are kept to stabilise inter-annual supplies, and emergency reserves, and as pipeline stocks for milling and distribution. In most countries, these functions are being shared by private traders and public agencies. Aggregate national level storage studies have been carried out in some countries of sub-Saharan Africa. These studies give information about the nature and evolution of the role of governments in grain storage.

In two related studies Buccola and Sukume (1988, 1991) worked out optimal grain pricing and storage policy for Zimbabwe in a government regulated market and where the government maintains most of the nations grain reserve stocks - a setting commonly observed in Africa (Buccola and Sukume, 1988:361).

Maritim's (1985) study on maize marketing in Kenya appraises storage polices and their implications on regional food supply. It is observed that maize storage in Kenya takes place at four different levels, namely, at producer, trader, National Cereals and Produce Board (NCPB), and millers level. (Maritim, 1985:79). In practice, however, about 80% of the producers and 75% of the traders studied did not store any maize intended for sale for more than two months, justifying government intervention (Maritim, 1985:79-80). These conclusions are, to some extent, applicable to many of the countries in sub-Saharan Africa. Earlier works by Hesselmark and Lorenzl (1976:176-177) and Schmidt (1979:65) on maize marketing in Kenya together with Odhiambo and Wilcock's (1990) recent review of maize marketing reforms in the country have persistently underlined the failure of the National Agricultural Produce Board to reach price stabilisation in surplus areas and consumer price stabilisation in rural deficit areas.

In other studies Pinckney and Gotsch (1987), Pinckney (1988) and Pinckney and Valdés (1988) evaluate the relationship between storage, trade, and price policies on the performance of the Kenyan maize industry. Besides the limitations resulting from robust modelling assumptions these studies provide a great deal of insights on the trade-offs between government storage objectives of a staple grain.

In a study conducted in Zambia, Zimbabwe and Malawi Pinckney (1993) discusses how governments can gain the efficiency advantages of moving towards free markets and still protect consumers from the large costs of fluctuating prices usually from random swings in domestic food production, inelastic demand curves and the high costs of storage and trade. While acknowledging past government policy failures this study proposes rules that generally move the countries in the direction of free markets from present policies and it calls for the maintenance of an important role for a government marketing organisation in pushing prices towards stability in all years (Pinckney, 1993:333).

5.2.3 Storage costs

At farm level storage investment costs are not very high because farmers may use locally available materials and slack season labour. In Tanzania, the average costs of local storage structures, are cheap, between TSh 500 and TSh 3,000 for structures of up to four tons (Ashimogo, 1988:129-130; Coulter and Golob, 1992:422). In Nigeria, the construction cost of a crib was estimated at Naira 25 compared to a cost of Naira 150 and Naira 50 for the construction of a modern drier and silo, as per instructions from the Ministry of Agriculture respectively (Patel and Adesuyi, 1975:38).

On the other hand, public investment in off-farm storage of food grain represents a major cost for many governments because they require both high capital cost to build facilities and an annual cost of approximately 15-25% of stock value (Pinckney, 1989:12; 1993:325). Reusse (1976:2) report that estimates by the Tropical Products Institute show that warehousing costs in a central grain storage scheme in the tropical region may cost 20% of produce value, excluding risks of storage hazards, a typical price developments, under utilisation of capacity and the opportunity cost of capital.

Moreover, according to Monterosso et al. (1985:101) most developing countries have historically followed a 'think big' strategy and have located large capacity storage space with less regard to transport economics. In Tanzania, for example, concentrating storage in intermediate areas and ports resulted in some nearly circular paths between production and final consumption, along with considerable spoilage (Green, 1988:74). A specific example of a planning failure in Tanzania is given by Coulson (1978:33) who explains about Tanzania's negotiations, and finally an agreement, with a donor country in the mid-1960s for the construction of 'modern silos' even though economic analysis strongly suggested that the traditional bag-stores were a cheaper form of grain storage.

Even though parastatal storage costs in Tanzania are not known with certainty, available estimates show that the largest component is the cost due to interest rates of stockholding. On the basis of monthly seasonal price rises in various urban centres Ngondo and Kottering (1991:9-10) estimated that the most likely opportunity cost is 5% per month, after taking allowance for storage losses and labour costs.

5.3 The state of the storage literature

Earlier bibliographies on technical aspects of storage focusing specifically on Africa appear in Hall (1970). Stiles (1977) prepared a comprehensive list of annotated references paying attention to control of post-harvest losses in cereals and grains in Africa. Adam's (1977) bibliography encompassed the complete post harvest system (including storage) of losses in tropical and subtropical countries. In 1982 the Commonwealth Bureau of Agricultural Economics, UK, published a bibliography containing some 200 abstracts on all aspects of post-harvest losses world wide. Audette and Grolleaud (1983) cited about 700 studies which concentrated in the Sahelian countries. A more recent (1970-1982) compilation of bibliography of research publications on post-harvest losses covering both developed and developing countries is found in Gardner et al. (1987).

This review does not exhaust the list of persons who have studied and written about the storage of grains in tropical Africa, although it comes close. Other articles are either too technical, outdated, limited in focus or very general.

CHAPTER 6

RESEARCH METHODOLOGY FOR THE CASE STUDY

The case study approach is used for the investigation reported in here. Casley and Lury (1987:64) define case studies as involving the detailed examination of relatively few persons and items. In this chapter we describe the research area and we explain the methods of data collection. Justifications for the choice of the survey area and the focus of the survey on tne maize subsector are provided. At the end major limitations of the data are summarised.

6.1 The study area

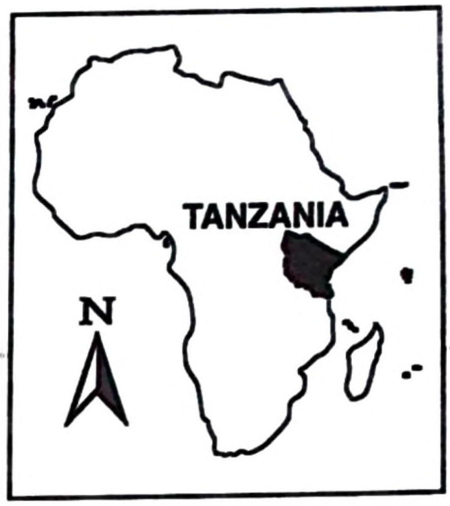
6.1.1 Geographical location

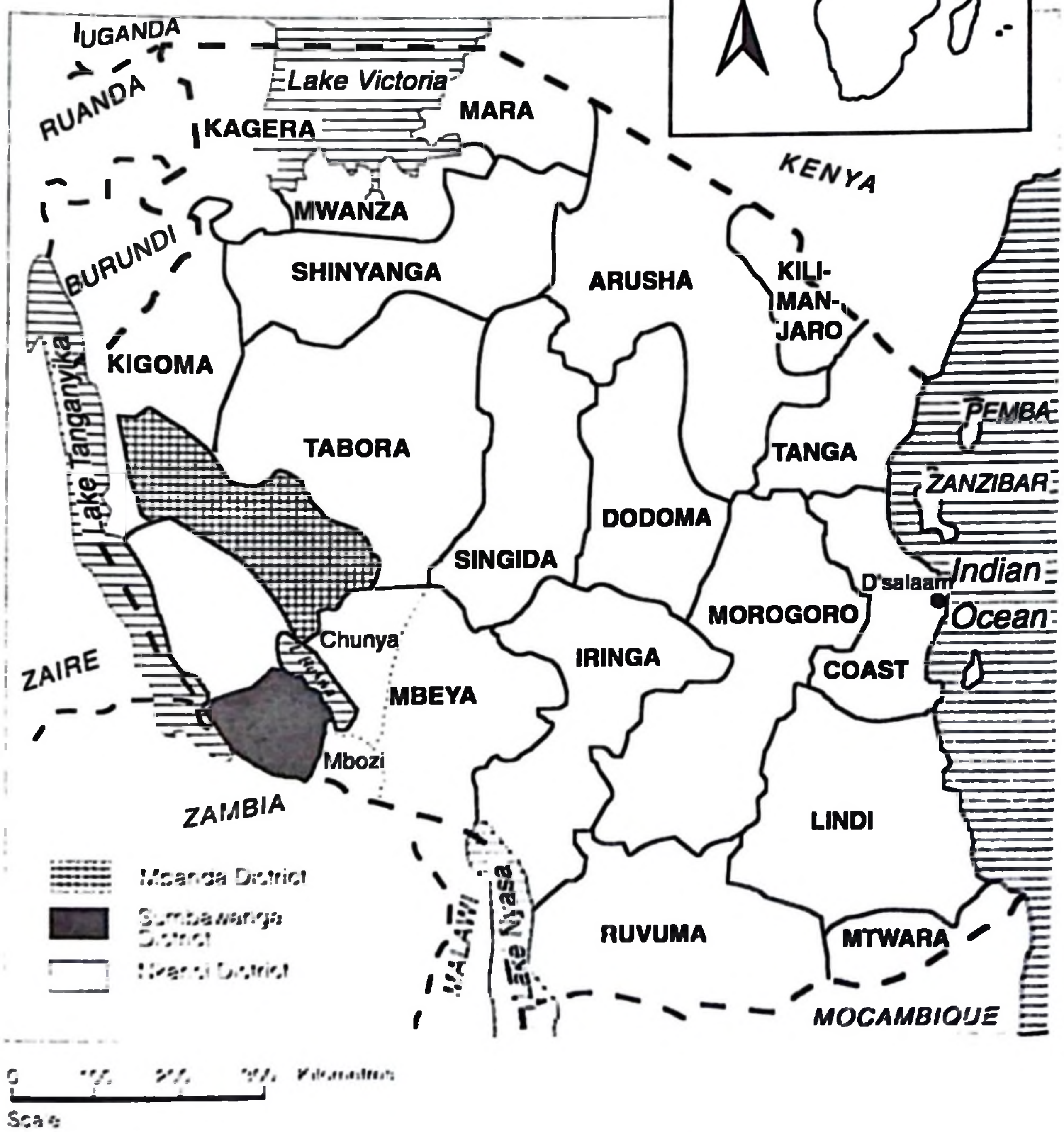
Sumbawanga is one of the three districts[11] of Rukwa region located in the remote south-western extreme of Tanzania between lake Tanganyika and lake Rukwa (Maps 6.1). The other districts are Mpanda and Nkansi. Sumbawanga district occupies 13,417 km^2 of land and 1,172 km^2 of water (URT Bureau of Statistics, 1991:7-8). The district is bounded by Zambia in the south, by lake Tanganyika and across the lake by Zambia in the south-west, and Nkansi district in the north-west. It is also bordered by lake Rukwa and across it Mpanda district and Chunya district (in Mbeya region) in the north and in the north-east respectively. To the east Sumbawanga is bounded by Mbozi district, in Mbeya region.

11 Administratively the District is divided into two districts, that is, Sumbawanga Urban District and Sumbawanga Rural District but the agricultural department, and in the context of this study, the district is considered one and the same.

Map 6.1

Location of Sumbawanga District in Tanzania





6.1.2 Marketing environment

6.1.2.1 Transport infrastructure and facilities

The socio-economic development of Sumbawanga district and Rukwa region is largely influenced by its remote location. Sumbawanga town, which is the administrative and business centre of the region, is situated at 1,186 km from Dar-es-Salaam and 331 km from Mbeya (URT, Bureau of Statistics, 1987:47). The road infrastructure within Sumbawanga district and between the district and the rest of Tanzania are underdeveloped (Beier et al. 1990:37).

The road connections between Sumbawanga and other areas in the country are shown in Map 6.2. The district is mainly served by a 240 km earth road to Mpanda in the north and by a gravel road, also 240 km long to the Tanzania-Zambia (TANZAM) tarmac road and to the Tanzania-Zambia Railway (TAZARA) at Tunduma station south of Mbeya region.

The condition of the roads[12] in the district is so poor that they become impassable in the rainy season between November and February (Beier et al. 1990:37). This is a serious problem, given the fact that feeder roads, which demand relatively more annual repairs, constitute about 61 % of the total road distance in the district (Table 6.1). At regional level feeder roads comprised about 57% of all roads in 1987[13] (URT Bureau of Statistics, 1991:19).

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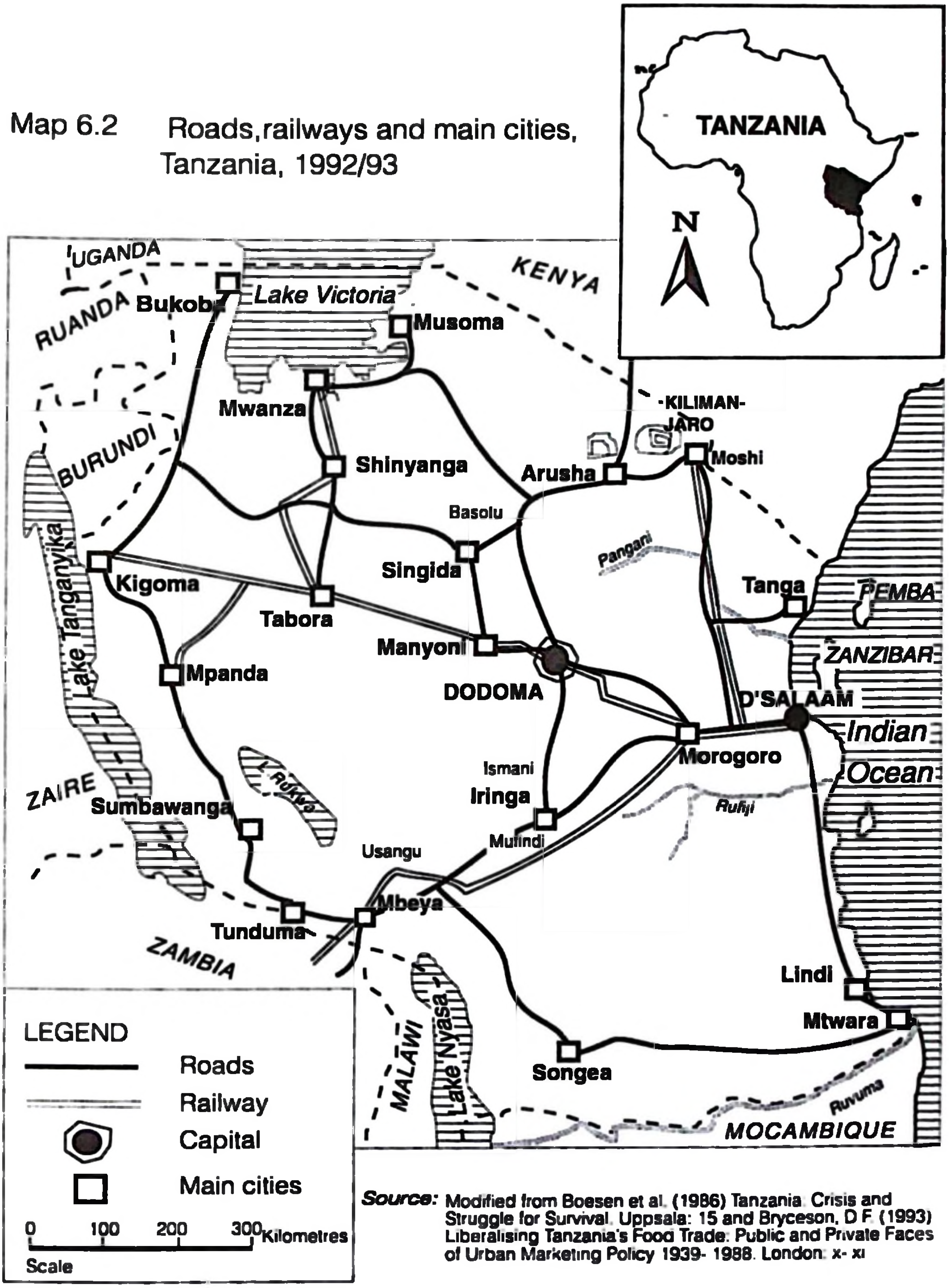
12 The road network within Sumbawanga district is depicted in Map 6.4 under section 6.2.2.1.

13 A recent unpublished World Bank (1993) report puts the total length of truck roads in the region at 967 km and a road density of 0.99 km/'000 ha on high potential land. The road density is the lowest in the country except for Ruvuma with a density of 0.90 km/'000 ha.

Map 6.2 Roads, railways and main cities, Tanzania, 1992/93



Source: Modified from Boesen et al. (1986) Tanzania. Crisis and Struggle for Survival. Uppsala: 15 and Bryceson, D.F. (1993) Liberalising Tanzania's Food Trade: Public and Private Faces of Urban Marketing Policy 1939- 1988. London: x- xi

Table 6.1 Roads in Rukwa Region by district and type, 1987 (km)

Type of road[a]	District			
	Sumbawanga	Mpanda	Nkansi	Total
Trunk road	241	498	106	845
Regional road	269	375	243	887
Feeder road	797	1,200	290	2,287
Total	1,307	2,073	639	4,019

[a] Truck roads are all weather roads; regional roads connect district towns and are passable during the rainy season only when well maintained; Feeder roads connect villages and may be impassable during the rainy season.

Source: URT Bureau of Statistics, (1991) Rukwa Regional Statistical Abstract, Dar-es-Salaam:19.

The road problem is further confirmed by the fact that out of a selected number of villages, where co-operative marketing dominated before market liberalisation, only 10 out of 31 villages were passable throughout the year (Appendix 6.1). The 630 km total distance to the 10 villages represented only 29% of the total distance to all 31 villages[14].

The Rukwa Regional Road Engineer informed, however, that Sumbawanga district is currently well linked to Mbeya region after reconstruction and major repairs of the road to Tunduma were completed in May 1993. Furthermore, under the contract agreement between the Government of Tanzania and the International Development Agency (IDA), which foresaw this (Sumbawanga-Tunduma) road's construction, routine maintenance of the road would continue for the next four years up to 1997. This agreement has been undertaken partly

14 Against this background it was assumed that market failures can result from; imperfect competition, in which a small number of buyers are able to influence aggregate demand and therefore affect market prices; externalities, in which producers are unable to get the full benefits for the agricultural produce; and institution market failures, which may render markets not to function efficiently or fail to exist because of inadequate infrastructure, institutions and regulations. See Maro (1986) for an account of the nature of agricultural transportation in Tanzania.

in response to requests by Sumbawanga residents to tarmac the road because of the recognition that gravel roads are a problem during rainy season (Daily News, 9th July 1993:5).

Except for the Sumbawanga-Tunduma road and the two secondary roads from Sumbawanga town to Mpanda and Nkansi districts headquarters no other roads are maintained regularly mainly due to lack of funds. The 1992/93 Regional Development Plan shows, for example, that only TSh 135 million (or 14% of the development budget) was budgeted for road maintenance for the year (URT Rukwa Region, 1992:127). The Development Plan reports that because of the acute financial limitations some rural roads in the district have never been maintained for the past 10 years.

The present road transport is essentially provided by Rukwa Regional Transport Company (RETCO) which had 97 trucks (including trailers in 1990), by Regional Trading Company (RTC), Government Departments, lorries of the Rukwa Development Programme (RUDEP) and the Rukwa Regional Co-operative Union (RURECU), and by private operators (Beier et al., 1990:38). Beier et al. report further that calculations made by Rukwa RETCO showed that 60 additional 10-ton trucks were necessary by then to cover the supply/demand gap for intra- and inter-regional road transport. In addition to road transport Beier et al. (1990:38) report that the lake transport confined to Lake Tanganyika depend on two ships belonging to the Tanzania Railways Corporation and a number of small privately owned boats linking the Tanzanian ports, mainly Kasanga, along Lake Tanganyika and lake settlements to Zaire, Burundi and Zambia (Maps 6.1 and 6.2).

6.1.2.2 Market facilities

Personal observations gave the impression that market facilities in the district are still underdeveloped. There are weekly markets conducted mostly on Sundays in most of the rural areas especially in the divisional headquarter villages. Laela sub-urban locality on the main road to Tunduma also serves as a major wholesale area apart from Sumbawanga town (Map 6.4). Sumbawanga town has four major markets for food grains and other foods. These are the Main market (*Soko Kuu*), Bangwe, Chanji and *Soko Matola*. In addition the SGR located at a distance from the centre of town, buys mainly maize from both traders and farmers. Discussions with some of the traders and farmers revealed that the major problem at the SGR was unavailability of cash which made most of them sell their maize on credit.

The main market is located at the town centre and has shops all round the outer wall. The central part of the market caters mainly for retail trade in rice, fish and other perishables, mostly fruits and leafy vegetables. Both wholesale and retail selling of maize, finger millet, beans and rice takes place in the open, mainly outside the main market complex and rendering the nearby roads almost impassable. There were about 20 wholesale traders for maize and beans with an average current stock of 30 bags each at the time of the MDB survey in 1991 (URT MDB, 1992a:72). Bangwe, Chanji and *Soko Matola* markets are open spaces, and where only retail trade for grains dominate even though some wholesale practices for perishables were taking place.

Contrary to expectations, and as also reported by the MDB study (URT MDB, 1992a:73) Sumbawanga town has no recognised organisation for traders. In addition, no specific plans exist for the development of new markets, although it was planned to improve the existing markets. The later case is surprising given the fact that the Town Council charges TSh 120/bag for grains and beans on the arrival day and TSh 30/bag per subsequent days.

Agricultural products, mainly maize, beans and rice, sold in Sumbawanga town are mainly collected from the districts food shed, that is, the surrounding villages. Due to the poor road condition explained above grain collection can be very costly. We shall observe in chapter eight (section 8.3.2.2) that this study revealed that transport charges from villages surrounding Sumbawanga to town centre ranged between TSh 180 and 830/bag depending on distance and road condition. These results compare closely to those by the MDB (URT MDB, 1992a:73) which reported a range of between TSh 350 and 700/bag within the district and attributes these high costs to bad roads. This implies that the produce transfer function in Sumbawanga district has a high potential for increasing overall marketing costs.

Discussions with regional and district officials revealed that the Rukwa Regional Co-operative Union through its network of Primary Co-operative Societies was previously collecting maize, but was unable to pay the farmers in cash due to financial problems. Kashuliza and Ngailo (1993:23-24) substantiate that by the end of June 1990 the Union had total debts amounting to TSh 1950 mill. Compared to its total assets disposition of TSh 558 mill. The Union's debt/assets ratio was 3.5 indicating that its assets could not cover its debts (or liabilities) when and/or if liquidated. Furthermore, the National Milling Corporation (NMC) could not buy from the Co-operative Union due to lack of funds. Informal discussions with traders revealed further that traders transactions with farmers were done on cash basis. Traders had, however, to sell on credit to the NMC or the SGR. Details regarding the trade practice are a subject of chapter seven.

6.1.2.3 Off-farm storage capacity

Off-farm storage capacity in Sumbawanga District is approximately 60,000 tons mostly belonging to the Strategic Grain Reserve (SGR) and the Regional Co-operative Union (RURECU) (Table 6.2). Most of the storage capacity in the district is located in Sumbawanga town. This emphasises the need for more elaborate means of transportation to link the rural markets to the district headquarters. Almost all of the available storage capacity, except that for the Tanzania Fertiliser Company (TFC) and Tanzania Seed Company (TANSEED) which are used to store fertiliser and seed inputs respectively, is used for storing agricultural produce.

Table 6.2 Ownership and distribution of off-farm storage capacity, Sumbawanga District, 1992/93 (t)

Owner	Total capacity	Capacity location
Strategic Grain Reserve (SGR)	35,500	29,500-Sumbawanga town 6,000-Laela
Rukwa Regional Co-operative Union (RURECU)	13,100	600-Sumbawanga town 12,500-43 villages[a]
Ministry of Agriculture	6,300	5,000-Sumbawanga town 1,300-four villages[b]
Tanzania Fertiliser Company (TFC)	5,000	5,000-Sumbawanga town
Tanzania Seed Company (TANSEED)	250	250-Sumbawanga town
Total	60,150	60,150

[a] Initially these belonged to the Primary Co-operative Unions in the respective villages. After the collapse of co-operative marketing the stores belong to Village Councils.
[b] Allocated in Matai (400 t), Mpui (350 t), Mwimbi (300 t) and Songambele Azimio (250 t).

Source: Regional Agriculture and Livestock Development Office (RALDO) (1992/93). Unpublished draft.

Beier et al. (1990:39) argue that the storage capacity would largely be sufficient, if produce could be transported to the consumption centres in time. They point out that the problem is, however, that maize, for example, is not transported out of the region because of the high transportation costs[15]. The authors argue that to build more stores, a frequently voiced demand by planners and politicians, can not be the solution to the high transportation costs or poor management capabilities. Indeed, discussions with regional officials

15 Beier et al. (1990:38) report that in the 1988/89 period it cost, on average, about TSh 15/kg to transport maize from Sumbawanga to Dar-es-Salaam using private trucks. Compared to the then average open market consumer price of TSh 20.28/kg (Bryceson, 1993:262), transport cost represented some 74 % of the consumer price.

revealed that following the 1987/88 surplus maize production about 23,000 tons of maize in excess of the NMC storage capacity was stored in the open, while the Co-operative storage facilities were nearly empty.

Two aspects directly related to Sumbawanga District's location and its road, marketing, and storage facilities discussed above need be pointed out because these factors have a direct effect on farmers' storage and marketing patterns of agricultural products. First, in the face of the underdeveloped infrastructure and the consequent unreliable market access, there is a big possibility for farmers, especially those in border villages, to sell their agricultural produce to neighbouring regions or to the not yet legalised cross border markets to the neighbouring countries. Second, with particular reference to cross-border trade, differences between domestic prices and prices offered in the neighbour countries could easily reinforce the desire to sell outside the country. For example, for the 1988/89 marketing year maize price was lowest in Tanzania relative to prices in all other border countries except in Malawi (Table 6.3).

Sumbawanga town is only about 60 km from the Zambian border (Beier et al., 1990:25). Discussions in the rural areas gave an impression that cross-border trade between Sumbawanga and Zambia takes place easily through the border settlements of Kasyesya, Kasanga and Mambwekenya[16]. Indeed, cross-border trade of agricultural produce from Tanzania in Zambian markets has been documented previously (Bury, 1983:274; Pottier, 1986:55).

16 See Map 6.4 under section 6.2.2.1.

Table 6.3 Farm prices of maize, Tanzania and neighbour countries, 1988/89 (US$/t)

Country	Price
Burundi	173
Kenya	122
Malawi	64
Mozambique	158
Rwanda	na
Tanzania	92
Uganda	na
Zaire	120
Zambia	125
"na" Data not available.	

Source: CIMMYT (1990) CIMMYT world maize facts and trends: Realising the potential of maize in sub-Saharan Africa. Mexico, D.F.:45-49.

In an outlook on prospects for increased maize exports from Tanzania the MDB (URT MDB, 1992a:27) acknowledges that most of the major maize production zones in the country are near the country's borders. Furthermore, some of these zones are relatively inaccessible and have their 'natural' markets in neighbouring countries. This is particularly true of Rukwa and highland Mara. Development in these regions would be facilitated if official attitudes to food crop exports were more encouraging. The MDB study argues further that if export procedures are simplified and facilities established for handling export trade at places like Kasanga port on Lake Tanganyika it might be possible to formalise and develop this trade.

6.1.3 Agroecological features

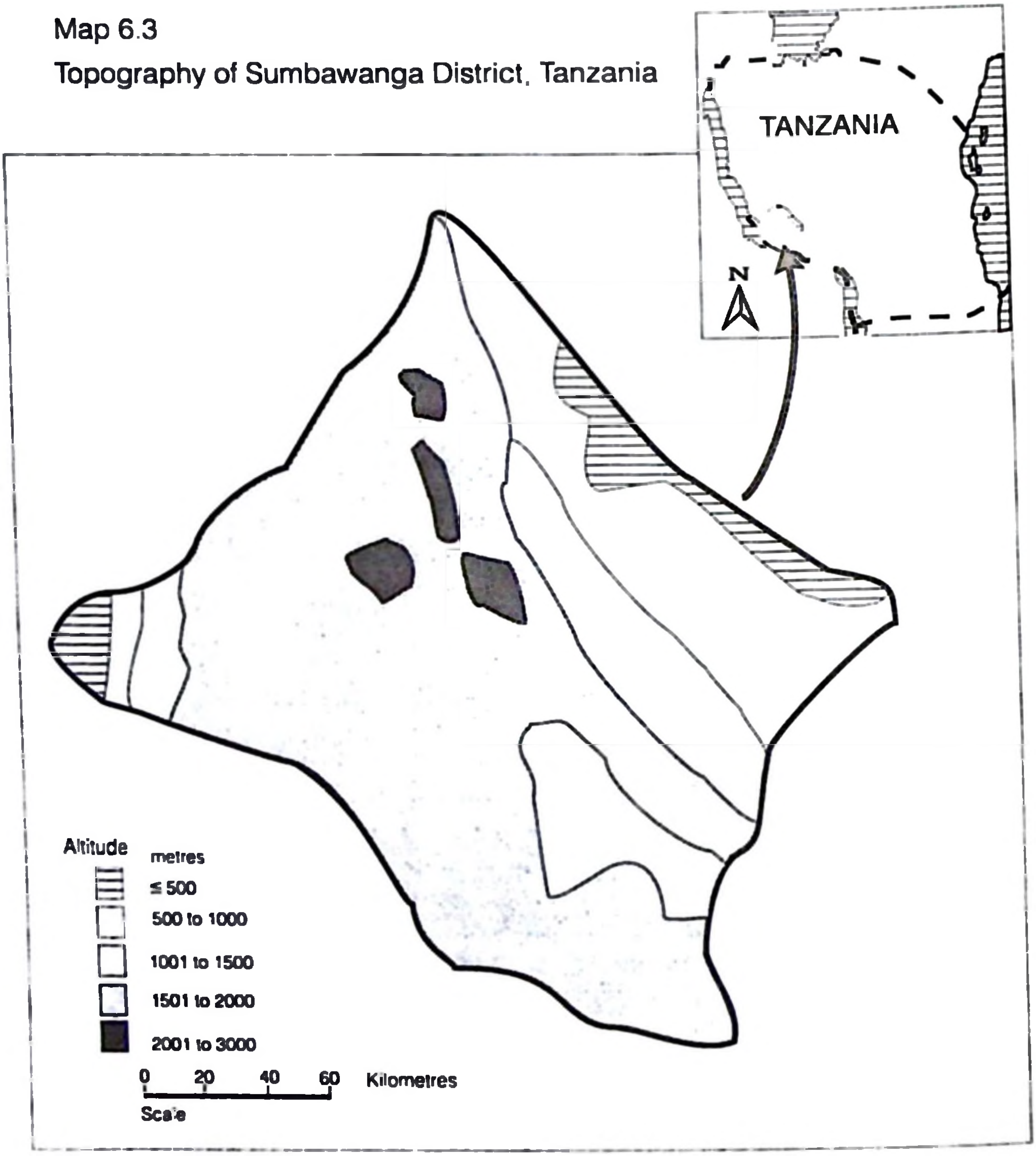
6.1.3.1 Climate and rainfall

The topography of Sumbawanga district is characterised by the East African Rift Valley's gently undulating hills running in the north-west to south-west direction. The valley is divided into two major portions, that is, the Western Rift Land and the eastern portion which is part of the Central Plateau Land Province. The two valleys are separated by the Ufipa Plateau which comprises most of Sumbawanga district. Beier et al. (1990:32) and Mascarenhas (1984:1) inform that the Ufipa Plateau and hence Sumbawanga district has the highest land surface of the Rukwa region with an average elevation of 1,700 m and a maximum of 2,461 m above sea level (Map 6.3).

According to an analysis by the Institute of Resource Assessment of the University of Dar-es-Salaam (Mascarenhas, 1984:1), soils of Sumbawanga district are either sandy, with granular, loamy and coloured subsoil more suitable for traditional agriculture than for large-scale farming. Soils more suited to intensive agriculture are limited. The vegetation is comprised of a variety of vegetation types such as forests, bush land and grassland.

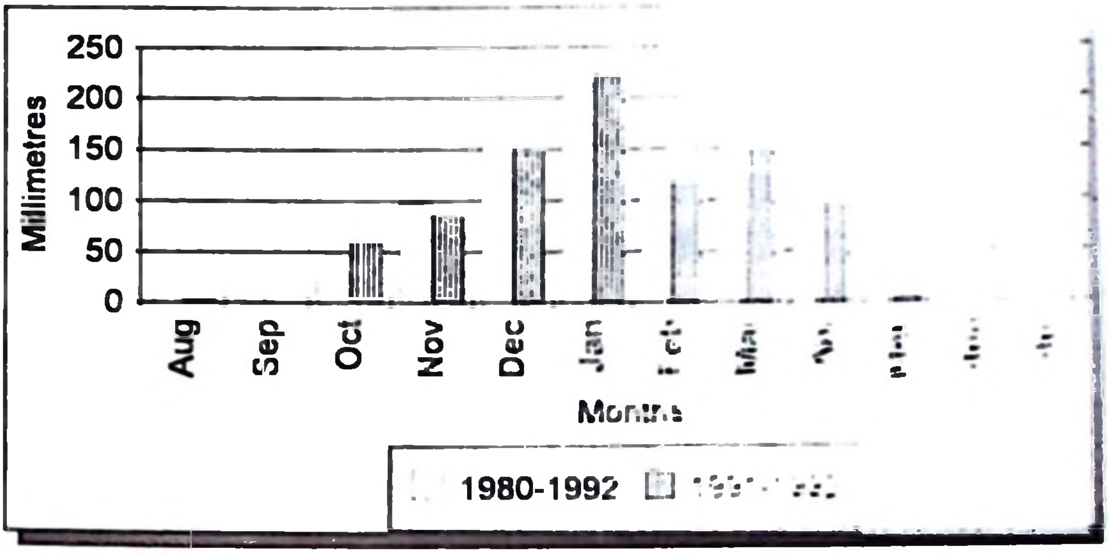
The climate of the district is predominantly semi-arid although sub-humid conditions exist in the south-west. Rainfall is restricted to a five to six months period from November to April or May. For the period between January 1980 and December 1992 the district received an average of 925 mm/a of rainfall, ranging between 659 and 1465 mm/annum, during a wet season that lasts approximately 93 days (Figure 6.1 and Appendix 6.2).

Map 6.3
Topography of Sumbawanga District, Tanzania



Source: Extraned from Times Books (eds.) (1992) The Times Atlas of the World: Comprehensive Edition. London: 92.

Figure 6.1 Average monthly rainfall, Sumbawanga [illegible] (mm)



Source: Appendix 6.2.

We observe from Figure 6.1 and Appendix 6.2 that the amount of rainfall for the June 1991-May 1992 cropping season was more or less equal to the average amount for the entire period between 1980 and 1992 implying that the [illegible] production year, referred to as the production year for our study, was a normal year. Sumbawanga district has the most moderate climate in the region with mean annual temperatures of between 24° C and 27° C and a minimum of between 13° C and 16° C (URT Bureau of Statistics, [illegible])

6.1.3.2 Agriculture

The above rainfall data clearly indicate that inter-annual and intra-annual variability in rainfall plays a significant role in dictating both annual and seasonal crop production patterns. This may in turn lead to market supply and price variations. Since the cropping system in the district is predominantly rain-fed there is an elaborate seasonal pattern of agricultural activities characterised by periods of high and low demand for production resources notably labour and food. The seasonal nature of agricultural activities is elaborated more in chapter seven.

Most inhabitants of Sumbawanga district depend on small-scale agriculture for food supply. Beier et al. (1990:42-43) and Holmboe-Ottesen and Wandel (1991:85-86) report that the majority of the population are subsistence farmers and in principle produce most of the foods they eat. In addition to the rainy season cultivation, dry season cultivation is possible for some very few farmers using water from streams and springs. The above authors report that almost all households in the rural areas are practising farming. In addition to their own farming, some of the households engage in casual labour on neighbouring farms for food or cash.

The survey by Holmboe-Ottesen and Wandel (1991:85) observe further that even though most households have usufruct rights over larger pieces of land, for a given season most households cultivate about 1-1.5 hectares scattered some 15 minutes to 2 hours walking distance from each village[17] . The rest of the land is allowed to lie fallow for a certain number of years even though the fallow period has become shorter than was the case some years ago. It is argued that (Holmboe-Ottesen and Wandel, 1991:85) cultivation of larger pieces of land due to introduction of the plough and increased need for cash are the underlying reasons for this pattern.

Maize, finger millet and beans are the most important food crops. Groundnuts, potatoes, cassava, rice and vegetables are also cultivated by some farmers (see section 6.1.6). In addition to cultivation some of the farmers keep cattle and either pigs, goats or poultry. Even though finger millet was the traditional food crop in the area most agriculture in the last two decades has shifted towards maize cultivation. This change was accompanied with a change from

17 For details regarding land ownership and distribution see section 7.2.1.1.

subsistence to market production characterised by increased use of a plough and modern agricultural inputs as the need for cash expanded for much of the population (Beier et al., 1990:41-44; Holmboe-Ottesen and Wandel, 1991:86).

Beier et al. (1990:42-43) and Holmboe-Ottesen and Wandel (1991:86) cite evidence to the fact that even though the majority of households cultivated at least as much maize and beans as was needed for household consumption many ran out of stocks before the next crop. These households had different means of procuring food when faced with a shortage situation. This involved, among other means, bartering, exchange food for labour, and the consumption of alternative crops. This observation has a lot to bear on the farmers management of crops stored for consumption.

6.1.4 Socio-economic characteristics

6.1.4.1 Population

During the 1988 national census (URT, Bureau of Statistics, 1991:13; Beier et al. 1990:35-36) Sumbawanga district's population was estimated at 328,312 people scattered in about 60,877 households averaging 5.4 people per household (Table 6.4). Given the Rukwa regional annual population growth rate of 4.3% between 1978 and 1988, the Sumbawanga district population for the years 1992 and 1993 can be estimated at 388,529 and 405,236 respectively. Sumbawanga district has the highest population density in Rukwa region with about 24 people/km^2 compared to the regional mean of 10 people/km^2 (Table 6.4). According to Beier et al. (1990:36) about 39% of all people in Sumbawanga district live in urban areas, while the remaining 61 %, most of whom belong to the Fipa tribe of Bantu origin, live in rural areas practising small-scale agriculture for their food supply. The relatively small non-agricultural rural sector is engaged in fishing, mining and services.

Table 6.4 Population characteristics by district, Rukwa Region, 1988

District	Population	Area (km^2)	Population density ($persons/km^2$)	Annual growth 1978-88 (%)	No. of households[1]	Average household size
Sumbawanga[a]	328,312	13,417	24.5	na	60,877	5.4
Nkansi	110,175	9,375	11.8	na	20,277	5.4
Mpanda	256,487	45,843	5.6	na	49,605	5.2
Total	694,947	68,635	10.1	4.3	130,759	5.3

[a] Includes a 47,878 population of Sumbawanga town.

Source: Beier et al. (1990) The Southern Highlands Development and the Food Security in Tanzania: The Case of Rukwa Region. Volume 1 National Policies and Their Effects on Rukwa. Sumbawanga:35.

[1] URT Bureau of Statistics (1991) Rukwa Regional Statistical Abstract. Dar-es-Salaam:13.

Beier et al. (1990:35) attributes the high rate of population growth partly to immigration to the region from areas experiencing more land pressure, mainly Sukuma pastroralists from the north and farmers from Mbeya and Iringa regions. Regional migration statistics, however, give a somewhat contradicting evidence of this conclusion. Records show that between 1986 and 1990 a total of 708 households immigrated from the region compared to only 36 households which emigrated into it (URT Bureau of Statistics, 1991:18). There is, therefore, a possibility that either most migration is unrecorded or that factors other than emigration contribute to the high population growth rate in the region.

6.1.4.2 Income

The main source of income for the majority of people in the rural areas of Sumbawanga district is agriculture with limited non-farm income sources. Estimates of Gross Domestic Product (GDP) at district level could not be made available. However, data from the National Accounts of Tanzania (URT Bureau of Statistics, 1992:21-28) show that Rukwa region's GDP at current prices for the period between 1984 and 1991 was TSh 11,987 mill. representing about

4.5% of the national average. Using the average annual exchange rates for this period, (URT TET, 1992:68), this is equivalent to US$ 124 million. At these GDP figures Rukwa is regarded to be one of the average developed regions ranking ninth out of the 20 regions comprising mainland Tanzania (Appendix 6.3). Average GDP per capita at current prices for the same period was estimated at TSh 15,618 (equivalent to US$ 179). This is higher than the national average of US$ 160 recorded for the 1988 fiscal year (CIMMYT, 1990:47). For regional rankings on the basis of GDP and GDP/capita figures see Appendix 6.3.

Particular care must, however, be taken in interpreting the results which uses GDP as a measure of income because, as Amani et al. (1987b:29) note, only a small part of the economic activity in rural areas of Tanzania is monetarised. This implies that reported GDP could be an underestimation of actual level. In line with this argument Booth (1991) observes that in view of the rapid expansion of unrecorded economic activities since the mid-1980s, the GDP figures may in fact underestimate the economic growth that has taken place in Tanzania.

6.1.5 Justification of choice of the study area

A number of reasons led to the choice of Sumbawanga district as a study area:

(a) We observed in chapter two that Sumbawanga district has one of the highest rates of per capita food production. However, research work in the region - for example Beier et al. (1990:4) and Holmboe-Ottesen and Wandel 1991:86) - provide evidence to show that the District and Rukwa region in general has a very low standard of nutrition. Beier et al. (1990:4) list high population growth rate, the change from finger millet to maize as the major staple crop, the change from subsistence to market cropping, and the change from a planned economy to market liberalisation as the major causes of this problem. In addition to these reasons another working hypotheses which guided our study is the idea that "improper" storage methods and stock management practices are major causes explaining household food insecurity in the district.

(b) Besides its remote location, the socio-economic development of Sumbawanga district is also influenced by its lack of any significant export commodity. This implies that the major food crops grown in the district must also serve as cash crops. The trade-off between households utilisation of agricultural products for cash needs and for subsistence food requirements merits scientific analysis.

(c) The significance of Sumbawanga district as a case study is its location in Rukwa region which together with Iringa, Mbeya and Ruvuma regions constitute the Southern Highlands which are the major maize producing regions and the principal sources of official maize purchases in Tanzania. As noted in chapter two the four regions dominate per capita maize output and per capita official marketings.

(d) Market liberalisation in Tanzania was followed by a near collapse of the parastatal marketing system which used to provide most of the transport and marketing facilities. The effects of lack of transport are more pronounced in the relatively less developed areas like Sumbawanga. It was observed in section 6.1.2.3 that transport costs could account for almost three-quarters of the retail price of maize from Sumbawanga district sold in Dar-es-Salaam. Lack of parastatal transport and storage facilities implies that farmers will have to either sell their marketable surplus immediately after harvest or store the crops themselves for relatively longer times before selling. To study the effects of these alternative decisions to the farmers income and food sufficiency is one of the aims of this study.

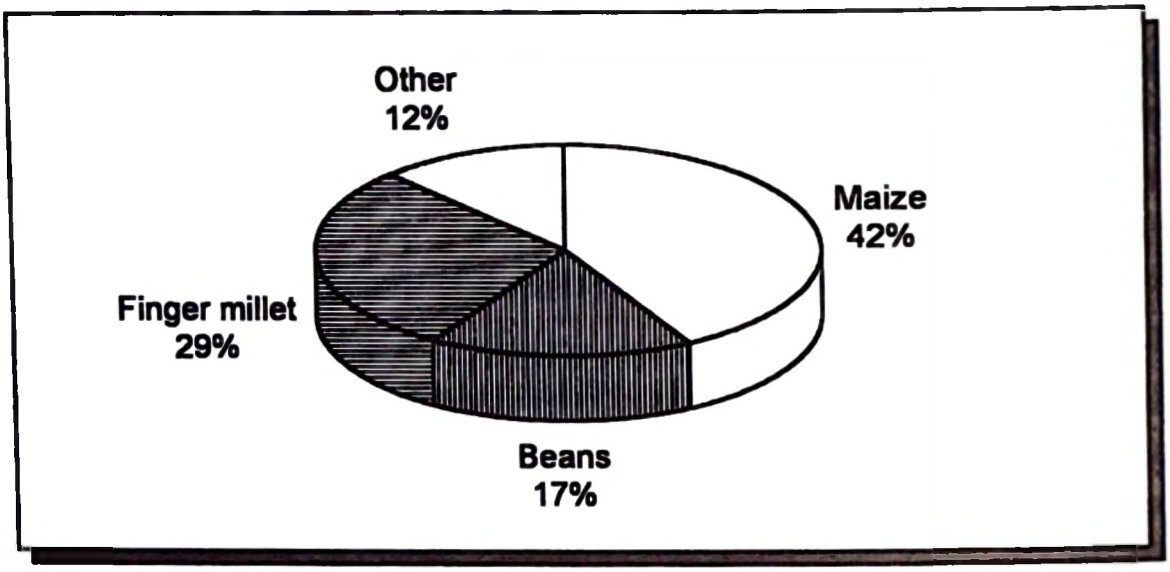
(e) The German Agency for Technical Co-operation (GTZ) has financed an Integrated Food Security Programme (IFSP) in Rukwa region since 1983. Its assistance was initially concentrated on the National Milling Corporation (NMC) and to villages in store construction, store management and post-harvest crop protection training. In the meantime, the project has shifted its emphasis to food security and nutrition at household level. Collaboration with this project availed materials which provided most of the background literature and data to this study in addition to logistical support during the fieldwork.

6.1.6 Justification of survey focus on maize subsector

Since the undertaking of a survey of an entire food system is not easy to manage, this study focuses on maize while keeping relevant system relationships and linkages as part of a narrowed-down focus. Maize is a representative and the most important crop in the study area in terms of volume and value. As a result, it has the potential to generate the most benefits to households in terms of food supply and income generation. Data from the Sumbawanga District Agriculture and Livestock Development Officer (DALDO, 1992/1993) show that of the six most important crops in Sumbawanga District, that is, maize, finger millet, beans, sorghum, rice and cassava, maize contributed about 42 % of the mean area under cultivation for the period between 1983/84 and 1991/92 (Figure 6.2 and Appendix 6.4).

Sumbawanga district is the most prominent maize producer in Rukwa region. Using data from chapter two (Appendices 2.3 and 2.4) it is noted that Rukwa region's average area under maize cultivation and production for the period between 1985/86 and 1991/92 was 86,000 ha and 175,000 t respectively. Compared to the respective figures for Sumbawanga District (Appendix 6.4), the prominence of Sumbawanga district in maize production is very obvious because it contributed respectively 66% and 76% of the Rukwa region's area under maize cultivation and maize production for this period.

Figure 6.2 **Average area under different crops, Sumbawanga District, 1983/84 - 1991/92 (%)**



Source: Appendix 6.4.

6.2 Methods of data collection

Results presented here is an outcome of a nine months fieldwork. Both secondary and primary sources were used to obtain data for the analysis.

6.2.1 Secondary data sources

Secondary data from different institutions at district, regional and national levels were useful in establishing the background to the study and the role of parastatals in crop storage in the district. Furthermore, secondary data assisted in filling gaps and in understanding the institutional set-up in grain storage and marketing. The main institutions that provided the information for the study both in Sumbawanga and Dar-es Salaam are:

- the Rukwa Region and the Sumbawanga District Agriculture and Livestock Development Offices provided statistics on crop production and marketing for the district.
- the Strategic Grain Reserve (SGR) Office in Sumbawanga town gave information on institutional crop buying arrangements in Rukwa region.
- the Rukwa Development Programme (RUDEP) provided information on the regions development institutions and their contribution to crop marketing arrangements.
- the Integrated Food Security Programme (IFSP) gave useful background information on food security. This information was supplemented by materials from the Tanzania Food and Nutrition Centre located in Dar-es Salaam.
- the Bureau of Statistics and the Economic Research Bureau of the University of Dar-es-Salaam, both based in Dar-es-Salaam, gave a lot of macroeconomics data on performance indicators of the national and Rukwa regions economy.
- the Marketing Development Bureau's annual national and regional crop production and marketing statistics were also solicited.

6.2.2 Primary data sources

This study draws data from four different primary sources, namely:

- a cross-sectional survey conducted among 120 farmers in the four survey villages between August 1992 and May 1993;
- a trader survey carried out among 14 traders in the survey villages and neighbouring villages and in Sumbawanga town main market between December 1992 and April 1993;
- a multiple visit survey among 20 farmers in two of the survey villages, namely Lula and Mkima and laboratory loss assessment of samples drawn from the maize they stored undertaken concurrently between December 1992 and May 1993; and

- weekly price data for maize collected from the four survey villages and from Sumbawanga town main market between July 1992 and June 1993.

6.2.2.1 Selection of survey villages

The field survey was basically limited to four villages in Sumbawanga district. Discussions with Sumbawanga District agricultural officials in line with our village selection criteria resulted in an initial proposition of four villages in different factor combinations (Table 6.5).

Table 6.5 Survey village selection criteria, Sumbawanga District, 1992/93

Yield potential[1a] (t/ha)	Road[2]		Distance to Sumbawanga[2c]		Suggested villages[d]
	Accessibility	Class[b]	Distance (km)	Travel time[c] (minutes)	
Surplus (>2 tons)	Accessible	B	< 10	15	Isesa, Kankwale, Kiswita and Milanzi
Surplus (>2 tons)	Inaccessible	B-C	30-60	70	Kisungamile, Kitete, Lula and Myunga
Deficit (<2 tons)	Accessible	A	30-60	50	Kalambanzite, Mkima, Mpui and Mumba
Deficit (<2 tons)	Inaccessible	C-D	> 60	125	Mikonko, Mpombwe, Mtutumbe and Ngoma

[a] Estimated by dividing previous years (1985/86-1991/92) average production data by total area. Since data were severely incomplete for individual villages, these figures are crude estimates and should be interpreted as only indicative.
[b] A-Gravel road, good even during rainy season.
B-Gravel road, becomes difficult during rainy season
C-Earth road, during rainy season passable only by 4-wheel drive vehicle
D-Tracks, during rainy season impassable even by a 4-wheel drive vehicle.
[c] Travel to (underlined) survey villages during dry season using a four wheel drive land rover.
[d] Underlined: selected randomly.

Source: [1] District Agriculture and Livestock Development Officer. Sumbawanga. Several annual reports and personal communication.
[2] Regional Road Engineer, Rukwa Region. Personal communication.

A three-stage, stratified random sampling was used to select villages to be included in the survey. First, survey villages were grouped based on whether they were relatively deficit or surplus areas in maize production. Due to lack of complete secondary data on village level maize production this stratification was done with the assistance of the local agricultural officials who understood better the production potential of many of the villages in the district. Second, villages were stratified into two categories according to whether farmers in those areas had relatively good or poor road access to the central urban market in Sumbawanga town. Finally, geographical scatter of the villages with reference to their proximity to Sumbawanga town was used to get both close and distant villages. Therefore, the village selection criteria allowed for representation to many storage and marketing practices in the district under different conditions of maize production levels, road accessibility and distance from the central market in Sumbawanga town.

From each of the four villages one village was selected at random to give the final four villages. The selected villages were: Kankwale, Lula, Mkima and Mtutumbe (Map 6.4).

6.2.2.2 Profile of survey villages

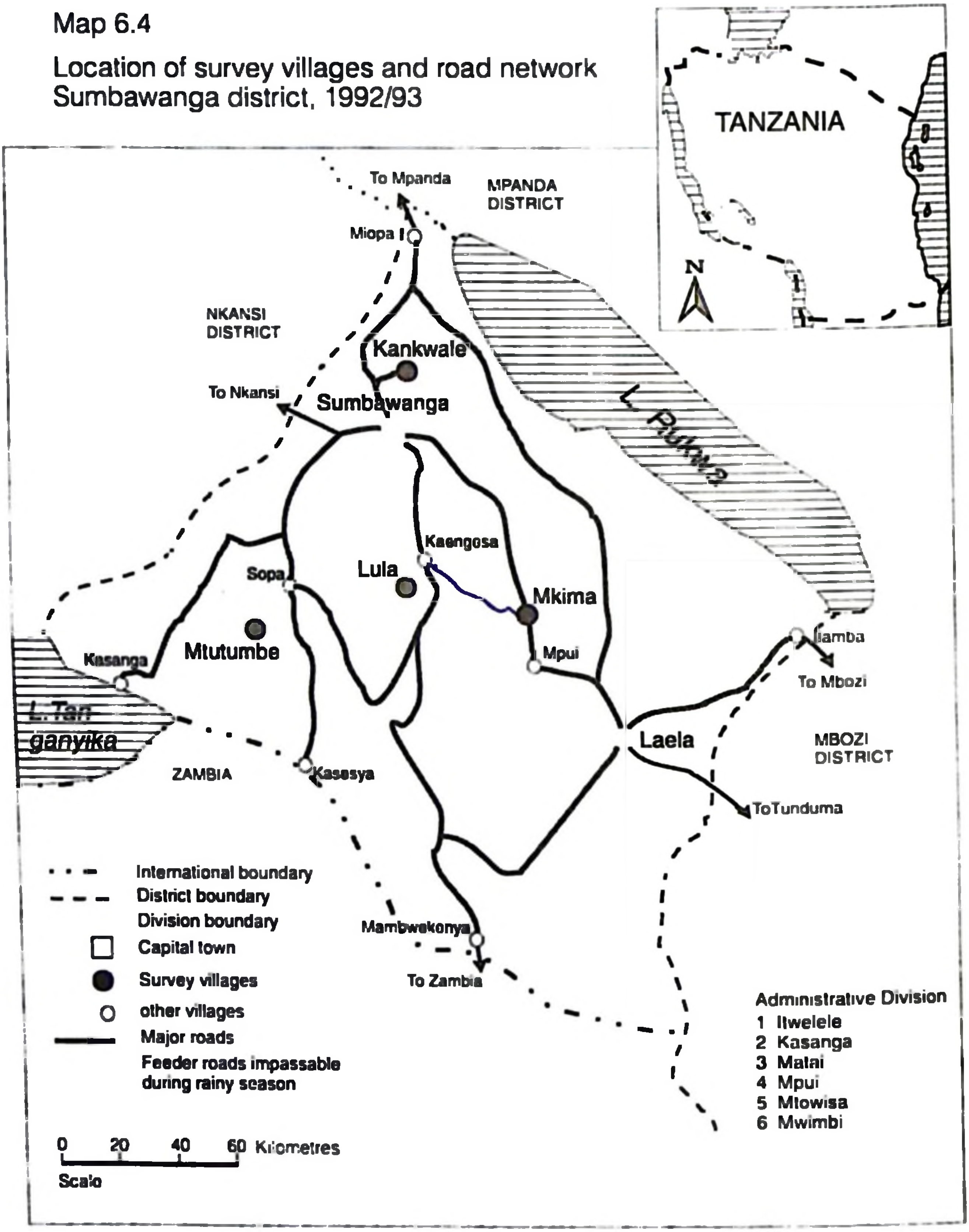
(a) Kankwale

Kankwale village, located some 10 km from Sumbawanga town was selected to represent the villages near the town markets. Village records show that it has an estimated area of about 20 km^2 which seem to be extensively cultivated. In 1985 it had more than a half of its village land under cultivation (Mohammed, 1985:17).

Most of the cash income in Kankwale is earned from the sale of agricultural produce, mainly maize, finger millet and beans even though cassava, and some horticultural crops like cabbage and tomatoes are also grown by some farmers. Like many villages in Sumbawanga District, maize is the principal food

Map 6.4

Location of survey villages and road network Sumbawanga district, 1992/93



Source: Extracted from Regional Agriculture and Livestock Development Office, Rukwa Region (1992/93). Unpublished draft. Sumbawanga crop but several households consume finger millet too. Even though the hand hoe remains to be the main agricultural tool, use of oxen for ploughing is also common. Village leaders informed that there were about 50 ox-ploughs in the village at the time of this survey.

Kankwale, which existed even before the villagisation process of 1974, expanded after villagisation when residents from nearby villages and from regions neighbouring Rukwa region, especially the Wanyika and Wandari tribes from Mbeya Region, settled in the village. With about 350 households the village had an estimated 1992/93 population of about 1,500 people. The village has its own primary school and its residents get their daily services from two shops. The village has also clean water, a dispensary and three bars. The agricultural population is served by an extension officer who resides in Sumbawanga town.

The close location of Kankwale to Sumbawanga town implies that its residents depend more on this market both as the principal outlet for selling their crops and services as well as a source of commodities and food during times of need. Its exposure to the town markets has expanded possibilities of increased commercialisation and earning income from artisanal activities, vending and trade in firewood and charcoal. There was, indeed, a common observation among residents of the village that most youth from the village settle in Sumbawanga town for at least some time of the year earning additional income from petty business. Beer brewing is a source of additional income especially for women.

(b) Lula

Lula village is located 42 km south of Sumbawanga town. Although the 35 km road stretch between Sumbawanga and Kaengesa is good, the remaining 7 km strip from Kaengesa to Lula; off the Sumbawanga to Tunduma road becomes extremely swampy and impassable at the peak of the rainy season between November and March. During this time Lula can only be reached by means of a four-wheel-drive vehicle, though still with difficulty. Since regular transport is non-existent, people have to walk the 7 km to Kaengesa to catch a vehicle, and even there it is uncertain.

The village was registered in 1974 and had 384 households (equivalent to about 2,000 people) in 1987. By 1992/93 the population had increased slightly to over 2,400 people. During the villagisation process people from neighbouring villages settled in Lula because the village, already had relatively more residents.

Although almost all residents of Lula belong to the Fipa tribe, the village population is divided into two approximately equal groups of people along religious grounds. One group is comprised of strong believers of the Watch Tower Christian or Salvation Army[18] denomination which prohibits some practices, like brewing and drinking alcohol, considered to be contrary to their religious belief. The other group follows a more liberal religious course.

Using mostly ox-ploughs the village population cultivates mainly maize, finger millet and beans although some farmers also grow sunflower and wheat in addition to raising cattle. Other sources of income for residents of Lula are local trade in alcohol and slaughtering animals. The agricultural extension officer in charge of Lula village stays in Kaengesa. The village owns a 7-ton lorry and has a primary school, clean water and six small retail shops. Rental charges for the lorry and local taxes for sales of alcohol and other businesses are the major sources of income for the village government. By the time of this survey the village was planning to build a godown on self-help basis for the storage of agricultural inputs and products.

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18 For an account of the impact of this religion and other social forces to food marketing in Northern Zambia see Pottier (1986). Given the proximity of Sumbawanga district to Zambia it seems as if the largest sphere of influence of this religion included Southern Tanzania as well.

(c) Mkima

Mkima village is at 55 km along the main trunk road from Sumbawanga to Tunduma. It is situated at a distance of 50 km from Laela suburban town on the way to Tunduma. As is typical of villages located between two markets along a good road, farmers in Mkima have an option of selling their agricultural products in either Sumbawanga urban market or in Laela. Situated so strategically villagers can easily catch a vehicle to either of the two main market areas with relative ease.

In 1992/93 the village had 346 households mostly of Fipa origin. There is only one retail shop in Mkima together with a primary school and a health clinic. Since 1989 Lula and Mkima villages were already included in the Kilimo/Sasakawa Global 2000 project and about one a quarter of our survey farmers from the two villages were participating in this programme. The project works with small-scale farmers to test and demonstrate improved crop production technologies, first on a limited scale and, if the results prove promising, on a large scale to build-up widespread farmer support (Quiñones et al, 1992:29). Parallel efforts are made to increase village level availability of fertiliser, improved seed, credit, and market outlets. By these means the project seeks to act as a catalyst for strengthening the linkages between Tanzania's farmers and its agricultural research, education and credit organisations. Quiñones et al (1992:33) report that in the 1990/91 cropping season there were a total of 895 Management Training Plots (MTPs) in some 23 villages of Nkansi and Sumbawanga districts of Rukwa Region.

Mkima, like many villages in rural Tanzania, is characteristically a village which in the past depended heavily on co-operatives for crop marketing. The Sumbawanga District Co-operatives Officer informed that following the nation-wide reorganisation of agricultural co-operatives, the Mkima Primary Co-operative Society, along with 49 others in Sumbawanga District, was deregistered in February 1993. This left villagers in Mkima without any other market outlet except private traders.

(d) Mtutumbe

Mtutumbe, a maize deficit village is the most remote and inaccessible of all the survey villages located in a distant corner of Sumbawanga District close to the Zambian border and, approximately 78 km from the district headquarters and some 16 and 15 km from the nearest trading centres in Kisombwe and Sopa respectively (Map 6.4). The road to Mtutumbe, especially the last 10 km off the road to Sopa, becomes so poor during the rainy season such that occasionally all road communication to the village is completely cut-off.

The village was registered in 1974 and its land area is still not very widely cultivated and as a result Mtutumbe is still surrounded by fallow and stands of bush and grasslands. With 180 households Mtutumbe has the lowest number of households compared to the other survey villages. Apart from a primary school, no other services are available in Mtutumbe.

Farmers in Mtutumbe also grow mainly maize, finger millet and beans. Some farmers also grow groundnuts. Almost all farmers in the village use ox-ploughs to prepare land. There is little regular income in Mtutumbe. Most of the available income is derived from the sale of agricultural produce and local beer made from maize and finger millet. Not a single household is really well off and the quality of housing, which consists mostly of mud houses with grass thatched roofs, is generally poor. In 1992/93 the village had only 4 houses with corrugated iron sheets compared to 10 in Kankwale, 60 in Lula and 30 in Mkima.

6.2.2.3 Sampling and data collection procedure

(a) Farm household survey

The cross-sectional farm household survey constitutes the major data source for this survey. Data were collected from 120 households. To get the 120 household sample size, thirty households were randomly selected from each village using household lists provided by village leaders. No consideration was given to the location of farmers within the village. Farmers who did not grow maize during the 1991/92 cropping season were excluded from the sample. This implies that a household in our survey was identified from the maize production perspective[19] .

Since this research was concerned primarily with the costs and productive efficiency of storage and marketing it was preferable to undertake fieldwork when crops were being placed in, or released from, stores. To capture the seasonal nature of production, storage and marketing as dictated by cropping calendar, farmers were visited twice. The first visit was done in December 1992, some three to four months after farmers have filled the stores, with grain. This first round of interviews collected information for the time period between June and November 1992.

The second interview undertaken in April and May 1993 covered information for the period between December 1992 and May 1993. It was purposely conducted at this time because it is at the end of the storage period which covers approximately eight months and before the next maize crop matured in May and June. In the end information was obtained covering 12 months between June 1992 and May 1993. Sample households were interviewed using a structured questionnaire (Appendix 6.5). The questionnaire included sections on household identification, crop farming practices, maize harvesting and pre-storage practices, storage structure and methods, maize marketing patterns, utilisation of stored maize and food security as well as questions regarding inflow of income.

Farmers were interviewed by means of a personal interview method. With the household as the unit of investigation, information was obtained mainly from the household heads. In order to overcome the language barrier both Swahili

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19 This may slightly bias the relative importance of maize upwards compared to other crops among the sample farmers.

and Fipa versions of each question were used. Furthermore, we were able to administer the questions with the assistance of three enumerators carefully trained during the pre-test survey in August and September 1992. Each of the three enumerators were fluent in both languages in addition to the fact that they have diploma level certificates in agriculture.

(b) Trader survey

Trader sampling was aimed at including both rural and urban based traders. At village level sample farmers were used as the starting point for exploring marketing channels and practices, employing a technique of linked interviews. According to the method of linked interviews, as explained by Hayami et al. (1988:51-53) and Ellis (1993:430), each farmer was asked to whom they sold most maize. Then each willing trader mentioned by farmers was interviewed and asked to whom they had made their sale. A structured questionnaire (Appendix 6.2) was also used for the trader survey. The questionnaire covered sections on traders' background information, commodity flow, maize market condition and impact of grain market liberalisation policies.

Table 6.6 Types of sample traders, Sumbawanga District, 1992/93

Trader Location	Number of traders	Type of trader[a]
Kankwale	2	Village collector
Lula	2	Village collector
Lula	1	Inter-village collector
Mkima	1	Inter-village collector
Mkima	1	Village collector
Mtutumbe	1	Village collector
Mtutumbe	2	Inter-village collector
Sumbawanga town	3	Wholesaler
Sumbawanga town	1	Retailer
Total	14	-

[a] Village collector is limited to one village. Inter-village collector collects produce from more than one village.

For traders in Sumbawanga town sampling was mainly based on the traders availability and willingness to participate in the interview. As Table 6.6 shows in the end 14 traders were interviewed in total. The same enumerators used for the farmer survey were used for the trader survey.

(c) Assessment of storage losses

For the assessment of storage losses samples were drawn from traditional granaries of 20 farmers in Lula and Mkima villages (see Map 6.4). The two villages are located close to each other and this facilitated easy supervision of the maize grain sampling exercise. Selection of the 20 households for the loss assessment exercise depended on the storage technology used by each farmer. Three different types of treatment against pests (no treatment, traditional treatment, and application of synthetic insecticides) were introduced as sources of variation. The drawing of the samples was carried out in the first week of every month between December 1992 and May 1993. A monthly sampling interval was selected to facilitate storage loss estimate on regular (monthly basis). At every sampling occasion the 20 farmers were asked questions regarding their stored grain management and utilisation. Laboratory loss analyses of the samples were carried out at the Uyole Agricultural Centre in Mbeya. Weight losses were determined using the gravimetric method as described by Boxall (1986:36-42) and Bengtsson (1991:6-10) using the expression:

$$\text{Percent weight loss} = \frac{(UNd)-(DNu)}{U(Nu+Nd)} \times 100 \text{------------------} (23)$$

Where U = Weight of undamaged grain

D = Number of damaged grain

N_u = Number of undamaged grain

N_d = Number of damaged grain

This method was chosen because: being recommended by FAO; it is widely used in Tanzania, thus facilitating a comparison of different regional storage systems. Furthermore, it is relatively easy to apply since the laboratory staff at Uyole had already gathered some experience with this method.

One methodological aspect related to grain loss assessment must be pointed out. It is emphasised that when making an assessment of the total storage loss at farm level it is important to relate losses calculated from samples to the quantities of grain originally stored and the pattern of consumption or disposal (Albert, 1991:105-109; Bengtsson, 1991:8-10). An elaboration of these relationships is provided in Appendix 6.7.

(d) Weekly price data collection

Agricultural extension workers in the survey villages and an agent of the Marketing Development Bureau (MDB) were trained to collect weekly maize prices in the villages and in Sumbawanga town market, respectively. The prices collected were farm level prices and wholesale and retail prices at the Sumbawanga market. In all cases prices were reported as average because it was noted during the pre-test survey that price differences in a given area per day were normally very minor. The data were collected weekly by asking farmers and traders. In order to increase reliability of price data farm-gate prices were collected indirectly through the farmer questionnaire by recording prices received by selling households or prices paid by buying households at different times that they transacted. Unfortunately, this exercise was useful only during the first months of grain sales and less reliable during later months towards the next harvest due to the reduced number of transactions as many farmers had exhausted their grain stocks. The average of the two series was used to construct the final price series. The sources, methods and use of information collected are summarised in Table 6.7.

Table 6.7 Sources and uses of primary data, Sumbawanga District, 1992/93

Type of survey	Number of respondents	Type of information collected	Time span	Uses of information
Farmer survey	120	Crop production, storage and transactions	June 1992-May 1993 (12 months)	Analysis of storage and marketing patterns
Loss asses-sment	20	Quantities of maize stored and storage losses over time	December-May 1993 (6 months)	Estimate storage losses with respect to time and quantity stored
Trader survey	14	Quantities marketed, marketing costs and margins	June 1992-May 1993 (12 months)	To study role of traders in grain storage and marketing
Price survey	-	Weekly farm gate, wholesale and retail maize prices	July 1992-June 1993 (52 weeks)	To study seasonal and spatial marketing efficiency

6.2.3 Data limitations

Ideally, an evaluation of storage systems should include widespread coverage of the industry as well as changes over time. However, the necessity to collect reasonable data requires a compromise between wide-spread coverage, resource constraints and detail in data collected. Therefore, the number of villages and the size of respondents sampled in this study were kept small due to time and financial resource constraints and to allow for a deeper analysis of collected data. This implies that the extent to which findings of this research could be generalised is limited.

Furthermore, this case study concentrated on seasonal dimensions of household maize storage and marketing with little details on changes between years. Since the observed seasonal patterns in storage and marketing are not necessarily regular year after year, caution must be taken in interpreting the inferences drawn in this study which used only one year's mainly cross-sectional seasonal data.

While the focus of this study is on maize, the real situations in the field indicated that the household utilisation of maize is very much tied to the use of other crops, notably finger millet and beans. This focus on maize and the relatively little coverage of the other crops may have missed important relationships among commodities which are maize substitutes and/or complements in both production and consumption.

Data collected by using interviews depended heavily on the respondents ability to recall past incidences due to lack of record keeping in the rural sector in which most farm activities and transactions take place. Data were collected for crops grown in the 1991/92 cropping season and which were harvested and utilised in the 1992/93 season. As for secondary data scarcity and unreliability of available data might have limited the accuracy of some conclusions derived from this study.

The major use of time series price data are to conduct seasonal and spatial price variation and the calculation of marketing margins. Thus, reliability of price data is important in reaching meaningful conclusions. Since it was not possible to make a close follow-up of enumerators collecting prices, the details of actual price collection were left to the discretion of the District Crops Officer who co-ordinated price collection and to a large degree to the men who collected the prices. Two additional problems related to price data collection must be emphasised. First, there is a possibility that prices reported do not apply to the same day in all markets partly because of differences in market days and the fact that there generally were no regulation as to the time of the week when prices were to be collected. Second, even though all prices are recorded on per kilogram basis a number of retail measures were used in grain trading. This implies that the prices per kilogram may have varied according to the measure by which grain is purchased. Under such circumstances Jones (1968:100) proposes that such a price data are more suitable for analysis of seasonal efficiency than for spatial efficiency due to possible variation of collection between villages and lack of standard measures over time in any one village.

Two other problems may have affected the accuracy of the conclusions of this study. First, traders especially those based in Sumbawanga urban market were very elusive in responding to our questions. This means that the linked interviews approach described above was relatively more useful for identifying village and inter-village traders than the town based ones. Due to this shortcoming important links within the marketing chain could have been missed. Second, the loss assessments were only limited to visible pest, fungal and physical damages since these could easily be translated into weight losses. No attempt was made to assess qualitative losses of stored grain. Furthermore, due to the late start of the investigation, no initial sample was taken when the farmers put the maize into stock. Thus, the proportion of damage caused by pre-storage activities could not be isolated.

CHAPTER 7

EMPIRICAL FINDINGS OF THE CASE STUDY

This chapter seeks to explain the seasonal patterns of the sample households maize production, storage, marketing and consumption. The inherent relationship between agricultural storage and marketing is underlined by Mcfarlane's (1988:130) definition of storage patterns as the distribution of storage locations and the timing of grain product movements. He argues that these (storage patterns) are a key issue for long-term planning. The impact of these patterns on market efficiency, income distribution and food security are discussed in chapter eight.

7.1 Characteristics of sample households

The main identification features of our sample households are laid out in Table 7.1. The typical average household size, which worked out to be 6 persons with a range from one to 14, is slightly higher than the Sumbawanga District average of 5 people per household reported in chapter 6. Across all villages the number of children, on average, accounted for more than half of household sizes. This implies that agricultural activities are performed mostly by adults, as children attend schools.

Table 7.1 Average characteristics of sample households, Sumbawanga District, 1992/93

Characteristic	Kankwale	Lula (n=30)	Mkima	Mtutumbe	Total sample (n=120)
Age of household head (years)	41.4 (27)	37.6 (34)	36.3 (32)	33.2 (33)	37.1 (32)
Education of household head (years)	4.3	2.3	4.6	5.8	4.3
Household size	7.9 (33)	6.3 (38)	5.8 (43)	4.9 (49)	6.2 (43)
Number of children (<16 years)	4.6	3.7	3.2	2.5	3.5
Children as % of total family size	58	59	55	51	56
Figures in parenthesis are the coefficients of variation in percent.					

Source: Appendix 7.1, questions 2 and 3.

Overall, more than 70% of the household heads were literate. In Lula however, about 50% of the household heads did not attend school at all (Appendix 7.1, question 2). Data in Table 7.1 also show that the typical household head is between 33 and 41 years old.

7.2 Farming systems

7.2.1 Agricultural resource endowment

7.2.1.1 Land holding and distribution

The holding of land in the survey villages provides unrestricted cultivation rights over property which essentially is a public property[20]. After the villagisation process of the 1970s land distribution in villages became essentially the responsibility of the Village Council. Immigrants who settled in designated villages from other villages had to beg for a piece of land. In our survey villages this was provided by either the Village Council or a fellow farmer. In one such a case a farmer reported 'borrowing' a piece of land from a neighbour free of charge.

A characteristic of the Sumbawanga District, and one that is common over much of the country, is the division of the farmers holding in a number of non-adjoining or non-contiguous plots. About 42% of our sample households worked on adjoining land (Appendix 7.1, question 7a). The rest had their total farm area dispersed in different places around the village. The average number of plots for the sample households worked out to be 1.8 per farm household (Table 7.2). It is worthy of mention that for this degree of dispersion a rising pressure on fallow land for cultivation and the desire of growing different types of crops on separate or pure stand plots appear to be chiefly responsible. Initially, fresh plots seem to have been added through appropriation of bushes, especially for finger millet cultivation which requires fresh land for better growth and productivity. The end result of this process has been to create a situation where a farmer's plots can often be situated at quite considerable distances

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20 According to the Agricultural Policy of Tanzania, (URT Ministry of Agriculture, 1983:10-11) all land in Tanzania is publicly owned and vested in the state. In practice, however, most agricultural land is held under either customary or communal systems and most agricultural land is not properly surveyed or mapped. Land owned by a household is that land which is used in perpetuity by a household to the exclusion of others. Characteristic here is the fact that the farmer pays no rent, and that he possesses a full proprietor's right without limit of time. For a subsequent analysis of legal problems and limitations of the Tanzanian land law on agricultural production see Tenga (1987).

away from his homestead. In our survey the average distance to the farms was 3 km, with some farms located as far as 6 to 8 km. Farms located at far away distances necessitates availability of farm transportation.

Table 7.2 Average number of farm plots and distance from homestead for sample farms, Sumbawanga District, 1991/92

Parameter	Kankwale	Lula (n=30)	Mkima	Mtutumbe	Total sample (n=120)
Number of plots	2.0	1.8	1.6	2.0	1.8
Average distance (km)	2.3	2.3	2.9	3.1	2.6

Source: Appendix 7.1, question 7.

Table 7.3 demonstrates that average farm land owned by sample households ranged between 2.6 ha in Kankwale and 4.4 ha in Mtutumbe with 3.4 ha being the mean hectarage for all sample households. These land size figures fall in the medium farm size class according to the classification of farm sizes by the International Crops Research Institute for the Semi Arid Tropics (ICRISAT) [21].

However, in so far as its utilisation is concerned, a substantial amount (35 %) of owned land was under fallow at the time of this research. This reduced substantially the operational land holding to around 2 ha per household, thus falling well within ICRISAT's low farm size bracket (Table 7.3).

21 Renkow (1990:670) reports that ICRISAT classifies land areas of between 0.21-2.50 ha as small farms; between 2.51-5.25 ha as medium farms and above 5.25 ha as large farms.

Table 7.3 Share of cultivated area sown to all crops by sample households, Sumbawanga District, 1991/92 (ha)

Type of use	Kankwale	Lula	Mkima	Mtutumbe	Total sample (n=120)
	(n=30)				
Total farm area	2.6 (56)	3.3 (148)	3.2 (60)	4.4 (65)	3.4 (93)
Fallow land	0.7	0.7	1.4	1.8	1.2
Total cultivated area	1.9 (73)	2.6 (187)	1.8 (50)	2.6 (55)	2.2 (122)
- Maize area	1.2 (67)	1.4 (134)	.9 (47)	1.2	1.1 (94)
- Finger millet area	0.3	0.3	0.6	0.4	0.4
- Beans area	0.3	0.6	0.2	0.8	0.5
- Other crops[a]	0.3	0.3	0.1	0.2	0.2

[a] Include groundnuts, potatoes and garden area.
Figures in parenthesis are coefficients of variation in percent.

Source: Appendix 7.1, questions 5 and 6.

The intensity of land cultivation, as measured by the proportion of cultivated land to total owned land was relatively higher in Kankwale (73 %) and Lula (79 %) than in Mkima (56 %) and Mtutumbe (59 %). Given this situation it would not be unreasonable to assume that land-use pressure is relatively more felt in the former than in the latter villages.

Maize is the dominant staple food crop as well as a major cash crop. In our sample households maize occupied about 50 % of total cropped area on average (Table 7.3). Although finger millet is consumed to a lesser extent as compared to maize, it plays an important role in meeting food and cash needs when maize harvests are poor. Beans is an important source of plant protein consumed more often as relish together with either maize or finger millet. In our sample 43 and 53 % of all farmers respectively grew finger millet and beans in addition to growing maize. Average hectarage under finger millet and beans for all sample households was 0.4 and 0.5 ha respectively (Table 7.3)[22].

22 For those households which actually grew any finger millet and beans the average areas were 1.0 and 0.8 ha respectively (Appendix 7.1, question 8).

Although the main occupation of the rural households is agriculture, livestock is raised and plays a notable role in meeting cash requirements through sales. Nearly two-thirds of all sample households keep cattle with an average of between 3 and 5 heads of cattle per household (Appendix 7.1, question 4a). Informal sector activities, like masonry and selling of firewood, are also important sources of non-agricultural income.

The pattern of distribution of cultivated land between different farm sizes and between different crops is set out in Tables 7.4 and 7.5, respectively. It is evident at a glance that the distribution of land in the district is markedly unequal. About 80% of the land is in the hands of 40% of the households owning more than 2 ha, while 60% of the households cultivating less than 2 ha hold only 20% of the land (Table 7.4). This pattern is more or less the same across all villages. For all households the median household (that with as many below it as above it) was 1.6 ha, and the range between the group of households having the least land and the group having the most is from 0.7 ha to 5.2 ha (Appendix 7.1, question 5b).

Table 7.4 **Distribution of operational[a] land between sample households, Sumbawanga District, 1991/92**

Land size (ha)	Kankwale[b]		Lula[b] (n=30)		Mkima[b]		Mtutumbe[b]		Total sample[b] (n=120)	
	% HH	% ha	%HH	% ha	% HH	% ha	% HH	% ha	% HH	% ha
0-1.0	30	12	27	12	23	10	10	2	23	6
1.1-2.0	43	36	37	22	37	33	33	18	37	14
2.1-3.0	17	25	23	18	33	43	14	12	23	38
>3.0	10	27	13	48	7	14	43	68	17	42
Total	100	100	100	100	100	100	100	100	100	100

[a] Land actually cultivated excluding fallow land.
[b] % HH means percent households;% ha means percent ha falling in a group.

Source: Appendix 7.1, question 5a.

Table 7.5 Sample households share of cultivated land sown to all crops by size class of land, Sumbawanga District, 1991/92 (n = 120)

Land size (ha)	Mean land cultivated		Maize	Finger millet (%)	Beans	Other[a]
0-1.0	0.67	100	79	9	5	7
1.1-2.0	1.50	100	63	14	19	4
2.1-3.0	2.43	100	49	25	22	4
> 3.0	4.96	100	43	23	27	7
Total sample	2.17	100	52	20	22	6

[a] Includes groundnuts, potatoes and garden area.

Source: Appendix 7.1, questions 5a and 6.

This later measure indicates the holding that may be considered representative for the area. The largest single group (the modal group) falls in the 1.1-2.0 ha interval (Table 7.4). An interesting land-use pattern emerges if the share of cultivated land sown to different crops is examined with respect to land-size groups (Table 7.5). Although maize was of overriding importance across all land size groups, the share of land committed to maize peaked at 79 % for farmers cultivating less than one ha to all crops, compared to 43 % for farmers cultivating more than 3 ha. This, perhaps, reflects the priority of resource-poor households in growing maize as a staple crop. The more land resource endowed households on the other hand committed relatively large shares of land to the growing of other crops, notably finger millet and beans which could serve as additional sources of income.

7.2.1.2 Labour

Reliance on family labour for farm work predominates in Sumbawanga District. Production operations including land preparation, planting, weeding and harvesting mostly make use of family labour. However, labour hiring in and out of the household was noticed to be a common phenomenon especially in peak labour demand operations like weeding and harvesting. Work groups arrange to work jointly on one's farm on specific days. This implies that on a rotating basis, a man may enlist the aid of his fellow farmers in exchange, after work is accomplished, for cash, grain, beer and/or his labour at a subsequent time. The bigger the labour group, the larger the area covered at one time. Furthermore, a larger group of workers seems advantageous in extensively cultivated fields. Peak labour needs which occur at slightly different seasons promote a shifting of the major work force between family labour and hired or exchange labour. Labour selling outside a household was more common among members of the relatively poor households. Payments in kind, regarded as non-cash transactions in economic analysis, have a lot of implications on household grain production, storage and utilisation because such transactions commit the labour hiring household to pay for labour from harvested or stored grain.

Division of labour within a household follow, to a large extent, a long standing tradition. It was reported, for example, that traditionally some specific farm operations in Sumbawanga District, notably weeding and harvesting, were predominantly done by women. Adult males on the other hand have a great potential for clearing land, cultivating and transporting crops, and directing economic operations. In recent times, however, and due to area expansion, especially area under maize, both males and females participate in all these activities almost jointly. Furthermore, as also noted by Hyden (1990:304) elsewhere in Tanzania, the fact that maize in the district is both a food crop and a cash crop makes men and women share in the agricultural tasks in a unique way that is not common in many parts of the country. Children are mainly available for farm activities during school vacation time.

7.2.1.3 Capital

The term 'capital' is here taken to refer principally to the permanent stock of capital assets that a person invests in agriculture. The Fipa farmers themselves consider this in terms of cash or equipment like oxen, ox-ploughs and other agricultural tools. As noted above, agriculture in the area is largely done using human energy with the hand hoe or using animal traction with a pair of oxen. Nearly 70 % of the sample households owned both oxen and an ox-plough (Appendix 7.1, question 4b). If we consider the number of cattle owned and land under cultivation as proxies of wealth, it is noted that ownership of a plough was mostly concentrated in the hands of relatively rich farmers. While, on average, farmers owning ox-ploughs cultivated some 2.6 ha[23] and owned about 5.7 cattle each the relative figures for farmers without an ox-plough were 1.2 ha and 0.5 cattle (Appendix 7.1, questions 4a and 5a). Just like labour, ox-ploughs can be leased in and outside the household in return for cash or grain.

The dual utilisation of capital equipment for both production and consumption purposes is very common in the district. A pair of oxen, for example, can either be used to till land or transport harvested grain from the farm to the homestead or transport other household utilities like firewood. Ellis (1988b:8-9) argues that a problem ensues in distinguishing profit from returns to family labour, given such a dual production and consumption nature of the peasant household.

7.2.2 Seasonal farming activity pattern

Since the cropping system in the district is rainfed there is an elaborate seasonal pattern of agricultural activities characterised by periods of high and low demand for production resources, notably labour and food. Dictated by the rainfall regime there is only one maize crop in Sumbawanga District. Following

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23 This aspect should not be overemphasised because their is an inherent relationship between owning an ox-plough and oxen used for ploughing.

Ellsworth and Shapiro (1989:198-193) and Reardon and Matlon (1989:121-122) we employ four seasons defined on the basis of climate and maize production activity schedules as observed during the survey. This approach will signify the role of seasonality on maize storage and marketing patterns in the subsequent analysis. The harvest quarter is defined as June-August. The other quarters are September to November; December to February; and March to May. Activity patterns for each of these quarters is discussed below:

1. *Harvest (June-August)*

   The principal maize harvest is carried out between June and August, although sometimes the harvest is a few weeks before or after those months. Depending on the planting date and the variety of maize cultivated most crops are harvested in this season. In our survey 26 % of sample households harvested maize in June while 59 and 9 % harvested in July and August, respectively (Appendix 7.1, question 11b).

2. *Post-harvest (September-November)*

   Storage activities and post-harvest ceremonies are usually concentrated at this period when there is less work to do in the farms. Inter-household exchange and marketing activities which start during the harvest period are also common during this period. Land preparation for the next crop could start as early as October.

3. *Rainy (December-February)*

   Farming activities like planting and weeding are concentrated in this quarter. In accordance with the rainfall regime, planting begins shortly after the first rains in November and December. The majority of farmers plant maize between these two months. 58 % of sample farmers planted maize in December while 28 and 8 % planted in November and January, respectively (Appendix 7.1, Question 11a).

4. *Pre-harvest (March-May)*

   This is the time when activities similar to those in the rainy season predominate. Willis (1981:110) reports that the traditional Wafipa, the dominant tribe in Sumbawanga district, call the period between December and January as *unnsaaka* implying the absence of food while people work hard and the period between February and March *ukwisala* meaning the time of food shortage and potential famine. As will be elaborated in the following analyses most farm households reported that they exhausted their maize reserves during this time.

7.2.3 Production systems and technology

Despite the above-mentioned differences among villages and households the farming system by which crops are grown in the survey villages and Sumbawanga district in general are the same. The farming system is characteristic of both rotation of fields as well as of crops. Crops are either intercropped or grown as pure stands followed by fallow periods which according to Geier et al. (1989:50) can last between three and four years. For example, maize can be intercropped with other crops mainly beans. The most common rotation system in the study area is used for maize, finger millet and beans in that sequence. In this cropping system beans are grown twice in a year. Two bean crops are possible because the rainfall season lasts for about six months while a bean crop matures within three to four months.

Three observations from this system are evident. First, by cultivating different crops on his small plot, the farmer is able to obtain all the items he needs for consumption. Second, that there is a substantial proportion of unused but cultivable land makes it evident that there exists in Sumbawanga District a possibility for shifting cultivation. Third, crop combinations and fallow vegetation are aimed at the restoration of soil fertility due to lack of physical inputs.

Crop production technology is underdeveloped. Even though about 81 % of all farmers used animal power for land preparation (Table 7.6) dependence on muscle power and simple implements, e.g. a machete and a hoe, for cultivation, is still common. Only 23 and 39 % of farmers used improved seeds and chemical fertilisers, respectively, on maize farms. Furthermore, the average seeding rate of about 21 kg/ha is slightly below the rate of 25 kg/ha recommended by the Tanzania Seed Company Limited (TANSEED, 1990:1).

The nitrogen equivalent of fertiliser application also falls short of the recommended 115 kg N/ha (Quiñones et al. 1992:30). Moreover, It was established that no one uses fertiliser on the finger millet or bean field, preferring to move on when successive crops have exhausted the soil.

Table 7.6 Maize production technology in sample farms, Sumbawanga District, 1991/92

Technology	Kankwale	Lula	Mkima	Mtutumbe	Total sample
	(n=30)				(n=120)
Hand hoe (%)[a]	20.0	13.3	26.7	13.3	18.3
Oxen plough (%)	80.0	83.3	73.3	86.7	80.7
Local seeds (%)	93.3	40.0	56.7	93.3	70.8
Improved seeds (%)	6.7	56.7	26.7	3.3	23.4
Local&improved seeds(%)	-	3.3	16.0	3.3	5.7
Seed rate (kg/ha)[b]	21	19	25	18	21
Fertiliser rate (kg/ha)[b]	46	118[c]	56	50	73
Farmers using fertilisers (%)	33.3	50.0	40.0	33.3	39.2

[a] One farmer from Lula used a tractor for land preparation.
[b] Calculated by dividing average quantities used by area under maize.
[c] The high rate is due to a number of farmers who used fertiliser from the Sasakawa Global 2000 project.

Source: Appendix 7.1, questions 8, 9 and 10.

7.2.4 Yield and aggregate production

Therefore, low production intensities - lack of access to improved seed, fertiliser, and insecticides - are the most important constraints to increased grain production and seem to be major factors, explaining the low yields among farmers (Table 7.7 and Figure 7.1). Typical maize yields among survey households during 1991/92 were generally low, ranging between 1.5 t/ha in Mtutumbe and about 3.6 t/ha in Lula. With good cultural practices, including use of fertilisers and with pest and disease control, improved cultivars in Rukwa Region have reached yield levels of up to between 3.5 and 5.6 t/ha in 1989/90 (Quiñones et al. 1992:34) compared with a potential yield of between 5.3 and 6.8 t/ha reported by the Tanzania Seed Company (TANSEED, 1990:1). Relative to other sub-Saharan countries and to the Tanzanian national average, maize yields in the district appear to be above average. CIMMYT quotes average pure stand maize yields of 1.6 and 1.5 t/ha in the Eastern Africa region and in Tanzania respectively (CIMMYT, 1990:5&47). Yield levels for beans also compare well with the range of between 200-670 kg/ha reported by Karel and Ashimogo (1991:996) compared to between 1,500-3,000 kg/ha for improved cultivars grown under good cultural practices.

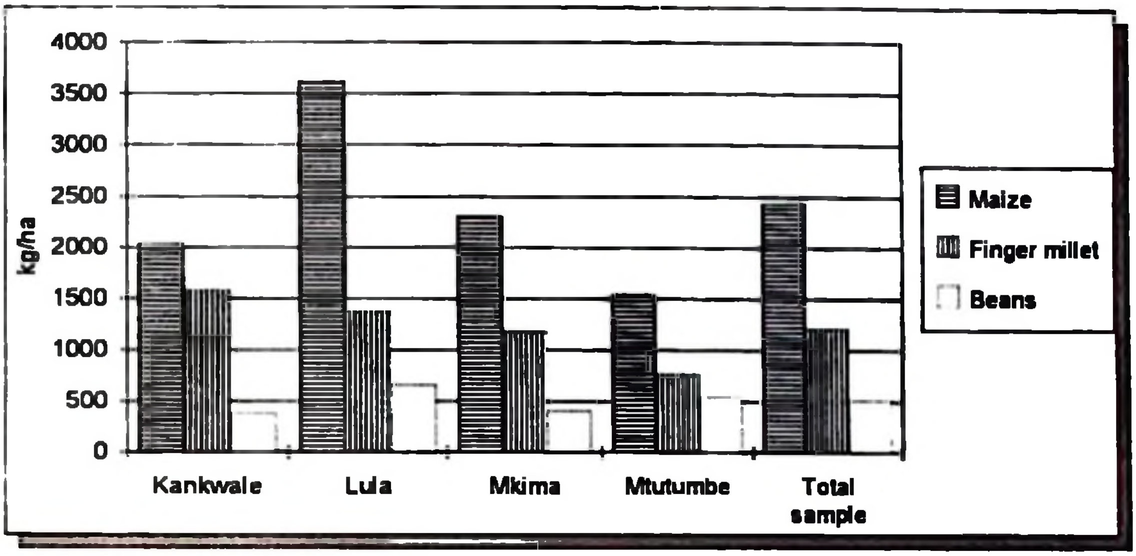
Table 7.7 Average production and yield of maize, finger millet and beans grown by sample farms, Sumbawanga District, 1992/93

Village	Crop					
	Maize		Finger millet[a]		Beans[a]	
	Production (kg)[c]	Yield[b] (kg/ha)	Production (kg)[cd]	Yield[b] (kg/ha)	Production (kg)[cd]	Yield[b] (kg/ha)
Kankwale	2,131	2,029	825(12)	1,581	141(12)	378
Lula	5,062	3,616	1,577(6)	1,380	441(20)	655
Mkima	1,976	2,298	934(22)	1,183	131(19)	402
Mtutumbe	1,901	1,533	635(11)	766	435(23)	540
Total sample	2,767	2,427	919(51)	1,210	311(74)	510

[a] Applicable only to those households who cultivated finger millet and beans.
[b] Yield calculated by dividing average output by average area cultivated.
[c] All quantity measures in Appendix 7.1 are given in bags. In this study all conversions to tons and/or kg are based on the assumption that a bag weighs on average 100 kg for maize and 110 kg for beans and finger millet. These estimates are based on personal observations.
[d] Figures in parenthesis are number of farmers who cultivated finger millet or beans. All farmers grew maize.

Source: Appendix 7.1, questions 6 and 34.

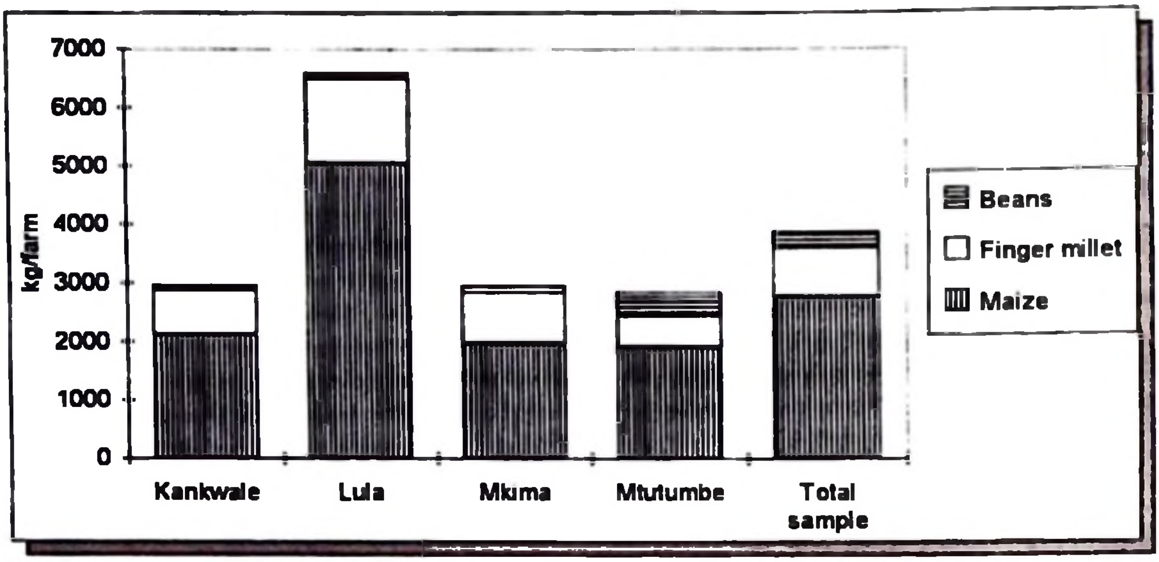
Figure 7.1. **Average crop yields in sample farms, Sumbawanga District, 1992/93**



Source: Table 7.7.

Some qualifications for yield and production levels outlined above are pertinent. First, maize outperformed both finger millet and beans in average output (Figure 7.2). Corresponding to respective areas allotted to the respective crops these results are in line with our expectations. Across all villages, finger millet production fluctuated between 31 and 47 % of maize production (Table 7.7). This underlines its importance as a consumption substitute during times of maize shortages.

Figure 7.2 Average crop output in sample farms, Sumbawanga District, 1992/93



Source: Table 7.7.

Second, with the use of agricultural inputs farmers can substantially increase the rate of crop yield per unit area. As Table 7.8 indicates, maize yield levels resulting from the use of fertilisers increased by about 61 % relative to farms without fertiliser. Even though fertiliser supply (and the resultant relative high production and yield, notably in Lula) in the survey villages at the time of this survey was, to some extent, linked to the Sasakawa Global 2000 programme mentioned earlier, yield increases resulting from fertiliser use confirm that only those farmers with financial ability to buy fertilisers can benefit more from the use of fertilisers.

Table 7.8 **Effect of fertiliser use on maize yields of sample farms, Sumbawanga District, 1992/93**

	Kankwale		Lula		Mkima		Mtutumbe		Total sample	
	No.	kg/ha	No.	kg/ha	No.	kg/ha	No.	kg/ha	No.	kg/ha
With fertiliser	20	2,342	15	4,810	11	3,107	10	2,256	46	3,394
Without fertiliser	10	1,827	15	3,141[a]	19	2,158	20	1,448	74	2,155
Total/mean	30	2,029	30	3,616	30	2,298	30	1,533	120	2,427

[a] The higher yield levels for Lula even without fertiliser use can be attributed to the use of better seeds. As Table 7.6 demonstrates 57 % of sample households in Lula used HYVs Compared to 7, 27, and 3 % in Kankwale, Mkima and Mtutumbe respectively. In addition, technological spillover effects of the Sasakawa project in the village could have also led to better farm management practices.

Source: Appendix 7.1, questions 6a, 10 and 34a.

To be able to compare maize production and utilisation between villages and between different categories of farmers we use the land-size classification of sample farmers according to land under maize into small (up to 1.0 ha), medium (1.1-2.0 ha), and large (> 2.0 ha). The data support the observation that total farm maize production among sample farmers varied directly with land area (Table 7.9). Examination of the survey data (Appendix 7.1, questions 6a and 10) revealed that the correlation between farm size and grain production is positive and high ($r = 0.68$; $p < 0.5$).

Table 7.9 reveals two other features. First, given the small farm size, output per farm is usually very low and that emphasis for effective crop marketing and storage policies and practices should take this fact into consideration. For example, overall, about a half of all farmers with an area of up to 1.0 ha harvested only about 1.9 tons compared to an average of more than 5.6 tons for farmers with more than 2 ha. Relatively more farmers in Mkima and Kankwale seem to fall within the least area cultivated and corresponding low production. However, the reciprocal relationship between farm sizes and their contribution to total grain production is exemplified by the fact that farmers with more than 2 ha contributed only about 13 % of total grain produced (Table 7.9). This confirms the observation that besides their 'smallness' the majority of farmers in Sumbawanga District contributes more to total grain produced.

Table 7.9 Average maize harvest and distribution by size of land under maize, Sumbawanga District, 1992/93

Parameter	Land size (ha) 0-1.0	1.1-2.0	> 2.0	Total
Kankwale (n = 30)				
Percent farms[a]	63.3	30.0	6.7	100
Harvest (kg)	1,630	3,033	2,825	2,131
Percent grain[b]	48.9	43.7	7.4	100
Lula (n = 30)				
Percent farms[a]	46.7	46.6	6.7	100
Harvest (kg)	2,472	6,208	15,170[c]	5,062[c]
Percent grain[b]	20.9	51.1	28.0	100
Mkima (n = 30)				
Percent farms[a]	80.0	16.7	3.3	100
Harvest (kg)	1,891	2,056	3,600	2,004
Percent grain[b]	76.6	17.3	6.1	100
Mtutumbe (n = 30)				
Percent farms[a]	40.0	50.0	10.0	100
Harvest (kg)	1,428	2,264	1,980	1,901
Percent grain[b]	30.1	59.4	10.5	100
Total sample (n = 120)				
Percent farms[a]	57.5	35.8	6.7	100
Harvest (kg)	1,857	3,685	5,691	2,776
Percent grain[b]	37.6	49.1	13.3	100

[a] Percent farms falling under each land size class.
[b] Percent of total maize produced by farms in each land size class.
[c] Figures are skewed because of one farmer who had an exceptionally high harvest of 206 bags (or ≅ 20,600 kg).

Source: Appendix 7.1, questions 6a and 34a.

Second, production may be increased by expanding the size of the farm. But since most maize farms are limited to one hectare or two, and given the limited labour and lack of mechanisation, it seems difficult to expand area under maize production. Economic data are not available from this study to substantiate fully the postulated factors limiting area expansion but expressed desire for increased crop production to alleviate poverty and reduce household food insecurity support this interpretation.

Two conceptual aspects must be underlined at this point. First, as noted in Table 7.7, total maize production is recorded in bags. Bags in our survey were interpreted to have weights of between 90 and 110 kg depending on age and type of sack and on intensity of bag filling. For our purpose a bag is considered to weigh 100 kg. Second, it should be noted that total maize harvests may be an underestimation of actual production for two reasons. First, maize could be harvested when it is green for selling or for own use as a snack, boiled or roasted. It was a common feature to see street vendors selling green maize in Sumbawanga town at the time of this research. Second, as also noted by Ellis (1993:431) for rice in Indonesia, sample farmers, more often than not, interpreted total harvest as the amount of grain remaining after provisions for in-kind payments are taken care of.[24]

7.3 Analysis of the post-harvest maize systems at farm level

Wos (1985:8) defines a post-harvest system as one which is concerned with the post-agricultural agro-industries sphere and includes, at traditional level, all of the essential technology of storage, transportation, and processing of agricultural raw materials into food products. Other complementary post-harvest operations are harvesting, drying, cleaning, and marketing and consumption. In this section we present an account of the major post-harvest operations in the study area with emphasis on the management aspects of farmers practising storage.

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24 As a solution to this problem Ellis (1993:431) proposes the use of the term 'net harvest' for the remaining harvest over which farmers had decision making control. Even though care was taken to incorporate in-kind transactions into our results no attempt was made to estimate amounts of maize harvested green.

7.3.1 Pre-storage practices

In order to appreciate the implications of farmers' grain storage management strategies, a brief review of the pre-storage and storage practices is necessary. The major pre-storage factors and practices that influence grain quality and that might cause losses, if carried out improperly, are the harvesting time, the transport from the field to the farm/household, the drying process, and the shelling and cleaning operations. Bourne (1984:328-332) lists other factors as inherent stored grain stability, environment, sanitation and time of storage. From our survey, about one-third of the sample farmers identified storage operations as the biggest sources of grain losses (Appendix 7.2, question 16). Others mentioned pre-harvesting time (29 %) and harvesting operations (16 %) as the major crop loss operations. The former is attributed to vermin and theft.

7.3.1.1 Harvesting and drying

As noted earlier, maize is harvested during the dry season between May and August. When the cobs are physiologically mature and dry, which is indicated by the bending of the ear, they are generally sheathed and removed from the standing stalks. Harvested maize is bundled and left to dry in the field or is carried to the homestead for drying. Due to the relatively low humidity and small amounts of rainfall during and shortly after harvest season, grain may be dried to a reasonably safe storage moisture content by natural sun drying methods.[25]

As Table 7.10 shows the majority (89 %) of all households dried maize either in the field (45 %) or in the homestead (44 %). It is interesting to note that

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25 Indeed, technicians who analysed the loss assessment samples reported that the average moisture content for the maize sampled in December ranged between 11 and 18 %, with only 3 farmers out of the 20 having maize with a moisture content above the recommended level of 14 percent.

relatively more farmers in the remote areas of Lula and Mtutumbe dried maize in the field. On the other hand, probably as a measure against theft, most farmers in the villages of Kankwale and Mkima located relatively close to Sumbawanga town dried maize at the homestead. The drying period ranges from 1 to 4 weeks (Appendix 7.1, question 14b) depending on the level of the moisture content at the time of harvest and on the variety.

Table 7.10 Place for maize drying after harvest by sample households, Sumbawanga District, 1992/93 (%)

Drying place	Kankwale	Lula (n=30)	Mkima	Mtutumbe	Total sample (n=120)
In field	13.3	76.6	33.3	56.6	45.0
At home	60.0	16.7	63.4	36.7	44.2
Did not dry[a]	26.7	6.7	3.3	6.7	10.8
Total	100.0	100.0	100.0	100.0	100.0
[a] Implies harvested maize after it was completely dry in the field.					

Source: Appendix 7.1, question 12a.

Almost all of the maize is dried unshelled either on the ground or on platforms of various sizes supported by a wooden framework raised some 1 to 1.5 metres off the ground. On these structures ears of maize are piled to various depths, the maximum being 1 metre. In this survey about two-thirds of those farmers who dried maize did so on the ground (Appendix 7.1, question 12c). The others used platforms.

However, the drying procedure used on the farms bear some risks due to facility design, lack of control of incoming field infestation from insects and rodents, and lack of protection from rain. All these could lead to early grain infestation or non-uniform drying of grain. In Sumbawanga district storage of shelled maize is predominant. After drying maize is shelled by beating the dry cobs with sticks. Prior to putting the grain in store it is usually cleaned by winnowing. Other recommended practices like checking moisture content of grain, sorting out infected grains and cleaning and disinfecting the storage structure are hardly followed.

7.3.1.2 Farm to homestead transport

Harvested maize from fields to the homestead is transported primarily by pack animals (Table 7.11). The relatively significant reliance of farmers in Lula on the use of motor transport for crop haulage is explained by the villages' ownership of a 7-ton lorry which could be hired to them.

Table 7.11 Major means of transporting maize from field to home-stead, Sumbawanga District, 1992/93 (%)

Method of transport	Kankwale	Lula (n=30)	Mkima	Mtutumbe	Total sample (n=120)
Donkey/oxen	66.6	63.3	83.3	90.0	75.8
Head load	23.4	0	16.7	10.0	12.5
Lorry/other means	10.0	36.7	0	0	11.7
Total	100.0	100.0	100.0	100.0	100.0

Source: Appendix 7.1, question 13.

7.3.1.3 Treatment against pests

Insect pests are the most severe and widespread biological constraint on grain storage. Paster (1993:220) approximates that world-wide 20 insect species, out of 100 known to cause damage to food, are considered to be major pests. In tropical climates the consequences of improper pesticide use pose a greater threat than in temperate climates because, as Annis et al. (1990:748) point out, tropical conditions generally favour the rapid growth and development of stored product insects.

Farm level stored maize losses caused by insect infestation in Tanzania has been well reviewed by Bengtsson (1991). These losses have been estimated to be in the range of between less than 1% to total crop destruction depending on the maize variety, type and amount of pesticide applied, ecological and climatic conditions, and duration, time, type, and extent of pest infestation. For example, in a recent study cited above Bengtsson (1991:15-16) observed relatively higher insect damage in stored hybrid maize than in local varieties.

Although Bengtsson (1991:2) also attributes this variability in loss figures to methodological and conceptual flaws, McFarlane (1988:121) attests that it was against the background of the unusually severe losses caused by the Larger Grain Borer (*Prostephanus truncatus* (Horn)) that the Government of Tanzania began to organise its current control programmes against this pest, with the support of FAO and the British Government. In such a situation it was clearly imperative to consider the possibility of using pesticides to achieve effective protection of stored produce.

The major observation from our survey was the lack of uniformity among farmers in their comprehension of stored maize protection as the following account demonstrates. About 43% of the 120 farmers applied commercial pesticides (Table 7.12). 19% used natural deterrent materials, mainly burned cowdung ash, and 38% did not use any protectants.

Table 7.12 Means of treating maize before storage by sample households, Sumbawanga District, 1992/93 (%)

Maize treatment	Kankwale	Lula (n=30)	Mkima	Mtutumbe	Total sample (n=120)
Chemical pesticides	70.0	46.7	26.7	26.7	42.5
Natural materials	3.3	6.6	46.6	20.0	19.2
No treatment	26.7	46.7	26.7	53.3	38.3
Total	100.0	100.0	100.0	100.0	100.0

Source: Appendix 7.1, questions 14a.

Following the problems due to attacks of the Larger Grain Borer in Tanzania in the 1980s, strong and generally successful efforts were made by extension agents to introduce new storage techniques, including the use of synthetics. These efforts increased farmer awareness to the need for using commercial pesticides. Table 7.13 compares the results of this current survey to other studies in the country on farmers' awareness of use of pesticides. An obvious conclusion from the table is that more than half of farmers studied in all these studies used pesticides to control storage pests.

However, a number of discrepancies were noted. Out of the 49 farmers who applied pesticides in this study only 55 % used Actellic Super Dust, the pesticide most recommended in the district[26] (Table 7.14).

Table 7.13 Use of pesticides in stored maize, Tanzania, 1986/87-1992/93

Region or District	Sample size	Farmers using pesticides (%)	Reference
Sumbawanga	120	42	Own survey, (1992/93)
Southern Highlands	na	80	Shetto (1993:3)
Iringa, Mbozi, Njombe, and Sumbawanga	54	94	Mkoga (1992:15)
Rukwa	214	53	Nyang'ali et al. (1986:6)
Rukwa	498	17-72[a]	Agrar- & Hydrotechnik GmbH (1986:6)
10 Districts[b]	71	45	Bengtsson (1991:14)

[a] Variable with respect to location of respondents.
[b] The study included 10 districts in Arusha, Iringa, Morogoro, Mwanza, Ruvuma and Tabora regions.

26 There exist internationally recognised regulations which determine which insecticides are permissible for use on grain and what quantities. These are given by the Codex Alimentarius Commission and by the Joint Meeting on Pesticide residues of the FAO/WHO. For an account of the common regulations see Gwinner et al. (1990:159-207).

The remainder used either synthetics which only protect effectively against a narrow spectrum of pests (18 %) or synthetics which are not recommended, some of which could lead to health hazards (27 %). For example DDT was used by 12 % of all farmers using chemical pesticides (Appendix 7.1, question 14b). Bengtsson (1991:14) and Mkoga (1992:15) even mention that respectively 11 and 27 % of pesticide users they surveyed used DDT.

Table 7.14 Chemical pesticides used by sample farmers, Sumbawanga District, 1992/93

Pesticide used	Example of pesticide	Kankwale	Lula	Mkima	Mtutumbe	Total sample	
		(No.)					(%)
Generally recom-mended	Actellic Super Dust	5	12	5	5	27	55.1
Partially recom-mended[a]	e.g. Fenitrothion	5	1	1	2	9	18.4
Not recom-mended/ harmful	e.g. DDT	11	0	1	1	13	26.5
Total	-	21	13	7	8	49	100.0

[a] Recommended only for specific pests.

Source: Appendix 7.1, question 14b.

When considering the question of rates of application the figures vary again. Out of the 37 farmers who used either Actellic Super Dust or the partially recommended pesticides only 16 farmers or 43 % of all farmers using pesticides used the recommended rate of application per bag of stored maize[27] (Appendix 7.1, question 15a). This is barely 13 % of the original

27 The recommended rate of application for Actellic Super Dust (Pirimiphosmethyl) is 100 g/ 90 kg bag of maize.

sample of 120 farmers. Bengtsson (1991:14) reported that only 11 % of the 71 farmers he surveyed used the correct insecticide and the recommended rate of application at the same time.

The results of the above analysis reveals a number of interesting features. First, it confirms that farmers use a combination of pesticides and traditional methods for the prevention and control of pests. Elsewhere it was reported that the combination of chemical and non-chemical methods of insect pest control has been recommended for farm stored grain since the early 1900s (Reed et al. 1993:1590). Second, results also suggest that use of pesticides is the most preferred pest control strategy. There are, however, a number of issues which must be addressed in line with farmers' desire to adopt a particular pest control strategy. This and other studies quoted here show that many grain producers in Tanzania do not follow recommended insect control techniques for farm-stored grain.

Reusink (1976:27) defines pest management as the reduction of pest problems by actions selected after the life systems of the pests are understood and the ecological as well as economic consequences of these actions have been predicted, as accurately as possible, to be in the best interest of mankind. Pest management, therefore, consists of a combination of processes including acquiring information of the agroecosystem, decision making and taking action to manage the pest situation.

It appears that a lack of information on the part of both extension staff and farmers is one of the most important problems facing pest management strategies in the study area. Among the 120 farmers interviewed, about 82 % complained that they never received any expert advice on proper grain storage methods and practices (Appendix 7.1, question 26). Furthermore, the fact that 34 % of those farmers who did not use pesticides gave lack of information as the reason which made them fail to use pesticides (Appendix 7.1, question 5d) offers evidence to the magnitude of the problem. As a result farmers have an inadequate information when deciding when and how to use pesticides. Norgaard (1976:46) attests that lack of information results in sub-optimal decisions and uncertainty about outcomes. Decisions can be improved and certainty be increased by acquisition of better knowledge.

Another problem is the unavailability of commercial pesticides. Although more than a half of the surveyed farmers are aware of the need for pesticides, failure of the distribution system is a major constraint. There appear to be four commonly employed means of distributing pesticides in rural areas. 41 % of farmers using pesticides informed that they purchased them from shops (Appendix 7.1, question 5b). Others obtained pesticides from dealers (20 %) and from extension agents (16 %). The rest obtained pesticides from a variety of other sources including private traders. This diversity of pesticide sources increases the risk of using expired, or nonrecommended pesticides.

Another area of concern is the lack of integration, in the minds of economists and entomologists who provide advice to farmers, national policy makers, and others in between, of the diverse interrelationships between socio-economic factors and pesticide use. Norgaard (1976:45) considers the misuse of pest control inputs as a social problem. He argues that insufficient consideration is given to the economics and technological limitations of using pesticides and other pest control strategies in relation to the pest complex and the total post-harvest system. Investment in insect control for farm-stored grain may not be cost effective for many farmers. In addition the Tropical Development and Research Institute (TDRI) (1984) stresses that proper supervision is necessary for safe and effective use of pesticides at farm level.

7.3.2 Storage methods and structures

7.3.2.1 Types of storage structures

The main types of storage structures commonly used in Sumbawanga District are outlined in Table 7.15. Amongst the Fipa people the most important storage container for most of the main staple, maize, is the granary called *kihenge* or *Inkoma*. Elder sample respondents and Chung (1975:20) confirmed the use of this storage structures for a long time in Sumbawanga District.

Table 7.15 Characteristics of major types of grain storage techniques, Sumbawanga District, 1992/93

Type of storage	Construction material	Utilisation	Method of storage
Kihenge (Granary)	Thin, flexible reeds of sticks, mud bricks[a], stones and timber	Mainly for large storage of grain for food	Shelled Maize or finger millet
Gunny bags	Sisal gunny bags, normally bought	Mainly grain for sale	Shelled maize or finger millet
Ceiling storage	No material used	Seed grain	Sheathed maize on cob; finger millet on heads
Small containers	Mud pots, tins and gourds	Seed grain	Shelled maize, finger millet, beans and ground nuts
[a] Only for brick structures			

Source: Own Survey, (1992/93) and Chung, D.S. (1975) Review of on-farm grain storage in Tanzania. Food and Feed Grain Institute. Grain storage, processing and marketing report No. 49:17.

Each family, or each one of a polygamist's wives with sufficient grain to store, has a *kihenge*. Most families had one or two structures of their own (Appendix 7.1, question 24a) although some farmers may use up to three. Separate structures are used either for a separate storage of different types of agricultural produce or for the distribution of the stored grain to more smaller granaries and hence, as also observed by Greeley (1978:40-41) in India, doing away with the necessity to build a bigger store. It seems therefore that there are no economies of scale in utilisation of bigger storage structures.

Table 7.16 **Types of storage used by sample households, Sumbawanga District, 1992/93**

Storage type	Storage purpose					
	Food		Selling		Seed	
	No. of farmers	%	No. of farmers	%	No. of farmers	%
			Kankwale			
Kihenge	18	60.0	3	14.3	5	17.2
Bags	8	26.7	18	85.7	16	55.2
Other[a]	4	13.3	0	0	8	27.6
Total	30	100.0	21	100.0	29	100..0
			Lula			
Kihenge	25	83.3	2	8.0	1	4.0
Bags	8	26.7	22	88.0	19	76.0
Other[a]	7	23.4	1	4.0	6	20.0
Total	30	100.0	25	100.0	25	100.0
			Mkima			
Kihenge	22	73.3	3	11.5	3	11.1
Bags	0	0	23	88.5	14	51.9
Other[a]	8	26.7	0	0	10	37.0
Total	30	100.0	26	100.0	27	100.0
			Mtutumbe			
Kihenge	27	90.0	6	26.1	15	51.8
Bags	0	0	18	78.3	1	3.4
Other[a]	3	10.0	1	4.3	13	44.8
Total	30	100.0	23	100.0	29	100.0
			Total sample			
Kihenge	82	68.3	14	14.4	24	21.6
Bags	16	13.3	81	83.5	50	44.0
Other[a]	22	18.4	2	2.1	37	33.4
Total	120	100.0	97	100.0	111	100.0

[a] Includes storage in pots, tins and under the roof eaves.

Source: Appendix 7.1, question 19.

Table 7.16 confirms the preference of many farmers to use the *kihenge*. About two-thirds of all sample farmers used this structure to stock maize which was stored for food. Thirteen percent stored food maize in gunny bags while the rest (18 %) stored it in a variety of other small containers including pots, tins and storage under the roof eaves.

Grain for sale is most commonly filled into sisal gunny bags and left inside the house. Informal discussions revealed that small containers are mainly used by relatively poor farmers generally considered as "social cases" who have very small harvests and who rely on gifts from their family and friends. Whereas it is apparent from Table 7.16 that most farmers store maize meant for sale in bags the preference of storage method for seed maize was somewhat ambivalent.

The *kihenge* used in the survey villages is generally better suited to smaller quantities. There are two types: grass type and the brick type, but the grass type predominates due to its relatively low construction costs. In our survey only five farmers (4 %) had permanent brick storage facilities.[28] This is reflected in the high cost of building permanent storage facilities. The construction itself consists of a cylindrical reed basket build on a wooden or stone platform or stand approximately half a metre above ground. The *kihenge* is covered most of the time with a conical grass thatched lid which is normally removable and serves as a grain inlet and outlet at the same time. The inside of the *kihenge*, and in rare cases its outside, is plastered with a mud cover. It seems, therefore, that a choice of storage structure is determined by the local cost and availability of raw materials. As data in Appendix 7.1 (question 24b) imply, almost all farmers built the structures themselves.

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28 These were relatively prosperous farmers 3 from Kankwale (no. 9, 26 &29) and 2 from Lula (no. 36 & 43) who had, on average, 3.06 ha under maize and harvested some 21.3 bags of maize (Appendix 7.1, questions 5a and 34a).

Storage structures in Sumbawanga District are not very different in their way of construction or in terms of building materials used. This is due to the fact that suitable construction trees and materials are readily available in remoter areas like Mtutumbe, although they are relatively in short supply in areas closer to Sumbawanga town like Kankwale. In addition, at the farm level storage facilities are relatively unspecialised. Differences were rather on the attention farmers give to their stores. During the grain sample drawing from stores of the twenty farmers, which also included a thorough check of the structures and of the hygienic conditions of the closer surroundings, it was observed that some of the storage structures are not well kept. Eight of the 20 farmers owned structures that had big holes and cracks (partly due to old age of structure) rendering easy access to insects and rodents. The immediate surroundings of some of the structures were not clean and could offer shelter to rodents.

Even though it is very difficult to define a good storage structure Bengtsson (1987:3) summarises that a proper container for grain stored for consumption in the farm family should, among other things meet the following requirements: protect the grain from attack or re-infestation by insects by appropriate preventive and hygienic measures; should be constructed using cheap and locally available materials; durable and easy to clean, repair and maintain; easy to load and empty; and have sufficient capacity.

7.3.2.2 Effects of storage practices on weight losses

Several studies have already estimated storage grain losses in Sumbawanga district. The presented loss values vary widely, giving a whole spectrum of values between: "not a serious problem" (Hoper et al. 1991:59); ..."losses are estimated at 10 % annually" (Kavishe 1991:15); and "11% of maize stored at household do get lost (Nyang'ali et al, 1986:1).

As noted earlier on methodological grounds these figures are questionable because the above studies used formal questionnaires, in which farmers were asked to quantify the magnitude of grain losses in their own *kihenge* instead of actual grain sampling and analysing. The present study applied a standard scientific methodology for assessing storage loss, which is discussed in chapter six. Consequently data obtained from this study can easily be compared with data collected by other loss assessments using a standard method.

Weight loss assessment was done to check the effect of storage technology on losses among the twenty farmers from whose stores grain was sampled on a monthly basis. The results are presented in Table 7.17. We note from these results that total weight losses of maize were considerably lower than previously assumed.

Table 7.17 **Cumulative weight losses by type of maize treatment, Sumbawanga District, 1992/93 (%)**

Treatment	Months after storage[a]							
	2	3	4	5	6	7	8[a]	9
Pesticides[b] (n=7)	0.09(3)	0.34(7)	0.53(6)	0.73(6)	1.09(6)	1.36(4)	1.57(2)	na
Natural materials (n = 6)	0.06(1)	0.31(4)	0.51(6)	1.20(5)	2.04(4)	2.66(3)	5.52(2)	na
No treatment[b] (n=7)	na	0.54(4)	1.50(7)	1.94(5)	2.33(5)	3.53(2)	3.90(2)	5.10(2)

[a] Data for the initial losses at the time of storage and for the first month of storage could not be available because grain sampling started late. For the method of calculating losses see Appendix 6.7. Loss figures after 8 months of storage are less reliable because there were only two observations in each treatment.

[b] At the 5 % confidence level average losses between treatments were not significantly different except between maize treated with commercial pesticides and that which was not treated at all.

Figures in parentheses in the treatment column show number of farmers from whom samples were collected in each type of treatment. Those under months of storage show the actual number of samples analysed per sampling occasion.

Source: Own survey, 1992/93.

These results however, should be interpreted with caution since some farmers depleted their stored grain stocks before the grain sampling exercise was finalised. Nonetheless, at least two farmers in each of the 3 sub-groups still had grain left at the end of sampling period in May 1993.

The variation in weight loss ranged between 1.6 % for those farmers who applied pesticides to 5.5 % for farmers who applied natural materials after eight months of storage. Average loss in stores of farmers using natural materials is slightly more than one and a half times that for farmers not treating maize although for the entire storage period this difference is not statistically significant. These results perhaps reflect the ineffectiveness of the natural materials in protecting grain against storage pests, especially if the natural materials are used in combination with unhygienic storage practices. Indeed, efforts to use natural materials to control the Larger Grain Borer in Tabora region showed that natural materials are effective only at very high application rates, for example, 30 % wood ash by weight and 20 % sand by volume (Golob and Hanks, 1990:194).

Generally, the weight losses recorded increased considerably after six months of storage reflecting an exponential increase of insects in infected grain. This pattern of losses coincides well with farmers' awareness of the effect of time or duration of storage on weight losses. Asked about the time in which storage losses are more serious, about a half of all farmers reported the time between December and February (Appendix 7.1, question 17), approximately between six and eight months after putting grain in store. Differences in average weight losses can therefore be partly explained by duration of storage in addition to the storage technologies used.

7.3.2.3 Capacity and life span of storage structures

The structures had an average capacity of one and half tons although this could vary from 0.2 to 4 tons (Table 7.18). This range of capacity is similar to that of up to 40 bags (or 4 tons) reported by Coulter and Golob (19992:422). Given the uniformity of the materials used to construct the *kihenge* the average capacity and useful life span are correspondingly similar. Table 7.18 shows that the average life span of this traditional form varies between four and seven years. Improved versions of the *kihenge* are build out of bricks and can last for up to twenty years. The grass lid is often changed annually but is occasionally left for more than 3 years.

Table 7.18 Mean capacity and life span of *Kihenge* structures of sample households, Sumbawanga District, 1992/93

Parameter	Kankwale (n=20)	Lula (n=9)	Mkima (n=22)	Mtutumbe (n=24)	Total sample (n=75)
Capacity (t)	1.68(65)	1.63(42)	1.32(50)	1.27(22)	1.45(48)
Life span (Years)	6.6(44)[a]	5.4(67)[a]	5.4(46)	3.6(73)	5.9(69)

[a] The total number of farmers using the *kihenge* to store maize was eighty, and life span figures presented here excludes those of 5 farmers (three in Kankwale and two in Lula) who used mud brick structures. For these the average life span was estimated at 16.6 years.
Figures in parenthesis are the coefficients of variation in percentage.

Source: Appendix 7.1, questions 20 and 21.

7.3.2.4 Location of structures

The *kihenge* may be located inside or outside the living house (Table 7.19). It seems plausible that factors like space availability and security against theft exert considerable influence in store location. More than 90 % of farmers in Kankwale located maize granaries inside the living house. In sharp contrast the majority (92 %) of farmers in Mtutumbe located far away from Sumbawanga town and where presumably theft is rare located their granaries outside their living houses.

Table 7.19 Location of store by sample households, Sumbawanga District, 1992/93 (%)

Location of store	Kankwale (n=23)	Lula (n=11)	Mkima (n=22)	Mtutumbe (n=24)	Total sample (n=80)
Inside main house	91.3	81.8	63.6	8.3	57.5
Outside main house	8.7	18.2	36.4	91.7	42.5
Total	100.0	100.0	100.0	100.0	100.0

Source: Appendix 7.1, question 22.

7.3.3 Purpose of storage

Our focus in this section is the distribution of maize at the period following harvests. In particular, the section attempts to gauge the allotment of harvested maize grain and other crops to different uses by assessing the proportion of grain used immediately after harvest, that is, sold or consumed, and the amount stored for future use.

7.3.3.1 Utilisation of harvested maize

Overall, about 81 % of the harvested maize is reserved for future sales, consumption and other purposes (Table 7.20). About 12 % of grain is sold immediately after harvest to take care of immediate cash needs while 7 % is used in the transition period before households start consuming stored maize.

However, the amount of maize sold immediately after harvest varied between villages and size of farms. The biggest inter-village contrast of grain retention is observed between Lula, a relatively surplus village, and the rest of the villages.

For example, while farmers in Lula stored, on average, some 3,984 kg each those in Mtutumbe stored slightly over one-third this amount. Furthermore, small farmers in Mtutumbe stored only 1,146 kg; their corresponding counterparts in Lula stored one and half this quantity. However, proportion of grain stored do not differ very much according to size of land under maize. Overall, all types of farmers stored more or less about 80% of grain which is the mean across villages and farm type (Table 7.20).

Table 7.20 Use of maize harvested by sample households by size of land under maize, Sumbawanga District, 1992/93 (kg) (n = 120)

Type of use	Small	Medium	Large	Average
Kankwale				
Immediate sale[a]	37	22	0	30
Immediate consumption[b]	190	339	300	242
Stored	1,402	2,672	2,525	1,858
Harvest	1,630	3,033	2,825	2,131
Lula				
Immediate sale[a]	393	1,226	1,550	859
Immediate consumption[b]	197	218	380	219
Stored	1,882	4,764	13,240	3,984
Harvest	2,472	6,208	15,170	5,062
Mkima				
Immediate sale[a]	155	120	1,800	202
Immediate consumption[b]	218	150	300	205
Stored	1,562	1,786	1,500	1,597
Harvest	1,891	2,056	3,600	2,004
Mtutumbe				
Immediate sale[a]	142	340	200	246
Immediate consumption[b]	140	129	100	131
Stored	1,146	1,795	1,680	1,524
Harvest	1,428	2,264	1,980	1,901
Total sample				
Immediate sale[a]	168	536	688	335
Immediate consumption[b]	192	204	245	200
Stored	1,511	2,944	4,759	2,241
Harvest	1,857	3,685	5,691	2,776

[a] Sold within the harvest month.
[b] Consumed before household starts to consume stored maize.

Source: Appendix 7.1, question 35.

In relative terms farmers in Lula and Mtutumbe had sold more grain (17 and 13% respectively) immediately after harvest than farmers in Kankwale and Mkima. This may be interpreted as a precaution against a potential failure to secure markets in the future or relatively higher commitments which may require cash.

On the consumption side for the total sample small farmers consumed more (10 %) of total grain harvest within the harvest time compared to 5 % for the medium and large farms. This pattern is however not similar in all villages. For example, in Kankwale all categories of farmers consumed about 11 % of harvested maize immediately after harvest compared to 8, 5 and 3 % for the small, medium and large farmers respectively. The declining pattern of the proportion of maize consumed during the harvest time by increasing total production is also observed in Mtutumbe. In Mkima village smaller farmers consumed one and half the percentage of grain consumed by their medium and rich counterparts.

Comparison of aggregate maize consumption immediately after harvest across villages reveals that farmers in Lula consumed the least (4 %) from total production. Although the absolute quantity of maize consumed by Lula farmers compares well to that consumed by farmers in other villages except for Mtutumbe, the percentage is lower because of the relatively bigger production in Lula.

The foregoing description implies that the level of grain retained at farm level is a function of total harvest, which in turn is a result of farm size and land productivity. Whether amount stored reflects the families' desire to ensure for food security and profitable sales in the lean season depends on how farmers utilise the stored grain, a subject on which we focus our attention in section 7.3.3.3. Prior that the role of storage of other products is summarised.

7.3.3.2 Storage of other products

The contribution of other storage products, notably finger millet and beans, into the food and cash obligations of the families is substantial. Table 7.21 shows that about 52 and 68 % of finger millet and beans produced were stored alongside maize. Moreover, the cropping calendar in the region dictates that all these major crops are harvested approximately at the same time, that is, between April and August, emphasising the need for joint storage and utilisation patterns. This underlines the importance of these crops as substitutes and compliments of maize in production, consumption and as sources of income.

Table 7.21 Proportion of finger millet and beans stored by sample households, Sumbawanga District, 1992/93 (kg)

	Kanyawale		Lula		Mkima		Mkutumba		Total sample	
	Finger millet (n=12)	Beans (n=12)	Finger millet (n=6)	Beans (n=23)	Finger millet (n=22)	Beans (n=19)	Finger millet (n=11)	Beans (n=23)	Finger millet (n=51)	Beans (n=7[illegible])
Prod.	825	141	1,577	441	934	131	635	435	919	311
Stored	471	76	631	353	560	88	288	239	478	211
Share	57%	54%	40%	80%	60%	68%	45%	55%	52%	68%

Source: Appendix 7.1, questions 34b, 34c, 35d and 35e.

We noted earlier that one of the features of the farming systems in Sumbawanga district is a lack of the country's major cash crops. This situation, coupled with the fact that agricultural production is the mainstay of the rural majority in the district, implies that the available food crops also serve as cash crops. Therefore, maize or finger millet and beans may also be used as a source of income by direct sales or indirectly through the use of these crops for commercial purposes like brewing alcohol for sale in the case of finger millet.

Furthermore, stored grain can also be used for seed requirements, for in-kind payment for labour and for giving out remittances as presents to friends and relatives.

7.3.3.3 Utilisation of stored maize

Tables 7.22 and 7.23 show how sample farmers disposed of maize stored during the 1992/93 cropping season by village and by farm size, respectively. It is noted that the share of farm storage in the post-harvest system for maize maintains its dominant role for both subsistence and market requirements. That, on average, the quantities used for consumption and selling were the highest, each accounting for approximately 44 % of a total mean quantity stored, underscores this conclusion. Furthermore, the aggregate share of maize sales out of total storage underlines the trade-off between cash and food requirements from stored maize. However, maize utilisation differs substantially between villages with the sales share highest in Lula village. Farmers in Mtutumbe, on the other hand, consumed a greater share of total grain stored.

The discussion regarding the use pattern of stored maize takes another dimension when the analysis is based on land size under maize cultivation. As it is apparent in Table 7.23, overall the share of total consumption out of stored maize decreased with land size, and presumably, given the high correlation between land size and maize production, with maize harvested. Maize sales shares related inversely to the proportion of maize consumed. It can therefore be inferred that small farmers consumed relatively more of their maize production while the bigger farmers sold most of total stored maize.

Table 7.22 **Average disposal of stored maize by sample households by village, Sumbawanga District, June 1992-May 1993 (kg)**

Type of use	Kankwale	Lula	Mkima	Mtutumbe	Total sample
	(n=30)				(n = 120)
Selling	582	2,321	568	520	978
Consumption	989	1,378	819	811	994
Brewing	92	58	118	71	85
Seed	20	23	24	42	27
Presents	55	75	28	15	44
Payments[a]	70	99	28	46	86
Remaining[b]	50	30	12	19	27
Total stored[c]	1,858	3,984	1,597	1,524	2,241
Total harvest[c]	2,131	5,062	2,004	1,901	2,776

[a] e.g. In-kind payments for labour.
[b] Remaining in store as of end of May 1993 at the end of the field work.
[c] See Table 7.20. The difference between total stored and total harvested is the amount consumed and/or sold immediately after harvest.

Source: Appendix 7.1, question 39.

Table 7.23 **Average disposal of stored maize by sample households by land under maize, Sumbawanga District, 1992/93 (kg)**

Type of use	Small (n = 69)	Medium (n = 43)	Large (n = 8)	Total sample (n = 120)
Selling	482	1,456	2,688	978
Consumption	795	1,230	1,450	994
Brewing	91	73	98	85
Seed	20	34	53	27
Presents	40	44	71	44
Payments[a]	57	83	346	86
Remaining[b]	26	24	53	27
Total stored[c]	1,511	2,944	4,759	2,241
Total harvest[c]	1,857	3,685	5,691	2,776

[a] e.g. in-kind payments for labour.
[b] Remaining in store as of May 1993 at the end of the field work.
[c] See Table 7.20. The difference between total stored and total harvested is the amount consumed and/or sold immediately after harvest.

Source: Appendix 7.1, question 39.

The utilisation pattern between different types of farmers provide some support to the hypotheses that home consumption increases less than proportionally and the marketed surplus increases more than proportionally with increases in output (Table 7.23). While small farmers sold 32 % of the stored grain, the medium and large farmers sold 49 and 56 % of stored maize, respectively. On the contrary large farmers consumed only 30 % of stored grain compared to 42 and 53 % for the medium and small farms, respectively. The subsistence nature of agriculture is underlined by the fact that no category of farmers consumed less than 30 % or sold more than 60 % of stored grain.

In addition to the need for consumption during the year and for seed at the next sowing season, there are other social and economic obligations that are spread over the year and these make it necessary to store grain. Table 7.23 shows that brewing of alcohol, remittances including in-kind labour payments and seed requirements accounted for a small (11 %) proportion of stored maize. The relative shares being four, five and two percent, respectively (Appendix 7.1, question 39). Rich farmers in used a relatively more (7 %) of stored maize for labour payments. This reflects a possible dependence of smaller farmers on grain in return for labour. In a previous study in Kilosa District, Ashimogo (1988:117-120) recorded a 20 % commitment of maize stored by farmers for purposes other than consumption and marketing. About 1 % of stored maize was recorded as a carry-over stock.

Stored maize use patterns follow maize production levels closely in the respective villages and confirm significant trade-offs in marketing and consumption activities. This contradiction becomes more evident when peasants' reasons for storing and selling grain are revealed. About three-quarters of selling households mentioned household cash needs as the major factor determining the amount of maize sold (Appendix 7.1, question 38a). That almost four-fifths of all households sold some grain confirms this observation

(Appendix 7.1, question 37). On the other hand, the majority (73 %) of all households mentioned food requirements as the major determinant of the amount of maize placed in store (Appendix 7.1, question 38b).

7.3.3.4 Total disposal of harvested maize

In summary, the majority (81 %) of all households in all four villages sold maize. For the sample as a whole about 47 % of the grain harvest was sold, but the surplus village of Lula dominates these statistics (Table 7.24). The Lula sample sold 63 % of its harvest while none of the other 3 villages sold more than 41 percent. For the entire sample a household consumed about 1,194 kg (43 %) of harvested maize, the range being between 32 % in Lula and 58 % in Kankwale.

Table 7.24 Average disposal of total maize harvested by sample households, Sumbawanga District, 1992/93

Type of use	Kankwale	Lula	Mkima	Mtutumbe	Total sample
		(n = 30)			(n = 120)
Selling[a] (kg)	613 (24)	3,180 (26)	770 (25)	766 (22)	1,313(97)
Sales/harvest (%)	28.8	62.8	38.4	40.3	47.3
Consumption[a] (kg)	1,231	1,597	1,024	942	1,194
Consume/harvest (%)	57.8	31.5	51.1	49.6	43.0
Other[b] (kg)	237	255	198	174	242
Remaining[c] (kg)	50	30	12	19	27
Total harvest (kg)	2,131	5,062	2,004	1,901	2,776

[a] Sum of sales and consumption immediately after harvest and from stored grain. See Tables 7.20 and 7.22.
[b] Includes grain used for in kind payments and remittances, brewing, and seed reserves. See Tables 7.20 and 7.22.
[c] Remaining in store as of May 1993 at the end of the field work.

Source: Tables 7.20 and 7.22.

The analysis on utilisation of harvested maize shows three aspects. First, the high quantity of maize sales out of storage in particular and out of total production in general may support the hypothesis that "overselling", that is, selling more grain than needed to fulfil minimum cash needs, could be one of the key problems leading to food insecurity. However, maize shortages could as well be offset by use of other storable crops like finger millet. Furthermore, money obtained from maize sales could also be used to buy food maize or any other food item in the lean season.

Second, the fact that use of maize for selling transactions was almost as significant as home consumption in terms of total share of maize disposal suggests, as argued by Stanning (1987:263), that decisions about on-farm retention are not based on household demand alone. Indeed, Renkow (1990:664) attest that within a given cropping cycle, the output from which marketed surplus is drawn, is predetermined and exists as currently held inventories and/or recent harvest. Stocks on hand and expected future output are likely to influence short-run marketing decisions, but only through wealth effects on consumption.

Third, total maize output for a given year can be disposed of in several ways. It can be sold for cash in the market, bartered for household consumption items, used to pay in-kind farm expenses including wages, consumed directly by the farm household, or added to end-of-year stocks. Maize not consumed on the farm is assumed to eventually find its way into market channels, and represents the total marketed surplus. The question of factors affecting the marketable surplus and the food security implications, for example, on whether the consumed maize meets food security demand is discussed in chapter eight.

7.3.4 Period of storage

The period of storage gives a picture of production seasonality and farmers consumption and marketing strategies of stored grain. Longer storage periods may imply that farmers store for later sales or for food security purposes. On the other hand, they may reflect the lack of consumption substitutes or lack of alternative income sources. In both cases storage for longer periods of time may be viewed as an insurance against both income and food shortages. Due to seasonality of production the grain stored on farms remains in store for fairly long periods. Maize could be stored for as long as one year under good storage conditions. The average period of storage for our survey villages worked out to be 6.5 months and varied between 5 and 8 months (Table 7.25). However, the absolute limits of storage time ranged between one and eleven months. Farmers in Lula stored maize slightly longer than their counterparts in the rest of the villages. An examination of the relationship between quantities of maize harvested and time of maize depletion show that farmers who stored for the period of between one and 5 months harvested, on average, 1,615 kg compared to 3,064 kg for those who stored longer.

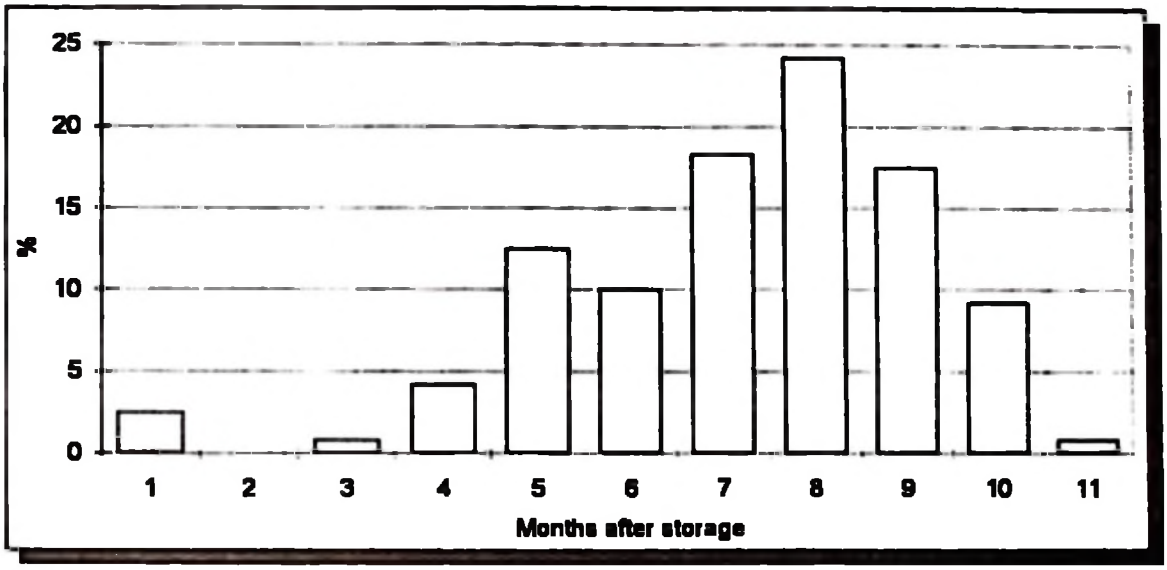
Table 7.25 Duration of maize storage by sample households, Sumbawanga District, 1992/93 (months) (n=120)

	Kankwale	Lula	Mkima[a]	Mtutumbe	Total sample
Mean	6.9	7.5	5.7	6.1	6.5
SD	1.9	1.4	1.7	1.9	1.7
Minimum	3.0	5.0	1.0	3.0	1.0
Maximum	11.0	10.0	8.0	11.0	11.0

[a] While the relatively short storage period in Mkima could be explained by low quantities of maize harvested and stored, there is a possibility that, since 22 sample farmers in the village, more than in any other grew finger millet, they could deplete maize stocks earlier and rely on finger millet for consumption for the remaining time until the next maize harvest.

Source: Appendix 7.1, question 39.

Figure 7.3 **Number of sample households finishing stored maize by month, Sumbawanga District, 1992/93 (n = 120)**



Source: Appendix 7.1, question 39.

The above periods of storage conform to the time when most households had depleted their stored grain (Figure 7.3). It is of interest to note that the majority (74 %) of farmers depleted stored maize between February and April. Most likely this occurs because some foods like beans or earlier planted maize are by then available in peoples' diets. Furthermore, depending on the performance of the crop in the farms, farmers can estimate the forthcoming maize crop and if the prospects are good, farmers dispose of their remaining stocks.

7.4 Maize marketing and transactions

Stanning (1988:332-35) notes that farm household grain transactions involve both inflows and outflows. Grain sources include own production, purchases, non-monetary transactions and carryover stocks. On the other hand, farm households use grain in a variety of ways like consumption and sales. In this section an attempt is made to elaborate the nature of the marketing of maize by selling households

7.4.1 Farmers marketing management and decisions

In this section we explore the marketing management of farmers and its impact on the overall marketing system in the study area. In theory (Barker, 1981:355) marketing management should be of some importance to the individual farmer, since if he is aiming to maximise profit from his transactions then marketing considerations should be present in all of his decision making. It is, however, accepted from the outset (Ellis, 1988:7-9) that most peasants have only limited scope for profit seeking behaviour. Nevertheless, there remains scope within that limit to discover more about the actual extent of farmers marketing management and its importance to society. Throughout this section two main areas are taken into consideration: the stated opinions of farmers with respect to maize marketing, and their actual on-farm marketing decisions. Our survey considered three areas of on-farm management decision making in marketing: when to sell, to whom or where to sell and how to sell. The aim was to identify the reasoning behind the farmers' marketing management decision making.

7.4.1.1 Time of selling

The main maize harvest months are June to August. Maize prices drop at the harvest time and increase continuously until the next harvest. It is argued that (Ellsworth and Shapiro, 1989:199) most farmers in Africa sell cheaply at harvest and buy back grain at high prices towards the next harvest. The most prominent reason advanced towards this behaviour include pressing cash needs to meet other non-farm requirements.

In order to understand selling strategies of farmers (in relation to their market share) and to have representative farmers in each category, sample households were grouped into three categories on the basis of sales quantity data (Table 7.26). Poor farmers were those who sold up to 500 kg of maize for the whole year. Middle and rich farmers were those who sold between 501 and 2,000 kg and above 2,000 kg respectively.

Table 7.26 Distribution of sample farms by average[a] of maize sales, Sumbawanga District, 1992/93

Type of farmer	Kankwale		Lula		Mkima		Mtutumbe		Total sample	
	No. of Hhold	Mean sales (kg)	No. of Hhold	Mean sales (kg)	No. of Hhold	Mean sales (kg)	No. of Hhold	Mean sales (kg)	No. of Hhold	Mean sales (kg)
Poor	13	296	3	367	11	267	8	325	35	306
Middle	9	1,044	7	1,114	12	1,167	11	1,118	39	1,115
Rich	2	2,550	16	5,191	2	2,950	3	2,700	23	4,442
Total	24	766	26	3,669	25	924	22	1,044	97	1,612

[a] For those who actually sold any grain.

Source: Appendix 7.1, question 36.

Furthermore, we facilitate our analysis of time of maize sales in terms of the. quarters defined earlier. These classifications reveal that total maize sales during 1992/93 by all 97 selling households amounted to 1,576 bags (157.6 t). The average volume sold was about 1.6 t per annum, but the distribution was markedly skewed with a wide range of between a mere 10 kg to 5.2 tons (Appendix 7.1, question 36). The respective shares of total maize sales was 7, 28 and 65 % for the poor, middle and rich farmers, respectively. The seasonal selling pattern is shown in Table 7.27.

Table 7.27 reveals that following the harvest period farmers sell a bulk of the maize and then they market the rest of the produce in small quantities to meet periodic cash requirements. On average all sample farmers sold some 51 % of the maize harvest within three months of harvest between June and August (Table 7.27). However, this is partly due to one rich group in Lula. In this period maize sales were at the highest. Maize sales starts decreasing thereafter and the remaining being sold in decreasing proportions reaching a minimum of 7,610 kg (5 %) in the March-May pre-harvest quarter. These results, in aggregate, follow expectations more closely.

Table 7.27 Sample households share of maize sales by quarter, Sumbawanga District, 1992/93 (n=97)

	Jun.-Aug.		Sep.-Nov.		Dec.- Feb.		Mar.-May		Total sales	
	kg	%	kg	%	kg	%	kg	%	kg	%
Kankwale										
Poor	1,580	41	1,900	49	370	10	0	0	3,850	100
Middle	2,350	25	3,620	39	2,220	24	1,210	12	9,400	100
Rich	3,100	61	250	5	1600	31	150	3	5,100	100
Total	7,030	38	5,770	31	4190	23	1,360	8	18,350	100
Lula										
Poor	900	82	200	18	0	0	0	0	1,100	100
Middle	4,500	58	2,700	35	500	6	100	1	7,800	100
Rich	48,960	59	23,850	29	5,950	7	4,300	5	83,060	100
Total	54,360	59	26,750	29	6,450	7	4,400	5	91,960	100
Mkima										
Poor	2,460	78	600	19	100	3	0	0	3,160	100
Middle	5,150	37	6,750	48	1,450	10	650	5	14,000	100
Rich	1,400	24	1,300	22	2,650	45	550	9	5,900	100
Total	9,010	39	8,650	38	4,200	18	1,200	5	23,060	100
Mtutumbe										
Poor	1,350	52	1,200	46	50	2	0	0	2,600	100
Middle	5,450	44	5,100	41	1,350	11	400	3	12,300	100
Rich	2,600	32	4,400	54	850	10	250	4	8,100	100
Total	9,400	41	10,700	47	2,550	11	650	3	23,000	100
Total sample										
Poor	6,290	59	3,900	36	520	5	0	0	10,710	100
Middle	17,450	40	18,170	42	5,520	13	2,360	5	43,500	100
Rich	56,060	55	29,800	29	11,050	11	5,250	5	102,160	100
Total	79,800	51	51,870	33	17,090	11	7,610	5	156,370	100

Source: Appendix 7.1, question 36.

Further insight into seasonal maize selling patterns are elucidated in the examination of the behaviour of farmers according to village. In Mtutumbe the sales pattern for the first two quarters appears more evenly distributed than is typical in other villages (Table 7.27). Selling farmers in Mtutumbe sold the largest share of some 47 % of their maize sales in the second quarter. In the other villages the harvest quarter was the heaviest sales quarter and maize sales in the first two quarters accounted for not less than 69 % of all sales. In contrast, in none of the villages did farmers sell more than 8 % of total sales in the pre-harvest quarter between March and May.

The nature of the seasonal transactions is further modified if one examines the selling behaviour of individual farmers. Comparative analysis of sales is difficult, because more than two-thirds of those who sold more than 2,000 kg were in Lula while no more than 3 farmers from any of the remaining villages fall into this category. However, some interesting features are apparent. While poor and middle farmers in Kankwale and middle farmers in Mkima made their heaviest sales in the post-harvest (September-November) quarter, their counterparts in all other villages sold most maize in the harvest quarter. It could be speculated that given the accessibility of Kankwale and Mkima to Sumbawanga town markets even poor farmers in these villages could afford to wait for better prices for some time. On the other hand, rich farmers in all villages except in Mtutumbe sold much maize in the harvest quarter. There could be two possible explanations for this: First, large farmers are forced by lack of bulky storage facilities to part with much of their surplus during the harvest period when prices are low due to the post-harvest glut. A similar conclusion was given by Hariss (1984:158) in India. Second, early sales may be a precaution against a potential lack of large scale buyers in the off-season as discussed (in section 7.4.1.3) below.

Table 7.28 and Figure 7.4 show the number of households that made their largest amount of their sales and the total amount of maize sold as related to farmers transacting in the quarter shown respectively. Information in Tables

7.27 and 7.28 shows that the harvest quarter and the post-harvest quarter are indeed the heaviest sales periods for the largest number of households. Sales data supports this behaviour because about 84 % of all sales were effected in these two quarters (see Table 7.27).

Figure 7.4 underlines the fact that after harvesting farmers commit most of their sales within six months after harvest. Then, subsequent smaller transactions will be carried throughout the season up to the next harvest. As it can be seen in Figure 7.4 maize sales are low during the remainder of the marketing year up to April and May when the remainder of the old maize is sold and the granary is cleaned to make room for the next harvest.

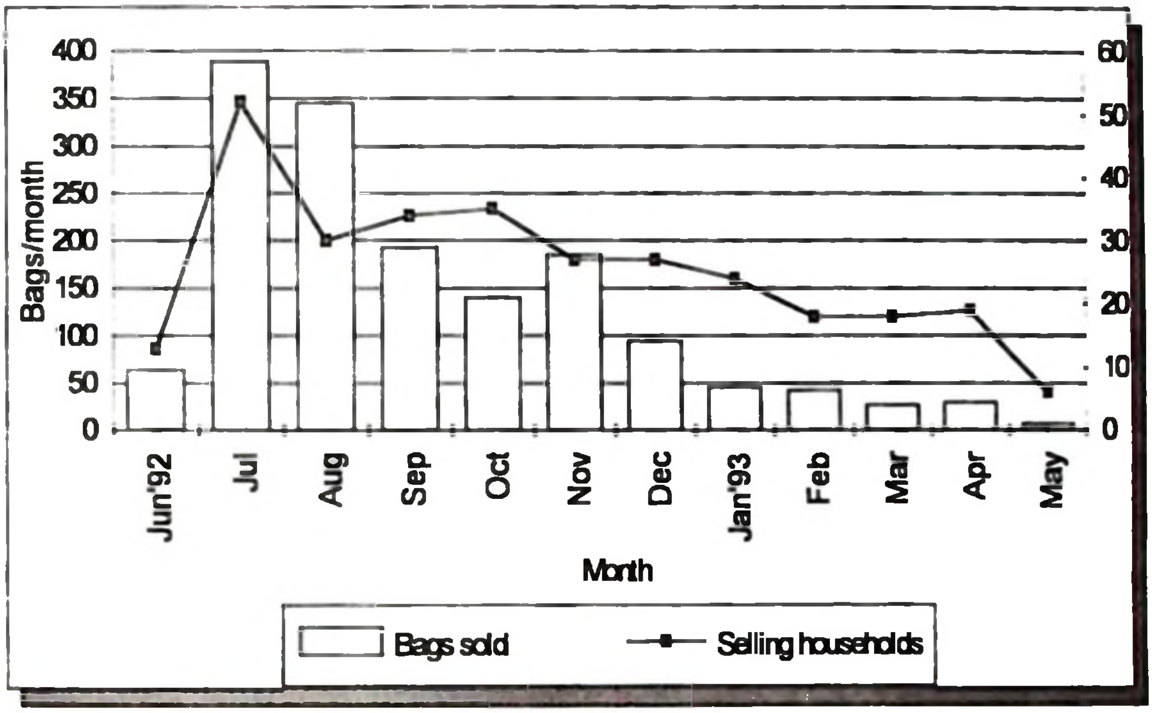
Table 7.28 **Number of maize selling sample households with their largest volume[a] of sales in each quarter, Sumbawanga District, 1992/93 (n=97)**

	Jun-Aug	Sep-Nov	Dec-Feb	Mar-May	Total
Poor	23	12	0	0	35
Middle	18	19	2	0	39
Rich	15	6	2	0	23
Total	56	37	4	0	97

[a] On the basis of the monthly sales data it was identified in which month had each farmer made his largest sale. The number of farmers who sold in each month were then summarised on a quarterly basis.

Source: Appendix 7.1, question 36.

Figure 7.4 **Total monthly maize sales and number of selling households, Sumbawanga District, 1992/93 (n = 97)**

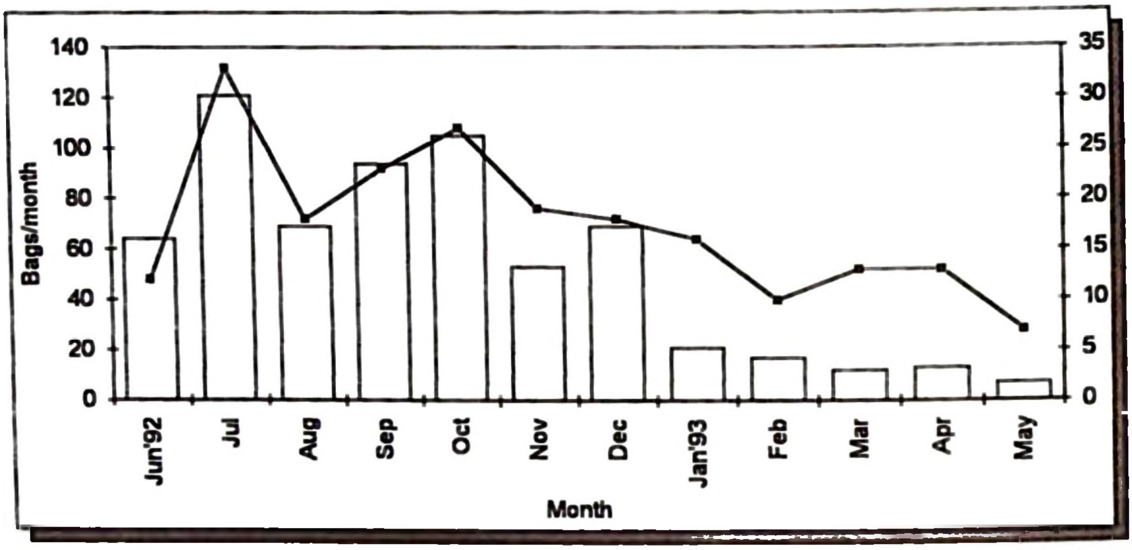


Source: Appendix 7.1, question 36

An attempt is made to assess the grain selling pattern, with the exclusion of Lula. The results are presented in Figure 7.5. The emerging sales pattern reveals an evening out of the peak sales between the first two quarters for the months between June and November. About 39 % of all sales for the three villages of Kankwale, Mkima and Mtutumbe were made in each of the first two quarters. The rest was marketed in the third (17 %) and fourth (5 %) quarters.

Farmers' seasonal maize selling patterns reveals two aspects: First, given the concentration of sales in the months immediately following harvest months and the delayed depletion of stored maize observed above implies that the rate of removals of stored grain are faster in the case of grain stored for purposes other than consumption. This suggests that farmers, aware of the risk of failure in next harvest, store for consumption for relatively longer times.

Figure 7.5 Total monthly maize sales and number of selling households excluding Lula, Sumbawanga District, 1992/93



Source: Appendix 7.1, question 36.

Second, if we consider prices as the major factor in selling decisions our data on sales pattern and seasonal price changes might call this expectation into question. With respect to profit seeking behaviour the guiding principle would make the farmer sell all his marketable surplus of a crop at the time of maximum profits, given his cost function. In actual fact, however, farmers sell their crops in several instalments spread over the entire period between two successive harvests with the bulk of market disposals made in the harvest months. Indeed, asked about the reasons for selling maize at a particular time an overwhelming majority (82 %) of selling households mentioned cash-flow requirements as reason of overriding importance (Appendix 7.1, question 37b).

7.4.1.2 Marketing channels for maize

It is argued (Raju and von Oppen, 1980:1-2) that if market channels are efficient, they will induce farmers to become more commercialised. This is because access to efficient markets serves as an incentive for farmers to specialise in the production of certain crops which are comparatively most advantageous for the region. It follows therefore, that policies to enhance channel market efficiency are crucial in agricultural marketing. This in turn needs knowledge of the operation and contribution to development of market channels. This section attempts to tackle this aspect in the survey district.

The individual farmer in the survey area has to decide how to allocate his total sales between the different channels. Chinn (1976:583) contends that for food grains this decision is sequential rather than simultaneous. From the individual farmers' point of view a critical parameter is his perception of the probability that he will face food insufficiency if he sells more than is needed for home consumption. It follows, therefore, that in a situation where sales are determined by periodic assessment of family food requirements channel choices may not be a very crucial issue. This is due to two reasons. First, the farmer might not be able to predetermine his sales well in advance. Second, and especially after most of the marketable grain is sold, subsequent grain sales may be too small in volume to warrant any such consideration.

To understand how maize moves through various channels, it is necessary to identify the roles of various market places and marketing agents involved. Maize sales by sample farms took place mainly at village level (Table 7.29). This survey suggests that over 80 % of maize sales occurred at the homestead within the survey villages (Table 7.30). Only 9 and 7 % of the main maize sales were marketed in neighbouring villages and Sumbawanga town, respectively.

Table 7.29 **Distribution of sample households by place where maize was sold, Sumbawanga District, 1992/93**

Sold in	Kankwale		Lula		Mkima		Mtutumbe		Total sample	
	No.	%	No.	%	No.	%	No.	%	No.	%
Residence village	19	63.3	20	76.9	24	96.0	19	86.6	82	84.5
Neighbouring village	1	4.2	4	15.4	1	4.0	2	9.0	8	8.2
Sumbawanga town	4	16.7	2	7.7	0	0	1	4.5	7	7.3
Total	24	100	26	100	25	100	22	100	97	100

Source: Appendix 7.1, question 37c.

Transport constraints appear to be the most limiting factor for distant trading. Eight of the fifteen farmers who sold maize in neighbouring villages sold it within an average distance of about 3 km using pack animals, wheel carts and a head load as means of transport (Appendix 7.1, questions 37d and 37e). The other 7 farmers used motor transport to take grain to Sumbawanga town markets.

Table 7.30 **Distribution of maize sales by sample households between different selling places, Sumbawanga District, 1992/93 (n = 97)**

Sold in	Kankwale		Lula		Mkima		Mtutumbe		Total sample	
	kg	%	kg	%	kg	%	kg	%	kg	%
Resident village	14,607	79.6	73,200	79.6	22,622	98.1	21,229	92.3	12,895	83.9
Neighbouring village	183	1.0	13,334	14.5	438	1.9	1,288	5.6	1,353	8.8
Sumbawanga	3,650	19.4	5,426	5.9	0	0	483	2.1	11,415	7.3
Total	18,350	100	91,960	100	23,060	100	23,000	100	156,370	100

Source: Appendix 7.1, questions 36 and 37c.

Following the liberalisation policies farmers everywhere in Tanzania are free to sell their produce to any village-based middlemen or directly to traders in town. At present, in Sumbawanga District maize trade is dominated by the private sector and private traders have been the only outlet where to dispose off the marketable surplus produce, although the SGR has been of assistance since the 1991/92 marketing year. In this regard it can be argued that traders serve farmers relatively better. Data from this survey tend to imply that agricultural producers depend largely on these traders for their income which, as a result, is influenced by the nature of functioning of this channel. Although they have an alternative to sell grain to any outlet of their choice, farmers seem to sell their maize mainly to village collectors although occasionally wholesalers from Sumbawanga and other urban areas may also enter the rural markets and buy directly from farmers (Table 7.31).

Table 7.31 Distribution of sample households by marketing outlet for maize sales, Sumbawanga District, 1992/93

Sold to	Kankwale		Lula		Mkima		Mtutumbe		Total sample	
	No.	%	No.	%	No.	%	No.	%	No.	%
Village collector	2	8.3	8	30.8	0	0	0	0	10	10.3
Non-village collector	22	91.7	17	65.4	12	48.0	20	90.9	71	73.2
Fellow farmer	0	0	1	3.8	13	52.0	2	9.1	16	16.5
Total	24	100	26	100	25	100	22	100	97	100

Source: Appendix 7.1, question 37g.

Table 7.32 shows that over 80 % of all farmers sold almost an equivalent percentage of grain to middlemen and about 73 % of farmers sold some 76 % of maize to non-village based middlemen including inter-village collectors and town-based traders. Indeed, village collectors did not play any role in maize purchases in Mkima and Mtutumbe. Occasional direct sales to consumers are also common, albeit to a lesser extent. Some farmers carried out some form of direct trading with consumers. As we shall discuss in chapter 8 such a direct marketing is an aspect of agriculture which is very popular, especially during times of grain shortfall. In our sample only about 10 % of maize was sold to fellow deficit farmers (Table 7.32).

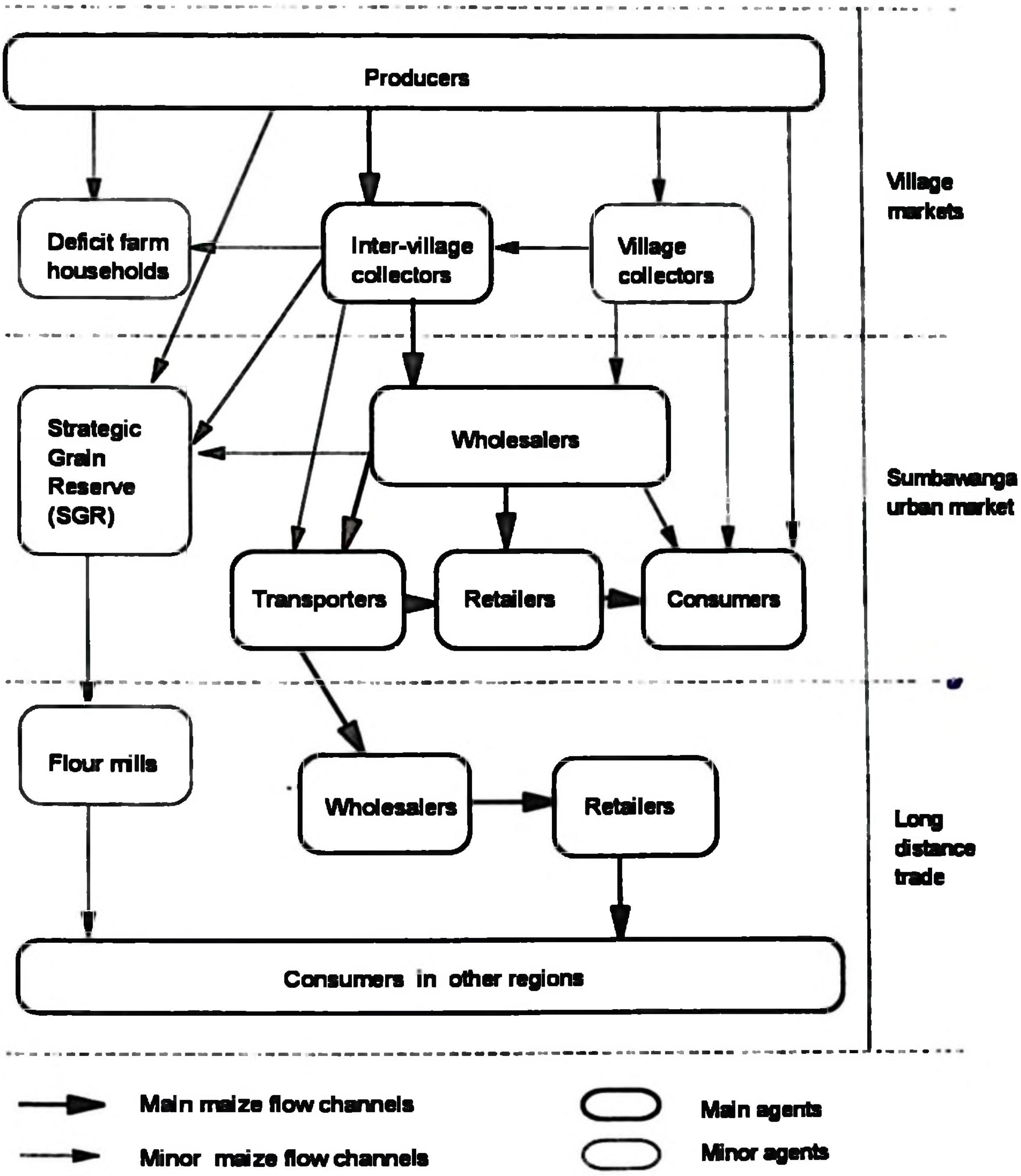
Table 7.32 Distribution of sample households maize sales between different marketing outlets, Sumbawanga District, 1992/93 (n=97)

Sold to	Kankwale (n=24)		Lula (n=26)		Mkima (n=25)		Mtutumbe (n=22)		Total sample (n=97)	
	kg	%	kg	%	kg	%	kg	%	kg	%
Village collector	1,431	7.8	21,611	23.5	0	0	0	0	21,735	13.9
Non-village collector	16,919	92.2	65,567	71.3	14,528	63.0	19,780	86.0	119,311	76.3
Fellow farmer	0	0	4,782	5.2	8,532	37.0	3,220	14.0	15,324	9.8
Total	18,350	100	91,960	100	23,060	100	23,000	100	156,370	100

Source: Appendix 7.1, questions 36 and 37g.

Figure 7.6 and Map 7.1 illustrates how the various marketing agents are linked to form the network of marketing channels for maize. As noted above grain was sold through a narrow variety of outlets and the marketing system involves less significant channels in the sense that there is very little activity outside the private traders. Such circumstances reflect a possible greater influence of traders on price formation and may lead to high marketing margins between the different marketing nodes. In a study on urban maize trade in Dar-es-Salaam Santorum and Tibaijuka (1992:432) reported a marketing chain based on a point-to-point trading system with few intermediate links between producers and consumers markets.

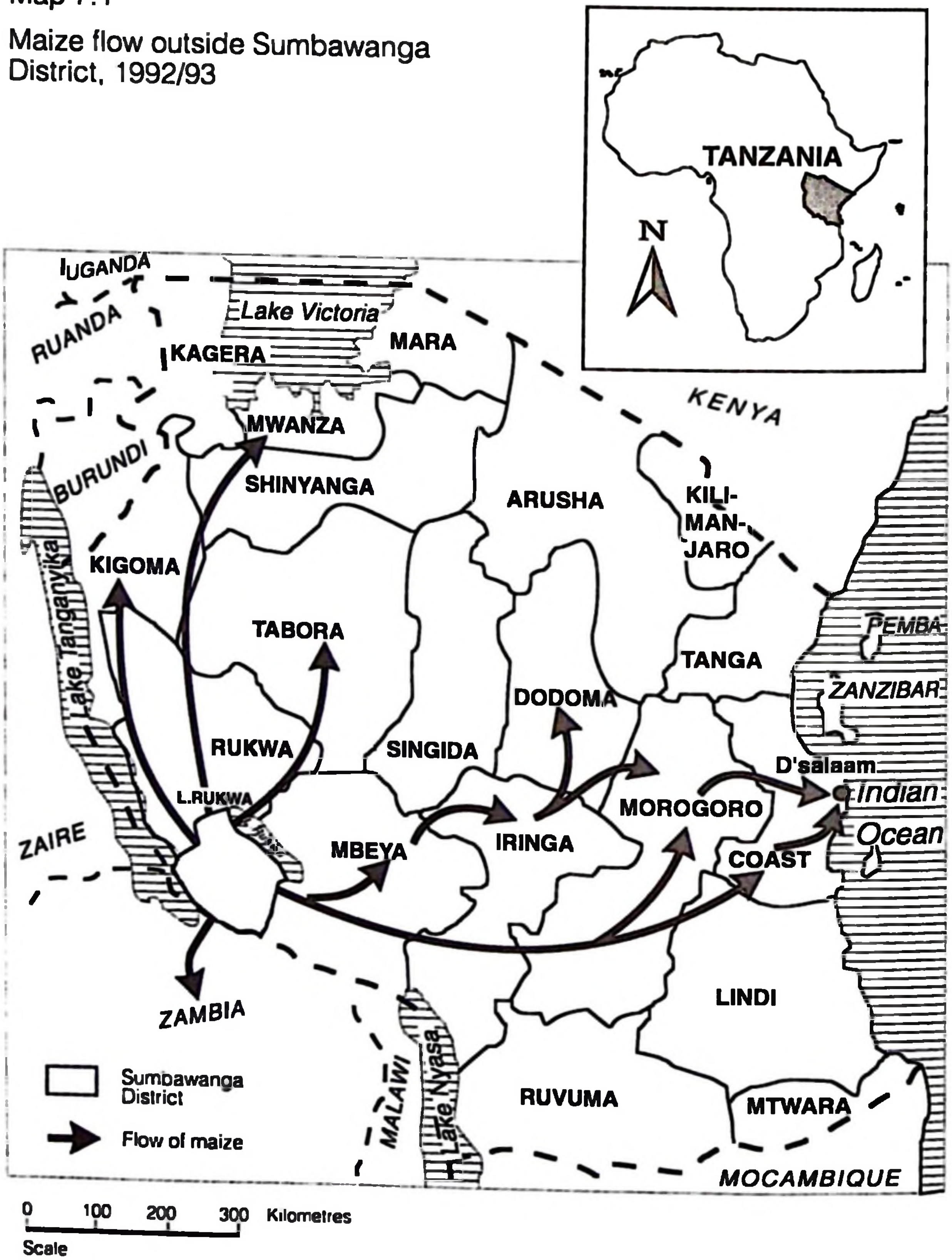
Figure 7.6 Marketing channels for maize, Sumbawanga district, 1992/93



Source: Own survey, 1992/93.

Map 7.1

Maize flow outside Sumbawanga District, 1992/93



Source: Own survey, 1992/93.

At the local level maize-buying from farmers is mainly conducted by village or inter-village collectors. Some of these collectors, acting also as agents[29] of town wholesalers buy grain, bulk it and wait up to when it can be collected by the wholesalers. Since village collectors are mostly farmers who engage in grain trading in addition to their normal agricultural undertakings they collect grain from neighbouring farmers. Due to their lack of mobility, village collectors can only confine themselves to the village environs for grain purchases. The major function of these traders is over after maize is sold to the town-based wholesaler (see Figure 7.6).

Bulked maize is then transported mostly by urban-based wholesalers to retail outlets either in Sumbawanga town or other urban centres. Upon reaching the town market maize can easily find its way to town consumers in the region or in neighbouring regions and outside the country.

Since 1991/92 the SGR has been buying maize through licensed agents. The SGR management in the region informed that some six agents were used for this purpose in the 1991/92 marketing season. Licensed traders may either travel directly to the villages to buy grain or may make use of village and inter-village collectors for grain bulking. Discussions with the SGR management gave the impression that to get an SGR licence a trader must assure that he will deliver grain at the SGR depot. The SGR bought grain only at its depots where it is stored while awaiting for transportation to other central stores or releases it to consumers at times of emergency. This mode of operation of the SGR confirms Amani and Maro's (1992b:198) conclusion that storing grain pending collection by the government is an extension of transportation.

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29 Legally defined, an agent is a person authorised by another to act in his behalf (Spiro, 1989:719). There was, however, no evidence of legal obligations of the village and inter-village collectors acting solely on behalf of particular "bigger" traders.

Because of shortage of transport equipment and/or due to seasonal nature of road conditions, storage is used to buy time until transport is available or until the roads are passable.

7.4.1.3 Conditions guiding farmers marketing decisions

Three main reasons were given for selling maize through a particular outlet, with lack of alternative market outlets of overriding importance, being mentioned by about 58 % of respondents (Table 7.33).

Table 7.33 Distribution of sample households by reason for selling maize to a particular marketing outlet, Sumbawanga District, 1992/93

Reason	Kankwale		Lula		Mkima		Mtutumbe		Total sample	
	No.	%	No.	%	No.	%	No.	%	No.	%
Good price	4	16.6	4	15.4	16	64.0	3	15.8	27	27.8
Only outlet available	13	54.2	19	73.1	5	20.0	19	84.2	56	57.8
Marketing convenience	7	29.2	3	11.5	4	16.0	0	0	14	14.4
Total	24	100	26	100	25	100	22	100	97	100

[a] Includes doing away with the need to transport grain to alternative outlet.

Source: Appendix 7.1, question 37h.

The least significant reason by far (14 %) is market convenience which mostly implied that farmers needed not to travel far in search of buyers. Twice as many respondents as those who gave marketing convenience as a reason for outlet choice mentioned price as their main selling choice parameter. Relatively more (64 %) farmers in Mkima mentioned good prices as the major reason for choice outlet. Among these were the twelve middle farmers who sold most of their grain in the third (December-February) quarter (see Tables 7.26 and 7.27

in section 7.4.1.1). It is of interest to note that the majority of selling households in the remote villages of Lula (73 %) and Mtutumbe (84 %) and even 54 % in Kankwale mentioned that they sold grain to the only available buyer.

The access to market can be assessed by the number of available middlemen operating in the respective villages. According to Hayami et al. (1989:31) the difficulty of direct access to town markets for farmers and a small number of middlemen who purchase farm products in the village may be considered a potential source of monopsony by the middlemen and a resultant reduction of farmers' bargaining capacity.

About 63 % of the sample farmers responded that they have no middlemen based in their village to whom they could sell maize (Table 7.34). This deficiency was more marked in Mtutumbe where only two selling households reported having any such contact in their village. Throughout the villages there seemed to be relatively better contacts to non-resident middlemen although even in this case more than 70 % of selling households have had either none or only one contact middlemen (Table 7.35).

Table 7.34 Distribution of sample households by number of resident village middlemen available as maize buying agents, Sumbawanga District, 1992/93

	Kankwale		Lula		Mkima		Mtutumbe		Total sample	
	No.	%	No.	%	No.	%	No.	%	No.	%
0	14	58.3	16	61.5	11	44.0	20	91.0	61	62.9
1	9	37.5	10	38.5	5	20.0	1	4.5	25	25.8
2	0	0	0	0	4	16.0	1	4.5	5	5.2
≥3	1	4.2	0	0	5	20.0	0	0	6	6.2
Total	24	100	26	100	25	100	22	100	97	100

Source: Appendix 7.1, question 28a.

Table 7.35 **Distribution of sample households by number of non-resident village middlemen available as maize buying agents, Sumbawanga District, 1992/93**

	Kankwale		Lula		Mkima		Mtutumbe		Total sample	
	No.	%	No.	%	No.	%	No.	%	No.	%
0	11	45.8	4	15.4	17	68 0	5	22.7	37	38.1
1	4	20.0	17	60.7	5	20.0	10	45.5	36	37.1
2	3	12.5	4	15.4	3	12.0	5	22.7	15	15.5
≥3	6	25.0	1	3.8	0	0	2	9.1	9	9.3
Total	24	100	26	100	25	100	22	100	97	100

Source: Appendix 7.1, question 28b.

Table 7.36 **Number of middlemen contacted before selling most maize by sample households, Sumbawanga District, 1992/93**

	Kankwale		Lula		Mkima		Mtutumbe		Total sample	
	No.	%	No.	%	No.	%	No.	%	No.	%
0	9	37.5	3	11.5	5	20.0	5	22.7	22	22.7
1	4	16.7	11	42.3	5	20.0	4	18.2	24	24.7
2	8	33.3	4	14.4	13	52.0	7	31.8	32	33.0
≥3	3	12.5	8	30.8	2	8.0	6	27.3	19	19.6
Total	24	100	26	100	25	100	22	100	97	100

Source: Appendix 7.1, question 28c.

Although there was a small number of middlemen who could purchase maize in the villages farmers tried checking possible offers from other middlemen before selling most maize. More than a half of selling farmers contacted more than one trader before deciding to sell the biggest share of the grain they sold (Table 7.36).

Some 23 % could not contact any middlemen before selling most of their grain. This implies that their selling practice was, most likely, done without the knowledge about the availability of alternative buyers. Indeed, the majority (71 %) of selling households confessed that it was not easy to sell maize in the absence of middlemen (Table 7.37). This lack of regular and reliable markets could then force farmers to sell out of storage any time a middlemen visits their village and to sell a rather large volume as the next visit of a trader is unpredictable. However, 83 % of sample farmers in Kankwale responded that it is easy to sell grain even in the absence of middlemen. This is possible because of the proximity of the village to Sumbawanga town.

Table 7.37 **Selling sample households response to whether it was easy to sell maize in the absence of middlemen, Sumbawanga District, 1992/93**

	Kankwale		Lula		Mkima		Mtutumbe		Total sample	
	No.	%	No.	%	No.	%	No.	%	No.	%
Yes	15	62.5	6	23.1	5	20.0	2	9.1	28	28.9
No	9	37.5	20	76.9	20	80.0	20	90.9	69	71.1
Total	24	100	26	100	25	100	22	100	97	100

Source: Appendix 7.1, question 29.

It could be argued in summary that measured by the number of available buyers more than three-quarters of all farmers had either none or only one assured buyer of their surplus grain. These may have faced monopolistic conditions and forced to sell grain at the time and price dictated by buyers. On the other hand, the remaining quarter of farmers had two or more possible grain buyers. These could have sold grain under somewhat competitive conditions.

7.4.2 Market organisation and trade practice

7.4.2.1 Role of the government

In addition to providing marketing infrastructure such as roads and market places the government needs to provide institutional and legislative support to safeguard the interests of producers, traders and consumers. Virtually no significant role of the formal marketing system was documented. After liberalisation there has been little government intervention into the maize market in the study area.

The only apparent 'role' of the government is concentrated in maize buying activity through the SGR and the District Council's collection of fees from traders. Most of the other kinds of market activities are unregulated. There is, in this respect, little scope for serving the interest of the traders or producers and for improving the marketing system.

As a measure towards income support for the farmers in Rukwa and Ruvuma regions, the government guarantees a floor price for domestic maize and has been using the SGR to provide the market for the maize in these regions by buying it at an official (indicative) producer price (URT MDB, 1992b:16). The government guarantee of floor price minimises the risks for both farmers and traders and, properly applied, should encourage participants to extend their market activities as a result of the curtailment of risk. For the 1992/93 period this floor price was fixed at 30 TSh/kg of maize. In addition some 4 TSh was paid as a flat rate transport subsidy for every kg of maize sold at the SGR depot. However, we will observe (in chapter eight) that, for some time of the year, this price is lower than that offered by private traders, making direct price supports ineffective. In addition, the fact that this price could only be obtained at the SGR depot in Sumbawanga town precluded the possibility for many farmers to benefit from it.

An earlier MDB study revealed that both big and small farmers and traders who attempted to sell maize directly to the SGR in the district were confronted by the problem of lack of cash which made them sell their maize on credit (URT MDB, 1992a:2). Our discussion with the SGR management indicated that this problem is still persistent and that there were acute shortages of gunny bags.

At the time of our research the SGR at Sumbawanga was mainly concerned about one thing: a government circular had been distributed stressing that the SGR should operate commercially and not as a buyer of last resort and that only maize should be bought and not any other grain. This circular has had two immediate implications. First, wary of incurring losses in transport charges, the SGR could not travel to distant areas to buy grain. Second, the SGR could not buy any surplus above its permitted quota, which for Rukwa region fluctuates between 15 and 30,000 t per season. Sumbawanga is ill-served by marketing facilities including transport facilities. Therefore, some of the reasons which limit producers' access to the higher prices offered in Sumbawanga town are well known. Among them are the distance most producers have to travel to get to Sumbawanga, and the time spent getting payment. Particularly for the small producers with little marketable surplus these difficulties may be insuperable.

This, to some extent explains why in the district the majority of farmers sold most grain at their homesteads through private traders. With the increased role of private traders, it becomes increasingly unfeasible for official controls to be implemented at the point of first sale. Given these conditions it is not surprising that no farmer in our survey villages acknowledged selling maize directly to the SGR. Even though this may reflect a sampling error, it may as well suggest that there is a limited farmers ability to reach the SGR market which was strictly required to buy grain only at its warehouses in Sumbawanga town (Mr. R.A. Mtuli, SGR Manager, Rukwa Region, Personal Communication, 22.04.1993). That is why, instead, the SGR preferred to use a number of private agents to buy maize on its behalf and buy a limited amount from farmers who could sell directly to it.

7.4.2.2 Market information

In Tanzania collection of market data is mainly done by the MDB. Availability of such information is, however, limited at village level especially in remote areas like Sumbawanga. In practice, information flows were inadequate. For example, our effort to trace open market monthly maize producer prices in recent years for Sumbawanga District from MDB annual publications discovered that only twenty-four out of the expected sixty entries for the period between 1986/87 and 1991/92 (except for 1988/89) were available. Available price data, therefore, represented only about 40 % of anticipated information. Even then the available data were discontinuous. It is not surprising, therefore, that only a quarter of the selling households reported full knowledge about prevailing prices in the market (Table 7.38) and that the overwhelming majority (over 80 %) of farmers obtained market price information from middlemen and neighbours (Table 7.39).

Table 7.38 Maize selling sample households knowledge of market prices, Sumbawanga District, 1992/93

	Kankwale		Lula		Mkima		Mtutumbe		Total sample	
	No.	%	No.	%	No.	%	No.	%	No.	%
Very well	10	41.7	5	19.2	5	20.0	4	18.2	24	24.7
Not well	12	50.0	17	65.4	11	44.0	8	36.4	48	49.5
Don't know	2	8.3	4	15.4	9	36.0	10	45.4	25	25.8
Total	24	100	26	100	25	100	22	100	97	100

Source: Appendix 7.1, question 30.

Table 7.39 **Maize selling sample households source of price information, Sumbawanga District, 1992/93**

Source	Kankwale		Lula		Mkima		Mtutumbe		Total sample	
	No.	%	No.	%	No.	%	No.	%	No.	%
Visit market	6	25.0	1	3.9	1	4.0	0	0	8	8.2
Middlemen	4	16.7	8	30.8	6	24.0	13	59.1	31	32.0
Neighbours	10	41.6	14	53.8	16	64.0	7	31.9	47	48.4
Extension agent	4	16.7	3	11.5	2	8.0	2	9.0	11	11.4
Total	24	100	26	100	25	100	22	100	97	100

Source: Appendix 7.1, question 31.

An attempt to establish the relationship between sales volume and source of price information gave inconclusive results. However, discussions with two of the biggest selling farmers in Lula (farmers 37 and 39) revealed that they had to travel to Sumbawanga town before selling maize to talk to prospective buyers on matters related to price and grain collection arrangements. From the presented results it can be argued that price information is relatively available for the majority of farmers even though it might not be very precise and up to date. An inquiry into farmers' marketing constraints identified low prices to be of overriding importance, being mentioned by 42 % of respondents, followed by problems such as unstable prices (17 %), lack of market outlets (8 %), lack of uniform measures (6 %) and the need to sell maize in small lots (6 %) (Table 7.40).

Table 7.40 **Major marketing problems mentioned by maize selling sample households, Sumbawanga District, 1992/93**

Problem	Kankwale		Lula		Mkima		Mtutumbe		Total sample	
	No.	%	No.	%	No.	%	No.	%	No.	%
Low prices	7	29.1	16	61.5	7	28.0	11	50.0	41	42.3
Unstable prices	6	25.0	6	23.1	4	16.0	2	9.0	18	18.6
No market outlet	1	4.2	0	0	6	24.0	1	4.5	8	8.2
Lack of uniform measures	1	4.2	1	3.8	1	4.0	3	13.6	6	6.2
Selling in small lots	5	20.8	0	0	0	0	1	4.5	6	6.2
Other problems[a]	1	4.2	0	0	2	8.0	1	4.5	4	4.1
No problem	3	12.5	3	11.6	5	20.0	3	13.5	14	14.4
Total	24	100	26	100	25	100	22	100	97	100

[a] Includes delayed sales and lack of transport.

Source: Appendix 7.1, question 33.

Only 14 % of farmers indicated having no marketing problem. Lula and Mtutumbe villages have the biggest proportion of selling farmers who mentioned low prices as the major marketing problem. The geographical isolation of these villages and a possible lack of buyer competition may be contributing factors. One observed pattern on farmers' responses on low prices is that 61 and 50 % of maize selling farmers in the remote villages of Lula and Mtutumbe respectively, complained of low prices compared to one-third in the accessible villages of Kankwale and Mkima (Table 7.40).

7.4.2.3 Markets and facilities

No market places are formalised in the survey villages and in this case farmers sold most of their maize at the homestead. There are no specialised markets. In previous years Co-operatives offered marketing facilities like godowns in a designated village where resident farmers and farmers from neighbouring villages could sell their produce. After the collapse of the Co-operative Unions these warehouses are rarely used. Amani and Maro (1992b:198) quote evidence which show that many of the village stores built in the country for use by co-operatives are used only for 3 to 4 months in a year, and then may be used to store agricultural inputs and not grain. Discussions with local authorities in the survey district gave the impression that use of these facilities by individual farmers is limited either due to lack of such a demand or due to insecurity of the stored grain due to theft incidences. Instead, some of these godowns are used as churches and places for meetings.

7.4.2.4 Weights and grades

Maize, when sold to traders at wholesale and retail level, is usually purchased in bags while sales to consumers are generally made in a tin, a typical unit, carrying maize weighing roughly between 18 and 20 kilograms. A diverse of other smaller units of measurement are also used at retail level.

Legislation which includes setting standards for quality, handling, trade and storage and moisture content was not practised except by SGR. During the days of Co-operatives standards were easily enforced due to presence of weighing scales and trained personal. Two major aspects were noted in the current marketing system. First, standardisation of containers was not common. All sorts of containers from tins to calabashes were used for maize selling especially at retail level where maize is sold in small quantities. Second, it is quite common for a "bag" to have different capacities depending on bag filling intensity, and source and age of bags used. There were assertions, for example, that an old bag can contain more grain than a new one, or that bags are filled more when traders buy from farmers than when the former sell to retailers. Furthermore, there were reports that bags originating from Zambia were being used with no consideration to the fact that they have a bigger capacity than those available domestically. Because of these size differences a bag could weigh anything between 90 and 110 kg. Therefore, in our study both weighing systems and measuring systems are open to abuse.

There exist no grades or quality standards at the farm gate level even though informal discussions revealed that grain which is severely damaged by storage pests will fetch a reduced price.

7.4.2.5 Role of traders

In this section we consider the maize market with particular reference to how transactions between farmers and middlemen are carried out. Maize marketing involves the transformation of the farmers' harvest in time and place. When we consider the role of middlemen, there are two roles to be distinguished. Siamwalla (1978:40) lists them as (a) product transformation and transport, which includes the processing and distribution activities and (b) product storage. We underlined previously that in Sumbawanga District and Tanzania in general storage mainly takes place on the farm by farmers themselves. Even though farm level marketing activities dominate in the district, the ultimate transportation of grain from farm to retail consumers is done by traders. Farm milling operations do not seem to be a critical link in local maize marketing. Maize is milled for local consumption in small service mills located in the villages and operated by villagers. The milling practice is usually based on family labour supplemented by a few hired labourers. A number of small-scale milling machines are dispersed widely throughout the villages and in Sumbawanga town.

Data in Appendix 7.2 (questions 1-5) show that a typical trader in our survey is 34 years old with some six years experience in grain trading. Only two traders reported to have started grain trading before the liberalisation policies were instituted in the mid-1980s. Six of the traders commit themselves to trade on full time basis. The rest trade only occasionally, with the remaining time devoted to other economic activities like agriculture and trading other non-food consumer goods. On average traders reported working 6 days per week. The numerous traders who make the purchase are generally known as *walanguzi*, small volume, non-licensed, traditional traders. According to the commercial law of Tanzania, (Santorum and Tibaijuka, 1992:440) all traders need to obtain a trading licence, but the system has not been enforced and most traders continue to operate without a licence. In our survey only the three wholesalers answered that they posses a trading licence for grains.

Two inter-village collectors mentioned buying maize from other districts in addition to buying from Sumbawanga District. The other two bought grain exclusively from within Sumbawanga District (Appendix 7.2, question 6). None of all the ten village and inter-village collectors interviewed reported selling maize in the villages, implying a one-way rural-urban grain flow. Although traders do not specialise in marketing a particular crop, maize constitutes the bulk of the total trade for traders of all categories.

Table 7.41 shows that village and inter-village based middlemen have a low grain turnover per annum. In our survey the two categories of traders handled only 178 and 390 bags respectively per year compared to 970 and 2,500 bags traded by two wholesalers. One wholesaler handled an exceptionally high figure of 33,000 bags during the study year.

All grain buying activities for village and inter-village collectors are exclusively done by themselves while wholesalers were found to rely on the help of both relatives and village and/or inter-village collectors. Wholesalers purchase the products assembled by the village collectors. They (wholesalers) then transport it to other regions or sell it to retailers or the SGR in Sumbawanga town (see Figure 7.6). In addition to using village collectors wholesalers could also buy directly from farmers (Appendix 7.2, question 8 and 9). In this case prior information may be sent to farmers through village collectors.

Table 7.41 Average annual volume of maize, finger millet and beans traded by different categories of traders, Sumbawanga District, 1992/93 (bags)

	Maize	Finger millet	Beans	Total
Village collectors (n=6)	178.3	65.0	3.3	246.6
Inter-village collectors (n=4)	390.0	165.0	97.5	625.5
Wholesalers (n=2)[a]	1,735.0	116.7	0	1,851.7
Retailer (n=1)	350.0	0	0	350.0
Total (n=13)[a]	496.1.1	102.7	30.0	618.1

[a] Calculated by excluding the one wholesaler with an exceptionally high operational volume. If this trader is included the average maize traded increases to 12,158 and 3,069 bags for the three wholesalers and for all traders respectively. The total products handled increases to 12,274 and to 13,469 for wholesalers and for all traders respectively.

Source: Appendix 7.2, question 7.

Even though both village and inter-village collectors buy grain from the same rural areas the activities of the inter-village collectors encompass a wider area. While village collectors bought maize exclusively from their resident villages inter-village collectors also bought grain from other small villages within reach of their villages to supplement purchases from their resident villages. In our survey inter-village collectors reported buying maize from between two and three villages covering some 18 to 25 km on average (Appendix 7.2, question 10).

The major condition that appears to characterise maize marketing in Sumbawanga District is that producers, given their low production per farm, transact grain in small lots, in the 18-20 kg tins, especially towards the next harvest. This is likely to increase the transaction cost per unit of grain collected. That the quantity of grain bought and sold by traders per consignment[30] ranged between 36 and 155 bags (Table 7.42) indicates that most traders accumulated a number of small lots to get a bigger load. This seems to be a strategy purposely undertaken to gain from economies of scale in grain transaction and transportation, by maximising the utilisation of handling and transportation capacity, and a resultant reduction of per unit costs. This may be a plausible explanation, given that all traders except one wholesaler reported using hired vehicles to transport grain from the rural areas (Appendix 7.2, question 19).

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30 A consignment in this context refers to a load bought or sold per buying/selling time. Time refers to the number of days needed to bring grain from the buying source up to selling it.

Table 7.42 Average quantities of maize bought and sold per consignment by different types of traders, Sumbawanga District, 1992/93 (Bags)

	Buying	Selling
Village collectors (n=6)	41.5	36.5
Inter village collectors (n=4)	67.5	76.3
Wholesalers (n=3)	155.0	140.0
Retailer (n=1)[a]	15.0	13.0[a]
Total (n=14)	74.3	71.2

[a] Discussions with other retailers indicated that the amount of grain traded per day at retail level, although constantly varying with season, could be even less than one bag.

Source: Appendix 7.2, question 12 and 22.

There is a marked variation in traders market outlets. Although multiple answers were given regarding who buys grain from traders, consumers were mentioned by 7 of all traders. Other outlets, with the number of reporting traders in brackets, were other traders (6) and the SGR (3) (Appendix 7.2, question 13). This implies that grain trade is poorly channelled and that multiple connections exist at both the buying and the selling points. Indeed, on average every trader sold grain to about 3 different buyers mostly in Sumbawanga town (Appendix 7.2, questions 14 and 15). Cash payment seemed to be the major means of effecting transactions in both buying and selling markets even though 5 traders reported selling grain on credit. Among these were three traders who sold maize to the SGR.

"Contracts" at both buying and selling outlets seemed to play a limited role. In our survey three and two traders respectively reported having some "contracts" with their buying sources and selling outlets (Appendix 7.2, question 27). A "contract" in this situation was no more than a verbal agreement. In only one case was a formal paper contract mentioned. Of the three traders mentioning "contracts" with buying sources there were two wholesalers and one inter-village trader. One of the two selling contracts involved an advance payment from a wholesaler to a village collector. In this case the village collector was supposed to buy grain and deliver it to the wholesaler. In return the village collector was rewarded with a favourable loan arrangement to finance his own grain trade. The other wholesaler was contracted to deliver grain to the SGR.

As anticipated, grain trade in Sumbawanga District is highly seasonal and the buying activity for traders is concentrated between June and September when maize in the district is being harvested and is more readily available (Appendix 7.2, question 25). As it will be discussed in chapter eight, prices are also lowest at this particular time. It is evident, therefore, that the role of traders in maize trading is concentrated within these months. Traders reported requiring approximately seven days to buy and sell one consignment of maize although it could happen quicker if grain is bulked in one place and depending on availability of transport for distant buyers (Appendix 7.2, question 23). Comparison between total maize handled per annum and the average quantity of maize sold per transaction (Table 7.42) indicate that a trader trades in approximately 73 transactions per year. Given the time needed to buy and sell one consignment a trader will be on business for 10 months of the year on average.

Data in Appendix 7.2 (questions 28 and 29) show that some short-term grain storage was carried out by nine traders. The average storage period was roughly one month. All storing traders except one stored grain in their own houses or stores. On average the nine traders stored about 147 bags at any one time with the scale varying widely between traders and between different categories of traders. Given the short duration of storage one finds two plausible reasons for this behaviour. First, storage at trader level is transitory. Although five of the storing traders (two of each wholesalers and inter-village collectors and one village collector), mentioned overcoming times of low grain prices as one of their reasons for storing grain (Appendix 7.2, question 32).

data on storage period does not reflect this strategy. Four traders mentioned bulking as the major storage decision factor while one trader mentioned transport delays.

Second, lack of capital dictates storage decisions. Village collectors in our survey indicated that they will need on average some TSh 950,000 to start grain trading. This is equivalent to about 384 bags of maize at the average buying price mentioned by all traders (Appendix 7.2, question 12a) and a very high amount of money at village standards which could not even be obtained by the farmer selling most of the grain in the village. Asked about what limits their capacity to store more grain for longer periods all traders except one mentioned lack of capital. An equal number of traders complained that they did not have enough capital to trade in grain for the 1992/93 marketing season (Appendix 7.2, questions 33 and 34). Shortage of capital could have been alleviated if institutional lending was possible. As noted in chapter four institutional credit in Tanzania is very scarce. Of the seven traders who acknowledged receiving loans four obtained them from relatives and/or friends, two from a bank and one from a peer trader.

On the other hand, five traders offered loans to farmers (four traders) and to a fellow trader (one trader) (Appendix 7.2, questions 36 and 37). This scarcity of capital is also reflected by the fact that nine traders used money from other businesses to finance grain trade. An equal number of traders said they used money from agricultural proceeds to start trading (Appendix 7.2, question 41). It can therefore be assumed that under such scarcity of capital, the short transaction periods is a deliberate strategy taken by traders so that working capital spent in collecting grain can be recovered by selling the commodity as soon as possible to get cash to facilitate the next round of buying. Hayami et al. (1988:59) reported a similar observation in the Indonesian soybean market. Besides the apparent lack of capital no concrete evidence was observed from our study on the tying of capital to grain trade.

In addition to the lack of capital traders mentioned other problems as unstable prices (4), low prices (3), lack of transport (2) and fluctuating grain supply (2). Two traders said they did not experience any problem (Appendix 7.2, question 40). Our findings confirm the findings by Santorum and Tibaijuka (1992:433) that the main constraints on traders' stock holding can be identified as lack of storage structure in market places, price uncertainty, scarcity of initial investment capital, inability to tie up working capital for long periods, and risk of theft and pest damage.

As far as price information collection is concerned traders used a variety of means to gain knowledge on grain prices and supplies. The most prominent means were gathering information from fellow traders (6), visiting market places (5) and listening to radio programmes or from extension officer (3) (Appendix 7.2, question 38). Compared to the case of farmers, it would seem that, in line with Coulter and Golob's (1992:424-425) conclusion, in Tanzanian maize markets traders are relatively more informed about market prices than farmers.

In summary, we have identified factors underlying the nature of trader activity as (a) small marketable surplus per farm, (b) small scale economies in the transportation of produce, (c) and the differences in the financial positions and opportunity costs of labour between different categories of traders. Town based wholesalers need to collect maize produced in small lots by dispersed farmers into a quantity sufficiently large to exploit the scale economies in transportation. Because large traders have more access to capital and are engaged in other businesses in addition to trading in grain, it is profitable for them to provide capital to village collectors, in exchange for an assured delivery of the collected commodity from them.

CHAPTER 8

EFFICIENCY AND DISTRIBUTION EFFECTS OF MAIZE STORAGE AND MARKETING

Attention is now directed to various effects of maize storage and marketing patterns on temporal and spatial efficiency, income distribution and household maize sufficiency for consumption. The chapter opens with a brief examination of the role of maize in household cash income followed with the assessment of the factors which determine the marketable surplus of maize. Market efficiency is then assessed on the basis of an examination of data on prices, costs and marketing margins. At the end of the chapter food security analysis will compare the ability of maize consumed to meet the standard recommended energy intakes for a household and the coping strategies for families with insufficient consumption maize.

8.1 Role of maize in household income

How do earnings from maize sales fit into the overall income strategies for the households? This is the question we attempt to answer before we analyse further the different income distribution aspects resulting from maize production, storage and marketing. We attempt in this section to underline the importance of maize as a source of income in the survey area. Stanning (1988:346-47) notes that full specification of farm household income includes the value of agricultural products producers consume directly or use for exchange, as well as monetary income flows. This requires that values be imputed for agricultural products that are consumed on the farm. This aspect merits further research.

Data to estimate total income for survey households could not be collected in this study. Instead we concentrate only on cash income flows as reported by heads of household through the questionnaire. The section presents information about the main income sources, levels and distribution among rural families. This will assist in appreciating the importance of maize in the district and in assessing and understanding coping strategies of rural families. Data on household income were collected for the period between June 1992 and May 1993. Complete income data were available for 112 households.

8.1.1 Income levels and composition

To isolate the contribution of maize and other income sources to total household cash income, the total income was divided into four sources:

(1) Maize - includes cash income from quantity of maize sold valued by the weighted price for quantities sold in each month;

(2) Other crops - includes cash income from sales of finger millet, beans, potatoes and garden products as declared by the household;

(3) Livestock - includes returns from traded livestock (cattle, goats, sheep, pigs and poultry);

(4) Non-farm - includes wage earnings from non-farm labour and informal sector employment.

As shown in Table 8.1, the mean correlation between maize income and total income is the highest of all four income sources: 0.663. By contrast, the correlation between non-farm income and total income is the lowest of all income sources: 0.418. One of the main reasons for this difference has to do with opportunities for non-agricultural wage earning opportunities. Collier et al. (1986:106) assert that in Tanzania the poor are poor because of low returns to labour rather than because of labour shortages. These low returns to labour can in turn be explained by the low endowments of non-labour assets owned by the poor.

Table 8.1 Simple correlations between total cash income[a], land under cultivation and income by source among survey households, Sumbawanga District, 1992/93 (n = 112)

	Total income	Cultivated land	Maize	Other crops	Livestock	Non-farm
			income			
Total income	1.000					
Cultivated land	0.385*	1.000				
Maize income	0.663*	0.649*	1.000			
Other crops income	0.464*	0.150	0.248*	1.000		
Livestock income	0.617*	0.043	0.038	0.064	1.000	
Non-farm income	0.418*	-0.065	0.121	0.029	-0.040	1.000

[a] All income figures are based on mean annual cash income per household expressed in '000 TSh.

* Significant at the 5% significant level.

Source: Calculated from Appendix 7.1, questions 6a and 43.

Table 8.2 presents summary data for the four income sources by village. Household income averaged some TSh 96,000. Income derived from maize sales was by far the biggest share accounting for between 29 and 53 % of total cash income. Livestock sales and non-agricultural income sources each accounted for about 18 and 19 % respectively of total cash income. Overall, agricultural activities (including livestock) contributed about 80 % of all cash income.

Table 8.2 Composition of mean annual cash income of sample households by source, Sumbawanga District, 1992/93

Income from sales of	Kankwale (n=29)	Lula (n=30)	Mkima (n=27)	Mtutumbe (n=26)	Total sample (n=112)	
	(000 TSh)					%
Maize	20.6	82.8	22.1	22.9	38.1	40
Millet	6.6	12.3	7.6	3.2	7.6	8
Beans	1.5	11.4	0.4	14.2	6.8	7
Other crops[a]	16.1	4.5	4.9	2.9	7.2	8
Crops subtotal	44.8	111.0	35.0	43.2	59.7	62
Livestock	10.2	14.0	31.3	15.4	17.5	18
Non-farm activities	14.1	31.5	11.2	16.8	18.7	19
Total per household	69.1	156.5	77.5	75.4	95.9	100
Coeff. of var. (%)	88	95	175	83	120	-

[a] Includes income from gardening and minor agricultural activities.

Source: Appendix 7.1, question 43.

Analysis of gross cash income by village suggests marked differences in both income earnings and important sources of income. Lula reported the highest average total income of some TSh 157,000 compared to the lowest in Kankwale (TSh 69,000). The high total income level for Lula could partly be explained by the high level from maize income which contributed 53 % of total income. Furthermore, while income from maize played a significant contribution to farm household income across all villages the contribution of livestock sales to total income is markedly higher in Mkima where this component contributed about 40 % of total income.

To demonstrate the dependency of different categories of farmers on different sources of income, the four sources of income are presented by land under cultivation. The results are presented in Table 8.3. According to the data, there exists a direct relationship between cultivated area and maize income and an inverse relationship between size of holding and the share of non-farm income.

Table 8.3 Dependency of sample households on different sources of income by size of land under cultivation, Sumbawanga District, 1992/93

Land size (ha)	No. of farms	Average income ('000 TSh)	Maize income	Other crops income	Livestock income	Non-farm income
			(%)			
≤ 1.0	25	56.7	28	36	9	27
1.1 -2.0	42	88.8	38	19	13	30
2.1 - 3.0	27	118.3	37	19	37	7
> 3.0	18	133.6	53	25	6	16

Source: Appendix 7.1, questions 6a and 43.

For the poorest (that is, farms up to 1.0 ha) group, maize income accounted for 28 % of mean household income compared to 53 % of their rich (more than 3.0 ha) counterparts. In contrast, non-farm income activities provided 27 % of the poor households income against 16 % for the rich ones. These results are expected given the high correlation between land under maize and maize production discussed in chapter seven and that between land under maize and total income (Table 8.1).

8.1.2 Role of maize in income distribution

A further dimension of the importance of maize to total income is its contribution to total income inequality between different income recipients. To test on whether the i-th income source is inequality increasing or inequality decreasing, that is, whether or not an enlarged share of that income source leads to an increase or decrease in overall income inequality, Adams

(1994:113-115) proposes the use the relative concentration coefficient.[31] Calculation of the relative concentration index from the income data yielded the relative concentration coefficient for maize income among the survey households of 0.87. This implies that maize is an inequality decreasing source of income in Sumbawanga district.

From the foregoing analysis of cash income three key findings are recorded. First, maize is the most important source of income, contributing over one-third of total cash income. Second, when the sample households are ranked by land under cultivation, those in the lowest land group receive slightly less than one-third of their cash income from maize against just over half for households with more than 3 ha. Lastly, while maize represents the largest single source of rural households' income, it also has a favourable impact on income distribution. Maize income represents an income inequality-decreasing source of income. From this result, a clear policy prescription emerges, namely, that efforts to improve income levels and distribution in Sumbawanga district should focus on expanding maize income. The next section discusses the factors which determine the quantity of maize marketed.

8.2 Factors determining the marketed surplus of maize

Minde (1989:1) classifies factors affecting marketed surplus in Tanzania into three main categories. First, household factors assumed to affect the quantity of food crops marketed include family size, education, consumption habits, and cropland holdings. Second, there are economic factors like crop prices, income levels, and the price and availability of credit, consumer goods, and production

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31 The basic expression is $C_i = \rho_i \left[(S_i/X_i)/(S/X)\right]$ where C_i is the relative concentration coefficient of the i-th source in overall inequality, ρ_i is the correlation coefficient between the i-th source and total income, X_i and X are the mean income from the i-th source and from all sources respectively, and S_i and S are the standard deviations of income from i-th source and of total income respectively. From this expression, it follows that the i-th income source is inequality increasing or inequality decreasing according to whether C_i is greater than or less than unity.

inputs. Finally, state intervention in the agricultural sector, and particularly in grain marketing arrangements which have been in effect for a long time in the country. While a thorough coverage of the role of the government in grain markets was well discussed in chapters two and three a review of the relevant literature on the first two groups of factors is relevant.

Despite the general acknowledgement of the importance of the marketed surplus to overall development, there is still no general agreement on one central issue, namely, what is the nature of the impact of the different factors listed above on marketed surplus? Consider the case of the household characteristics. On the one hand, Chinn (1976:586) concludes that household grain retention for home consumption is negatively associated with marketed surplus, especially in the case of subsistence crops. On the other hand, Strauss (1984:330) stresses that the above conclusion is not absolute because changes in household characteristics and the production technology alter marketed surplus.

Consensus is also lacking regarding when economic factors affecting the marketed surplus are to be taken into consideration. Producer prices are among the most important and effective tools for influencing agricultural production. Opinion is divided over the nature and direction of the relationship between producer price and marketed surplus. For example, Minde (1989: 2-3) cites evidence which shows an inverse relationship to prices and marketed surplus in some situations where farmers are marginally subsistence producers. In contrast, studies by Haessel (1975), Harris (1984), Strauss (1984) and Toquero et al. (1975) stress that an increase in producer price did have a positive effect on the amount of marketed surplus of a subsistence crop.

The studies by Haessel (1975), Harris (1984) and Toquero et al. (1975) also showed an increase in marketed surplus resulting from an increase in output. Strauss (1984:329) reported a positive correlation between the use of advanced production technology and output. Harris (1984:153-155) reported a negative relationship between distance to market and level of marketed surplus.

The interventionist role of the government in Tanzanian grain markets and its implications were reviewed in chapter three and it was underlined, for example, that any efforts to increased agricultural production in Tanzania prior to the mid-1980s were ineffective largely because of declining real producer prices. In this section we report the response of marketed surplus of maize to both price and non-price factors.

By identity, the output of a subsistence crop (Q) is divided into the quantity consumed by the producer's household (C) and the quantity sold in the market (M).[32]

$$Q = C + M \quad \text{--} \quad (24)$$

If the equilibrium quantities of marketed surplus and home consumption are determined by price (P) and output (Q), the post-harvest marketed surplus supply function can be expressed as

$$M = f(P, Q) \quad \text{--} \quad (25)$$

But analysis in chapter seven gives the impression that other factors in addition to price and production may as well influence this decision. Thus taking equation (25) as the basic relationship, and by incorporating other non-price factors which might influence allocation of grain between consumption and

32 Following Toquero et al. (1975) we abstract in this section from disposition of output other than consumption and sale.

marketing, we specify a model[33] for estimating the market supply parameters as:

$$M_i = a_o + a_1P_i + a_2Q_i + a_3S_i + a_4Dummy_i + a_5Dist_i + e_i \text{ ------------ } (26)$$

where

Q	=	disposable maize produced (in kg) obtained by subtracting in kind expenditure of grain for payments, remittances, seed reserves, and grain used for brewing, and carry-overs.
M	=	quantity of maize offered for sale in kg
P	=	price of maize received by farmers[34] in TSh/kg
S	=	household size in adult equivalents[35]
Dummy	=	dummy variable (1 for villages which are accessible and 0 for others) to trace possible changes in farmers' behaviour with respect to accessibility
Dist	=	distance to Sumbawanga town market in km
e	=	error term
i	=	farm identifying subscript

33 Estimation of the home consumption function using the same specification produces similar results (with possible changes in the signs of the coefficients) underlining the substitutability between consumption and sales from total production.

34 Since farmers marketed grain in small lots over the entire period, and because prices differed within a season, average prices weighted by corresponding quantities sold in each instalment are used.

35 For most of the analyses in this chapter we use adult equivalent scales to weight the effect of different age groups of family members in production, marketing and consumption. Adult equivalent units are aggregated using age data in appendix 7.1, question 3 and World Health Organisation (WHO) consumption weights of 0.5 and 0.75 for children below 11 and 16 years respectively, and 1 for adults, 16 years plus. For a similar approach in a Tanzanian situation see Tibaijuka (1994:75).

An ordinary least squares method was used to estimate the model. To test the influence of the independent variables on the dependent variable for different categories of farmers, the model was also run for the three categories of maize selling farmers, that is, poor (selling up to 500 kg), middle (501-20,000 kg) and rich (> 20,000 kg) as categorised in chapter seven (see Tables 7.26 and 7.27). The results are presented in Table 8.2.

Table 8.4 Parameter estimation results for the marketed surplus function for maize, Sumbawanga District, 1992/93

	Poor	Middle	Rich	Total sample
No. of farmers	35	39	23	97
Intercept	-4.241	185.016	-1078.797	-554.851
	(0.025)	(0.456)	(0.730)	(1.419)
Price	8.509**	6.191	47.307	9.832
	(2.181)	(0.588)	(0.958)	(0.912)
Production	0.179**	0.288***	0.771***	0.771***
	(4.427)	(4.366)	(15.021)	(33.747)
Family size	-46.505***	-31.440	-196.960*	-127.772***
	(3.433)	(0.970)	(2.060)	(4.033)
Dummy	16.696	7.911	-252.997	-32.510
	(0.291)	(0.052)	(0.471)	(0.215)
Distance	0.304	2.391	1.333	0.838
	(0.258)	(0.851)	(0.113)	(0.278)
R^2 (Adj.)	0.369	0.292	0.933	0.938
F-ratio	4.983	4.130	62.46	292.904

Figures in parentheses are absolute t-ratios.
*** Significant at the 1% confidence level.
** Significant at the 5% confidence level.
* Significant at the 10% confidence level.

Source: Appendix 7.1

The goodness of fit (measured by the coefficient of determination adjusted for degrees of freedom) for the total sample and for rich farmers are high, and shows that all independent variables together explain about 93 and 94 % of total variation in marketable surplus. The coefficients for distance and the dummy variable for accessibility are not statistically different from zero at the specified confidence levels indicating that accessibility, and distance have no significance influence on the amount of marketed maize. The little influence they have, however, could be explained by the variations in the marketing patterns between villages as explained in chapter seven.

The coefficients for amount produced (Q) are positive and significant for all categories of farmers and for the total sample, supporting the fact that marketable surplus is a function of the quantity of maize harvested. As expected, the coefficients of the family size are negative and highly significant ($p < 0.01$) for poor farmers and for the whole sample. In contrast, the family size coefficient is not significant for the middle farmers and is only significant for the rich farmers at the 10 % confidence level. The implication of these results is clear, that is, an increase in family size significantly reduces the amount of grain marketed by poorer households while it has a negligible effect on middle and rich farmers.

The coefficient for price for poor farmers is positive and statistically different from zero at the 5 % confidence level. For the middle and rich farmers and for the whole sample, however, the coefficients for price are not significant. This indicates that, except for the poor, price has a negligible effect on the allocation of output to market sale and presumably to home consumption. Such finding seems reasonable considering the fact that maize serves as the main source of income in addition to being the main staple. The discussion in chapter seven did not discover any price discrimination against smaller farmers. A tendency was also noticed in chapter seven that the majority of rich farmers sold most maize in the harvest (June-August) quarter when prices were at their lowest, while most poor and some middle farmers sold most maize in the (September-October) post-harvest quarter when prices were somehow higher (see Table 7.27). These results show that incentives resulting from seasonal price increases could be more beneficial to poor farmers than to rich farmers.

The regression results show that the price elasticity[36] of market supply for the poor farmer group is inelastic (η = 0.74) at the average price and production levels (Table 8.5). This means that a price increase raises the quantity marketed proportionately less than the price increases, that is, prices would have to rise by 1.35 % to draw a one percent increase in marketed surplus and that increases in total revenue, which is the product of price and quantity, is relatively small as a result of price increases. Marketed output with respect to total maize harvested is relatively inelastic for poor (η = 0.88) and middle (η = 0.70) farmers and relatively elastic (η = 1.15) for rich farmers, implying that changes in marketed surplus as measured by output elasticity will benefit rich farmers more than poor farmers. The estimate of the family size elasticity of marketable surplus is in the range of -0.68 for poor farmers and -0.20 for rich farmers. These elasticity estimates imply that changes in marketed surplus resulting from changes in family size are negative.

Table 8.5 Elasticities[a] of marketed surplus with respect to significant variables, Sumbawanga District, 1992/93

	Poor	Middle	Rich	Total sample
Price	0.74	-	-	-
Production	0.88	0.70	1.15	1.53
Family size	-0.68	-	-0.20	-0.37

[a] Elasticity (η) = (X/Y) × (dY/dX), where X is significant variable. Elasticities are evaluated at the means of the variables.

Source: Table 8.4 and Appendix 7.1.

36 The ratio of the relative change in the dependent variable, y, to the relative change in the independent variable, x, is the elasticity of y with respect to x. The elasticity of y with respect to x measures the responsiveness of y to changes in x.

To test the hypothesis that household consumption increases less than proportionally and the marketable surplus increases more than proportionally with increases in output we make use of the marginal propensities to sell and consume.[37] As is seen in Table 8.6 the marginal propensity to sell (when the home consumption demand for maize is satisfied) increases from 0.18 for poor farmers to 0.77 for rich farmers. In contrast, the marginal propensity to consume decreases from 0.82 in the case of poor farmers to 0.23 for rich farmers. For all sample farmers, increases in maize output will lead to proportionally more sales than consumption. These findings fully support our hypotheses.

Table 8.6 The marginal propensity to sell and consume with respect to maize output by sample farmers, Sumbawanga District, 1992/93

Marginal Propensity to	Poor	Middle	Rich	Total sample
Sell (MPS)	0.1787	0.2883	0.7711	0.7708
Consume (MPC)[a]	0.8213	0.7117	0.2289	0.2292

[a] Since production (Q) is either marketed (M) or consumed (C) and Q = C + M the marginal propensity to consume, MPC = 1 - MPS = 1 - dM/dQ.

Source: Table 8.4 and Appendix 7.1.

These results fall in line with results from the survey questionnaire on farmers' marketing and consumption decisions in response to increases in output and price. Out of the 97 farmers who sold maize 33 % replied that they would sell all of the increased output. Out of these there were 7 poor farmers and 13 middle and rich farmers representing 25, 50 and 57 % respectively of all

37 The marginal propensity to sell, the rate of change in selling as maize production increases, is greater than 0 but less than 1. This implies that farmers are disposed, as a rule and on the average, to increase their marketings as production increases, but not by as much as the increase in their production.

farmers in each subgroup (Table 8.7). The rest intended to sell a part and retain the remainder for home consumption. On the other hand, less than a quarter of all maize selling households replied that they would increase the proportion of maize sold (out of a given output) if prices were to increase. By far the majority (84 %) planned no change in allocation of harvested maize following a price increase (Table 8.7).

Table 8.7 Motivation survey on the sample farms disposition of maize in response to changes in output and price, Sumbawanga District, 1992/93

	Poor	Middle	Rich	Total sample	
	Number of farms				%
	Output increase				
Sell all	7	13	13	33	34
Sell only part	28	26	10	64	66
Total	35	39	23	97	100
	Price increase				
Increase sales	7	5	4	16	16
No change	28	34	19	81	84
Total	35	39	23	97	100

Source: Appendix 7.1, question 44.

These results confirm the findings of the regression analysis that (a) an increase in output results in an increase in both home consumption and market sales, (b) for rich farmers the desire to increase sales out of total output increases is higher relative to an increase in consumption while the converse in true in the case of poor farmers, and (c) price has a negligible effect on the allocation of a given output between home consumption and sales *ceteris paribus*.

8.3 Storage and marketing efficiency

Product prices exhibit differences in space, time and form. These price differences are brought about either by costs and/or market power (Lorenzl, 1994:4). The costs represent transformation processes while market power emanates from the degree of market competition and state controls. It was discussed in chapter four that agricultural markets are allocatively efficient if, among other things, (a) prices between geographically separated markets move together, (b) price differences between markets are explained by transfer costs, and (c) price differences between the harvest price and the release price, for a storable commodity, are explained by storage costs. In order to test the hypotheses about allocative efficiency stipulated in chapter one, analysis is carried out to assess market integration, spatial pricing efficiency and seasonal pricing efficiency.

8.3.1 Market integration

The success of market liberalisation and price stabilisation policies depends on the transmission of price signals among the markets in various parts of a region or of a country. Golleti and Babu (1994:311) stress that in order to transmit the intended incentives of these policies to the beneficiaries, integration of these markets is essential. Market liberalisation policies in Tanzania were effected with a parallel introduction of the SGR. Given the geographical scatter of high potential areas for maize production in the country having information about market integration can assist in decisions regarding the location and size of storage facilities. In addition, information on market integration can assist in identifying food insecure regions for appropriate interventions.

To understand market integration one needs, among other things, hypotheses building on reasons for integration and this requires a very precise and broad knowledge of the market situation in the study area (Lorenzl, 1994:7). The best indicator to measure market efficiency is the supply and demand of goods and services over a long period of time. This is not possible because the availability and reliability of data for economic analysis in LDCs is minimal. Therefore, special care must taken in selection and specification of market analysis tools in LDCs (Lorenzl, 1970:529).

Spatial market integration has been traditionally tested by the use of correlation coefficients. An example of the application of this method in Africa was done earlier by Jones (1968) in Nigeria. However, the use of correlation coefficients has been questioned by Harris (1979) and Timmer (1974) in that they are a misleading measure of market integration because the effect of other factors like inflation, seasonality, population and procurement policy can not be distinguished. Subsequently, more accurate methods of assessing market integration were proposed by Delgado (1986) and Ravallion (1986) and tested by Heytens (1986). On the other hand, cointegration methods to study the long-term relations between non-stationary price series have been utilised by Engle and Granger (1987), Ardeni (1989), Palaskas and Harriss-White (1993), Goodwin and Schroeder (1991), and Wyeth (1992). More recently further insight in these methodological developments were brought by Golleti and Babu's (1994) study of market liberalisation and integration of maize markets in Malawi.

In this analysis assessment of market integration is carried out using both correlation coefficients and Timmer's Index of Market Connection (IMC) which is based on the model proposed by Ravallion (1986). The tests are attempted at two levels. First, the integration of local markets in Sumbawanga District to the Sumbawanga town markets is evaluated. Second, the extent of market integration and segmentation between Sumbawanga town market and Dar-es-Salaam market is studied. In addition, the integration of maize markets between the neighbouring regions of Mbeya and Iringa with reference to Dar-es-Salaam markets are also evaluated for the purpose of comparison.

The basis of the Ravallion model is the assumption that price developments in a local market are influenced by price changes in a certain reference market. Specifically, it is assumed that price changes in a local market at a given time (P_{it} - P_{it-1}) depend on four exogenous variables, namely, (a) the price changes in the reference market between two periods ($Þ_t$ - $Þ_{t-1}$), (b) the difference between prices in the local market and lagged reference market prices (P_{it} - $Þ_{t-1}$), (c) the lagged reference market price ($Þ_{t-1}$), and (d) dummy variables to account for local market conditions. The model is then summarised as (Heytens, 1986:28-31):

$$(P_{it} - P_{it-1}) = (\hat{a}_i - 1)\,(P_{it-1} - Þ_{t-1}) + ß_{i0}(Þ_t - Þ_{t-1}) + (\hat{a}_i + ß_{i0} + ß_{i1} - 1)Þ_{t-1}$$
$$+ ç_iX_t + e_{it} \text{ ---(27)}$$

To be able to measure market integration equation (27) can be rewritten as

$$(P_{it} - P_{it-1}) = b_1(P_{it-1} - Þ_{t-1}) + b_2(Þ_t - Þ_{t-1}) + b_3Þ_{t-1} + b_4X_t + e_{it}.\text{-----(28)}$$

where $\hat{a}_i - 1 = b_1$, $ß_{i0} = b_2$, $\hat{a}_i + ß_{i0} + ß_{i1} -1 = b_3$, and $ç_i = b_4$.

By rearranging the variables the expression

$$P_{it} = (1+b_1)P_{it-1} + b_2(Þ_t - Þ_{t-1}) + (b_3 - b_1)Þ_{t-1} + b_4X_t\text{---------------(29)}$$

is developed.

Assuming that the reference market is in a long-run equilibrium (that is $Þ_t - Þ_{t-1} = 0$) and also that $b_4 = 0$ than $(1 + b_1)$ and $(b_3 - b_1)$ remain and reflect, respectively, the contribution of local and reference market price movements for the formation of the current local price level (Heytens, 1986:31).

The combined effects of these two changes are brought together in Timmer's Index of Market Connection (IMC), which is the ratio of the lagged local market coefficient to the lagged reference market coefficient.

$$IMC = \frac{(1+b1)}{(b3-b1)} \qquad (30)$$

According to this criteria a coefficient of less than one reflects a high degree of short-run market integration. The b_2 coefficient measures much the same thing as the simple bivariate correlation coefficient.

The model has been applied to weekly farm gate prices for the survey village markets and to wholesale[38] prices for the Sumbawanga, Iringa, Mbeya and Dar-es-Salaam markets (see Appendix 8.1). Village market weekly[39] prices and wholesale prices for Sumbawanga urban market were collected during the survey period. Wholesale prices for Iringa Mbeya and Dar-es-Salaam were obtained from MDB files. The MDB and the Early Warning and Monitoring Unit of the Ministry of Agriculture collect bi-weekly data for market analysis. The price data base used to fit the model consisted of 52 observations for the period between July 1992 and June 1993. The assumptions are that within Sumbawanga district, the town markets in Sumbawanga are considered to be the central market. For the regional markets we assume that Dar-es-Salaam markets exert influence to the regional markets of Iringa, Mbeya and Sumbawanga. The results of the regression are discussed below.

38 The use of wholesale prices for the urban markets is assumed to be more appropriate than retail prices because the former are mostly charged by integrating traders who transfer commodities from one market to another. In that case traders are responsible for transmission of price information either directly or indirectly by their influence on supply and demand of traded goods.

39 Weekly data are more appropriate than averaged monthly data because the averaging introduces smoothness into the data by dampening the fluctuations in the weekly data. According to Gujarati (1988:358) this smoothness may itself lend to a systematic pattern in the disturbances, thereby introducing autocorrelation.

8.3.1.1 Market integration between rural and town markets in Sumbawanga district

The b_2 coefficients for all markets are significantly different from zero except for Mtutumbe (see Table 8.8). The coefficients support the conclusions derived by examining the values of the simple bivariate correlation coefficients that spatial prices of maize markets in Sumbawanga district are integrated and that the hypothesis for market segmentation can be rejected. The results for Mtutumbe are inconclusive. However, the insignificant b_2 coefficient is consistent with the lower correlation coefficient relative to the other villages (Table 8.8).

Table 8.8 Regression results and short-run inter-market connections between markets in survey villages and Sumbawanga Town, July 1992 - June 1993

	b_2	IMC	r
Kankwale	0.298**	2.410	0.958**
Lula	0.327**	2.126	0.915**
Mkima	0.362**	1.550	0.962**
Mtutumbe	-0.030	-32.236	0.837**
** Significant at $p < 0.01$			

Source: Appendix 8.1.

Computed indices (IMC) from the Ravallion model seem also to support the above conclusions. Mkima market, with the lowest IMC seem to be best integrated to Sumbawanga town markets. On the other hand the largest IMC (in absolute terms) was recorded in Mtutumbe. The indices for Kankwale and Lula stand between the values for Mkima and Mtutumbe. Given the proximity of Kankwale to Sumbawanga town the inaccessibility of Lula relative to Mkima the results of the IMC suggests a puzzling price relationship which could be explained in two ways. First, farmers in Kankwale situated in the north of

Sumbawanga town could have also sold grain to the northern deficit districts of Nkansi and Mpanda and therefore reducing its potential integration to Sumbawanga town markets. Second, since Lula and Mkima are located close to each other there is a possibility that trading in maize also occurred between the two villages. This could indirectly increase the integration of Lula to the town markets.

8.3.1.2 Integration between regional markets and Dar-es-Salaam markets

The results for the regional market integration show that correlation coefficients give the same impression as the b_2 coefficients for Iringa and Mbeya regions (Table 8.9). The b_2 coefficient for Sumbawanga town market is not significant indicating that prices in Dar-es-Salaam have no significant influence on the development of prices in the region. The IMC for Sumbawanga is also the highest compared to those of Iringa and Mbeya.

Table 8.9 Regression results and short-run inter-market connection between Sumbawanga, Iringa, Mbeya markets to Dar-es-Salaam markets, July 1992-June 1993.

	b2	IMC	r
Sumbawanga	0.192	4.627	0.814**
Iringa	0.195**	4.125	0.754**
Mbeya	0.233*	3.149	0.841**
* Significant at $p < 0.05$;	** Significant at $p < 0.01$.		

Source: Appendix 8.1.

In general we could conclude that the market integration study reveals two aspects. First, integration of markets within Sumbawanga district is higher than the integration between Sumbawanga town market and the Iringa and Mbeya regional markets and Dar-es-Salaam markets. Second, the integrations are not absolute and expected exceptions are recorded in both cases. While Mtutumbe market within Sumbawanga district show a marked element of segmentation from the Sumbawanga town market, so does Sumbawanga town market with reference to the Dar-es-Salaam market. In both cases road accessibility and distance from the reference market seem to be the most plausible explanations, whereby distance stands for the state or fact of the local markets being far or remote from the reference market.

8.3.2 Spatial pricing efficiency

8.3.2.1 Marketing margins

We attempt here to outline the main factors that explain the inter-market differences in price spreads between producers and the ultimate consumers. The marketing margin is generally defined as the price difference between the price paid by consumers and that obtained by producers (Tomek and Robinson, 1991:108). It is the price of a collection of marketing services that is the outcome of the demand for and supply of such services at different stages of the marketing chain.

In response to the observation of the sharp swings in farm gate prices this section attempts to examine the maize marketing margins, that is, the urban-rural price differences. According to Timmer (1974) comparison of the urban and rural price series can indicate if commodity flows are from rural to urban areas or vice versa. Examination of price differences between urban and rural areas could also give a picture of the costs associated with the transfer of the product from one area to another (Loveridge, 1991:101). Indeed, the disparity between movements in producer and urban retail prices after the liberalisation policies could be used to explain the potential effects of these price changes on farm household incomes.

Details of the weekly prices of maize at different stages of marketing are given in Appendix 8.1. Analysis of price data for the different prices and margins reveals a number of interesting characteristics. First, as discussed earlier, producer prices rose steadily between July 1992 and March 1993 but, started to drop again in April at the start of the new harvest season. The data show further that short-run fluctuations in prices have tended to be reflected, at least in part, in wholesale prices during the study period. Indeed, the price data show that both farm gate and retail prices hit troughs in the midst of June and August (Figure 8.1).

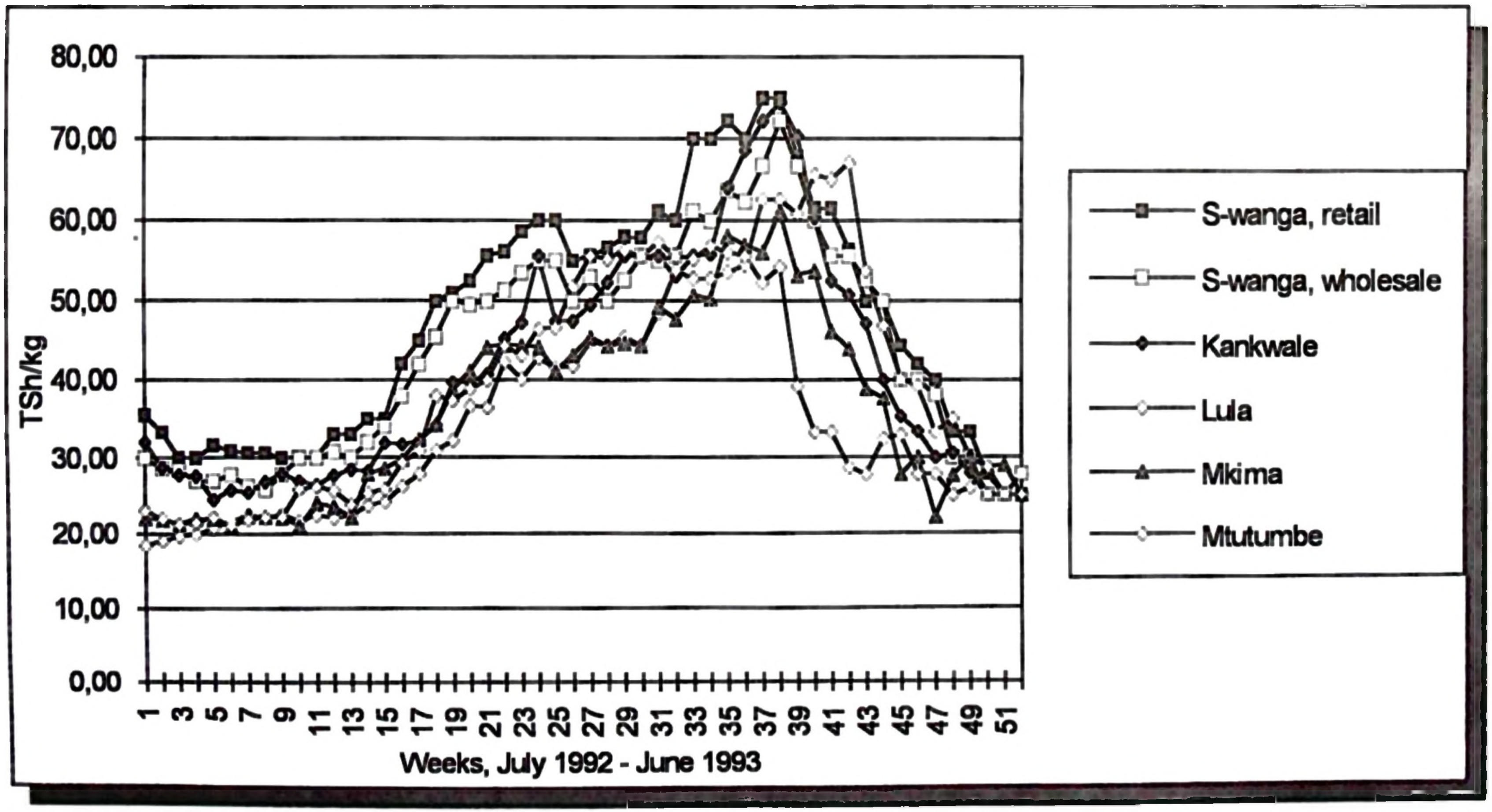
Second, the coefficient of variation calculated for the producer price series are generally higher than those for wholesale and retail prices. Even though the pattern of producer prices has been reflected in the retail maize prices in the Sumbawanga urban markets, retail maize prices exhibit considerably less variability than farm gate prices. The coefficients of variation calculated for the retail series are generally much lower than those for producer prices. The coefficient of variation for the farm gate prices ranged between 33 % in Mkima and 39 % in Lula (Table 8.10). Overall, both wholesale and retail prices in Sumbawanga town had respective mean variability of about 14 and 15 TSh, equivalent to 31 % deviation of the wholesale and retail prices from their respective mean levels. The coefficients of variation show that retail prices are much less volatile than producer prices and that total maize price instability is absorbed between the farm and the wholesale level.

Table 8.10 Summary statistics of weekly farm gate, wholesale and retail prices for survey villages and Sumbawanga town, July 1992-June 1993

	Kankwale	Lula	Mkima	Mtutumbe	Sumbawanga	
	Farm gate				Wholesale	Retail
Mean (TSh/kg)	41.79	37.95	36.76	36.36	44.15	47.83
C.V. (%)	34.98	38.86	33.19	35.78	31.20	31.10
Max. (TSh/kg)	74.40	67.10	61.10	57.30	72.20	75.00
Min. (TSh/kg)	24.60	18.50	21.10	21.10	25.00	25.00

Source: Appendix 8.1.

Figure 8.1 **Weekly maize wholesale and retail prices for Sumbawanga town and farm-gate prices in survey villages, July 1992 - June 1993**



Source: Appendix 8.1.

Santorum and Tibaijuka (1992:433) cites evidence that seasonal price adjustments in Tanzania, both up and down, are more rapid in rural markets (3 months) than in urban markets (5-6 months). This is likely to be the consequence of stock release behaviour in rural areas and may also indicate a low degree of integration between rural and urban markets.

Third, except for Kankwale, the retail to wholesale margin is smaller than that between wholesale and farm level (Table 8.11). According to Goetz and Weber (1986:41) this implies that relatively more transformation services are added to maize between wholesale and farm levels, as compared to wholesale and retail levels and this may in turn indicate that wholesale traders are more competitive and hence command more market power. Since maize consumed in Sumbawanga town must be transported from the producing villages most of the margin between wholesale and farm level prices can perhaps be explained by the cost and risk of transportation. This is expected because, as we observed in chapter seven, some wholesale traders also buy maize directly from the villages in addition to buying from village and inter-village collectors. The particular behaviour of margins between Kankwale and Sumbawanga need to be further explored.

Table 8.11 shows that the retail to wholesale margin for Kankwale at TSh 3.68 is larger than the wholesale to farm level margin of TSh 2.60. On individual observations some figures for the wholesale farm margin were actually negative. While this could be attributed to the closeness of the price figures for the two areas, given the proximity of Kankwale to Sumbawanga, that some traders were engaged in both wholesale and retail trade implies that such traders may be willing to buy at a loss from farmers in the hope of recovering the loss from the retail trade. Another possibility, at least in the case of the negative margin values, is for a backflow of grain from Sumbawanga to Kankwale. As we shall see under the food security section of this chapter some of the maize buying farmers in Kankwale depend on the Sumbawanga town market as their source of grain.

Table 8.11 Average marketing margins of maize trade between survey villages and Sumbawanga town, July 1992-June 1993

	Marketing margin (TSh/kg)	Share of retail price[a] (%)
(a) Kankwale		
Retail-farm gate margin	6.04	12.63
Wholesale-farm gate margin	2.36	4.93
Farm gate price	41.79	87.37
(b) Lula		
Retail-farm gate margin	9.88	20.66
Wholesale-farm gate margin	6.20	12.96
Farm gate price	37.95	79.34
(c) Mkima		
Retail-farm gate margin	11.07	23.14
Wholesale-farm gate margin	7.39	15.45
Farm gate price	36.76	76.85
(d) Mtutumbe		
Retail-farm gate margin	11.47	23.98
Wholesale-farm gate margin	7.79	16.29
Farm gate price	36.36	76.00
Retail-wholesale margin[b]	3.68	7.69

[a] Retail price as given in Table 8.10.
[b] Since wholesale and retail prices were applicable only in Sumbawanga town the wholesale-retail margin is the same for all villages.

Source: Appendix 8.1.

In general, it can be concluded that internal marketing for maize in the district is characterised by narrow margins despite the observed lack of competitive environment in the rural areas. It is possible that the maize demand structure in Sumbawanga town may prevent the widening of these margins. The remaining alternative for able and well resourced traders could be to transport grain and sell it where more returns could be obtained. This perhaps explains the outflow of maize from Sumbawanga to areas outside its boundaries. The economics of such a distance trade is, however, an open research question.

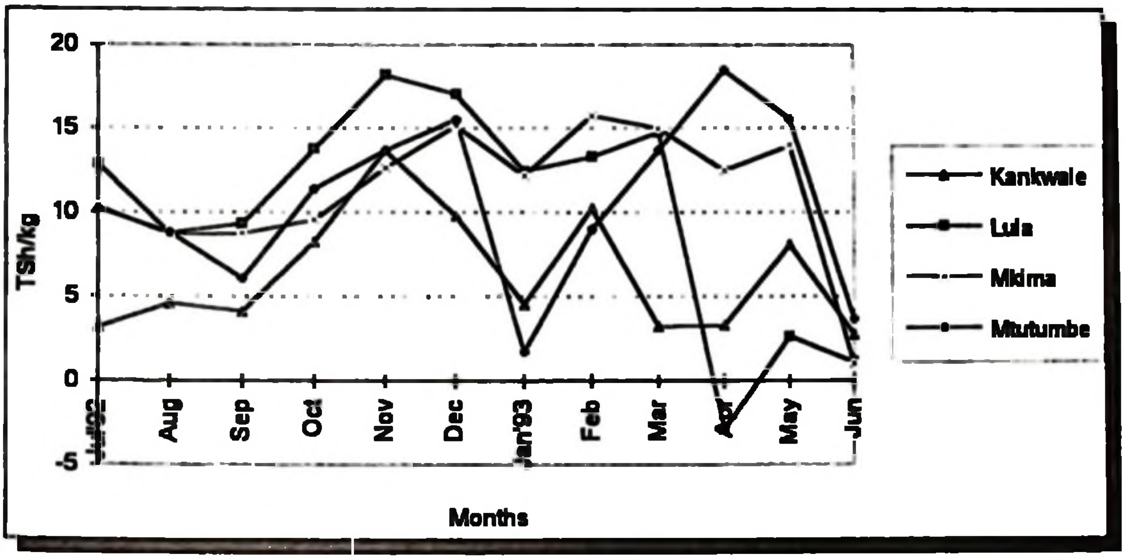
Finally, the widespread use of average costs, average prices and average margins is likely to obscure the range of costs and returns experienced at all levels from production to consumption and at all times with less regard to seasonality. Furthermore, Timmer et al. (1983:166) argue that rural prices and urban prices are strongly interdependent for some parts of the year, but possibly not for others. In an attempt to assess the seasonal nature of the calculated average margins we report the mean monthly retail to farm margins for all four villages (Table 8.12 and Figure 8.2).

Table 8.12 Monthly farm gate-retail marketing margins for maize in survey villages and Sumbawanga town, July 1992-June 1993 (TSh/kg)

	Kankwale	Lula	Mkima	Mtutumbe
Jul.'92	3.18	12.88	10.33	10.20
Aug.	4.60	8.78	8.72	8.82
Sep.	4.13	9.33	8.75	6.08
Oct.	8.28	13.75	9.58	11.40
Nov.	13.70	18.20	12.63	13.70
Dec.	9.80	17.03	15.15	15.53
Jan.'93	4.54	12.45	12.18	1.70
Feb.	10.27	13.30	15.75	9.03
Mar	3.23	14.75	14.98	18.48
Apr.	3.28	-2.88	12.48	28.18
May	8.12	2.62	13.96	15.56
Jun.	2.73	1.10	1.00	3.68
Average	6.33	10.12	11.29	11.86
C.V. (%)	57	65	36	60

Source: Appendix 8.1.

Figure 8.2. **Monthly farm gate-retail marketing margins for maize in survey villages, Sumbawanga District, July 1992 - June 1993**



Source: Table 8.12.

Margins between the nearest village, Kankwale and the furthest village, Mtutumbe do not follow any discernible pattern over time. On average, Kankwale farm gate prices with respect to Sumbawanga retail prices fell to 6 % in June and rose up to 27 % in November. In Mtutumbe the margins were lowest (4 %) in January and the maximum (59 %) in April. On average, prices in Lula and Mkima were 10 and 11 % respectively above the retail prices in Sumbawanga compared to 6 % in Kankwale and 12 % in Mtutumbe. Note that in April, Farm gate prices in Lula were 6 % below those in Sumbawanga. Price variability (as measured by coefficient of variability) was relatively higher in the inaccessible villages of Lula and Mtutumbe compared to Kankwale and Mkima (Table 8.12). This pattern follows closely the seasonal price movements reported in Table 8.10 and Figure 8.1.

8.3.2.2 Marketing costs

In this section we summarise the main marketing costs for maize as revealed by the trader survey. Hauling of farm products within the village is usually done by men with carts or wheel barrows. These costs are incurred by farmers selling maize. However, transferring maize from the survey villages to Sumbawanga town involves transport costs for the use of either public or hired transport and other costs such as fare for the trader, purchase of gunny bags, and levies (Table 8.13).

Table 8.13 Average costs of transferring maize from survey villages to Sumbawanga town, 1992/93 (TSh/bag)[a]

Village	Trans-port	Trader's fare[1]	Loading & unloading	Bag[b]	Market levy[1]	Total costs	Cost/kg
Kankwale	180	20	60	7	120	387	3.87
Lula	630	60	60	7	120	877	8.77
Mkima	580	50	60	7	120	817	8.17
Mtutumbe	830	90	60	7	120	1,107	11.07

[a] All values in Appendix 7.2 are reported on per bag basis; they were converted to kg basis by dividing them by 100, the assumed weight of a bag throughout this work.

[b] Calculated by dividing reported average price of TSh. 280 for a new bag by its estimated useful life of 3-4 years and the number of times the bag is used per year - estimated to be 10 times in this survey.

Source: Appendix 7.2, questions 15c, 18, 20, 21 and 30.
[1] Own informal survey in villages and at Central Market in Sumbawanga town.

Too few observations were available to generalise on these costs or to give a precise categorisation of the different types of traders. However, it is useful to discuss a general behaviour of marketing costs. First, in all villages except Kankwale at least half of the total cost of marketing is attributed to transport. Kankwale village market, located near Sumbawanga, incurred lower transportation costs (TSh 4/kg) for delivering maize to Sumbawanga. In contrast, transferring maize from Mtutumbe, the furthest village was more expensive than in other villages. Since all other costs were of a similar magnitude, transfer cost differences arise from transport costs.

The price differences among these markets are consistently higher than the costs of transporting maize from the rural markets to the Sumbawanga urban market. However, the magnitude of the difference between retail-farm gate price margins and the transfer costs gives a rather pessimistic picture for motivation of grain transfer from rural areas in Sumbawanga district to Sumbawanga town markets. Compared to figures in Table 8.12 it is noticed that for Lula and Mtutumbe the potential profit margin is barely 3 and 2 % respectively of the Sumbawanga town retail price. The respective figures for Kankwale and Mkima are 5 and 7 per cent. This supports our previous observation that maize trade in Sumbawanga district could be influenced by marketing forces from outside the district.

Farmers could receive better prices if they could transport their grain to Sumbawanga town. But this will cause them to incur additional costs to transport it besides other handling costs, an option which could not be relied upon given the scarcity of transport in the region. It is, therefore, no wonder that only 7% of the maize marketed was sold by farmers direct in Sumbawanga town markets mostly from Kankwale (see Table 7.30).

8.3.3 Temporal efficiency

Temporal efficiency is limited to the two villages of Lula and Mkima where the monthly storage loss data were carried out. To permit comparison of actual prices with a "normal" seasonal price rise, a simple model of storage costs was calculated. Since maize is harvested between June and August, stocks are accumulated then and the peak volume of stocks occurs annually in late July and mid-September. Maize sales from October through May are supplied primarily from storage. Using the August price as a base we want to assess to what extent storage costs can express the observed seasonal price rise through the end of the season. We first discuss the nature of the storage costs and then present the seasonal price behaviour.

8.3.3.1 Storage costs

As discussed in chapter four to be able to assess temporal efficiency it is necessary to calculate costs of storage and compare them to seasonal price changes. In this section we itemise the main assumptions and the different types of storage costs as reported from our field survey or from literature.

(a) Investment in storage facility

Our survey showed that the *kihenge*, a common traditional storage structure during 1992/93 was priced at TSh 2,236 in Lula and TSh 1,956 in Mkima (Appendix 7.1. question 36). As noted in chapter seven the average capacity of the structure was 16 and 13 bags of maize and a life span of some 5 years (see Table 7.18). While the average storage duration ranged between 5 and 8 months. For our purpose we consider 8 months as the average storage period. Since our discussion in chapter seven showed that longer storage takes place using the traditional structure, bag storage is not considered in this analysis.

(b) Interest on stored grain and on investment

Since the discussion in chapter four underlined the variability of interest rates by size and source of credit we simulate the interest rates in this analysis so as to understand how storage costs and storage profitability varies at different interest rates. The adopted interest rates are (a) 10 % (for loans from friends and relatives), 30 % (for loans from large farmers, businessmen and the government), and 50 and 100 % (for loans from shop owners). Furthermore, the MDB (1992c:6-7) proposes an annual interest rate of up to 94 % on grain storage operations.

In addition interest must be charged on the storage investment. According to Goetz and Weber (1986:104) this charge reflects the fact that the storing agent has money tied in the investment, which he could have put to alternative (interest bearing) uses. We use the same simulations for interest on stored grain for the interest on investment calculations. Conventionally, however (e.g. see Gittinger, 1982), the interest on investment is charged only on a half of the original investment cost.

(c) Handling and treatment

This includes the cost of getting the crop into the store and the use of pesticides for those farmers who applied it. On average farmers who used pesticides spent some TSh 1,177 and 876 respectively in Lula and Mkima to buy pesticides for all stored maize (Appendix 7.1. question 15c). Discussions in the villages revealed that treating maize with pesticides and/or filling grain in a typical store needs one 8-hour working day for an average male. Farm wages in Tanzania are put at 5 kg of maize grain per working day (Appendix 2.1). Valued at the average farm-gate prices for the 1992/93 season (Table 8.15) this is equivalent to TSh 190 and 184 in Lula and Mkima respectively and represent the handling and treatment costs for farmers who did not use commercial pesticides during storage. The average handling and treatment cost for farmers who used pesticides worked out to be TSh 1,367 and 1,060 respectively for Lula and Mkima. Since grain treatment was done only once at the time of filling of store, this cost is considered as a fixed cost.

(d) Losses

Ideally both qualitative and quantitative losses should be considered in calculating storage losses. However, due to time and resource constraints only quantitative losses were determined in our case. We noted in chapter seven (Table 7.17) that cumulative percentage weight losses after 8 months of storage ranged between 1.6 and 3.9 % for farmers who used pesticides and those who did not use pesticides,[40] respectively. The respective monthly figures with and without pesticide use are as given in Table 7.17 in chapter seven.

(e) Costs of production and marketing

For the 1991/92 production year the Marketing Development Bureau (URT MDB, 1992b:19-20) estimates pure stand maize production costs for a medium technology and in a medium potential area at TSh 16,331/ha. Given the 1991/92 average maize yield of 15.3 bags/ha (Chapter 7, Table 7.6) in sample households farms puts the average production cost per bag at TSh. 1,067 or TSh 11/kg. Marketing costs are negligible given the fact that most farmers marketed their maize within the village of residence. Even though 15 farmers sold maize outside their villages and incurred additional marketing costs these costs are ignored in our analysis These cost elements are summarised in Table 8.14.

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40 We consider here only the maize treated with pesticides or not treated because it was the only pair whose difference in average losses was significantly different at the 5 % confidence level (see Table 7.17).

Table 8.14 **Summary of farm storage cost components in Lula and Mkima villages, Sumbawanga District, 1992/93**

Cost component	Lula	Mkima
Cost of store (TSh)[1]	2,236	1,956
Store capacity (bags)[2]	16	13
Life span of store (yr.)[3]	5	5
Storage duration (months)[4]	8	8
Interest on stored maize (%/yr.)[a]	10-100	10-100
Interest on investment (%/yr.)[1b]	10-100	10-100
Cost of treating grain (TSh)[5c]	1,367(190)	1,060(184)
Losses (%/yr.)[6d]	1.6(3.9)	1.6(3.9)
Costs of production (TSh/bag)[7]	1,067	1,067

[a] Simulated, see description above. Stored grain is initially valued at the harvest price in August. (see Table 8.15).
[b] Simulated as for interest on stored grain. Conventionally charged on half of investment cost (see Gittinger, 1982).
[c] For all stored grain and includes cost of pesticide plus handling costs.
[d] Monthly rates are given in Table 7.17.
Figures in parentheses are for farmers who did not treat grain.

Source:
[1] Appendix 7.1, question 23.
[2] Appendix 7.1, question 20.
[3] Appendix 7.1, question 21.
[4] Appendix 7.1, question 39i.
[5] Appendix 2.1 for the wage rate and Appendix 7.1, question 15c for cost of pesticide.
[6] Table 7.17.
[7] URT MDB, 1992b Review of Maize, Rice and Wheat. Report R2/91. Dar-es-Salaam:19-20.

8.3.3.2 Seasonal farm gate prices

Prices offered at harvest and the price in each subsequent (post-harvest month) are displayed in Table 8.15 and Figure 8.3 for each of the 4 survey villages. These monthly averages are constructed using the weekly price data collected in the respective villages. Goetz and Weber (1986:103) note that, ideally, these prices would be historical averages so that the analysis could be used for making future storage decision. However, data limitations precludes such a long-term analysis. We consider August as our harvest month because our finding in chapter seven showed that the majority of farmers harvested and stored maize between July and August.

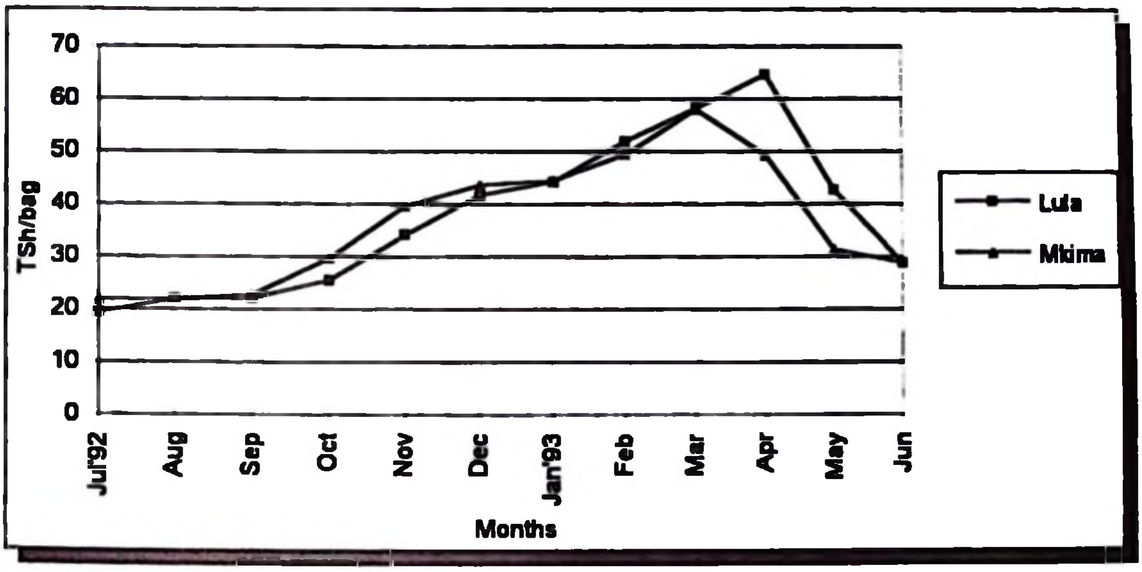
We note from Table 8.15 and Figure 8.3 that prices rose slowly from the harvest months of July and August through the immediate post-harvest months of September and October. Prices then increased rapidly in November, December and January before reaching maximum values in February and March and then after dropping off rapidly to low levels in June. In the next section we attempt to analyse the returns to storage for farmers practising seasonal storage.

Table 8.15 Seasonal farm gate prices for maize in survey villages, Sumbawanga District, 1992/93 (TSh/kg)

	Kankwale	Lula	Mkima	Mtutumbe
1992 July	29.63	19.33	21.88	22.00
August	26.14	21.96	22.02	21.92
September	27.38	22.14	22.75	25.43
October	31.00	25.53	29.70	27.88
November	38.58	34.08	39.65	38.58
December	48.93	41.70	43.58	45.20
1993 January	52.10	44.20	44.44	54.92
February	55.03	51.98	49.55	56.25
March	69.83	58.33	58.08	54.58
April	58.53	64.68	49.33	33.63
May	37.18	42.68	31.34	29.71
June	27.13	28.75	28.85	26.18
Average	41.79	37.95	36.76	36.36

Source: Appendix 8.1

Figure 8.3 **Monthly maize price pattern in Lula and Mkima villages Sumbawanga District, July 1992 - June 1993**



Source: Table 8.15.

8.3.3.3 Returns to seasonal storage

(a) Economics of maize storage

On the basis of the information given in sections 8.3.3.1 and 8.3:3.2 above and by using a series of equations elaborated in chapter four, we worked out the worksheets for the profit (loss) analysis of storage of a kg of maize in every month for the whole storage period. An example of these calculations is attached as Appendix 8.2. Examples of the summary of the economic performance of storage are given in Tables 8.16 and 8.17 and Figures 8.4 and 8.5.

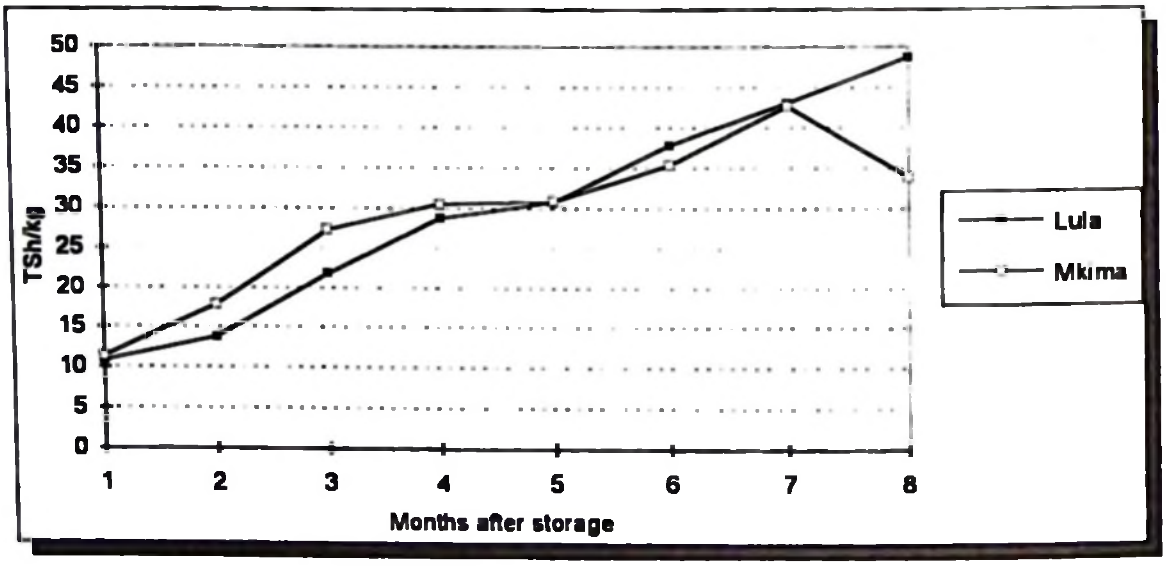
Table 8.16 Net profit[a] from sample households maize production and storage, Sumbawanga District, 1992/93 (TSh/kg)

	Months after storage							
	1	2	3	4	5	6	7	8
Lula	10.81	13.78	21.82	28.69	30.68	37.85	43.10	48.74
Mkima	11.37	17.87	27.26	30.44	30.80	35.35	42.72	33.85

[a] Worked out at 10 % interest and without pesticide treatment.

Source: Appendix 8.2

Figure 8.4 Net profit from sample households maize production and storage, Sumbawanga District, 1992/93



Source: Table 8.16.

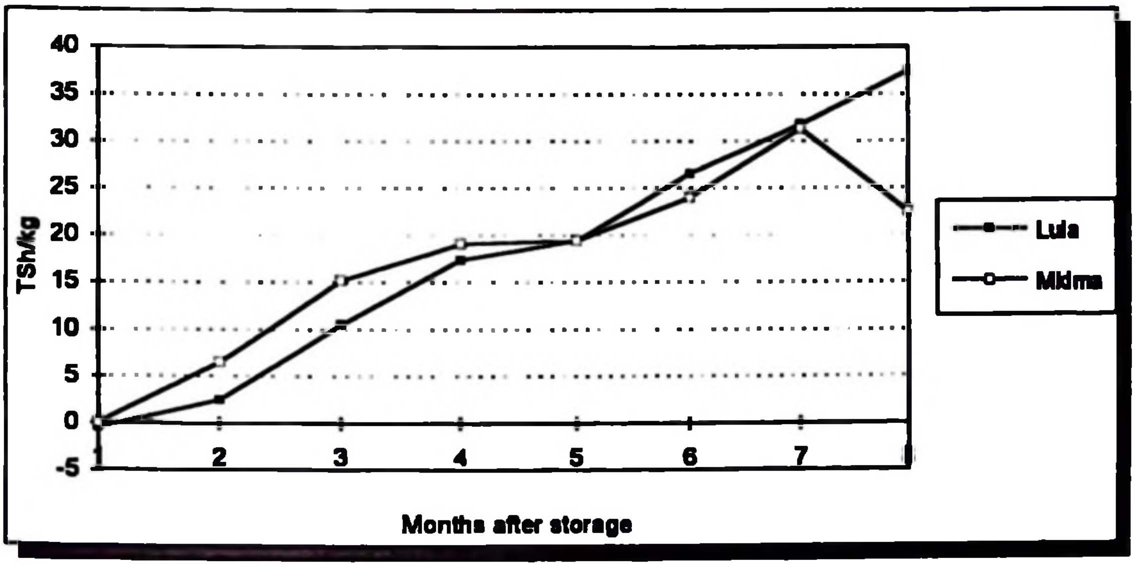
Table 8.17 Net gain)[a] over sale at harvest of maize stored by sample households, Sumbawanga District, 1992/93 (TSh/kg)

	Months after storage							
	1	2	3	4	5	6	7	8
Lula	-0.48	2.49	10.53	17.40	19.39	26.56	31.81	37.45
Mkima	0.02	6.52	15.91	19.09	19.45	24.00	31.37	22.50

[a] Worked out at the 10 % interest and without pesticide treatment.

Source: Appendix 8.2

Figure 8.5 Net gain over sale at harvest of maize stored by sample households, Sumbawanga District, 1992/93



Source: Table 8.17.

We note from the above tables and figures that there are three months of key interest to the farmer who is a seasonal holder of maize: (a) the low-priced month when he will decide to store the maize; (b) the month when he will get the highest profit from selling maize; and (c) the last month in which he can sell the stored maize without a loss. In Sumbawanga district, the farmer has a high degree of certainty that the low-price months will be June, July or August. Similarly, he has a fair degree of certainty that the high-priced month will be about February and March. However, there is little certainty that the seasonal price rise will always cover the storage costs for any given storage period.

The optimal month for selling the maize would have been the seventh and/or eighth month for the two villages when both net profits and net gains over sales are maximised. Net returns with regard to time of selling varied from a loss in the first month in the case of Lula to maximum returns in the seventh and eighth months' of stock holding for Mkima and Lula respectively. In view of the fact that net returns did consistently cover storage costs the price risk involved in holding maize appears to be minimum.

There is, however, a considerable amount of variation in storage profits both between the two villages and between months within a given year. Furthermore, as expected, both profit from production and storage and the net gain over sale at harvest increased consistently with increasing time of storage. The low levels of returns in the early months are a result of the low post-harvest prices and the relatively heavier initial storage costs at the beginning of the storage operation.

(b) Economics of storage with simulation of interest rates

Since it was not very realistic to derive a fixed interest rate for the above analysis, an attempt was made to vary the interest rates and test on how returns to storage varied with the various interest rates. In the simulation farmers in the two villages were grouped into users and nonusers of pesticides and the respective loss figures were used. The results of this simulation in terms of the number of months in which it is profitable to store are summarised in Table 8.18.

Table 8.18 Number of months for which farm storage is profitable[a] at different interest rates, Sumbawanga District, 1992/93

Interest rate	Lula		Mkima	
	With pesticide[b]	Without pesticide[b]	With pesticide[b]	Without pesticide[b]
10	6	6	7	7
30	6	6	6	7
50	6	6	6	6
100	5	5	5	5

[a] Based on the ratio of the sum of harvest price and storage costs to harvest price (see equation 12, p.65) and a 20 % profit margin.
[b] Whether farmers used commercial pesticides or not.

Source: Appendix 8.2.

It is noted that the number of months for which storage is profitable decreases with increasing interest rates. If the inflation rate of 23 % for the period between June 1991 and March 1993 (URT TET, 1993:97) is used to estimate real interest rates (nominal interest rates of between 12-31 % less inflation rate) storage operations will even be more profitable.

An analysis of seasonal price patterns should be used to identify the advantages of medium- to long-term storage in terms of higher prices. Seasonal price increases observed in the district may present incentives to store for localised arbitrage. Why then do farmers store maize meant for selling only for a short time? Three interesting implications can be derived from the above temporal price and storage cost analysis. First, the net seasonal rise in prices exceeds the expected price rises resulting from storage costs[41] reflecting a high degree of technical inefficiency. There is thus an opportunity for farmers practising storage to make excessive profits if they could sell stored

41 χ^2 tests for the difference between observed and expected price increases resulting from storage costs gave significant results ($p < 0.05$) for all simulations and for both treated and untreated maize. This implies that seasonal price increases were consistently and significantly above storage costs.

grain in the lean season. However, our analysis of farmers selling behaviour in chapter seven revealed quite a contrary phenomenon where, regardless of the size of their marketable surplus, farmers sold most maize in the low-price post-harvest seasons. From this point of view it can be suggested that the price increases observed over time are more a reflection of forces of supply of and demand for grain acting on the rural grain markets than a result of storage costs incurred by the storing farmers. Furthermore, it reflects the farmers demand for cash to meet other household purchases and commitments such as debt payments.

Second, farmers storage and marketing decisions are influenced by factors other than motives for profit-seeking. From our perspective these factors would be household food security and the fact that buyers are more available at the harvest and post-harvest quarters. The later may force farmers to sell soon after harvest before their access to markets, through lack of middlemen and road inaccessibility cuts them off from the market.

Thirdly, as Greeley (1978:40) points out, if the storage period is regularly short, because grain stocks are small, the use of a carefully built storage structure or the adoption of storage improvement programmes which may include the use of pesticides will be less likely. Typically, this will be the case for small farmers who cannot justify the expense of construction of proper stores or the use of pesticides. In addition, farmers cash needs and liquidity problems may force farmers to store grain for shorter periods.

(c) Economics of pest control in stored grain

In this section the economics of pest control is studied for the Lula and Mkima villages where grain sampling for loss assessment was carried out. Golob (1984), Greer, (1990), Greene et al., and Barklay and Li (1991) stress that pest control methods must be economically feasible and should not cost more than the value of the resource being protected. To determine the economic damage threshold and the break-even point on grain protection, storage losses are financially valued and are related to costs of grain protection for the storage period. First, an outline of the parameters necessary for this evaluation is provided and then some conclusions on the basis of the analysis are made.

(i) Benefit (output) of use of pesticides

The benefits of a loss-reduction programme are based on two parameters, that is, the level of grain losses which are saved through the programme, and the price difference between the storage time and the time when grain is disposed of. The combined effects of these two parameters determines the value of the reduced losses. For this purpose the loss data were first converted to absolute (kg) weight measure for a bag of maize stored. For example, a loss of 2.33 % after 6 months of storage for untreated grain (Table 7.17) means a farmer loses the equivalent amount of maize in kilograms if he stored one (100 kg) bag at the start of the season. This value could easily be interpolated to get total quantity of grain lost from total amount initially stored by multiplying the percent loss by the stored grain.

Second, the respective farm-gate prices for the storage period were used to effect the valuation of losses. Maize is usually stored at the end of the harvest quarter in August or in the beginning of the post-harvest quarter in September. We therefore consider September as first full month of storage, and as in the foregoing analysis use prices for August as the harvest prices and the prices for September through April, the period for which storage loss data are available and when storage comes to an end, as the off-season prices.

(ii) Costs (inputs) of use of pesticides

Costs of a loss reduction programme are the direct money costs the farmer incurs as a result of the pest control decision. This includes the cost of getting the crop into store and the use of pesticides for those farmers who applied it. For this purpose we apply the costs of treatment figures itemised in Table 8.14

(see section 8.3.3.1). According to figures in Table 8.14 the average handling and treatment costs works out to be TSh 85.44 and 81.54 respectively for Lula and Mkima per bag of stored maize.

(iii) Economic damage threshold

Given the above parameters, at what point could the farmer decide to use pesticides? What benefits did farmers receive as a result of applying commercial pesticides? To answer these questions we first analyse the general relationship between costs of pesticide application and storage losses without pesticide application as presented in Table 8.19 and Figure 8.6. The economic losses of stored maize exceeded costs of pesticide application between the sixth and seventh month of storage. This implies that preventive measures against pests could have only been beneficial for maize stored that long.

Another measure which could be used to evaluate returns to pest control strategies is the economic damage threshold. Under this criteria, pesticide application will increase farmers profit at the point where expected losses exceeds the economic threshold.

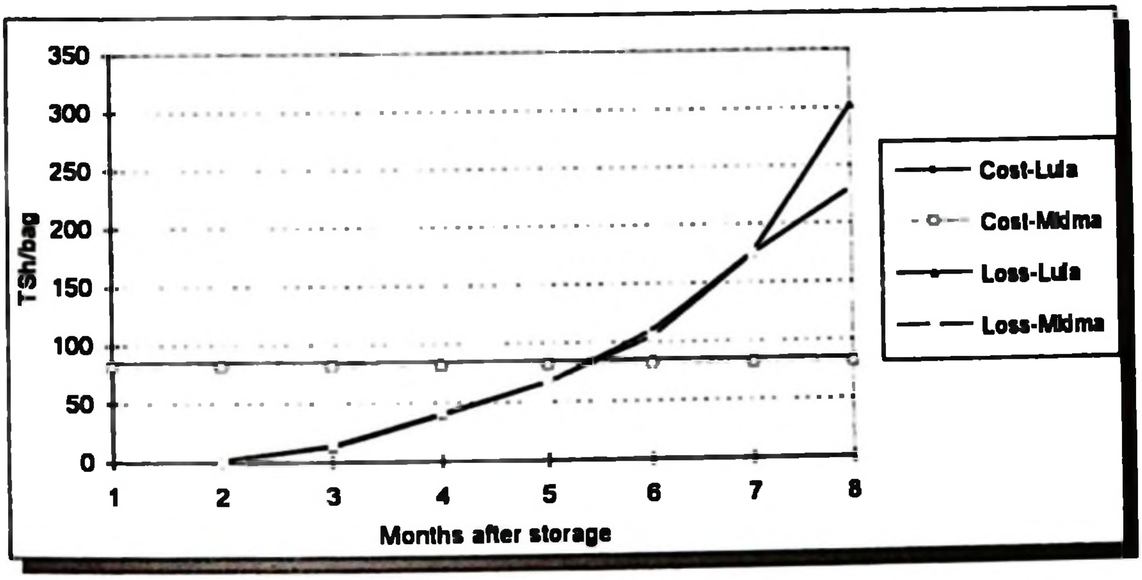
Table 8.19 Economic loss of farm stored maize, Sumbawanga District, 1992/93 (n = 20)

Month after storage	Calendar month	Storage losses (kg/bag)[a]	Storage losses (TSh/bag)[b]		Cost of control (TSh/bag)[c]	
			Lula	Mkima	Lula	Mkima
1	Sep.	na	na	na	85.44	81.54
2	Oct.	0.06	1.53	1.78	85.44	81.54
3	Nov.	0.54	12.61	14.67	85.44	81.54
4	Dec.	1.50	39.62	41.40	85.44	81.54
5	Jan.	1.94	67.18	67.55	85.44	81.54
6	Feb.	2.33	110.20	105.05	85.44	81.54
7	Mar.	3.53	176.16	175.40	85.44	81.54
8	Apr.	3.90	302.70	230.86	85.44	81.54

[a] Cumulative weighted losses for farmers who did not use commercial pesticides (see Table 7.17).
[b] Valued by the appropriate farm-gate prices in Table 8.15.
[c] Obtained by dividing total treatment and handling costs by average storage capacities in the respective villages.

Source: Own survey, 1992/93.

Figure 8.6 **Economic loss of stored maize and costs of pesticide application in survey villages, 1992/93**



Source: Table 8.19.

From the above data pesticide application is only necessary when losses exceed the 2.1-3.0 % range after five and/or six months of storage (Table 7.17). This range compares favourably with the economic thresholds of 3.5, 4.7 and 2.3 % for respectively 1988/89, 1989/90 and 1990/91 after 6 months of storage obtained by Henckes (1992:71) in Arusha and Arumeru districts. This implies that, in areas where the Larger Grain Borer is not prevalent, maize could be stored for up to 6 months without the need for pesticide application.

The foregoing analysis assumes that farmers using pesticides reduces losses to negligible levels. However, given the economic (e.g., high costs of pesticides) and technological (e.g., use of wrong types of pesticides or using less than the recommended application rate of the correct pesticide) problems embedded in pesticide application loss prevention is, in most cases, sub-optimal. As Table 7.17 shows farmers applying pesticides incurred losses of up to 1.57 % after 8 months of storage. In this case benefits derived from pesticide application will be less than the maximum possible. To decide on whether farmers using pesticides really benefited, losses incurred with pesticide application must be netted out of the losses incurred without the use of pesticides. Table 7.20 presents these figures and shows that break-even point for pesticide application at farm level is attained after seven months of storage.

Table 8.20 Economic gain of pesticide application in Lula and Mkima villages, 1992/93 (n = 7)

Month after storage	Calendar month	Storage losses (kg/bag)[a]	storage losses (TSh/bag)[b]		Cost of control (TSh/bag)[c]	
		Lula	Lula	Mkima	Lula	Mkima
1	Sep.	na	na	na	85.44	81.54
2	Oct.	-0.03[d]	-0.77	-0.89	85.44	81.54
3	Nov.	0.20	0.77	0.89	85.44	81.54
4	Dec.	0.97	17.51	18.30	85.44	81.54
5	Jan.	1.21	34.92	35.11	85.44	81.54
6	Feb.	1.24	53.54	51.04	85.44	81.54
7	Mar.	2.17	96.83	96.41	85.44	81.54
8	Apr.	2.33	202.15	153.42	85.44	81.54

[a] Difference of losses for maize treated with commercial pesticides and those not treated. (See Table 7.17 and Footnote 40).
[b] Valued by the appropriate farm-gate prices in Table 8.14.
[c] Obtained by dividing total treatment and handling costs by average storage capacities in the respective villages.
[d] Estimated.

Source: Own survey, 1992/93.

Some interesting conclusions emerge from the above analysis. The decision to treat or not to treat stored grain seems to be dependent on, among other things, the quantity of grain stored and, presumably, the length of storage time and economic factors. The latter is expressed in terms of seasonal price increases for the stored commodity and the costs of pesticide application. A comparative observation of the quantity of maize stored and length of storage from the main sample of 120 farmers seem to support this argument. On average farmers who applied chemical pesticides stored some 28 bags of maize compared to 18.5 for those who either used natural deterrent materials or did not treat grain at all, while the respective storage durations were 7.7 and 6.7 months (Appendix 7.1, questions 35c and 39i).

Lack of funds may also limit the capacity to apply pesticides. 20 % of all farmers interviewed and who did not use pesticides reported that they had no cash to buy pesticides while 16 % said they had only little grain to store (Appendix 7.1, question 5d). The latter case is justified by the fact that stored grain will be finished before the pest problem becomes very serious. As loss assessment results showed, weight losses only became serious after 6 months of storage. Indeed, one farmer considered the use of pesticides a waste of money stating ..."we do not have storage problems ...by the time storage losses become very serious we would have already eaten everything away". It is perhaps due to these economic reasons that new approaches and strategies, including non-chemical methods, of pest control have been devised.

8.4 Implications of maize storage and marketing patterns on food security

In this section we assess the sufficiency of the amount of maize consumed by sample households and assess the overall coping strategy of food insecure households. We limit ourselves to food sufficiency from the farmers' point of view while taking nutritional references only for purposes of confirming our field findings. With this in mind we adopt Ogbu's (1973:317) definition of a 'hungry season' as a period when the resources available do not permit people to satisfy their hunger in a way prescribed by their culture. It is a period of the year when members of a population feel they eat less than they normally would and that what they eat is not what they regard as a good diet. As a result people in the hungry period have, more often, a compelling need or desire for food.

Our aim in this section is: (a) to describe the degree of sufficiency of produced maize for household consumption, (b) to explain the factors which might have caused maize deficiency and determine whether these problems affect households equally, and (c) to examine the coping strategies of deficit households including the contribution of bought and received maize to offset food deficiencies.

In this context households are defined as being production insufficient[42] if they reported exhausting own produced stocks during the 1992/93 harvest and hence rendering the household food deficient before the next crop matured.

8.4.1 Determination of a subsistence level

Analysis of maize sufficiency will require knowledge of the contribution of maize to total household food availability. To determine the consumption adequacy of maize in the survey villages a number of assumptions are necessary: Ideally calorie intake estimation should be based on the nutrient content of each food, adjusted for edible portion (Rogers and Lowdermilk, 1991:463). Food availability should, in turn, be measured by the daily dietary energy and protein intake levels, adjusted for household size and age and gender composition (adequacy level) as recommended by the FAO/WHO/UNU Expert Consultation Group (FAO-WHO-UNU, 1985). However, in Sumbawanga District no nutritional studies for accurate estimation of share of different food groups in total energy supply by age and sex were available.

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42 A more precise definition of food insecurity is given by the World Health Organisation (WHO) which considers an individual consuming less than 80% of the average required daily intake of 2,850 kilokalories (kcals) for a moderately active adult equivalent as food insecure (FAO-WHO-UNU, 1985:76-78).

In a study on food consumption and nutritional adequacy in the neighbouring region of Iringa, Seshamani (1981:9) established that on average foods other than cereals contributed about 20 % of energy in the diet. On the basis of the fact that Iringa and Rukwa regions fall in the same agricultural set up (Rasmussen, 1986:191) this study adopts the figure of 80 % as the contribution of cereals in total energy supply in Sumbawanga District. Since our survey collected consumption quantities for maize an estimation of the proportion of calories from maize, given the above assumption should be possible.

Colorie consumption was estimated based on the energy content of 357 calories per 100 grams of edible portion of white maize (FAO, 1968:12) and the NMC's maize to flour conversion ratio of 90 % (URT MDB, 1992b:26). The average daily calorie requirement for a moderately active adult equivalent (AE) is 2,850 kcal/day (FAO-WHO-UNU, 1985:71-73). According to standards of the World Health Organisation (WHO), a safe minimum daily intake should not fall below 80 % (or 2,280 kcals/AE/day) of this requirement. With these assumptions in mind the minimum daily maize requirements per adult equivalent per day turns out to be some 568 g or a minimum of 207.3 kg of maize (or any grain expressed in maize equivalents) per year. By comparing this minimum requirement to the amount of maize actually consumed by each household member (expressed in AEs), we should be able to assess the maize adequacy for each family. We assume that this is a better basis for assessing maize adequacy than the "Bag Method" proposed by the Tanzania Food and Nutrition Centre (TFNC) (Kavishe, 1991:11). The outcome of this exercise is summarised in the next section.

Households are defined as being production-deficient if the maize stocks immediately following the 1991/92 harvest were below levels required to meet 80 % of the WHO average caloric requirement until the 1992/93 harvest. Reardon and Matlon (1989:119) inform that a household can be production deficient, and either food-secure or food insecure in any given season, depending on (1) the resources available to buy food, (2) the receipt of transfers, (3) the inter-temporal distribution of consumption that it chooses, and (4) the availability of food in the market or community.

Vulnerability denotes dependence on sources outside of production to provide food for the household. These sources include purchases from the market, in-kind transfers and gifts and collection of wild fruits and hunting. Dependence on the former two sources could be very risky because, due to high covariance of production, non-market transfers between households tend to be a positive function of the overall production sufficiency in any given year (Toulmin, 1986:58). Therefore, in years of relatively poor harvests gifts and non-cash transfers are also limited.

8.4.2 Quantities of maize consumed and food adequacy

In our survey own production was the most important source of food maize and carry-over stocks played a minor role in total household food maize stocks. Even though data from our sample households showed that, on average, about one bag of maize was carried over from the previous (1991/92) year about a half of it was held by only eight people out of the total 55 people who declared having had carry over stocks (Appendix 7.1, question 27a). One farmer alone reported having some 25 bags (about 21 %) of all carry-over maize stocks. Furthermore, slightly less than a quarter of the 55 households with maize carry-overs used it for food (Appendix 7.1, question 7b). Most used it for brewing alcohol or sold it to those who brew alcohol.[43] The insignificance of carry-over stocks was further confirmed by the fact that by the end of our survey in May 1993 an average of only a quarter of a bag of maize was reported to be remaining from the 1992/93 maize crop (Appendix 7.1, question 39g).

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43 Carry-over maize was preferred for brewing alcohol rather than fresh maize, presumably because it had a relatively less moisture content and hence better germination quality, an important characteristic for fermentation. Sample farmers reported that because of this factor carry-over maize was exchanged for fresh maize at a one to one and a half ratio.

Largely due to the reasons described in the above paragraph we limit our analysis of food maize sufficiency without consideration of carry-in or carry-over stocks. Maize availability as used here means production declared to have been consumed and bought or gifts received. Results of the estimation of maize sufficiency as described above are presented in Table 8.21.

Our findings suggest a number of facts. First, there is an increased vulnerability of maize deficit households from own production especially among smaller farmers. Table 8.21 shows that the deficit farmers had consistently less area under maize than the surplus farmers. This implies that for smaller maize farmers own produced maize was not sufficient for household consumption. Household sizes were also relatively large for the deficit households. Maize supplies are normally adequate during the harvest season. Food maize needed thereafter for the family is usually stored. The quantity stored may or may not last up to the next harvest, either due to small amounts stored or due to the use of stored maize for purposes other than family consumption.

Table 8.21 Assessment of sufficiency of maize consumed by sample households, Sumbawanga District, 1992/93

Village	Maize sufficiency[a]	No. of households	Ave. family size (AEs)	Area cultivated (ha/AE)
Kankwale	Surplus	10	4.73	0.34
	Deficit	20	6.69	0.26
Lula	Surplus	24	4.46	0.64
	Deficit	6	5.29	0.34
Mkima	Surplus	15	3.87	0.51
	Deficit	15	4.83	0.36
Mtutumbe	Surplus	20	3.15	0.82
	Deficit	10	4.83	0.65
Total sample	Surplus	68	3.99	0.62
	Deficit	52	5.60	0.37

[a] With reference to the minimum required quantities.

Source: Appendix 7.1.

Second, more than half (57 %) of farm households in the villages satisfy their demand for maize through their own production. The remaining had to supplement their household production by means of a number of coping strategies described in the following sections.

The third observation is that there exists food adequacy differences between villages. This implies that even though the observed mean maize intake does not satisfy the recommended maize consumption levels for the majority of households, the extent of the shortfall varies in different villages (Table 8.21). For example, Kankwale village had the highest proportion of households which faced risks of maize insufficiency while Lula had the least. As underlined earlier this analysis was meant to give a general picture of maize sufficiency from the recommended energy intake level point of view. The same analysis is now carried out using farmers own responses.

8.4.3 Maize deficit households coping strategies

Farm households used different strategies to cope with food maize insufficiency. Other studies (e.g. Corbett, 1988:1100; Webb and Reardon, 1992:236) have indicated that strategies are carefully planned to cope with food insecurity. The most important of these strategies are income diversification and adjustment of cropping calendars to space alternative food crop harvesting dates.

In our survey about 41 % of those households which reported maize consumption shortfalls used money from sales of other crops or livestock (Table 8.22). Maize purchases was therefore, by far the most important coping strategy for deficit households. The other important coping strategies were selling labour (33 %), brewing and selling alcohol (10 %) and eating finger millet (8 %). To a lesser extent other coping strategies include the use of salaries for government employees (e.g. school teachers), and money from informal sector activities and leasing oxen.

There are, however, considerable variations on deficit households coping strategies among villages. While the use of money from crop sales dominate in all villages, its emphasis in Kankwale is more remarkable, since 8 of the 11 households which reported maize deficit sold crops to earn money for buying food. The use of money from crop sales imply, by rational assumption, that since maize is the prime agricultural product in the survey villages, it is sold soon after harvest just to be bought back in the lean season. It seems, therefore, that many of the farmers who sell maize at harvest time run out of it later in the season and are forced to buy it back from the market.

Table 8.22 Coping strategies of sample households with insufficient maize for consumption, Sumbawanga District, 1992/93

Coping strategy	Kankwale	Lula	Mkima	Mtutumbe	Total sample	
			No.			%
Money from crop sales	8	4	4	2	18	36.7
Selling labour	1	3	3	4	11	22.4
Brewing and selling alcohol	0	2	2	1	5	10.2
Eating finger millet	1	1	0	2	4	8.2
Selling livestock	1	0	1	0	2	4.1
Informal sector activities	0	1	0	1	2	4.1
Using employment salary	0	0	1	1	2	4.1
Other strategies[a]	0	4	1	0	5	10.2[a]
Total	11	15	12	11	49	100.0

[a] Includes leasing of oxen and ox-ploughs for land preparation.

Source: Appendix 7.1, question 40c.

Thus, early crop sales does not mean that people have always enough to eat. Quite the contrary, it underlines the farmers desperate need for cash soon after harvest. For Kankwale farmers more emphasis is placed on buying from the market, related, no doubt, to its relative proximity to Sumbawanga town. In other villages, such as Mtutumbe, there is a marked reliance of maize deficit households on sales of labour.

It is argued (Renkow, 1990:664-665) that two factors may motivate households to hold inventories of staple foods. First, households might want to minimise their reliance on local markets for the satisfaction of basic food needs, holding stocks of food as a contingency against anticipated supply disruption. Second, inventories of home-produced staples might result from profit-seeking behaviour in response to seasonal price movements for a particular storable commodity. Subject to storage costs and on-farm storage capacity, such arbitrage opportunities could influence the timing of market sales.

One characteristic of the rural economy is especially pertinent to maize in Sumbawanga district and it may significantly affect its marketing. This is: maize, the staple foodstuff that enters into commerce is also an important element in the diets of farmers who produce it. Hunger may result when farmers who have sold their crops in the glutted post-harvest markets find it necessary to buy them back at high prices in the off-season in order to feed their families while waiting for the new crop to mature.

If markets are competitive traders will move maize over space if the difference in prices between two markets equal or exceeds transportation costs and will move maize over time if the expected difference in prices between harvest and the time when maize is to be consumed equals or exceeds storage costs. In this process, competitive movements tend to narrow the difference in spatial and temporal prices to a minimum economic profit margin. Presumably at this margin, spatial price differences would equal (or on average, would not exceed) transport costs, and seasonal price differences from harvest would equal (or on average, would not exceed) storage costs. The analytical task is to determine whether, in fact, these conditions are satisfied. Therefore, the analysis of prices gives an indication of the effectiveness of the physical distribution.

8.4.4 Seasonal maize purchase patterns

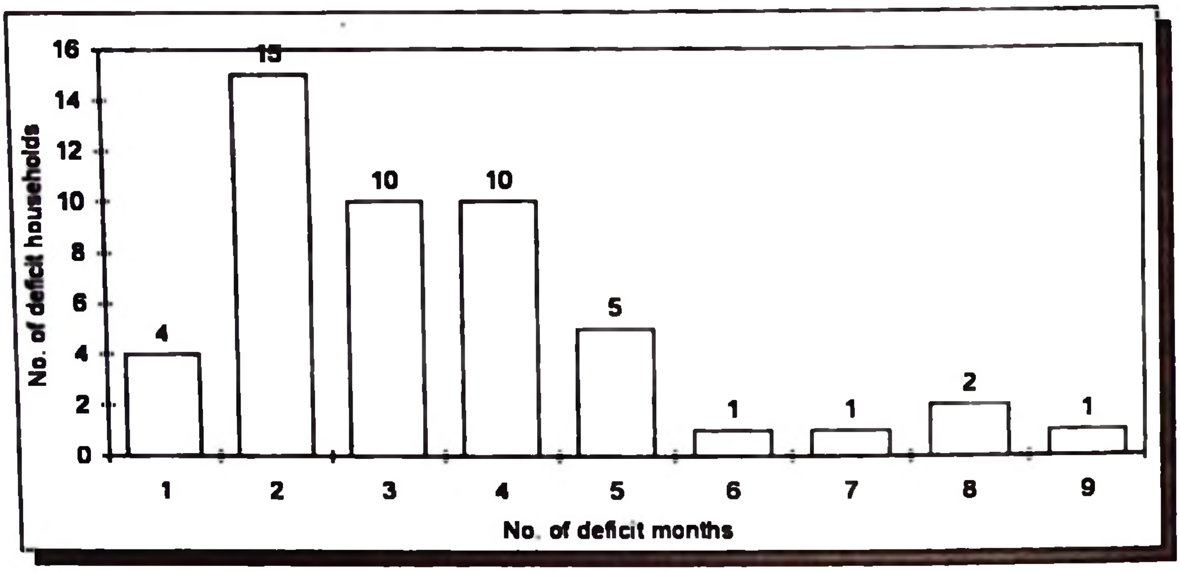
In this section we analyse peasants' seasonal maize purchasing patterns while keeping in mind the sales patterns we discussed in chapter seven. The 41 % maize deficit households ran out of their own maize supply for some months before maize is available from the next harvest (Table 8.23 and Figure 8.7). Surprisingly, half of all 30 survey farmers in Lula reported food maize shortages besides the fact that the households from this village excelled in maize sales (Appendix 7.1, question 40a). Eleven households from both Kankwale and Mtutumbe reported maize deficits while from Mkima 12 of the sample households claimed to run out of consumption maize before the next harvest.

Table 8.23 Maize deficit sample households months when food maize was lacking, Sumbawanga District, 1992/93 (n=49)

Village	Number of deficit months									
	1	2	3	4	5	6	7	8	9	Total
	Number of respondents by number of deficit months									
Kankwale	0	0	0	6	1	1	1	2	0	11
Lula	1	8	5	1	0	0	0	0	0	15
Mkima	2	2	3	2	1	1	0	0	1	12
Mtutumbe	1	3	3	2	2	0	0	0	0	11
Total sample	4	13	11	11	4	2	1	2	1	49

Source: Appendix 7.1, question 40b.

Figure 8.7 Number of maize deficit sample households by number of deficit months, Sumbawanga District, 19992/93 (n=49)



Source: Table 8.23.

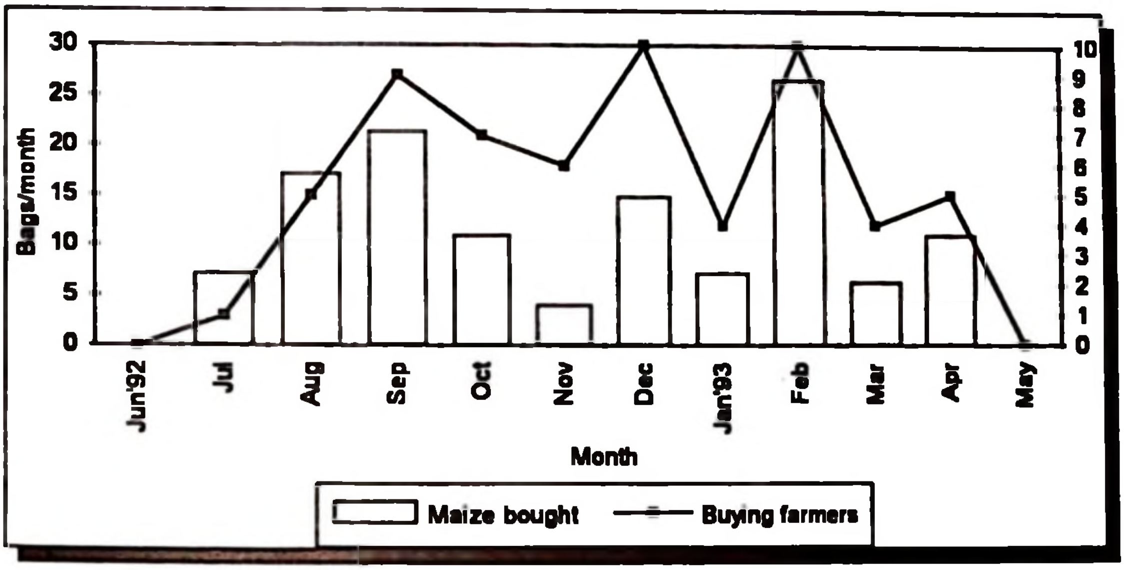
As in chapter seven we divide our year into four quarters for the maize purchase analysis. A summary of the purchase patterns and the portion of maize grain that accrues to each of market channel is given in Table 8.24 and Figure 8.8.

Table 8.24 Quantity of maize bought or received by maize deficit sample households by quarter, Sumbawanga District, 1992/93 (bags) (n=61)

	Jun-Aug	Sep-Nov	Dec-Feb	Mar-May	Total	
					Bags	%
Kankwale	0.2(1)	1.6(3)	20.6(6)	3.9(3)	26.3(13)	20.9
Lula	11.2(2)	10.0(7)	12.0(7)	4.3(3)	37.5(19)	29.8
Mkima	0(0)	20.0(8)	8.9(6)	3.5(1)	32.4(15)	25.8
Mtutumbe	12(3)	4.8(4)	7.0(5)	5.6(2)	29.6(14)	25.5
Total	24.4(6)	36.4(22)	48.7(24)	17.3(9)	125.8(61)	100.0
Figures in parentheses are number of buying households.						

Source: Appendix 7.1, questions 42a, 42b and 42c.

Figure 8.8 **Total monthly maize purchases and number of buying sample households, Sumbawanga District, 1992/93 (n=61)**



Source: Appendix 7.1, questions 42a, 42b and 42c.

The purchasing schedule indicates a high demand at the season of harvest and in the season close to the next harvest. This seasonal pattern corresponds with the households' food security needs and the pattern of grain stock depletion among survey households. It can thus be inferred that households with insufficient maize can buy in the low-price harvest season using money from other sources like livestock or beer sales. On the other hand, the steady rise in demand later in the season, which peaks just before the next crop matures, is attributable largely to rural households running out of their own grain stocks. Immediately after harvest, most farm households consume grain from their own production. As the year progresses as a growing proportion of rural households deplete their maize stocks from own production and demand for grain purchases rises, reaching a second peak during the months just before the next harvest.

Several features of the storage and marketing patterns described above are important in determining food self-sufficiency. We observed in chapter seven that, in the survey villages, some 97 (81 %) farmers reported selling maize. In contrast we also noted in this chapter that 61 (51 %) of all farmers declared receiving or buying maize later in the season (appendix 7.1, questions 42a and 42b). overall, some 20 (17 %) farmers both sold and bought maize within the same production year and appear to have suffered from the sell-low, buy-high phenomenon. Examination of the sources of purchased maize suggest that rural food markets appear to be playing an important role in assuring the food security of rural households (Table 8.20).

Table 8.25 Amount of maize bought or received by sample households by source, Sumbawanga District, 1992/93 (n=61)

	Kankwale	Lula	Mkima	Mtutumbe	Total sample	
	Bags					%
Other farmer	16.2(6)	31.7(16)	31.4(14)	29.6(14)	104.9(49)	83.4
Village trader	0(0)	5.8(3)	1.0(1)	0(0)	10.8(5)	8.5
Sumbawanga trader	10.1(7)	0(0)	0(0)	0(0)	10.0(7)	7.9
Total	26.3(13)	37.5(19)	32.4(15)	29.6(14)	125.8(61)	100
Figures in parentheses are number of households buying or receiving maize.						

Source: Appendix 7.1.

Among maize buying and gift transactions, those occurring within friends, kinship groups or families predominate. In our sample of maize buyers and recipients such transactions were observed in about 80 % of the buying households which accounted for an equivalent proportion of all maize bought or received (Table 8.25). Even though reasons for this pattern of behaviour were not deeply dealt with in this study, one probable explanation is the social dimension of rural life. Ben-Porath (1980:3-8) stresses that the most important characteristic of a family contract is that it is embedded in the identity with the partner, without which it loses its meaning.[44] He argues further that gifts and favours are recognised as a form of exchange often given in order to create an obligation. The exchange of mutual obligation to ensure labour supply among farmers in our survey villages is very common, as stressed in chapter seven. Since Kankwale is very close to the district capital, Sumbawanga, farmers in the village depend, as Table 8.13 shows, to some extent on non-farm cash earning activities and on food bought from the urban market. This implies that there are relatively more market-food-oriented households that, as defined by Phillips and Taylor (1990:1306), acquires the bulk of their food through the exchange of resources such as cash, services, or goods.

Asked about what reasons forced maize-buying households to buy maize, all but 3 of the 61 households buying maize gave low own production as the main reason. Low maize production might not be the real reason, at least for some households, given the fact that a number of the same farmers also sold maize. This observation brings us back to the trade-off farmers in the study area face in dividing the produced maize for food and cash requirements. The three farmers were the only who acknowledged that overselling of own production soon after harvest forced them to buy grain later in the season.

8.5 Concluding remarks

Staatz et al. (1989:711) stresses that cereal prices play a dual role: they act as an incentive to farmers and as major determinants of the real income of consumers. Higher prices may be necessary, at least in the short run, to induce

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44 It is against this background that transaction cost economics explains vertical integration as a response to the difficulties of regulating ongoing relationships by means of contracts. According to Pollak (1985:582) transaction cost analysis of vertical integration posits a situation in which efficiency requires the use of physical or human capital that is specific to the relationship between a particular supplier and a particular customer; since the value of such capital depends on establishing the supplier customer relationship, the willingness of either party to invest in capital depends on assuring the stability of the relationship.

increased cereal production; yet this imposes a heavy cost on low income consumers. This is what is generally referred to as "the food price dilemma" which constitutes the crux of food policy.

Weber et al. (1988:1045) argue that the key to designing effective food security policies is gaining an empirical understanding of how the various actions affect the constraints and incentives facing various groups in the economy and hence influence their behaviour. They point out that policy advocates in most sub-Saharan Africa build up from four assumptions that: (a) farmers are highly price responsive, (b) most farmers are net sellers of food, (c) emphasis on cash crops endangers food security, and (d) there is a private sector ready and willing to fill the vacuum left by the dismantling of parastatals. The above authors (Weber et al. 1988:1045) point out further that the incidence of policies to increase food prices would be highly skewed in favour of a minority of producers who are heavy net sellers of staples. The large number of households which are net buyers, would be harmed by such policies, at least in the short run, while a significant number of households which did not sell or which did not purchase may not be directly affected one way or another. They insist that the food price dilemma is high even in rural areas and put forward a recommendation quite applicable to our situation. Policy makers need to pay considerable attention to non-price as well as price constraints to increased farm production and to increased constraints to increase non-farm income, particularly among food deficit rural households.

It can generally be argued, doubtlessly, that increased prices of cereals will increase incomes of a part of the rural population. In our study, raising cereal prices would benefit approximately a half of the sample households with the bulk of the benefits accruing to the minority of producers who are net heavy sellers of maize, while harming the other half of farmers who are net buyers.

As Mellor (1978) argues about income distribution, in subsistence economies the largest effects, both relative and absolute, fall on the producers with the largest marketings (and presumably with the higher incomes). The effect of a relative change in agricultural prices in producers income depends on (i) the quantity they produce (ii) the quantity of home consumption and hence of marketings, and (iii) the quantity of purchased production inputs. The effect of price changes is much greater in both absolute and percentage terms on larger farms than on smaller farms, since larger farms normally produce more and market a higher proportion of their production. Thus, even though conventionally the basic determinant of supply response is price, at a given point in time an increase in price of maize is fully taken up by peasants selling more maize. A decline in maize prices reduces poor peasants' expenditure for more food purchases. The peculiarity of the elasticity of the marketable surplus of a subsistence crop arises from the fact that the peasant is the producer as well as the consumer of the commodity produced and hence a change in price has a different effect on his income from what it would be if he were a pure consumer.

CHAPTER 9

SUMMARY, CONCLUSIONS AND PROPOSALS FOR FUTURE RESEARCH

9.1 Summary

9.1.1 A revisit of the scope of the study

This work was undertaken under the auspices of a German Academic Exchange Service (DAAD) postgraduate programme in agricultural economics which included, in part, a structured research activity in Tanzania. The main objective of the study was to investigate Tanzanian peasant patterns of maize storage and marketing and the consequent effects of these patterns on efficiency and food security. Specific research objectives, together with research questions and hypotheses, are itemised in chapter one.

Chapters two and three discuss the setting of the maize sector and government maize policy, respectively. Maize is the major food grain in Tanzania in terms of production, consumption and farm income. Production is overwhelmingly concentrated in the hands of smallholders owning, on average, farm sizes of about 2.0 ha (see section 2.2).

Public policy has clearly been successful in promoting maize production. The introduction of HYVs into the smallholder subsector can be attributed to support by government policies and support activities, including the provision of inputs and extension services. Coupled with expansion of area under maize cultivation the government support resulted, on average, in an annual national production increase of about 5% for the period between 1961/62-1992/93 (Table 2.3 and Figure 2.2). However, further potential increases in yield and production at peasant level is still limited by low levels of technology.

Until the mid-1980s, maize pricing, marketing and storage policies fell under official control, nominally accorded to a regulatory agency, the National Milling Corporation (NMC). Chronic liquidity problems coupled with mismanagement, however, led to a decline in real producer prices of maize reaching record decline levels of above 20% during the 1978/79-1983/84 period (Table 3.1). The situation was further exacerbated by delays in NMC payments to producers. This resulted in a disincentive to supply maize and other staples to the NMC. Increasingly, producers diverted sales to the informal market. The result was a severe reduction of the share of grain handled by the government, which traded only about 8% of total maize production between 1970/71-1991/92 (Table 2.4). Government storage policies in the past have been inconsistent and were, in most cases, prompted by fluctuations in national grain production.

In response to the crisis facing the agricultural sector and to simultaneous pressure from the donor community, reforms in the grain marketing sector were instituted as part of broader macroeconomic changes starting from 1984. The reforms legally allowed private traders to participate in grain trade. Other macroeconomic changes included the devaluation of the shilling, removal of consumer subsidies, and increases in real producer prices, thus increasing the margin for agents involved in grain trade. Since then, the role of traders in marketing of staple foodgrains has increased.

Chapter four discusses the theoretical and conceptual framework on the basis of which the study was designed. Concepts of the internal productivity efficiency, structure-conduct-performance model, and the food systems framework were used as the broader basis for selecting parameters for measuring storage and marketing efficiency. In addition, elements of the household model were used to study the peasant trade behaviour. It is underlined in this chapter that, much as they are applied for assessing efficiency in peasant grain marketing systems, the various models still bear some practical limitations to their use and reliability of the results they may provide. This is because the assumptions underlying most of these models are much simpler than conditions seen in reality.

Grain storage systems in sub-Saharan Africa are reviewed in chapter six. Literature cited therein imply that farm storage in much of the region is practised in order to take care of seasonal food supply fluctuations. Farmers make use of traditional storage methods developed over a long period of time. Paraststal storage, when and where attempted, has been limited by soaring storage costs and stock mismanagement. As a result on-farm storage is likely to play a central role in storage for the foreseeable future.

Chapter six discusses the background of the survey district and the methods employed to collect data. The field work was conducted in Sumbawanga district located in south-western Tanzania close to the Zambian border (Map 6.1). Sumbawanga district is located in Rukwa region, one of the 'big' four maize surplus regions in the country. Maize is an important crop in the district occupying about 42% of total land under crop production for the period between 1983/84-1991/92 (Figure 6.2). Due to lack of irrigation, foodgrain production in the district is marked by weather-prone fluctuations dictated by a rainfall regime spreading over some five months (Figure 6.1). Besides its distance from major maize consumption centres like Dar-es-Salaam, the road network within the district and between the district and other areas in the country is chronically underdeveloped (Table 6.1).

Data were collected mainly from primary sources including interviews with 120 farmers and 14 traders, weekly price data for 52 weeks, and monthly loss assessment for 6 months (Table 6.7). These were supplemented by secondary data from district files and from the Ministry of Agriculture in Dar-es-Salaam. Four villages, namely, Kankwale, Lula, Mkima and Mtutumbe were selected for the survey. These villages were characterised for (a) distance; far, intermediate, close to Sumbawanga town, (b) accessibility by road; easily accessible or not easily accessible, and (c) level of maize production; deficit or surplus (Map 6.4 and Table 6.5). The fieldwork was conducted for 9 months between August 1992 and May 1993.

9.1.2 Summary of results

The main findings of the case study are reported in chapters seven and eight and are summarised below.

(a) Patterns of maize storage and marketing

The agricultural system in Sumbawanga district depends on exchange of resources in both production and consumption. Both cultivation and storage are based on local practice; and, apart from the use of some fertilisers in production and some pesticides in storage, modern methods of cultivation and storage have virtually not been adopted.

Food maize is mainly stored in the *kihenge*, a traditional structure made of local materials widely available within the village environs. Maize meant for sale is mainly stored in gunny bags. Although in aggregate terms half of the stored maize is used for each consumption and marketing, maize stored for food is kept for relatively longer periods of time until the next crop matures.

The levels of storage losses were generally low even in cases where no pesticides were used to protect stored grain. After the average storage time of between six and eight months losses averaged 1.6% of stored grain for maize treated with commercial pesticides, 5.5% for maize treated with natural deterrent materials and 3.9% for untreated maize (Table 7.17).

Maize sales are concentrated in the first six months after harvest when prices are lowest. Of all the amount of maize marketed 51% was sold in June-August, 33% in September-October, 11% in December-February and 5% in March-May (Table 7.27). This pattern is however not extreme because some smaller farmers avoided selling all of their marketed surplus in the harvest quarter when most of the larger farmers sold most maize. The main reasons for this pattern of sales are liquidity problems, insufficient storage capacity for bigger farmers and unreliable market outlets in the lean season.

Over 90% of all marketable maize surplus was sold in the farmers living villages through traders based either in the villages or in Sumbawanga town (Table 7.32 and Figure 7.6). The rest was sold to maize-deficit households in the villages. The small village traders sold maize to wholesalers who in turn sold it to retailers in Sumbawanga town markets or to transporters who transferred grain to distant markets in other regions of the country. Retailers sold grain directly to consumers.

Since liberalisation, traders participation in the grain market has increased. However, there are still a number of structural problems, notably poor infrastructure and liquidity problems which limits the volume and scope of their trade. The government plays a very limited role in buying grain through the Strategic Grain Reserve.

(b) Factors affecting the marketed surplus of maize

Maize sales contributed about 40% of the sample households cash income for the 1992/93 season (Table 8.2). The allocation of maize between sales and consumption was found to be largely a function of the size of household and maize production: the smaller the family size and the higher the level of maize harvested the larger will be the proportion of maize sold and the smaller will be the proportion consumed (Tables 8.5 and 8.6). Price did not seem to be an important factor determining the level and timing of marketed surplus. Maize price was only a significant factor determining the marketed surplus for the smaller farmers and even in this case maize supply was relatively price inelastic.

(c) Market efficiency

The market efficiency analysis revealed four main results: first, rural markets for maize in Sumbawanga district are generally integrated to the town market. However, the degree of integration differs between villages depending on the distance of individual villages to the town markets and road accessibility. With some exceptions, it was generally noticed that the nearer and the more accessible a rural market to the town market is, the higher is the degree of market integration and *vice versa* (Table 8.8).

Second, even though price differences between rural markets and town markets were largely a function of the grain transfer costs, there seems to be a very minimum possibility for profit maximisation in maize trade within Sumbawanga district. The difference between transfer costs and the farm-retail marketing margin ranged between 2 and 7% of the Sumbawanga town consumer prices.

Third, as a result of the big seasonal price increases and the low costs of storage the temporal pricing efficiency is low and the price difference between the harvest price and the off-season price is consistently higher than the storage costs. However, the temporal price inefficiency is higher when the nominal interest rate ranges between 10 and 50% or when the real interest rate lies below 30 percent of the opportunity cost of capital tied in the stored grain (Table 8.18).

Fourth, technical storage efficiency viewed from the relationship between weight losses and costs of loss prevention is high. The benefit-to-cost ratio for loss prevention is small and is greater than one only after five or six months of storage (Table 8.20).

(d) Implications of maize storage and marketing on food security

As a result of the storage and marketing patterns 40% of the sample households did not have enough maize to meet their minimum daily energy requirements. These were mostly the smaller farmers with large family sizes (Table 8.21). To meet their grain demand these maize deficit households were forced to buy grain, mostly in the high-price season between December and February (Table 8.25).

9.2 Conclusions

The empirical results of this work support some generalisations which could have important policy implications for the study area in particular and the whole country in general.

1. The seasonal grain sales and purchases observed in the four survey villages supports the fact that semi-subsistance farmers sell most grain in the low-price post-harvest season and buy in the high-price pre-harvest season. Although a few small farmers avoided selling all the maize they sold in the lowest price harvest months, the majority of large farmers were affected negatively by seasonal price movements because they sold most of their grain in these months. Maize purchases for the poor families with insufficient maize were largest during the December-February quarter, when maize prices more than doubled. This implies that dependency on the market for poor families facing food shortages could be very risky.

2. In addition to purchasing grain another important strategy for coping with maize deficit households was selling labour. Seasonal food deficits are more pronounced in the cropping seasons between December and April when, presumably energy for cropping activities is more necessary. Since most maize deficit households were resource poor there is a high potential for cyclical low

productivity among them for two reasons. First, low energy intakes reduce their capacity to work. Second, by opting to work for food in other households farms they remain with insufficient time to attend to their own farms.

3. Since the supply response analysis did not show price to be a dominant factor determining the marketed surplus of maize it seems that there is little scope for the government to use prices as a policy instrument to alleviate rural poverty and food insecurity. Instead this survey underlined that resource endowment had a direct influence on the level of maize production, sales and consumption and efforts to increase maize production through the provision of inputs and credit or the creation of alternative off-farm income earning opportunities are likely to have more positive results.

4. Although the general approach to the problem of improving grain marketing in Tanzania has been to draw up common pricing and marketing policies for all small-scale farmers, it is evident from the results of this study that problems can be quite different depending on the season, geographical location and individual farmers resource endowment. This justifies the need to desegregate households by their geographical, wealth and demographic characteristics in order to assess the capacity of different types of farmers to respond to the reforms.

5. That most maize in the survey villages was sold through traders underscores the importance of the private sector as a market outlet for farmers. It was apparent, however, that the limited number of traders, especially in the remote villages, severely reduced competition in the market. As a result prices in the villages were generally low and volatile.

6. Although traders do not participate in storage operations due to high costs for investment in storage facilities, it is doubtful, given the thinness of the maize market within Sumbawanga district, whether traders will actually invest in storage facilities even if credit facilities are available. Instead increased capital

outlays are likely to increase their motivation for participating in interregional trade - a measure which could be counter productive to the district's food security objectives, if much of its maize production will continue to flow out of the district.

7. The relatively good degree of market integration within Sumbawanga district have some positive implications for food security and possibilities for increases in income. Improvements in road infrastructure can lead to an increase in the trader activities in marketing and the integration of farmers to the market economy. This can in turn lead to intensification of agricultural production, and an increase in farm income and food security. A legalisation of cross-border export trade to villages close to Zambia can be more significant to rural areas which are relatively less integrated to the Sumbawanga town markets.

8. The high seasonal price rises in the survey villages and the lack of speculative storage at farm and trader level within Sumbawanga district may indicate a possible higher maize demand outside the district at harvest time. This is however an open empirical question.

9. The relatively high technical efficiency observed in grain storage technology calls into question the need for concerted efforts in loss reduction measures involving high investment and operational costs. Unless the survey area becomes infested with the Larger Grain Borer (*Prostephanus truncatus* Horn), extension advice on proper drying, handling, and hygiene of storage structures are sufficient to keep losses below the economic damage threshold of between 2 and 3 percent. In addition, storage losses of above 3% only occur after five or six months of storage when the reserves of most farmers have been exhausted.

10. The role of the government to stabilise maize markets after liberalisation is not yet defined very clearly. Liberalisation policies in Tanzania were implemented together with price decontrols and the institution of a minimum support price for farmers especially in the remote regions like Rukwa. The minimum policy alternative failed because the government had limited resources to guarantee the support price. In addition, the majority of farmers could not benefit from the support price because it was only available at the town based SGR depots where, due to transport problems, the majority of farmers could not sell their grain. Furthermore, the maize market in the district is thin because even the SGR can only buy a limited amount of grain.

9.3 Suggestions for future research

Although the findings of this research are based on a detailed cross-section data set, the data set itself was never designed to be representative of rural Tanzania as a whole nor to give a long-term impression of peasant grain storage and marketing. It is therefore difficult, if not impossible, to generalise the results presented here. In particular, since the study area was chosen because it is a remote maize surplus district, it is likely that grain storage and marketing patterns - as well as the implications of these patterns on rural incomes and food security - are not as they would be in more 'representative' rural districts in Tanzania. For this reason, it is useful to develop data sets which are both sufficiently long term and broadly representative enough to test the robustness of the findings from this study. Four specific areas of further research are proposed:

1. Food security

Although this study established that food insecurity differs by household wealth, season and demographic characteristics, mainly family size, the way in which the existing farming systems incorporate risk-reducing strategies has not fully been explored. As Reardon and Matlon (1989:135) point out, gross measures such as yields or rainfall deficits poorly reflect the degree of food insecurity where there are important regional differences in the structure of production and in farm-level purchasing power. Risk-reducing strategies in Sumbawanga District include extensive farming systems, finger millet cultivation, and gathering. While such practices could be plausible in remote areas such as Mtutumbe, their efficiency in the villages close to towns such as Kankwale may be reduced by population pressure and the resultant limitations in arable land. These dynamics were not covered in this research.

2 *Market integration*

Further insight into market integration is important to understand how liberalisation policies have influenced different markets in the country. Since liberalisation, private traders have been allowed to operate freely in grain markets. The market integration section in this study is limited in both geographical coverage and time scope. In addition, concentration of maize production and marketing in the past were largely influenced by official interventions with welfare objectives to satisfy both producers and consumers simultaneously. As a result the transmission of price signals was centred in major grain demand areas, notably Dar-es-Salaam. To date it is not yet clear to what extent prices after liberalisation in Tanzania reflect information flow more efficiently and hence the transfer of incentives to different market participants.

In addition, even though the market integration results in this study conformed to theoretical expectations, some contradictions could not be fully explained. This reflects apparent weaknesses in the theory and methodology used. In line with the challenges pioneered by Palaskas and Harriss-White (1991) further insight is needed into how the market integration theory is developed in order to explain, as much as possible, how empirical results obtained by using the different theories reflect existing market conditions.

In 1994 such efforts were initiated by the Institute of Agricultural Policies Marketing and Agricultural Development of the Humboldt University of Berlin by forming the African Domestic Agricultural Market Integration Research

(ADAMIR) group to address this problem in the East African region. Time-series price data collected by respective Ministries of Agriculture, such as the MDB from different regions of Tanzania, could be screened and used to test and improve the different market integration methodologies and theories.

3. *Trader survey*

Due to the limited number of observations the role and activities of traders could not be exhaustively discussed in this study. A deeper analysis of trader activities will assist in the understanding of the exact role of traders in grain marketing under liberalisation and identify possible areas of assistance so as to make them perform their functions more efficiently. The recognition of the role of wholesalers as integrating traders makes it necessary to link the trader survey to the market integration survey discussed above. Of great interest here is the economics of the private traders marketing of maize from Sumbawanga district in other regions of Tanzania especially Dar-es-Salaam.

The lack of micro-level time series data on production, quantities stored, prices and marketed surplus precludes a quantitative analysis of how different categories of farmers and traders respond to liberalisation. Despite this problem it would be wrong, as Brandt (1984:108) argues, to invest in storage capacity on a large scale without a minimum knowledge of these statistics. More should at least be known about farmers' and traders' storage and marketing decisions in relation to market prices so that the possibility and substitutability of the parastatal sector for private storage may be fully understood.

4. *Area and crop specific storage studies*

Probably, as argued by Greeley (1978:40) in his study on farm-level storage in India, the most significant policy factor in considering farm level storage is the degree of variability, of both the incidence and the form of factors affecting storage losses. All storable crops have biological and physiological differences that affect their susceptibility to certain causes of loss. Agroclimatic conditions differ widely. Types of structure used, length and purpose of storage, grain treatment (e.g. use of pesticides) and pre-storage practices are all important variables affecting storage losses. The importance of these regional and crop variations immediately determines certain necessary characteristics of crop storage research. There is, on scientific grounds alone, the need for localised research and a correspondingly decentralised implementation programme.

Storage and marketing arrangements are likely to be crop and area specific. To obtain a more representative picture it is important to conduct a number of similar studies in other areas of the country and for other types of crops. Furthermore, this study was limited to an area in which maize is both a food and a cash crop. The storage and marketing pattern observed here might differ substantially from situations which could prevail under circumstances where farmers face a more pronounced trade-off between food grain and cash crop cultivation. Studies which could shed light on to these aspects will facilitate marketing improvement proposals that are more realistic.

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APPENDICES

APPENDIX 2.1

SELECTED MAIZE STATISTICS, TANZANIA, 1961/62 - 1988/89

Category	Type of statistic	Statistic
General indicators	1. Estimated population, 1989 (million)	26.3
	2.. Estimated growth rate of population, 1987-2000 (%/a.)	3.4
	3. Per capita income, 1988 (US$)	160
	4. Per capita cereal production, 1986-88 (kg/a.)	159
	5. Growth rate of per capita cereal production, 1973-77 to 1984-88 (%/a.)	1.9
Maize production	6. Maize area harvested, 1986-88 (000 ha)	1,665
	7. Maize yield, 1986-88 (t/ha)	1.5
	8. Maize production, 1986-88 (000 t)	2,495
	9. Growth rate of maize area, 1962-66 to 1973-77 (%/a.)	1.9
	10. Growth rate of maize area, 1973-77 to 1984-88 (%/a.)	2.9
	11. Growth rate of maize yield, 1962-66 to 1973-77 (%/a.)	2.4
	12. Growth rate of maize yield, 1973-77 to 1984-88 (%/a.)	3.5
	13. Growth rate of maize production, 1962-66 to 1973-77 (%/a.)	4.3
	14. Growth rate of maize production, 1973-77 to 1984-88 (%/a.)	6.5
	15. Estimated percentage of white maize, 1988-89 (%)	100
	16. Maize area as a percentage of total cereal area, 1986-88 (%)	57
	17. Average yield of all cereals, 1986-88 (t/ha)	1.3
	18. Growth rate of yield of all cereals, 1962-66 to 1973-77 (%)	1.4
	19. Growth rate of yield of all cereals, 1973-77 to 1984-88 (%/a.)	3.0
Trade and utilisation	20. Net imports of maize, 1986-88 (000 t)	-75
	21. Net imports of maize per capita, 1986-88 (kg/a.)	-3
	22. Per capita total maize utilisation, 1986-88(kg/a.)	99
	23. Growth rate of per capita maize utilisation, 1962-66 to 1973-77 (%/a.)	1.8
	24. Growth rate of per capita maize utilisation, 1973-77 to 1984-88 (%/a.)	2.1
	25. Percentage food use of maize, 1985-87 (%)	92
	26. Percentage feed use of maize, 1985-87 (%)	2
	27. Percentage other use of maize, 1985-87 (%)	7
Productivity factors	28. Area planted to unimproved local varieties as a percentage of total maize area, 1988 (%)	83
	29. Area planted to OPVs as a percentage of total maize area, 1988 (%)	6
	30. Area planted to hybrids as a percentage of total maize area, 1988 (%)	11
	31. Fertiliser applied to maize, 1988-89 (kg nutrients/ha)	70
	32. Fertiliser applied to all crops, 1986 (kg nutrients/ha)	8
	33. Growth rate of fertiliser applied to all crops, 1970 to 1986 (%/a.)	5.9
Prices	34. Farm price of maize, 1988/89 (US$/t)	92
	35. Ratio of farm-level nitrogen price to maize price, 1988/89	6.0
	36. Farm wage in kg of maize per day, 1988/89	5

Source: CIMMYT (1990) 1989/90 CIMMYT World Maize Facts and Trends: Realising the Potential of Maize in Sub-Saharan Africa. Mexico D.F.:47.

APPENDIX 2.2 **ESTIMATED PRODUCTION OF FOOD GRAINS, TANZANIA, 1961/62-1992/93** **(000 T)**

Production Year[a] (1)	Maize (000 t) (2)	Paddy (000 t) (3)	Wheat (000 t) (4)	Sorghum (000 t) (5)	Millet (000 t) (6)	Total of preferred[b] staples (000 t) (2+3+4)	Maize as % of total of preferred[b] staples (2)/(2+3+4)	Total of all grains (000 t) (2+3+4+5+6)	Maize as % of total of all grains (2)/(2+3+4+5+6)
1962	457	94	6	-	-	557	82	-	-
1963	475	104	18	-	-	597	80	-	-
1964	378	183	25	-	-	586	65	-	-
1965	589	120	27	-	-	736	80	-	-
1966	513	84	23	165	131	620	83	1023	50
1967	739	130	39	127	165	908	81	1369	54
1968	551	104	31	153	122	686	80	1096	50
1969	638	126	44	126	110	808	79	1214	53
1970	488	132	41	107	138	661	74	1079	45
1971	719	171	57	149	138	947	76	1462	49
1972	621	187	60	164	128	868	72	1407	44
1973	887	301	88	130	136	1276	70	1931	46
1974	761	223	85	230	88	1069	71	1695	45
1975	1367	265	82	330	160	1714	80	2551	54
1976	1449	346	69	260	130	1864	78	2669	54
1977	1664	314	64	521	220	2042	81	3161	53
1978	1465	387	55	451	319	1907	77	3119	47
1979	1720	262	70	500	335	2052	84	3219	53
1980	1726	291	87	500	380	2104	82	3362	51
1981	1839	200	90	525	350	2129	86	3294	56
1982	1654	320	95	554	373	2069	80	3411	48
1983	1651	350	58	475	320	2059	80	3262	51
1984	1939	356	74	455	305	2369	82	3559	54
1985	2093	427	83	615	410	2603	80	4138	51
1986[1]	2672	418	98	384	301	3188	84	4389	61
1987[1]	2748	511	72	363	250	3331	82	4527	61
1988[1]	2422	782	75	424	222	3279	74	4782	51
1989[1]	2527	767	81	410	217	3375	75	4850	52
1990[1]	2519	736	106	537	192	3361	75	4932	51
1991[1]	2259	406	84	750	203	2749	82	4192	54
1992[1]	2112	370	64	589	249	2546	83	3818	65
1993	2634	620	83	857[c]	-	3337	79	4897	54

[a] Refers to end of a July-June production year. [b] Maize, rice and wheat are liked more than millet/sorghum. [c] Includes millet.
"-" Not available/applicable.

Source: URT TET. (1993) Tanzania Economic Trends: A Quarterly Review of the Economy 6(1/2):112.
[1] URT MALDC (1992) Basic data: Agriculture and Livestock, 1985/86-1990/91:31-33.

APPENDIX 2.3

MAIZE PRODUCTION BY REGION, TANZANIA, 1985/86-1992/93[a]

(000 t)

Region	1986	1987	1988	1989	1990	1991	1992	1993[1b]	Mean
Arusha	365	493	200	378	229	153	157	144	265
Coast/DSM	35	37	29	14	33	18	7	17	24
Dodoma	25	61	59	61	36	54	21	33	44
Iringa	236	230	277	278	457	320	455	549	350
Kagera	41	84	34	38	94	56	28	48	53
Kigoma	67	64	43	45	54	94	49	78	62
Kilimanjaro	303	157	31	30	64	64	45	60	94
Lindi	14	22	11	18	18	26	23	23	19
Mara	62	65	33	20	21	20	32	35	36
Mbeya	279	292	233	311	275	239	288	370	286
Morogoro	126	116	134	122	186	61	65	135	118
Mtwara	42	33	55	35	46	45	30	34	40
Mwanza	107	163	175	158	72	158	109	136	135
Rukwa	195	170	182	181	160	120	217	228	182
Ruvuma	202	195	227	249	212	213	231	242	221
Shinyanga	238	175	345	320	312[c]	305	188	199	260
Singida	37	68	48	48	60	57	28	83	54
Tabora	124	185	203	120	155	174	82	126	146
Tanga	174	138	103	101	35	82	57	56	93
Total	2,672	2,748	2,422	2,527	2,519	2,259	2,112	2,596	2,482

[a] Refers to end of July-June production year.
[b] Provisional. [c] Estimated.

Source: URT MALDC (1992) Basic data: Agriculture and Livestock Sector, 1985/86-1991/92:31-33.

1 URT MALDC. Basic data : Agriculture and Livestock Sector, 1986/87-1992/93, unpublished draft.

APPENDIX 2.4

AREA UNDER MAIZE CULTIVATION BY REGION, TANZANIA, 1985/86 - 1992/93[a] (000 ha)

Region	1986	1987	1988	1989	1990	1991	1992	1993[1b]	Mean
Arusha	111	156	156	161	153	128	133	113	139
Coast/DSM	25	21	20	19	15	21	15	19	19
Dodoma	18	43	43	47	46	58	30	50	42
Iringa	135	144	180	152	257	274	305	305	219
Kagera	31	65	49	47	58	27	36	46	45
Kigoma	45	36	41	40	45	65	44	47	45
Kilimanjaro	131	61	34	30	22	56	123	48	63
Lindi	26	38	21	18	8	19	22	25	22
Mara	34	38	22	30	17	19	28	28	27
Mbeya	116	121	131	129	179	197	197	185	157
Morogoro	72	86	76	72	89	123	91	111	90
Mtwara	22	43	47	45	17	34	31	33	34
Mwanza	127	89	106	143	113	153	139	146	127
Rukwa	62	63	73	82	71	112	122	121	88
Ruvuma	104	110	126	140	135	125	122	140	125
Shinyanga	229	246	269	256	270	199	201	195	233
Singida	25	47	49	46	31	47	51	56	44
Tabora	144	96	118	110	115	113	85	84	108
Tanga	121	117	114	103	88	71	24	42	85
Total	1,578	1,620	1,675	1,670	1,729	1,841	1,799	1,794	1,713

[a] Refers to end of a July-June production year.
[b] Provisional.

Source: URT MALDC (1992) Basic Data: Agriculture and Livestock Sector 1985/86-1991/92:31-33.

1 URT MALDC. Basic Data: Agriculture and Livestock Sector, 1986/87-1992/93. Unpublished Draft.

APPENDIX 2.5

MAIZE PRODUCTION, GOVERNMENT PURCHASES AND IMPORTS, TANZANIA, 1962 - 1993

Year[a]	Production (000 t)[1]	Government purchases (000 t)[b]	Government purchases % of production	Net imports[1b] (000 t)	Self sufficiency ratio[c]
1962	457	-	-	68[4]	87.9
1963	475	-	-	28[4]	94.4
1964	738	109	14.8	-36[4]	105.1
1965	589	80	13.6	2[4]	99.7
1966	513	70	13.6	15[4]	97.2
1967	739	108	14.6	7	99.1
1968	551	105	19.1	-1	100.2
1969	638	130	20.4	-32	105.3
1970	488	47	9.6	19	96.3
1971	719	175	24.3	-24	103.5
1972	621	43	6.9	63	90.8
1973	887	96	10.8	79	91.8
1974	761	74	9.7	291	72.3
1975	1367	24	1.8	225	85.9
1976	1449	91	6.3	107	93.1
1977	1664	127	7.6	42	97.5
1978	1465	213	14.5	34	97.7
1979	1720	220	12.8	-49	102.9
1980	1726	161	9.3	5	99.7
1981	1839	105	5.7	275	87.0
1982	1654	89	5.3	235	87.6
1983	1651	86	5.2	123	93.1
1984	1939	71	3.7	194	90.9
1985	2093	85	4.1	128	94.2
1986	2672	178[3]	6.7	6	99.8
1987	2748	178[3]	6.5	94	96.7
1988	2422	235[3]	9.7	-91	103.9
1989	2527	106[3]	4.2	-19[5]	100.8
1990	2519	150[3]	6.0	-30[5]	101.2
1991	2259	36[3]	1.6	-55[5]	102.5
1992	2112	37[3]	1.8	0[5]	100.0
1993	2634	-	-	-	-

"-" Not available/applicable.
[a] Refers to end of a July-June production or marketing year.
[b] Net imports: total imports including food aid minus exports.
[c] [Domestic production/(Domestic production + imports - exports)] × 100. Calculated after Ahmad (1988:26).

Source:
1. Appendix 2.2.
2. URT MDB (1988) Annual review of maize, rice and wheat. R2/88:10,18.
3. URT MALDC (1992) Basic data: Agriculture and livestock sector, 1985/86-1991:66.
4. Kriesel et al (1970) Agricultural marketing in Tanzania: Background research and policy proposals:21.
5. URT MDB (1992a) The wholesale trade in grains and beans in Tanzania:26.

APPENDIX 2.6

PURCHASES OF MAIZE BY OFFICIAL CHANNELS[a] BY REGION, TANZANIA, 1985/86-1991/92[b] (000 t)

Region	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92
Arusha	36	46	70	26	41	6	1
Coast/DSM	.	.	.	2	2	.	.
Dodoma	12	7	26	25	35	.	.
Iringa	38	36	62	29	41	16	23
Kagera	.	1	.	.	.	.	.
Kigoma	.	1	.	.	.	.	.
Kilimanjaro	1	.	2	.	.	.	1
Lindi	1	1	.	1	1	.	.
Mara	.	.	2	.	.	.	.
Mbeya	16	12	14	1	2	5	2
Morogoro	.	1	1	2	3	3	.
Mtwara	1	.	.	.	.	.	.
Mwanza	5	2	2	.	.	.	.
Rukwa	29	28	18	5	7	6	1
Ruvuma	29	22	16	8	10	.	2
Shinyanga	3	4	.	.	.	.	6
Singida	5	5	10	7	8	.	.
Tabora	1	2	1	.	.	.	1
Tanga	1	4	11	.	.	.	.
Total	178	172	235	106	150	36	37

[a] Purchases by NMC, Co-operatives and Strategic Grain Reserve (SGR).
[b] Refers to July-June marketing year.
"." Negligible- < 0.5 t.

Source: URT MALDC (1992) Basic data: Agriculture and livestock sector. 1985/86-1991/92:66.

APPENDIX 6.1

ROAD CONDITION, DISTANCE AND TRAVEL TIME FROM SUMBAWANGA TOWN TO SELECTED VILLAGES[a], SUMBAWANGA DISTRICT, 1992/93

Village	Road condition[b]	Distance (km)	Travel time[c] (minutes)
Mpui	A	65	70
Ulumi	C	103	180
Ngorotwa	C	108	160
Mwanzye	B	61	95
Milanzi	B	10	20
Kalembe	C-D	157	190
Lyapona	B	46	70
Ulinji	A	17	25
Kaengesa	B	39	50
Ikozi	A	74	85
Katazi	B	73	120
Miangalua	A	115	35
Tamasenga	B	23	30
Malolwa	A	52	60
Mambwekenya	C-D	128	180
Matai	B	51	70
Milepa	C-D	118	140
Msanzi	B	38	45
Kizombwe	C	59	80
Kipeta	C-D	166	190
Matanga	A	16	15
Mwimbi	C	90	150
Lusaka	A	94	110
Muze	C	50	110
Ntendo	A	12	15
Kasense	C	18	25
Laela	A	105	120
Tatanda	B	84	120
Songambele	C-D	45	50
Kalamazite	A	80	95
Mtowisa	C-D	79	120

[a] Formaly headquarters of Primary Co-operative Societies.

[b] A-Gravel road, good even during rainy season.
B-Gravel road, becomes difficult durind rainy season.
C-Earth road, passable during rainy season only by a four wheel drive car.
D-Tracks, during rainy season impassable even by a four wheel drive car.

[c] By a Land Rover car during the dry season.

Source: Rukwa Regional Agriculture and Livestock Development Office, Sumbawanga. Unpublished draft.

APPENDIX 6.2 AVERAGE MONTHLY RAINFALL AND RAINY DAYS, SUMBAWANGA DISTRICT, JANUARY 1980-DECEMBER 1992[a]

Month	Year														
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989[1]	1990[1]	1991[1]	1992[1]	Mean	Rainy days[b]
January	214	121	173	176	570	73	402	228	261	118	80	133	225	213	15
February	58	188	92	133	80	190	137	156	181	107	103	198	120	134	11
March	176	179	147	133	113	152	212	95	203	210	194	99	155	159	14
April	136	26	153	46	47	119	74	108	47	141	129	103	102	95	13
May	3	5	28	20	2	1	19	69	0	34	7	3	12	16	9
June	0	0	1	0	0	0	1	0	0	2	0	0	0	0	2
July	0	0	0	0	1	0	0	0	0	0	0	15	0	1	0
August	3	0	0	3	0	0	1	0	1	0	0	3	1	1	0
September	9	8	1	0	0	4	0	6	0	2	2	0	2	3	0
October	28	4	89	24	11	9	73	30	19	5	0	60	43	31	4
November	108	25	199	34	143	79	218	76	98	83	15	86	111	98	9
December	233	103	215	165	182	139	328	95	156	185	172	147	179	177	15
Total	968	659	1098	734	1149	766	1465	863	966	887	702	847	950	928	93

[a] Average from Kasanga, Mwazye and Zimba meteorology stations. [b] Between 1980 and 1988.

Source: URT Bureau of Statistics (1991) Rukwa Regional Statistical Abstract. Sumbawanga:10-12.
1 Sumbawanga District Agriculture and Livestock Development Office. Unpublished draft.

APPENDIX 6.3

AVERAGE GDP AND GDP PER CAPITA AT CURRENT PRICES BY REGION, TANZANIA, 1984-1991 (TSh)

Region	GDP (Million TShs)	Rank[a]	GDP per capita (TShs)	Rank[a]
Arusha	19,184	2	13,414	5
Coast	2,668	20	4,126	20
Dar-es-Salaam	56,195	1	39,647	1
Dodoma	7,931	15	6,274	18
Iringa	15,872	4	12,909	6
Kagera	10,677	12	7,842	13
Kigoma	8,392	14	9,606	10
Kilimanjaro	7,654	17	6,715	17
Lindi	3,776	19	5,774	19
Mara	15,102	5	15,359	3
Mbeya	18,858	3	12,481	7
Morogoro	11,937	10	9,532	11
Mtwara	5,604	18	7,476	14
Mwanza	12,864	8	6,779	16
Rukwa	11,987	9	15,618	2
Ruvuma	11,310	11	14,119	4
Shinyanga	13,103	7	7,184	15
Singida	7,883	16	9,750	9
Tabora	10,054	13	9,466	12
Tanga	14,246	6	10,889	8
Total	265,298	-	11,624	-

[a] The regions are ranked in decreasing order, with the one having the highest GDP or GPD per capita being ranked first and the region with the least GDP being ranked last.

Source: Calculated from URT Bureau of Statistics (1992) National Accounts of Tanzania 1976-1991. Dar-es-Salaam:26,28.

APPENDIX 6.4

AREA CULTIVATED AND PRODUCTION OF MAJOR CROPS, SUMBAWANGA DISTRICT, 1983/84-1991/92

Year	Maize		Beans		Finger Millet	
	Area (000 ha)	Production (000 t)	Area (000 ha)	Production (000 t)	Area (000 ha)	Production (000 t)
1983/84	49	112	17	10	28	28
1984/85	59	127	29	29	43	43
1985/86	57	138	24	15	45	45
1986/87	60	167	31	28	46	60
1987/88	52	145	20	18	41	44
1988/89	51	140	24	22	43	42
1989/90	42	83	20	16	36	36
1990/91	71	134	11	16	41	36
1991/92	75	151	29	23	41	41
Mean	57	133	23	20	40	42
%Share	42	-	17	-	29	-

Cont. Appendix 6.4

Year	Sorghum		Rice		Cassava		Total Area (000 ha)
	Area (000 ha)	Production (000 t)	Area (000 ha)	Production (000 t)	Area (000 ha)	Production (000 t)	
1983/84	3	4	1	2	7	17	105
1984/85	3	4	4	4	5	16	143
1985/86	10	5	2	1	3	9	141
1986/87	8	10	4	2	7	21	156
1987/88	4	5	3	5	6	14	126
1988/89	6	4	5	4	6	15	135
1989/90	3	5	6	7	7	21	114
1990/91	4	4	8	6	10	22	145
1991/92	3	3	5	5	4	11	157
Mean	5	5	4	4	6	16	136
%Share	4	-	3	-	5	-	100

Source: District Agriculture and Livestock Development Office (1992/93) Annual reports. Several. Sumbawanga.

APPENDIX 6.5

FARMER QUESTIONNAIRE FOR THE STORAGE AND MARKETING STUDY FOR MAIZE, SUMBAWANGA DISTRICT, TANZANIA, 1992/93

Section I: Household identification

Farmers name__________________ Farmers number__________________

Interviewers name__________________ Date of interview__________________

1. Village 1 Kankwale 2 Lula 3 Mkima 4 Mtutumbe

2.a. Age of household head in years __________________

2.b. Level of education of household in years of attendance __________________

3.a-d.[a] In the table below give the breakdown of the household composition

Family member[b]	Sex	Age	Remarks[c]
Husband			
Wife			
Children (Total no. of children)			
1			
2			
3			
4			
5			
6			
7			
8			

[a] Coded in summary sheets as: 3a = Total household size; 3b = Children (0-10 yrs); 3c = Children (11-15 yrs); 3d = Adults (> 15 yrs).
[b] Include non-family members living in the same house.
[c] State if living inside the village or not.

Section II: Crop farming practices

4.a. How many heads of cattle do you own? __________________

4.b. Do you own an ox-plough ? 1 Yes 2 No

5.a. How many hectares is your farm? ____________________

5.b. How many of these hectares were cultivated in 1991/92? ____________

5.c. How many of these hectares were under fallow? ____________________

6. Out of the total farm area cultivated in 1991/92 how many hectares were under: (a) maize____________ (c) beans____________ (b) fingermillet__________ (d) other crops (specify) _____

7.a. In how many different places do you have plots? ____________________

7.b. What is the average distance to the plots in kilometres? ____________

8. What type of technology did you use to cultivate the farm?
   1 Hand/manual   2 Animal traction

9.a. What maize varieties did you grow in 1991/92?
   1 local   2 improved   3 both 1 and 2

9.b. What quantity of seed did you use in the 1991/92 maize crop? _______ Kg

10. How much chemical fertiliser did you use for the 1992/93 maize crop? __Kg

Section III: Maize harvesting and pre-storage practices

11. For the 1991/92 maize crop state the
   (a) planting month_________   (b) harvesting month_______

12.a. Where did you dry the harvested maize?
   1 in the field   2 at home   3 I did not dry

12.b. If you dried maize before storing for how many weeks did you dry it? ____

12.c. Which method did you use to dry the maize?
   1 dry on the ground   3 as a heap in the living house
   2 on drying platform

13. How was maize transported from the field to the homestead?
   1 by oxen/donkey   3 by lorry/tractor
   2 as a headload   4 other means(specify) ______________

14.a. What type of treatment did you use to preserve maize from pest damage during storage?
   1 chemical pesticides   3 I did not treat it
   2 natural deterrent materials

14.b. If you used pesticides or natural materials name the type of material you applied:

chemical pesticides	natural materials
1 actellic super dust	4 plant tubers/leaves
2 DDT	5 cowdung ash
3 other synthetics (specify)	6 Other natural materials (specify)

15. If you used chemical pesticides

(a) how many grams of the pesticide you mentioned above did you apply per bag of stored maize?_____

(b) what was the source of the pesticide?

1 dealer 3 extension agent
2 shop 4 other(specify____________)

(c) What was the total price of the pesticide? TSh________(specify unit of measurement)

(d) If you did not use chemical pesticides give reasons

1 lack of funds 3 little amount of stored maize
2 pesticides not available 4 lack of knowledge

Section IV Storage structures and storage Methods

16. During which of the following post-harvest operations did you experience a most important loss?

1 before harvest 4 during shelling
2 during harvest time 5 during storage
3 transport to homestead

17. In which month are storage losses more serious?________________________

18. How did you utilise maize damaged during storage?

1 throw away 3 brew
2 clean and eat 4 feed livestock

19. What type(s) of storage is used for maize intended for

(a) food_________ (b)sale_________ (c)seed_________

1 traditional structure (grass/brick type)
2 bags
3 Other (specify whether ceiling, pots, tins and heap storage)

20. If you used a *kihenge* granary to store maize what is its capacity? __bags

21. What is the estimated life span of the structure in years? ______________

22. Where is the storage structure located with reference to the main living house? 1 inside 2 outside

23. Itemise the total material and labour cost needed to construct a typical storage structure?

Cost component	Cost (TSh)	Cost component	Cost (TSh)
(a) Stakes		(f) Stones*	
(b) Pillars		(g) Bricks*	
(c) Rafters		(h) Labour (Hrs)	
(d) Rope		(i) Labour (TSh)	
(e) Straw		Total	
* Where applicable.			

24.a. If you used a 'kihenge' to store maize how many structures did you use?_

24.b. Who build the 'kihenge'? 1 myself 2 craftsmen

25. What type(s) of maintenance work did you carry out before storing the new maize in the storage structure?
1 sweep and smear
2 thatch
3 both 1 and 2
4 no maintenance

26. Did you get any advice from the extension agent on proper grain storage practice in 1992/93? 1 yes 2 no

27.a. How much maize from the 1990/91 season was remaining in store when the 1991/92 maize was ready for storage? ____________________bags

27.b. What did you do with the old maize before you stored the new one?
1 sell
2 brew
3 eat
4 feed livestock
5 other (specify)

Section V Maize marketing patterns

28. If you sold maize for the 1992/93 year could you explain how many regular middlemen could you sell your maize to?
(a) village based middlemen ____________________
(b) non village based middlemen ____________________

28.c. How many middlemen did you contact before you decided to sell most of your sold maize? ____________________

29. Was it easy to sell crops when the offers of middlemen were not satisfactory?
1 yes 2 no 3 I don't know

30. How well do you know about prices prevailing in the market?
    1 very well 3 no idea except middlemen's offer
    2 not very well

31. How do you collect information on market prices?
    1 direct visit to market
    2 chrosscheck with many middlemen
    3 hear from neighbours and friends
    4 extension services including radio

32. What major factors did you consider when you decided to sell maize?
    1 price offered 4 honesty of middlemen
    2 personal tie with middlemen 5 household cash needs
    3 continuity of trade

33. What was the major marketing problem associated with the market liberalisation policies?
    1 no problem 5 small piecemeal sales
    2 low producer prices 6 unstable prices
    3 lack of market outlets 7 delayed sales
    4 lack of uniform measures 8 lack of transport

34. How many bags of each of the following crops did you harvest in the 1992/93 cropping season?
    (a) maize_______ (b) finger millet_________(c) beans_________

35.a. How many bags of the total maize harvested was sold immediately within the harvest month?___________________________________

35.b. How many bags were consumed/eaten by the household in the transition period before starting to consume the stored maize? _______________

35. How many bags of different crops harvested were stored for future use from the total harvested quantities in question 34?
    (c) maize____bags (d) finger millet____ bags (e) Beans_____ bags

36. For all the maize you sold give the transaction particulars in table below:

Particulars	1992						
	a.Jun	b.Jul	c.Aug	d. Sep	e.Oct	f.Nov	g.Dec
Amount sold (bags)							
Selling price (TSh/bag)							
Buying agent (mention name)							

Question 36-continued.

Particulars	1993					Total
	h.Jan	i.Feb	j.Mar	k.Apr	l.May	Jun '92-May '93
Amount sold (bags)						
Selling price (TSh/bag)						
Buying agent (Mention name)						
Note: For each sale please indicate in which week of the month did the transaction take place						

37. For the major maize selling transaction (in question 36 above) please answer the following questions:
   (a) How many days after harvest did you sell most maize?________
   (b) Why did you sell at this particular time?
      1 household cash needs   3 marketing convenience
      2 availability of middlemen
   (c) Where did you sell the maize?
      1 in village of residence   3 in Sumbawanga
      2 in neighbouring village
   (d) How far was the selling point from your homestead? ________ km
   (e) How did you transport maize to the selling point?
      1 as head load   4 by lorry/tractor
      2 by wheelcart   5 other means (specify____________)
      3 by oxen/donkey
   (f) What was the transport cost per bag?________________TShs
   (g) To whom did you sell the maize?
      1 village middlemen   3 fellow farmer/neighbour
      2 non-village trader   4 other (specify____________)
   (h) Why did you sell to this particular buyer?
      1 good price   3 marketing convenience
      2 only middlemen available

38.a. What factors determined the amount of maize to sell?
   1 household cash needs   3 level of production
   2 good prices   4 lack of storage space

38.b. What factors determined the amount of maize to store?
   1 food requirements   3 level of production
   2 household size   4 other (specify______________)

Section VI Utilisation of Stored Maize and Food Security

39. Out of the total maize you stored (q35c) how much was used the following purposes? (specify unit of measure, that is, bag, tin, or kilogram)

(a) selling__________	(e) presents/remmitances______________
(b) consumption______	(f) labour payment__________________
(c) brewing__________	(g)How much maize is remaining? _______
(d) seeds___________	

39.h. In which month did you start consuming the stored maize? ____________

39.i. In which month was the stored maize finished?_____________________

40.a. Was the stored maize enough to feed your household until the next harvest? 1 yes 2 no

40.b. If the stored maize was not enough for how many months was maize lacking? ______

40.c. How did you feed the household during the time without maize ?

1 eat fingermillet	6 brew and sell alcohol
2 use crop sales money	7 informal sector cash
3 sale livestock	8 lease oxen
4 sell labour	9 use salary
5 use dry season crop	10 other

41. How many bags of fingermillet did you eat in the 1992/93 season? _______

42.a. How much maize did you receive as remittances in the 1992/93 Season? _______ bags/tins/bowls(specify)

42.b. How much did you buy? ___________________ bags/tins/bowls(specify)

42.c. In which month(s) did you buy or receive the maize?_________________

42.d. If you bought or received maize from whom did you buy?
1 Fellow farmer 2 middlemen 3 Sumbawanga town market

42.e. Give reasons which forced you to buy or receive maize
1 little own production 3 other (specify______)
2 overselling own production

Section VII Inflow and outflow of Income

43. How much money did you get in 1992/93 season by source of income?

Source of income	Amount sold (bags/kg/no.)	Money obtained (000 TSh)
Sale of crops		
(a) Maize		
(b) Fingermillet		
(c) Beans		
(d) Other crops		
Subtotal (crops)		
Livestock sales		
-Cattle		
-Sheep/goats		
-Chicken/poultry		
-Other livestock		
(e) Subtotal (livestock)		
Non agricultural income		
-Informal sector		
-Salary		
-Remittances		
Subtotal (non agricultural)		
Grand total		

44.a. If your maize production would increase by 20 % how would you dispose off the increased output? 1 sell all of it 2. sell part and consume the rest

44. b. If the price of maize increased by 20 % what would you do?
1. sell more 2 no change

APPENDIX 6.6

TRADER QUESTIONNAIRE FOR THE STORAGE AND MARKETING STUDY FOR MAIZE IN SUMBAWANGA DISTRICT, TANZANIA, 1992/93

Section I Background Information

Traders name_______________ Date of interview ________________

Middlemen's code number___ 1. Age of middlemen _________years

2. Level of education in years of attendance ____________________________

3.a. Type of trade 1 village collector 4 transporter
2 inter-village collector 5 retailer
3 wholesaler

3.b. For how many years have you been in the trade business?
____

4. Job status: 1 full time 2 part time (with other jobs)

5. For how many days do you work per week? ___________________________

6. Where is your major (a) buying area?_____ (b) selling area? _____

1 in village (mention) 2 In Sumbawanga town 3 other regions

7. How many bags of each of the following grains did you buy and sell in the 1992/93 marketing season? (a) maize_________ (c) beans____________
(b) fingermillet____

Section II Commodity Flow for the 1992/93 Marketing Season

(a) Buying

8. Who does the grain purchasing for you?
1 self 3 an agent
2 family member/relative

9. From whom did you buy grains in the 1992/93 season?
1 farmer 2 middlemen 3 trader 4 processor

10.a. From how many different buying places did you buy grain in 1992/93?
1 one 2 two 3 three 4 more than three

10.b. What is the average distance to these buying places ____________ km

11. What is your frequency of trade? 1 always 2 sometimes

12. What maize quantities did you purchase on average per transaction in 1992/93? ______ bags

(b) Selling

13. Who buys your grain: 1 farmer 2 regular trader 3 Other trader 4 Processor 5 Institutions

14. To how many buyers did you sell grain in 1992/93?_____
 1 one 2 two 3 three 4 four or more

15.a. In how many different places did you sell grain in 1992/93 __________

15.b. Where do you sell most of your maize?
 1 In villages(mention) 2 In Sumbawanga town 3 Other towns

15.c. What is the mean distance to your main selling place(s)? ________ km

16.a. What was the average buying price per bag of maize sold? ____ TSh.

16.b. What was the average selling price?______________________ TSh

17. What is the normal payment condition when you sell grain?
 1 in advance 2 in cash 3 deferred payment

18. What on average were the loading and unloading costs per bag of maize sold? _________________TSh.

19. Which means do you use to transport grain?
 1 own lorry/tractor 3 ox-cart/wheelbarrow
 2 hired lorry/tractor 4 as headload

20. What was the average transport cost for a bag of maize in 1992/93?
 _________________TSh/bag/km

21. How much money did you pay for miscellaneous costs in selling a bag of maize? __________TSh/bag

22. What is the average selling quantity did you handle per transaction?
 _________________bags

23. How many days does it take to buy and sell one grain consignment?___

Section III Maize Market Condition

24. What type of selling market do you use?
 1 municipal market in Sumbawanga town 3 village markets
 2 other urban markets

25. For how many months was maize readily available from your buying sources?

26. In which months was the maize buying and selling prices:
 (a) lowest_______ (b) highest_______

27. In the 1992/93 marketing year did you have any contractual arrangement with: (a) your sellers? 1 yes 2 no
(b) your buyers? 1 yes 2 no

28.a. Did you store the traded maize in 1992/93? 1 yes 2 no

28.b. If yes for how long did you store? ____________ months/days(specify)

28.c. If yes where did you store it?
1 market place 3 in own house/store
2 in hired godown

29. How many bags of grain do you usually keep in your store at any one time? __________

30 How much did you pay per bag for each of the following items while buying maize?

Cost component	Payment (TSh/bag)
Empty bag	
String	
Labour to fill and tie	
Other costs (e.g. fees)	

31.a. Do you own the store? 1 yes 2 no

32. Why did you store grain?
1 to assemble larger quantities 3 Lack of transport
2 to overcome periods of low prices

33. What limits your capacity to store more grain?
1 lack of capital/credit 3 little price increases
2 high storage costs 4 erratic price changes

34. How much capital do you need to enter the grain trade? ___ ('000 TSh)

35. Did you have enough money during the last season to purchase foodgrain 1 yes 2 no

36. If you got credit in 1992/93 what was the source of the credit?
1 banks 3 fellow grain traders
2 relatives/friends 4 informal money lenders

37.a. Did you provide credit in 1992/93? 1 yes 2 no

37.b. If yes to whom did you give credit? 1 farmers 2 grain trader

38. How do you get price information?
1 visit market places 3 from friends and relatives
2 extension agent/radio 4 from other traders

39. What reasons differentiate maize buying prices
    1 area of grain supply
    2 the season and year of grain production
    3 competition among traders

Section IV Impact of Liberalisation Policies

40. What is your main problem in foodgrain trade after the reforms?
    1 low prices
    2 lack of capital
    3 unstable prices
    4 fluctuating grain supply and demand
    5 lack of transport

41. How did you get the initial capital to enter into grain trade?
    1 using capital from other business
    2 using borrowed money
    3 using capital from agricultural activities

42.a. How much cash capital do you have now?______________(000 TSh)

42.b. How much capital in fixed assets do you have now? ______(000 TSh)

APPENDIX 6.7

RELATIONSHIP BETWEEN WEIGHT LOSS AND GRAIN CONSUMPTION[1]

In the simplest case we can assume that grain is left untouched throughout the season. But under semisubsistance conditions grain is removed from most stores at intervals during the season for consumption or sale. If the grain is infested with insects, then each quantity removed will have suffered a different, probably increasing, degree of loss, it will have been exposed to the insect infestation for a longer period of time. Thus, the high percentage loss that may be recorded towards the end of the season will only apply to the small quantity of grain remaining in the store at this time, while most of the grain has been removed. The total loss due to insects is considerably less than it would appear to be from looking at the condition of the grain at the end of the season. Table 1 hypothetically illustrates this phenomena.

Table 1 Relationship between weight loss and grain consumption

Parameter	Months during which grain is removed					
Month (A)	1	2	3	4	5	6
Quantity (volume) of grain removed(%)(B)	10	10	15	15	20	30
Weight loss in sample (%) (C)	1	2	3	5	7	10
Weight loss in removed quantity (as percentage of total stored (D)	0.1	0.2	0.45	0.75	1.4	3.0
Cumulative weight loss (as percentage of total stored) (E)	0.1	0.3	0.75	1.5	2.9	5.9

1 This appendix borrows heavily from Albert (1991:105-109) and Bengtsson (1991:8-10).

In the situation illustrated in Table 1 it is assumed that the pattern of insect attack is the same and the final recorded weight loss in a sample is 10 %. Row C represents grain that is stored for the full six months. Thus, at the end of the season, all the stored grain will have suffered a 10 % weight loss. Row E is the resultant loss in a store where grain is removed at intervals. In this case some grain is removed while losses are still low and when the losses that have occurred in each of the quantities removed are added together , the total will therefore be lower. Therefore, to produce an accurate figure for loss in a store from which grain is removed at regular intervals the following must be measured.

- Originally stored quantity
- The quantity removed from each withdrawal occasion
- The level of loss in the grain when it is put into the store (baseline)
- The level of loss in each quantity removed.

Two additional points need to be paid attention to. First, to obtain unbiased average weight loss figures for a group of stores the individual weight losses recorded in row E of Table 1 must be weighted to the respective original quantities stored by each farmer. Second, in circumstances where grain prices differ within one production cycle the money value of the weight loss per unit (e.g. month) of storage time should be derived by multiplying the quantity loss by the appropriate monthly price. Accordingly the annual monetary losses must be weighted to the corresponding prices and loss levels instead of using simple arithmetic averages. The summary statistics for all our 20 farmers are presented in Table 2.

Table 2 Storage loss summary table for all 20 households, Sumbawanga District, 1992/93

Average maize initially stored: Mean:15.2 bags; Range:1-37.4 bags; C.V.: (76 %)								
	Months after storage							
	2	3	4	5	6	7	8	9
Mean sample weight loss	0.73	1.01	1.54	2.30	4.15	5.69	12.25	15.5
Mean weight loss	0.32	.45	0.47	0.43	0.49	0.83	1.29	1.41
Weighted weight loss	0.09	0.27	0.41	0.39	0.46	0.59	1.17	1.2
Cummulative weight loss	0.09	0.36	0.77	1.16	1.62	2.21	3.38	4.58
Mean amount in store (bags)	8.6	9.2	7.5	6.3	3.8	2	0.6	0.2
Number of samples	4	16	19	16	16	9	6	2

Source: Own survey. 1992/93.

APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm	Question																			
No.	1	2a	2b	3a	3b	3c	3d	4a	4b	5a	5b	5c	6a	6b	6c	6d	7a	7b	8	9a	9b
1	1	29	7	6	4	1	1	0	2	1.6	1.2	0.4	0.8	0	0	0.4	2	0.5	2	1	10
2	1	32	7	6	4	1	1	5	1	1.2	1	0.2	0.6	0.4	0	0	1	1	2	1	9
3	1	50	3	7	5	1	1	0	2	2	1.2	0.8	1	0	0	0.2	3	2	1	1	12
4	1	42	0	5	2	2	1	0	2	2.4	2.4	0	1.2	0	1.2	0	1	1	1	1	54
5	1	53	4	11	9	1	1	8	1	6.5	6.5	0	3.3	0	3.2	0	8	3	2	2	80
6	1	35	7	6	4	1	1	3	1	2	1.2	0.8	0.8	0	0.4	0	2	4	2	1	18
7	1	36	7	8	6	1	1	12	1	1.2	1	0.2	0.4	0.6	0	0	1	2	2	1	18
8	1	35	7	8	6	1	1	6	1	1.7	1	0.7	0.4	0	0	0.6	2	8	2	1	10
9	1	30	7	7	5	1	1	4	1	3.2	1.4	1.8	1.2	0	0.2	0	2	2	2	2	30
10	1	50	4	6	4	1	1	4	2	1.7	1.2	0.6	0.8	0	0.4	0	2	4	1	1	18
11	1	46	4	11	9	1	1	8	1	2.4	1.6	0.8	0.8	0.4	0.4	0	2	2	2	1	9
12	1	67	2	4	2	2	0	7	1	1.6	0.8	0.8	0.8	0	0	0	2	1	1	1	36
13	1	41	0	10	7	1	2	16	1	2.4	1.6	0.8	1.2	0.4	0	0	4	3	2	1	38
14	1	38	0	10	7	2	1	26	1	2.8	1.6	1.2	1.2	0	0	0.4	2	7	2	1	36
15	1	29	7	5	3	1	1	4	1	3	2.2	0.8	1	0.6	0.6	0	3	2	2	1	27
16	1	32	0	7	5	1	1	0	2	2.8	0.4	2.4	0.4	0	0	0	2	1	2	1	9
17	1	32	7	9	6	1	2	1	1	3.4	3.3	0.1	0.6	0.8	0.8	1.1	1	2	2	1	36
18	1	58	3	4	0	3	1	6	1	2.8	2.8	0	1.6	0.4	0.4	0.4	1	0.5	2	1	18
19	1	27	7	4	2	1	1	0	2	0.6	0.6	0	0.4	0	0	0.2	2	1	2	1	9
20	1	45	0	7	4	1	2	3	2	1.2	1.2	0	1.2	0	0	0	2	3	2	1	54
21	1	46	4	9	4	4	1	4	1	4.5	2.8	1.7	0.4	1.2	1.2	0	2	1	1	1	20
22	1	37	1	12	9	1	2	1	1	5.3	1.6	3.6	1	0.6	0	0	1	0.5	2	1	9
23	1	72	0	5	2	2	1	0	2	0.4	0.4	0	0.4	0	0	0	1	1	2	1	9
24	1	39	5	10	6	3	1	4	1	4	4	0	2.8	1.2	0	0	2	1.5	2	1	63
25	1	29	11	4	2	1	1	1	2	2.9	1.3	1.6	1	0	0.3	0	1	3	2	1	36
26	1	49	7	8	6	1	1	0	2	1.8	1.8	0	1.2	0	0.4	0.2	2	0.5	2	1	9
27	1	40	4	8	6	1	1	2	1	1.5	0.9	0.6	0.8	0.1	0	0	2	2	1	1	18
28	1	52	0	6	4	1	1	9	1	4	2.8	1.2	1.6	1.2	0	0	1	2	2	1	36
29	1	38	7	14	10	2	2	5	1	2.4	1.6	0.8	1.6	0	0	0	4	4.5	2	1	18
30	1	32	7	5	3	1	1	0	2	0.8	0.4	0.4	0	0	0	0	2	3	2	1	4
Total	-	-	-	222	147	42	34	138	-	74.1	51.9	22.2	30.6	7.8	9.6	3.6	61	-	-	-	75.3
Mean	-	41.4	4.3	7.4	4.9	1.4	1.1	4.6	-	2.5	1.7	0.7	1.2	0.3	0.3	0.1	2.0	2.3	-	-	25.1
Cv(%)	-	27	72	35	50	55	38	121	-	56	73	111	67	153	201	204	69	78	-	-	-

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm No.	Question																				
	1	2a	2b	3a	3b	3c	3d	4a	4b	5a	5b	5c	6a	6b	6c	6d	7a	7b	8	9a	9b
31	2	38	2	6	3	1	2	0	2	3.6	1.2	2.4	0.6	0	0.6	0	2	1.5	2	1	18
32	2	22	7	3	1	1	1	0	1	1.6	1.6	0	0.8	0	0.8	0	1	1	2	2	18
33	2	46	1	9	5	1	3	5	1	2.2	2.2	0	0.8	0	1.3	0	3	1	2	1	36
34	2	28	7	5	3	1	1	5	1	3.6	3.6	0	1.6	0	2	0	2	2	2	2	40
35	2	54	2	5	2	1	2	2	1	0.8	0.6	0.2	0.2	0	0.4	0	1	1	1	1	5
36	2	27	0	5	3	1	1	2	1	3.4	2	1.4	0.8	0	1.2	0	2	2	2	2	25
37	2	59	0	4	2	1	1	17	1	27.8	27.8	0	11	10.8	4.8	1.2	1	3	2	2	80
38	2	36	0	8	6	1	1	0	1	1.2	1.2	0	0.8	0	0.4	0	2	4	2	2	20
39	2	30	0	6	4	1	1	2	1	2	2	0	1.6	0	0.4	0	2	2	2	1	30
40	2	37	3	7	5	1	1	3	1	2	1.2	0.8	1.2	0	0	0	1	1	2	2	30
41	2	32	7	5	2	1	2	0	1	0.8	0.8	0	0.8	0	0	0	1	0.5	2	2	10
42	2	45	0	9	7	1	1	3	1	0.6	0.6	0	0.6	0	0	0	3	5	1	1	36
43	2	52	0	9	7	1	1	3	1	4.5	2	2.4	1.2	0	0.8	0	2	12	2	2	18
44	2	56	2	4	2	1	1	4	1	1.8	1.8	0	1.6	0	0.2	0	1	0.5	2	1	18
45	2	67	0	6	0	4	2	12	1	4.9	3.6	1.2	0.8	2	0.8	0	2	2	2	1	32
46	2	63	0	6	2	3	1	6	1	4	2.8	1.2	1.2	0.8	0.8	0	1	2	2	2	30
47	2	44	2	12	8	2	2	30	1	4.5	2.4	2	1.2	0.6	0.6	0	2	4	2	2	40
48	2	42	0	11	7	1	3	9	1	6.9	2.8	4	1.2	0.8	0.2	0.6	3	1	2	1	20
49	2	24	7	3	1	1	1	4	2	3.2	1.2	2	1.2	0	0	0	2	1.5	2	2	30
50	2	20	7	5	1	2	2	4	1	3.6	3.2	0.4	2.4	0.8	0	0	2	4	3	2	40
51	2	33	2	7	5	1	1	8	1	3	2.2	0.8	2	0	0.2	0	1	1	2	1	18
52	2	33	0	6	4	1	1	2	1	2.2	0.8	1.4	0.8	0	0	0	1	0.2	2	2	20
53	2	33	4	9	7	1	1	7	1	2.4	2.4	0	1.2	0	1.2	0	4	0.7	2	3	27
54	2	24	0	2	0	1	1	6	1	1.6	1.6	0	1.2	0	0.4	0	2	0.5	2	1	45
55	2	27	7	5	3	1	1	2	1	2.4	2.4	0	1.6	0	0.8	0	2	1.5	2	2	30
56	2	30	4	5	3	1	1	2	1	1.6	1.2	0.4	1.2	0	0	0	1	0.5	2	2	30
57	2	35	4	6	5	0	1	0	2	0.6	0.6	0	0.6	0	0	0	2	2	1	1	18
58	2	35	0	4	3	0	1	0	2	0.8	0.4	0.4	0.6	0	0	0.2	1	3	2	2	10
59	2	25	0	2	1	0	1	0	2	0.8	0.8	0	0.6	0	0.2	0	1	2.5	2	1	9
60	2	31	0	5	3	1	1	0	2	0.6	0.6	0	0.6	0	0	0	2	6	1	2	15
Total	-	-	-	79	105	34	40	138	-	99	77.7	21	42	15.9	18	2	53	30	-	-	798
Mean	-	37.6	2.3	6.0	3.5	1.1	1.3	4.6	-	3.3	2.6	0.7	1.4	0.5	0.6	0.1	1.8	2.3	-	-	26.6
Cv(%)	-	34	119	41	64	68	45	135	-	148	187	144	134	375	156	337	44	66	-	-	-

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm No.	Question 1	2a	2b	3a	3b	3c	3d	4a	4b	5a	5b	5c	6a	6b	6c	6d	7a	7b	8	9a	9b
61	3	35	7	6	4	1	1	5	1	4	3.2	0.8	1.2	1.2	0	0.8	2	2.5	1	3	46
62	3	21	7	4	2	1	1	0	1	1.6	1.6	0	0.8	0.8	0	0	1	4	2	2	40
63	3	29	6	5	3	1	1	0	1	3.2	2.4	0.8	0.8	1.6	0	0	2	2	2	1	4
64	3	40	0	2	1	0	1	0	2	0.8	0.4	0.4	0.4	0	0	0	1	1	2	1	3
65	3	40	0	6	3	2	1	0	2	1.6	1.6	0	1.2	0	0	0.4	1	5	1	1	18
66	3	52	0	5	1	2	2	1	2	2.4	2.4	0	1.2	1.2	0	0	3	4	1	1	36
67	3	35	0	6	4	1	1	4	1	2.8	1	1.8	1	0	0	0	1	3	2	1	21
68	3	37	7	8	6	1	1	0	2	0.8	0.4	0.4	0.4	0	0	0	1	1	1	1	18
69	3	40	7	8	5	1	2	0	2	3.6	1.6	2	0.8	0	0.8	0	2	4	1	1	36
70	3	63	0	5	3	2	1	0	2	5.8	2.2	3.6	1	0.8	0.4	0	1	1.5	1	1	18
71	3	36	0	11	6	3	2	9	1	6	4.8	1.2	2.4	2.4	0	0	1	3	2	1	54
72	3	40	0	3	0	2	1	2	2	1.6	1.6	0	0.4	0.2	0.4	0.6	2	2	2	2	12
73	3	21	7	2	0	1	1	0	1	1.2	1	0.2	0.6	0.2	0.2	0	1	2	2	1	10
74	3	37	0	9	3	1	5	0	2	2	1.6	0.4	1	0.4	0.2	0	2	1.5	2	3	20
75	3	40	4	7	4	1	2	0	2	4	1.2	2.8	0.6	0.4	0.2	0	1	6	1	1	18
76	3	53	8	5	3	1	1	10	1	8	2.4	5.6	0.8	1.2	0.4	0	1	1	2	2	20
77	3	63	3	7	2	2	3	12	1	8.8	2.4	6.4	1.2	0.4	0.4	0.4	3	2.4	2	3	46
78	3	36	4	9	5	2	2	7	1	5.2	2.3	2.9	0.8	1	0.4	0.1	1	3	2	1	54
79	3	29	7	5	3	1	1	2	1	2.8	2	0.8	1	0.8	0.2	0	2	1.6	2	2	20
80	3	50	5	11	7	2	2	4	1	3.1	2	1.2	0.8	0.8	0.4	0	1	2	1	1	10
81	3	35	7	5	3	1	1	7	1	2.2	2.2	0	1.2	0.4	0.2	0.4	1	3	2	2	10
82	3	25	7	9	6	2	1	2	1	2	0.6	1.4	0.6	0	0	0	2	5	2	1	8
83	3	30	7	6	4	1	1	2	1	4	2.4	1.6	1	0.8	0.1	0.5	3	2	2	2	20
84	3	21	7	3	1	1	1	10	1	2	1.2	0.8	0.4	0.6	0.2	0	1	4	2	1	10
85	3	26	5	5	3	1	1	35	1	2.3	2.3	0	1	0.8	0.4	0.1	3	5	2	1	18
86	3	24	11	2	0	1	1	2	2	4	0.8	2.4	0.4	0.2	0.1	0.1	1	4	2	2	10
87	3	49	3	8	6	1	1	9	1	2.4	1.6	0.8	0.8	0	0.8	0	2	1.5	2	3	19
88	3	32	7	4	2	1	1	0	2	2.4	0.8	1.6	0.4	0	0	0	1	8	2	2	10
89	3	24	7	5	3	1	1	4	1	2.6	1.8	0.8	0.8	0.8	0.2	0	1	1.3	2	1	18
90	3	27	7	3	1	1	1	0	2	3.4	2.2	1.2	0.8	1.2	0.2	0	2	1	2	3	20
Total	-	-	-	174	94	39	42	127	-	96.6	54	42	25.8	18.2	6.3	3.4	47	-	-	-	647
Mean	-	36.3	4.7	5.8	3.1	1.3	1.4	4.2	-	3.2	1.8	1.4	0.9	0.6	0.2	0.1	0.6	2.9	-	-	21.6
Cv(%)	-	32	70	43	62	46	61	163	-	60	50	112	47	94	106	191	46	58	-	-	-

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm No.	Question																			
	1	2a	2b	3a	3b	3c	3d	4a	4b	5a	5b	5c	6a	6b	6c	6d	7a	7b	8	9a	9b
91	4	28	7	4	2	1	1	2	1	7	2.2	4.8	1.6	0	0.4	0.2	1	1	2	1	33
92	4	35	7	3	1	1	1	3	1	8	5.2	2.8	2	0.8	1.6	0.8	4	1	2	1	54
93	4	31	7	4	2	1	1	3	1	3.2	0.8	2.4	0.8	0	0	0	1	0.5	1	1	18
94	4	50	0	6	4	1	1	2	1	8	2	6	0.8	0.4	0.6	0.2	3	3	2	1	18
95	4	23	7	5	3	1	1	8	1	4.8	3	1.8	1.6	0	1.2	0.2	2	4	2	1	36
96	4	23	7	2	0	1	1	0	2	5.6	3.4	2.2	1.2	0	2	0.2	1	2	2	1	18
97	4	28	7	4	2	1	1	9	1	8.2	1.2	7	0.6	0.4	0.2	0	2	2	2	1	9
98	4	40	0	9	5	2	2	5	1	9.2	4	5.2	2.8	0	1.2	0	1	0.5	2	1	45
99	4	30	7	3	1	1	1	0	2	2	1.6	0.4	0.6	0.8	0	0.2	1	2	2	1	18
100	4	26	7	4	2	1	1	0	1	4.8	3.6	1.2	1.6	0	2	0	1	0.5	2	1	27
101	4	32	7	5	3	1	1	2	1	4	3.8	0.2	1.6	0	1.6	0.6	2	3	2	3	20
102	4	31	4	7	4	1	2	4	1	8	4.8	3.2	1.6	1.2	1.8	0.2	4	8	2	1	36
103	4	36	8	7	4	1	2	7	1	5.2	4	0	1.2	0	1.2	1.6	1	5	2	1	40
104	4	24	7	3	1	1	1	2	1	1.2	1.2	0	0.8	0	0.4	0	1	3	2	1	13
105	4	44	7	6	4	1	1	0	2	1.2	1.2	0	0.8	0	0.4	0	2	5	1	1	13
106	4	33	3	4	2	1	1	0	2	1	0.6	0.4	0.4	0	0	0.2	1	0.5	2	1	9
107	4	18	7	1	0	1	0	2	2	2.4	1.2	1.2	1.2	0	0	0	1	2	2	1	13
108	4	22	8	2	0	1	1	0	2	0.6	0.4	0.2	0.4	0	0	0	2	4	1	1	5
109	4	27	7	4	2	1	1	3	1	4.6	4.6	0	2.4	0	2	0.2	3	5	2	1	27
110	4	18	4	2	0	1	1	0	2	1.8	1.4	0.2	0.2	0.8	0.2	0	3	6	1	2	10
111	4	26	7	5	3	1	1	6	1	4	4	0	1.2	0	2.8	0	2	2	2	1	18
112	4	42	8	8	5	2	1	0	2	2.3	1.9	0.4	1	0.8	0.1	0	2	1.5	2	1	18
113	4	30	7	4	2	1	1	2	1	1.6	1.2	0.4	0.8	0	0.4	0	1	1.8	2	1	23
114	4	24	7	5	2	1	2	0	1	2.4	2.4	0	1.6	0	0.8	0	2	4	2	1	22
115	4	37	7	8	5	1	2	3	1	2.6	2.2	0.4	1.4	0.4	0.4	0	1	5	2	1	30
116	4	49	4	8	4	2	2	2	1	13.2	3.6	9.6	2.4	1.2	0	0	4	2	2	1	36
117	4	35	7	8	4	1	3	12	1	6	2.4	3.6	0.8	1.2	0.4	0	1	6	2	1	14
118	4	65	5	2	0	1	1	4	1	5	3.8	1.2	1.2	1.6	0.8	0.2	2	6	2	1	18
119	4	54	0	2	1	0	1	2	1	4	4	0	1.4	1	1	0.6	4	4.5	2	1	22
120	4	34	3	8	5	1	2	2	1	3.2	1.2	2	1.2	0	0	0	3	1.3	2	1	16
Total	-	-	-	143	73	32	38	85	-	135	76.9	56.7	37.2	10.5	23.4	5.4	59	-	-	-	679
Mean	-	33.2	5.8	4.8	2.4	1.1	1.3	2.8	-	4.5	2.6	1.9	1.2	0.4	0.8	0.2	2.0	3.1	-	-	22.6
Cv(%)	-	33	42	48	69	36	46	106	-	65	55	129	50	143	100	184	54	66	-	-	-

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm	Question																		
No.	10	11a	11b	12a	12b	12c	13	14a	14b	15a	15b	15c	15d	16	17	18	19a	19b	19c	20
1	0	12	7	2	5	1	4	1	1	138	2	500	-	5	2	3	1	2	2	8
2	0	12	7	2	2	1	1	1	3	50	2	700	-	5	1	1	1	1	3	20
3	0	12	7	3	-	-	2	1	1	50	2	200	-	2	3	1	2	2	1	6
4	0	12	7	2	1	1	2	3	-	-	-	-	2	5	1	3	1	2	2	15
5	300	12	7	2	2	1	1	1	3	75	3	1000	-	1	5	1	1	2	1	-
6	0	10	9	3	-	-	1	1	3	125	1	1250	-	4	1	3	1	-	2	20
7	0	12	8	2	2	1	1	2	6	-	-	-	2	7	12	3	1	-	-	-
8	0	10	6	1	1	1	1	1	3	25	1	400	-	2	2	2	2	-	2	20
9	250	12	7	2	2	3	1	1	3	45	1	1800	-	5	11	2	1	2	3	23
10	50	12	7	3	-	-	2	1	3	20	2	200	-	2	1	2	2	-	3	7
11	0	12	7	2	4	1	1	3	-	-	-	-	1	4	2	1	1	2	1	12
12	0	12	7	2	4	1	1	1	3	50	1	600	-	1	1	2	3	2	2	-
13	250	12	8	2	1	1	1	1	3	500	4	1000	-	4	2	1	1	2	2	23
14	100	12	7	3	-	-	1	1	2	100	1	700	-	5	1	3	2	1	3	20
15	150	11	7	2	4	2	1	1	1	100	4	800	-	1	12	3	1	2	2	-
16	0	12	7	3	-	-	2	3	-	-	-	-	3	5	2	1	3	-	3	-
17	0	12	9	1	2	1	4	3	-	-	-	-	1	1	2	2	1	2	2	9
18	0	12	7	1	2	3	1	1	3	100	2	750	-	5	1	3	2	2	3	40
19	200	12	6	2	8	1	2	1	3	10	4	2000	-	1	2	3	1	1	2	14
20	125	11	8	3	-	-	4	3	-	-	-	-	4	5	1	1	1	-	1	14
21	0	1	7	2	5	2	1	1	2	100	1	475	-	1	2	3	3	2	2	5
22	0	12	8	2	1	1	1	1	3	100	2	1800	-	5	2	3	1	2	3	7
23	0	12	7	3	-	-	2	3	-	-	-	-	3	2	7	2	1	-	1	2
24	0	11	7	2	8	1	1	1	2	100	2	3200	-	5	1	3	1	2	2	40
25	125	12	8	3	4	1	1	1	3	30	4	1000	-	1	12	3	2	2	2	40
26	0	11	7	2	1	1	2	3	-	-	-	-	3	5	12	2	2	-	2	12
27	0	11	6	2	12	1	1	1	1	100	1	100	-	1	3	3	1	2	2	10
28	0	12	8	2	4	3	1	1	1	100	1	2500	-	2	1	2	1	-	3	20
29	0	12	9	3	-	-	1	3	-	-	-	-	1	1	12	1	2	2	2	-
30	50	11	7	2	2	3	1	1	2	500	2	1700	-	1	3	3	3	2	2	-
Total	1600	-	-	-	-	-	-	-	-	3454	-	-	-	-	-	-	-	-	-	505
Mean	53.3	-	-	-	3.5	-	-	-	-	115	-	1080	-	-	-	-	-	-	-	16.8
Cv(%)	-	-	-	-	80	-	-	-	-	-	-	75	-	-	-	-	-	-	-	65

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm No.	Question 10	11a	11b	12a	12b	12c	13	14a	14b	15a	15b	15c	15d	16	17	18	19a	19b	19c	20
31	0	12	7	1	2	2	1	1	1	100	2	600	-	2	3	1	3	-	2	-
32	0	12	7	1	1	1	1	3	-	-	-	-	1	5	12	1	1	2	3	10
33	0	12	7	1	2	1	1	1	1	100	4	500	-	2	1	2	1	1	2	25
34	600	12	7	1	2	2	1	3	-	-	-	-	4	5	3	1	2	2	2	25
35	0	12	7	2	1	2	1	1	1	24	4	1400	-	2	12	1	1	-	2	12
36	300	1	7	1	2	1	1	3	-	-	-	-	4	1	9	2	2	2	-	7
37	0	12	7	1	3	1	3	1	3	100	3	1500	-	2	1	1	1	2	2	-
38	150	12	7	2	1	1	3	3	-	-	-	-	4	4	10	2	1	2	-	-
39	600	12	6	1	2	1	1	3	-	-	-	-	4	1	10	3	3	2	-	-
40	400	12	7	1	2	1	3	3	-	-	-	-	2	2	8	1	1	2	2	-
41	300	1	7	1	2	1	3	1	1	100	3	1600	-	5	12	3	2	2	-	-
42	0	12	6	3	-	-	1	3	-	-	-	-	1	2	12	2	3	-	2	-
43	0	12	9	1	2	1	1	1	1	20	2	600	-	1	12	1	2	-	-	16
44	100	12	7	1	1	1	1	1	1	100	3	200	-	5	9	2	1	1	3	13
45	0	12	7	2	1	2	1	2	4	-	-	-	4	4	1	1	1	2	3	20
46	150	11	7	1	2	1	1	1	1	100	3	2500	-	5	12	1	2	2	-	26
47	0	2	7	1	1	1	3	1	1	100	4	1600	-	4	1	2	1	2	1	-
48	0	11	7	1	1	2	1	3	-	-	-	-	4	4	4	1	3	-	2	-
49	450	12	7	3	-	-	3	1	1	100	1	500	-	2	2	2	1	2	2	-
50	0	12	7	2	2	1	3	1	1	100	3	2400	-	7	3	1	1	3	2	-
51	0	1	7	1	1	1	1	3	-	-	-	-	2	5	12	3	2	2	3	-
52	300	11	7	1	2	2	1	1	4	-	-	-	4	5	2	1	3	2	3	-
53	400	11	7	2	1	1	3	3	-		-	-	2	1	5	3	1	2	2	10
54	0	12	8	1	2	2	1	2	4	-	-	-	4	2	1	3	1	2	2	-
55	450	12	7	1	2	1	1	1	1	100	2	1200	-	1	4	2	1	2	2	-
56	450	12	7	1	1	2	3	3	-	100	-	-	1	2	12	1	3	2	2	-
57	0	12	8	1	2	1	1	3	-	-	-	-	1	4	2	3	3	2	2	-
58	150	12	7	1	1	2	3	3	-	-	-	-	1	2	12	3	2	2	3	-
59	0	12	7	1	1	2	1	3	-	-	-	-	1	5	3	1	1	2	2	15
60	150	12	7	1	2	1	3	1	1	100	3	700	-	2	12	4	2	2	2	-
Total	4950	-	-	-	-	-	-	-	-	2640	-	-	-	-	-	-	-	-	-	488
Mean	165	-	-	-	1.9	-	-	-	-	88	-	1177	-	-	-	-	-	-	-	16.3
Cv(%)	-	-	-	-	44	-	-	-	-	-	-	63	-	-	-	-	-	-	-	42

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm	Question																				
No.	10	11a	11b	12a	12b	12c	13	14a	14b	15a	15b	15c	15d	16	17	18	19a	19b	19c	20
61	0	12	7	2	8	2	1	2	5	-	-	-	1	5	12	3	1	2	3	15
62	0	12	6	3	-	-	1	3	-	-	-	-	1	1	2	2	3	-	3	-
63	0	12	6	1	1	2	1	2	5	-	-	-	3	5	8	1	1	2	2	-
64	0	12	7	2	3	2	2	3	1	100	2	1000	-	5	9	3	1	1	3	-
65	0	12	6	1	3	2	1	1	3	30	1	450	-	5	10	2	3	2	2	-
66	0	12	5	2	4	2	1	1	-	-	-	-	4	1	12	1	1	-	1	12
67	0	12	5	1	4	2	1	3	-	-	-	-	1	5	8	3	1	2	2	8
68	0	12	6	2	8	1	1	2	5	-	-	-	1	1	9	1	1	-	3	8
69	0	11	8	2	8	2	2	2	5	-	-	-	3	5	2	3	3	2	2	-
70	0	1	6	2	4	1	1	3	5	-	-	-	4	2	11	3	3	2	3	8
71	0	12	6	1	2	2	1	2	5	-	-	-	1	5	12	3	1	2	2	23
72	3	1	6	1	6	1	1	2	5	-	-	-	1	5	10	1	1	2	3	6
73	100	1	7	2	4	2	1	2	5	-	-	-	2	4	11	3	3	2	3	-
74	200	12	6	2	12	2	1	3	-	-	-	-	4	4	12	2	1	2	2	9
75	0	12	6	2	2	1	1	1	5	-	-	-	2	5	4	2	1	2	-	7
76	150	1	6	2	12	2	1	1	1	-	-	-	-	1	12	2	1	2	2	12
77	150	12	6	1	4	2	1	2	4	100	3	1800	4	5	12	2	1	2	2	12
78	0	1	7	2	4	1	1	2	5	-	-	-	1	5	8	1	3	2	2	8
79	100	12	7	2	8	2	1	2	5	-	-	-	3	1	9	1	1	2	2	15
80	0	11	6	2	8	1	1	2	5	-	-	-	1	2	6	2	1	2	1	15
81	100	12	6	1	9	1	1	3	-	-	-	-	4	5	12	3	1	1	3	30
82	0	12	7	1	4	2	2	1	1	-	-	-	-	5	8	2	1	2	1	16
83	200	11	6	2	12	1	1	2	1	125	2	800	3	1	12	3	1	2	-	28
84	0	12	7	2	1	2	1	3	-	-	-	-	3	1	4	1	3	2	3	8
85	0	12	7	1	3	2	1	1	-	-	-	-	-	5	10	1	1	2	2	17
86	100	12	6	2	4	1	1	1	1	100	2	1200	-	2	1	2	1	2	-	10
87	100	2	6	2	1	1	1	3	1	100	4	1400	2	1	3	3	1	1	3	9
88	100	12	6	2	4	2	2	2	-	-	-	-	1	5	10	1	3	-	2	-
89	0	12	6	1	8	1	1	2	5	-	-	-	2	5	4	3	1	2	2	15
90	150	11	6	2	2	2	2	1	2	250	2	500	-	5	1	1	1	2	2	-
Total	1453	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	48.4	-	-	-	5.3	-	-	-	-	3450	-	1021	-	-	-	-	-	-	-	13.2
Cv(%)	-	-	-	-	63	-	-	-	-	-	-	48	-	-	-	-	-	-	-	43.2

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm No.	Question																			
	10	11a	11b	12a	12b	12c	13	14a	14b	15a	15b	15c	15d	16	17	18	19a	19b	19c	20
91	150	11	7	1	5	2	1	2	7	250	4	500	-	5	11	3	1	2	3	10
92	150	11	7	1	2	1	1	3	-	-	-	-	2	1	1	2	1	1	1	8
93	200	11	7	2	5	1	1	3	-	-	-	-	2	5	11	3	1	2	1	24
94	0	12	6	1	4	1	1	3	-	-	-	-	1	1	1	1	1	5	3	6
95	0	11	7	2	1	2	1	1	1	100	2	500	-	4	1	2	1	1	1	37
96	0	11	7	1	3	1	1	3	-	-	-	-	4	5	2	1	3	2	3	8
97	0	11	7	2	3	1	1	3	-	-	-	-	2	5	9	3	1	1	1	10
98	0	12	7	1	1	1	1	2	5	-	-	-	1	5	1	1	1	2	1	37
99	0	11	7	1	1	1	1	3	-	-	-	-	3	1	1	3	1	2	1	7
100	100	12	7	1	2	1	1	1	1	125	2	500	-	5	4	1	1	1	3	12
101	150	11	8	2	4	1	1	3	-	-	-	-	4	1	1	1	1	2	1	7
102	0	11	7	2	4	1	1	1	2	21	2	400	-	5	2	2	1	2	3	11
103	150	11	7	1	1	1	1	3	-	-	-	-	4	1	1	2	1	2	1	-
104	0	11	7	1	2	1	1	1	1	100	2	480	-	5	11	1	1	2	3	12
105	0	10	7	2	1	2	2	1	3	100	2	250	-	5	11	4	1	-	3	-
106	0	12	6	1	1	2	2	3	-	-	-	-	4	1	9	1	3	-	1	-
107	0	2	8	2	2	1	1	1	3	166	2	200	-	5	1	1	1	2	3	9
108	0	12	6	1	5	1	1	3	-	-	-	-	2	1	11	3	1	2	3	6
109	0	11	7	1	2	1	1	3	-	-	-	-	4	2	11	2	1	2	5	11
110	0	11	4	2	1	1	1	1	1	125	4	4000	-	1	12	2	1	-	-	2
111	200	11	7	1	2	1	1	3	-	-		-	4	1	12	3	1	2	3	11
112	150	11	6	2	4	2	2	3	-	-	-	-	4	5	2	1	3	2	1	-
113	0	11	7	1	2	2	1	2	5	-	-	-	3	2	10	3	1	2	2	10
114	0	11	6	3	-	-	1	2	5	-	-	-	4	4	1	3	1	1	1	7
115	250	11	7	2	3	2	1	1	1	50	2	1050	-	1	2	1	1	-	1	13
116	0	1	6	1	3	1	1	3	-	-	-	-	3	5	11	2	1	-	3	13
117	0	12	7	2	2	1	1	3	-	-	-	-	4	1	10	1	1	-	1	25
118	0	11	6	1	1	1	1	2	5	-	-	-	1	3	12	1	1	-	1	-
119	0	11	7	3	-	-	1	3	-	-	-	-	1	1	11	2	1	1	3	-
120	350	12	7	1	2	1	1	2	5	-	-	-	4	4	1	1	1	2	1	9
Total	1850	-	-	-	-	-	-	-	-	3457	-	-	-	-	-	-	-	-	-	381
Mean	61.7	-	-	-	2.5	-	-	-	-	115	-	876	-	-	-	-	-	-	-	12.7
Cv(%)	-	-	-	-	55	-	-	-	-	-	-	137	.	-	-	-	-	-	-	22

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm No.	Question 21	22	23a	23b	23c	23d	23e	23f	23g	23h	23i	24a	24b	25	26	27a	27b	28a	28b	28c
1	10	1	40	0	0	0	200	0	40	8	800	1	1	2	2	0	-	0	6	1
2	6	1	40	0	100	50	150	80	0	12	600	1	1	1	2	0	-	1	3	2
3	14	1	100	0	50	60	0	0	0	8	400	1	1	3	2	1	3	0	0	0
4	10	1	50	0	0	0	300	0	0	12	500	1	1	2	2	1	2	0	0	0
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3	1	0	2	2
6	6	1	20	180	80	40	60	0	0	22	600	1	1	3	2	1	2	1	0	0
7	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	1	2	1	0	2
8	6	1	100	0	200	50	0	0	300	15	1000	1	1	3	2	0.2	1	-	-	-
9	6	2	0	0	0	0	0	0	4000	30	7000	1	1	3	2	2	3	0	1	2
10	10	1	60	0	0	0	0	0	5000	44	6000	1	2	4	2	0.4	2	1	0	0
11	3	1	100	100	0	100	0	0	0	3	1200	1	1	3	2	0	-	0	3	0
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	-	-	-
13	15	1	150	200	0	100	400	0	0	16	200	1	1	3	2	4	2	1	2	3
14	10	1	50	0	100	50	200	0	0	10	1200	1	1	2	2	3	1	1	2	2
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.4	3	1	1	2
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	-	-	-
17	5	1	20	20	50	10	200	0	0	40	400	1	1	4	2	0	-	1	0	0
18	10	1	150	0	200	200	250	0	1700	42	2500	1	1	3	1	2	3	0	0	0
19	10	2	0	300	0	0	100	300	300	5	1700	1	1	1	2	2	2	-	0	1
20	3	1	150	100	0	100	200	0	0	4	400	1	1	4	2	0	-	-	-	-
21	10	1	500	200	800	200	400	400	0	24	3000	1	1	3	2	0	-	0	5	2
22	5	1	50	100	100	50	200	0	0	4	400	1	1	2	2	0	-	0	4	2
23	10	1	20	80	40	20	100	40	0	6	200	1	1	2	2	0	-	-	-	-
24	5	1	460	600	600	200	300	0	0	12	1200	1	1	2	1	7	1	3	3	6
25	2	1	0	0	0	0	0	0	2000	40	3000	1	2	1	2	1	3	0	1	5
26	5	1	50	0	0	0	150	600	100	6	400	1	1	2	2	0	-	-	-	-
27	10	1	200	300	300	50	100	0	0	12	2000	1	1	3	2	0	-	0	0	0
28	14	1	50	0	100	50	200	0	0	4	400	1	1	4	2	0	-	0	0	0
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	1	0	1
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	1	0	1	1
Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.9	-	-	-	-
Mean	8.2	-	103	94.8	118	57.8	153	61.7	584	16.5	1526	1	1	-	-	1.0	-	-	-	-
Cv(%)	44	-	128	156	171	113	82	251	231	82	117	-	-	-	-	153	-	-	-	-

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm No.	Question 21	22	23a	23b	23c	23d	23e	23f	23g	23h	23i	24a	24b	25	26	27a	27b	28a	28b	28c
31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	-	-	-
32	10	1	100	500	200	100	100	400	0	8	300	1	1	4	2	1.5	1	0	1	1
33	6	1	100	150	200	100	0	0	0	2	300	1	1	3	2	1	3	0	1	0
34	3	1	150	150	600	300	500	400	0	4	300	1	1	4	2	6	2	0	1	6
35	3	2	150	200	200	100	200	500	0	2	200	1	1	4	2	0	-	-	-	-
36	10	1	0	0	0	0	0	250	4000	16	1200	1	1	1	2	0.8	1	0	1	6
37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	6	1	1	2	0
38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	3	0	1	6
39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	3	0	3	1
40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	0	1	1
41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	0	1	3
42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	-	-	-
43	10	2	0	0	200	10	0	200	450	8	600	1	1	3	2	1	1	-	-	-
44	20	1	100	150	120	50	100	0	0	10	600	1	1	2	2	1	3	0	1	1
45	1	1	400	200	250	50	50	700	0	7	400	1	1	2	1	0	-	1	0	1
46	20	1	0	200	200	0	0	0	400	4	400	1	1	2	2	4	3	0	1	6
47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	5	1	1	1
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	25	3	0	0	0
49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.4	1	1	2	6
50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	5	1	0	1
51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	1	1	2
52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	0	1	1
53	3	1	100	200	200	50	500	450	0	30	2000	1	1	2	1	1	2	0	2	4
54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	0	1	1
55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	0	1	2
56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	1	1	2
57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	1	2	3
58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	0	1	1
59	3	1	70	0	30	50	210	100	0	9	600	1	1	3	2	0	-	1	1	2
60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	-	1	0	1
Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52.8	-	-	-	-
Mean	8.09	-	106	159	200	73.6	151	273	441	9.1	627	-	1	-	-	1.8	-	0.4	0.9	2.0
Cv(%)	83	-	105	89	77	114	125	87	162	88	85	-	-	-	-	266	-	-	-	-

"-" Means nol applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm No.	Question 21	22	23a	23b	23c	23d	23e	23f	23g	23h	23i	24a	24b	25	26	27a	27b	28a	28b	28c
61	5	1	100	0	400	100	200	0	0	4	200	1	1	1	1	3	2	1	0	1
62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	-	-	-	-
63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1.5	1	-	-	-
64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	0	0	2
65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	0	0	0
66	4	2	200	200	150	60	150	0	0	3	400	2	1	3	2	0	-	-	-	-
67	3	1	300	200	300	100	200	0	0	8	800	1	1	2	2	0.8	1	5	0	2
68	5	1	100	150	200	50	90	0	0	4	300	1	1	2	1	0	-	-	-	-
69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	-	0	0	3
70	3	1	100	200	100	20	60	300	0	7	700	1	1	4	2	0	-	3	0	2
71	4	2	100	100	200	90	60	0	1000	7	400	1	1	1	1	5	1	0	0	2
72	5	1	0	50	0	50	100	200	0	7	400	1	1	1	1	0	-	0	0	0
73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	3	2	1
74	10	1	0	600	60	0	60	0	0	6	400	1	1	2	2	0	-	2	0	2
75	3	1	150	0	500	100	100	300	0	4	250	-	1	3	1	0	-	-	-	-
76	10	2	200	300	200	100	200	0	0	5	400	1	1	3	1	0	-	2	2	0
77	8	1	200	0	200	50	200	0	0	6	600	1	2	2	1	0	-	0	2	2
78	6	2	100	0	100	50	300	300	0	7	800	1	1	2	2	0	-	3	0	2
79	4	1	200	0	150	100	150	200	0	11	1100	1	1	2	1	1	1	2	1	2
80	6	1	100	0	150	150	200	200	0	11	900	1	1	3	2	0	-	1	0	2
81	8	1	100	100	100	50	150	100	0	7	400	1	2	2	1	0	-	1	0	1
82	3	1	100	0	50	50	150	100	0	6	900	1	1	2	2	0	-	0	1	2
83	8	2	100	0	150	100	600	200	0	6	600	2	1	3	2	1	3	0	1	2
84	4	1	100	200	50	100	150	0	0	2	500	1	2	3	2	0	-	0	0	2
85	3	2	100	0	100	60	400	500	0	5	500	1	1	3	2	1.5	1	0	0	0
86	10	1	200	0	200	100	300	400	0	2	200	2	1	3	1	0	-	0	1	1
87	3	2	400	0	300	60	60	600	0	14	5000	1	1	1	2	2	2	1	0	1
88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	-	-	-	-
89	4	1	200	600	300	150	60	0	0	4	600	1	1	3	1	0	-	2	0	2
90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	5	1	1	0
Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	5.4	-	143	123	180	76.8	179	155	45.5	6.3	752	1.2	1	-	-	17.7	-	-	-	-
Cv(%)	46	-	63	147	67	49	72	118	496	47	130	-	-	-	-	0.8	-	-	-	-
																195				

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm No.	Question																			
	21	22	23a	23b	23c	23d	23e	23f	23g	23h	23i	24a	24b	25	26	27a	27b	28a	28b	28c
91	3	2	100	30	60	50	200	0	0	12	4000	1	1	3	2	1	4	0	1	1
92	6	2	100	200	300	100	350	90	0	8	1400	1	1	3	2	1	1	0	1	2
93	3	2	50	300	250	100	350	0	0	6	700	2	1	2	2	0	-	0	2	4
94	4	2	200	0	100	100	80	150	0	10	1500	1	1	3	2	0	-	1	0	1
95	6	2	250	350	300	50	400	0	0	12	800	3	1	2	2	1.4	2	0	2	2
96	3	2	50	300	100	50	200	50	0	6	500	1	1	3	2	0	-	0	0	3
97	10	2	150	200	100	50	200	0	0	12	800	1	1	3	2	1	2	0	0	0
98	1	2	100	100	250	50	300	100	0	12	800	2	1	2	2	1	1	0	0	2
99	2	2	50	100	200	100	300	150	0	12	800	1	1	2	2	2	2	0	2	3
100	1	2	300	200	200	50	300	40	0	10	700	1	1	2	2	1.4	1	0	1	2
101	1	2	100	400	400	100	200	200	0	5	400	1	1	3	2	0.6	2	0	1	3
102	4	2	400	0	500	150	200	300	0	8	500	1	1	2	2	0	-	0	0	1
103	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	0	-	2	1	3
104	1	2	50	0	200	50	100	100	0	6	750	1	1	3	2	0	-	0	1	0
105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.2	5	-	-	-
106	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	-	-	-
107	3	1	200	0	150	100	100	50	0	5	300	1	1	3	2	0.6	1	0	1	0
108	1	1	50	0	100	50	250	100	0	9	450	1	1	2	2	0	-	0	1	0
109	2	2	100	0	150	45	100	600	0	4	600	1	1	2	2	0.6	4	0	1	0
110	3	2	200	200	10	10	200	0	0	7	400	1	1	3	2	0	-	-	-	-
111	1	2	50	75	75	50	60	50	0	2	250	2	1	2	2	0.2	1	0	4	4
112	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	-	-	-	-
113	5	2	100	0	250	100	250	50	0	7	300	1	1	2	2	0	-	0	2	2
114	6	2	50	100	100	100	360	60	0	10	450	1	1	3	2	0	-	0	1	1
115	1	2	20	50	50	20	100	30	0	6	350	1	2	2	2	1	2	-	-	-
116	10	2	60	75	75	50	120	80	0	4	260	1	1	3	2	0	-	-	-	-
117	6	2	20	50	50	50	150	20	0	5	550	1	1	3	2	2	3	-	-	-
118	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	1	-	-	-
119	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	0	2	2
120	4	2	30	200	200	100	400	100	0	4	600	1	1	3	2	0	-	0	4	2
Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-
Mean	3.6	-	116	122	174	69.8	220	96.7	0	7.6	757	188	1.2	-	-	0.5	-	-	-	-
Cv(%)	73	-	84	101	69	48	48	133	0	41	100	34	-	-	-	126	-	-	-	-

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm No.	Question 29	30	31	32	33	34a	34b	34c	35a	35b	35c	35d	35e	36a	36b	36c	36d	36e	36f	36g
1	1	1	3	2	6	17.2	-	-	2	3	12.2	-	-	0	2	0	0	0.3	2	0
2	2	2	1	2	2	19.5	12	-	0	2	17.5	8	-	0	0	0	0.8	0	3	0.3
3	1	1	3	5	6	17.6	-	-	0	2	15.6	-	-	0	0.8	0	0	0	0	0
4	2	2	3	2	1	21	-	1	0	2	19	-	0	0	6	0	0	0	0	0
5	1	1	1	5	6	19	-	1	0	3	26	-	0	0	0	0.5	0	1.5	0	0
6	2	3	3	2	2	17	-	1	0	4	13	-	1	0	0	0	3	0	1	0
7	1	1	1	2	5	13.6	6	-	0	2	11.6	5	-	0	0	0	1.5	0	0	0.5
8	-	-	-	-	-	14.9	-	-	0	4	10.9	-	-	-	-	-	-	-	-	-
9	2	1	4	2	6	49	-	2.5	0	2	47	-	2.5	0	0	2.5	0	0	13	0
10	1	2	1	1	2	18.5	-	2	1	1.5	16	-	1	0	1	0	1	0	0	0
11	2	1	4	5	3	25.6	5	2	0	3	22.6	4	1	0	0	0	8	0	0	1
12	-	-	-	-	-	19.5	-	-	0	0	19.5	-	-	-	-	-	-	-	-	-
13	2	3	2	2	5	36.3	8	-	0	5	31.3	6	-	0	0	0	0	6.7	0	0
14	1	2	3	5	5	52	-	-	1	5	46	-	-	0	1	0	0.5	2	0	16
15	2	1	2	2	1	32	5	1	0	0.5	31.5	2	1	0	0	7	0	0	1	0
16	-	-	-	-	-	9	-	-	0	0	9	-	-	-	-	-	-	-	-	-
17	1	2	1	2	2	13.2	6	0.2	0	3	10.2	4	0.2	0	0	0	0	0	1.6	0
18	2	1	1	2	6	38	3	1	0	4	32	-	0	0	5	0	0	0	0	0
19	1	2	2	5	4	17.4	-	-	0	3	14.4	-	-	0	0	3.5	0	0.5	0	0
20	-	-	-	-	-	17	-	-	0	2	15	-	-	-	-	-	-	-	-	-
21	1	1	4	2	2	14	12	0.4	1	0	13	4	0	0	1	0	0	0	1	0
22	1	2	3	5	6	6	3	-	0	3	3	3	-	0	0	0	0.8	0	0	0
23	-	3	-	-	-	4	-	-	0	1	3	-	-	-	-	-	-	-	-	-
24	2	2	3	2	2	26.7	21	-	0	3	23.7	2	-	0	0	1	0	0	0	11
25	1	1	4	5	5	27.8	-	2.5	0	2	25.6	-	1	0	0	0	0	6.5	0	0
26	-	-	-	-	-	8	-	0.8	0	5	3	-	0.8	-	-	-	-	-	-	-
27	1	2	3	2	1	17.6	4	-	0	2	15.6	4	-	6	0	0	0	0	0	0
28	2	2	2	2	2	47	5	-	0	2	45	5	-	0	0	30	0	0	0	0
29	-	2	3	2	5	14.5	-	-	1	3.5	10	-	-	0	0	0	1	0	0	0
30	1	2	3	5	8	10.1	-	-	3	0.1	7.4	-	-	0	3	0	1	0	0	0
Total	-	-	-	-	-	641	90	15.4	9	72.6	570	47	8.5	6	19.8	44.5	17.6	17.6	22.5	28.8
Mean	-	-	-	-	-	21.4	7.5	1.3	0.3	2.4	19	4.3	0.7	0.3	0.8	1.9	0.7	0.7	0.9	1.2
Cv(%)	-	-	-	-	-	58	70	60	234	60	64	40	96	-	-	-	-	-	-	-

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm No.	Question																		
	29	30	31	32	33	34a	34b	34c	35a	35b	35c	35d	35e	36a	36b	36c	36d	36e	36f	36g
31	-	2	3	-	-	10.5	-	3	0	2.2	1	-	1	-	-	-	-	-	-	-
32	1	2	2	5	2	15	-	3	14	1	28.8	-	4	0	14	14	0	0	1	0.3
33	2	3	2	2	6	17.2	-	10	1	2.2	14	-	8	0	1	0	0	0	0	0
34	1	1	1	2	2	78.5	-	10	5	3	70.5	-	8	0	5	40	0	11.5	0	2
35	-	-	-	-	-	4	-	1	0	1	3	-	0	-	-	-	-	-	-	-
36	2	2	3	2	2	20	-	5	0	0	20	-	2	0	0	0	11	0	2	0
37	2	3	2	2	2	206	27	12	0	1	205	7	5	0	0	2	8	0	112	0
38	1	2	3	2	2	46	-	3	3	5	38	-	3	0	3	0	2	0	0	1
39	2	2	3	5	2	101	-	3	0	2.6	98	-	2.2	0	0	65	0	5	0	10
40	2	2	3	2	2	60.5	-	-	14	1	45.5	-	-	0	14	20	0	3	0	0
41	1	1	4	2	6	37	-	-	0	0	37	-	-	0	0	13	0	0	0	0
42	-	-	-	-	-	15.9	-	-	0	1	14.9	-	-	-	-	-	-	-	-	-
43	-	-	-	-	-	15	-	3	0	1	14	-	2	-	-	-	-	-	-	-
44	2	1	3	2	2	44.2	-	1	6	1.2	37	-	0	0	20	0	0	0	3	0
45	2	2	2	5	4	24	8	4	9	1	14	8	4	0	9	0	0	0	0	0
46	2	2	3	2	1	64.4	16	3	26	0	38.4	6	1	0	26	0	15	0	0	1.2
47	2	2	3	2	2	58	12	2	2	2	54	5	3	0	2	0	17	0	1.5	0
48	2	3	3	5	2	30.2	17	3	5	2.2	23	4	2	0	5	0	0	0	0	0
49	2	3	3	5	2	59	-	-	2.6	0.6	55.6	-	-	0	2.6	30	0	2.5	0	2.5
50	1	1	4	2	2	97.2	6	-	31	6.6	59.8	4	-	0	31	20	0	0	10	0
51	2	2	3	5	2	118	-	4	0	2.2	116	-	4	0	0	0	22	0	0	4
52	2	2	2	2	6	33.8	-	-	11	2.4	20.4	-	-	0	11	0	7	0	0	3
53	2	2	2	2	6	42.9	-	2	10	6.2	33	-	0	0	10	19	0	0	0	0
54	1	2	4	5	1	78.5	-	4	34	1.5	43	-	2	0	34	18	0	1	0	0
55	2	2	2	2	6	98.5	-	4	30	2	66.5	-	2	0	30	25	0	11	0	0
56	2	1	3	1	2	65.5	-	-	37	5	23.5	-	-	0	37	0	8	0	0	0
57	2	2	2	5	2	14.2	-	-	3	2.2	9	-	-	0	0	3	2	0	0	0
58	2	2	3	2	6	37.6	-	-	7	5.6	25	-	-	0	0	7	6	0	2	2
59	2	2	3	2	2	19.2	-	0.2	4	1.2	14	-	0.2	0	7	0	0	1	1	0
60	2	2	3	5	1	20.8	-	-	3	2.8	15	-	-	0	6	0	1	1	0	0
Total	-	-	-	-	-	1533	86	80.2	258	65.7	1237	-	63.4	0	268	276	99	36	133	26
Mean	-	-	-	-	-	51.1	14.3	4.0	8.6	2.2	41.2	-	3.2	0	10.3	10.6	3.81	1.38	5.1	1
Cv(%)	-	-	-	-	-	83	53	78	132	82	99	-	78	-	-	-	-	-	-	-

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm	Question																		
No.	29	30	31	32	33	34a	34b	34c	35a	35b	35c	35d	35e	36a	36b	36c	36d	36e	36f	36g
61	2	3	4	2	4	36.8	3	-	0	1	35.8	12	-	0	0	0	0	7.5	0	0
62	-	-	-	-	-	3	2	-	0	1	2	2	-	-	-	-	-	-	-	-
63	2	2	1	5	3	43.2	4	-	0	2.4	40.8	1	-	0	0	2	3	0	0	25
64	2	3	3	2	6	6.1	-	-	0.1	0.5	5.5	-	-	0	0.1	0	0	0	0	0
65	1	1	3	5	1	13	-	-	3	0	10	-	-	3	0	2	0	1	0	0
66	-	-	-	-	-	3	3	-	0	0	3	0	-	-	-	-	-	-	-	-
67	2	3	3	5	3	11.8	-	-	1	0	10.8	-	-	1	2	0	0.5	0	0.5	0
68	-	2	3	-	7	8	-	-	0	3	5	-	-	-	-	-	-	-	-	-
69	2	2	3	5	2	24.8	-	1.4	0	0	24.8	-	0.2	0	0	5.5	0	0	0.5	0
70	2	2	3	2	7	7.5	7	2	0	2	7.5	1	0.2	0	0	2	0	0	0	0
71	1	2	3	1	1	36	48	-	18	3	15	20	-	18	0	0	0	0	0	0
72	2	2	3	5	1	12.7	1	1	0	1.7	11	0	1	0	0	3	0	1	0	0
73	2	1	2	5	2	7.8	1.8	0.4	1	1.8	5	1	0.4	1	1	0	0	0	0	0
74	2	2	2	2	3	15.7	3	0.4	2	1.9	11.8	2	0.4	2	0.5	0	0	0	0	0
75	-	-	-	-	-	11.7	8	1	0	1.5	10.2	6	0.8	-	-	-	-	-	-	-
76	2	2	3	2	6	38.6	20	4	9	4	25.6	10	4	9	4	0	0	1	1	0
77	2	3	3	1	3	24.5	6	0.8	0	4.5	20	4	0.8	0	0	0	0	7	0	2
78	1	2	3	2	2	10	5	1	0	2.5	7.5	3	0.8	0	0	1	0	3	0	0
79	2	1	2	5	1	25.3	8	0.6	3	4	18.3	8	0.4	0	3	0	6	0	0	1
80	2	2	3	2	6	20	5	3	3	1	16	5	0	3	0	1	0	0	0	0
81	1	1	3	1	2	24.5	5	1	3	2	19.5	1	1	3	0	0	0	6	0	0
82	2	3	2	2	3	21	-	-	0	3	18	-	-	0	0	0	0	12	0	0
83	2	2	3	5	2	34	11	0.2	0	2	34	11	0.2	0	0	0	0	0	12	0
84	1	3	3	2	7	11.6	10	1	2	1	8.6	7	0.2	0	3	0	0	0.5	0	0.5
85	2	3	3	1	2	22.5	17	1.5	0	3	19.5	7	1.5	0	3	0	0	0	0	0
86	2	1	4	2	2	20.3	5	0.2	3	1	16.3	3	0.2	3	0	0	0	7	0	0
87	2	1	2	5	1	31.7	-	2	1	9.7	21	-	2	1	0	0	0.5	0	6	0
88	-	-	-	-	-	7	-	-	0	0.3	6.7	-	-	-	-	-	-	-	-	-
89	2	3	2	2	3	10	6	0.6	0	3	7	2	0.2	0	0	1.5	0	0.5	0	0
90	2	2	3	2	6	45.6	8	0.6	12	2	31.6	6	0.2	12	0	0	10	0	0	1.5
Total	-	-	-	-	-	588	187	22.6	61.1	62.7	468	112	14.5	56	16.6	18	20	46.5	20	30
Mean	-	-	-	-	-	19.6	8.5	1.2	2.0	2.1	15.6	5.1	0.8	2.2	0.7	0.7	0.8	1.9	0.8	1.2
Cv(%)	-	-	-	-	-	63	118	82	199	91	66	96	89	-	-	-	-	-	-	-

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm	Question																		
No.	29	30	31	32	33	34a	34b	34c	35a	35b	35c	35d	35e	36a	36b	36c	36d	36e	36f	36g
91	2	2	3	2	3	28	-	5	4	2	22	-	5	0	4	0	0	7	0	2
92	2	3	2	2	6	29	1	4	15	1	13	0	1	0	15	3	0	0.5	0.5	0
93	2	2	2	2	4	44.4	-	-	11	1	32.4	-	-	0	11	0	16	0	0	0.5
94	2	2	3	5	2	14	1	0.2	1	2	11	1	0.2	0	1	0	0	5	0	1
95	2	3	2	2	4	39.1	-	14	4	1	34.1	-	2	0	4	0	0	10	0	0
96	3	3	2	2	2	18.8	-	2	3	1	14.8	-	1	0	3	0	0	6.5	0	0.5
97	2	2	3	5	1	16.1	8	1	0	2.1	14	6	0.6	0	2	0	0	0	0	0
98	2	2	3	2	6	28	-	7	6	1	21	-	5	0	6	1.5	0	0.5	0	0
99	2	2	2	2	2	10.1	8	-	1	1	8.1	4	-	0	3	0	1	0	0	0
100	2	3	3	2	2	25.2	-	5	7	2.1	16.1	-	4	0	9	0	0	1	0	0
101	1	3	2	3	2	21.4	-	7	0	1	20.4	-	3	0	0	0	1	0	6	0
102	2	1	2	2	5	18.3	6	6	0	1	17.4	3	4	0	3	0	0	0	0	0
103	2	3	4	5	2	42.8	-	6	5	1	36.8	-	4	0	5	0	16	0	0	2.5
104	2	3	2	2	2	18.2	-	4	3	0.6	14.6	-	4	0	3	0	2.5	0	0.5	0
105	-	-	-	-	-	7	-	0.4	0	2	5	-	0.4	-	-	-	-	-	-	-
106	-	-	-	-	-	7	-	-	0	1	6	-	-	-	-	-	-	-	-	-
107	2	1	4	2	2	11	-	-	1	1	9	-	-	0	0	2	0	1	0	0
108	1	3	2	5	2	12.2	-	-	0	1.1	10.1	-	-	0	0	0.5	3	0	0.5	0
109	2	3	2	2	2	25.4	-	8	0	1	24.4	-	1	0	0	0	0	8	0	1
110	-	-	-	-	-	2	4	2	0	1	1	3	1	-	-	-	-	-	-	-
111	2	2	3	5	2	37.9	-	5	10	2	25.9	-	4	0	10	0	12	0	0	2
112	-	-	-	-	-	15	1	0.8	0	2	13	1	0.8	-	-	-	-	-	-	-
113	2	1	2	2	1	9.8	-	1	1	1	7.8	-	0.5	0	1	0	2	0	1	0
114	2	3	3	2	4	15.2	-	5	2	0.8	12.4	-	3	2	3	0	0	1	1	0
115	-	-	-	-	-	17	1	3	0	2	15	1	3	-	-	-	-	-	-	-
116	-	-	-	-	-	6	-	-	0	1	5	0	-	-	-	-	-	-	-	-
117	-	-	-	-	-	15.5	23	2	0	2	13.5	4	1	-	-	-	-	-	-	-
118	-	-	-	-	-	5.5	1.5	1.5	0	1.5	4	1.5	1	-	-	-	-	-	-	-
119	2	2	2	5	1	10.5	9	1	0	0	10.5	7	1	0	2	0	0	0	0	0
120	2	1	2	1	7	19	-	-	0	2	17	-	-	0	0	0	3	0	0.5	0.5
Total	-	-	-	-	-	569	63.5	90.9	74	39.2	455	31.5	50.5	2	85	7	56.5	40.5	10	10
Mean	1.9	-	-	-	-	19	5.8	4.0	2.5	1.3	15.2	2.6	2.2	0.1	3.9	0.3	2.6	1.8	0.5	0.5
Cv(%)	-	-	-	-	-	94	114	82	156	43	58	113	138	-	-	-	-	-	-	-

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm No.	36h	36i	36j	36k	36l	37a	37b	37c	37d	37e	37f	37g	37h	38a	38b	39a	39b	39c	39d	39e	39f	39g
	Question																					
1	0.5	0	0	0	0	120	1	2	5	2	200	2	2	1	2	3	8.2	1	0.4	0.6	0	0
2	0	0	0	0	0	150	1	1	0	-	-	2	1	2	2	4	11.2	0.9	0.1	0.6	0.7	0
3	0	0	0	0	0	.	1	1	0	-	-	2	3	1	2	0.8	5	0.8	0.2	1	0	0.6
4	0	0	0	0	0	.	1	1	0	-	-	2	2	3	1	6	11.6	0	0.2	0.2	0.2	0
5	0	0	0	0	0	120	1	1	0	-	-	2	3	1	2	2	18.2	4.5	1	0.3	0	0.8
6	1	0	0	0	0	30	1	1	0	-	-	2	2	1	1	5	8	0.1	0	0	0.9	0
7	0	0	0	0	0	30	1	1	2	2	100	2	2	1	2	2	8	0.9	0	0.2	0.5	0
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	8.2	0	0.3	1.9	0.5	0
9	1	2	0	0	1.5	90	1	3	8	4	400	2	3	1	1	20	20	0	0	1	4	0
10	0	0	0	0	0	40	1	1	0	-	-	2	2	3	2	1	5	0	0	0	10	0
11	0	0	1	0	0	90	1	1	0	-	-	2	1	1	1	10	12	0	0	0	0	0.6
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	12.5	0	1	1.5	0	4.5
13	0	1	0.5	2	0	60	1	1	0	-	-	2	2	1	1	10	19.4	1	0	0.6	0.3	0
14	0	0	0	1.5	0	120	1	1	0	-	-	2	2	1	2	20	17.5	4	0.4	0.9	1.2	2
15	0.9	0	0.6	0.5	0	14	1	1	0	-	-	1	2	1	2	10	12.3	6	0	0.2	1.2	1.8
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	7.7	0.9	0	0.4	0	0
17	0.4	0	0	0	0	60	1	1	0	-	-	2	3	1	2	2	7	0	0	0.4	0.8	0
18	0	0	0	0	0	.	1	3	0	-	-	2	2	1	2	5	15	4	1	2	0	0
19	1	0	0	0	0	7	3	1	0	-	-	2	1	2	2	5	7.8	0	0	1.4	0.2	0
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	14.5	0	0.5	0	0	0
21	1	4	0	0	0	120	3	1	0	-	-	2	1	1	2	6	5.8	1	0.2	0	0	0
22	0	0	0	0	0	90	1	3	8	1	200	2	2	2	2	0.8	2	0	0.2	0	0	0
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	3	0	0	0	0	0
24	0	0	1	2	0	150	2	1	0	-	-	1	3	3	2	15	6.7	0	0	1	0	1
25	1.3	0	1	0	1	30	1	1	0	-	-	2	2	1	1	10	12.6	0	0	1.4	0	1.6
26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	2.7	0.3	0	0	0	0
27	0	0	0	0	0	.	1	1	0	-	-	2	2	1	2	6	7.7	0.6	0.3	0	0	1
28	0	0	0	0	0	.	1	3	0	-	-	2	3	3	1	30	12.7	1	0.3	0	0	1
29	0	0	0	0	0	21	1	1	8	2	200	2	3	1	2	0	9.5	0.2	0	0	0.3	0
30	0	0	0	0	0	60	1	1	0	-	-	2	2	1	1	1	4.8	0.4	0	1	0.2	0
Total	7.5	7	4	6.2	2.5	-	-	-	-	-	-	-	-	-	-	175	297	27.6	6.1	16.6	21	14.9
Mean	0.3	0.3	0.2	0.3	0.1	75	-	-	1.3	-	20	-	-	-	-	5.82	9.89	0.92	0.2	0.55	0.7	0.5
Cv(%)	-	-	-	-	-	-	-	-	217	-	50	-	-	-	-	125	50	170	152	111	274	194

"-" Means not applicable. "." = Missing information or no response.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm No.	Question 36h	36i	36j	36k	36l	37a	37b	37c	37d	37e	37f	37g	37h	38a	38b	39a	39b	39c	39d	39e	39f	39g
31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	7.6	0	0.4	0	0.2	0
32	2.5	2.2	0	0	0	30	1	1	0	-	-	2	2	1	1	20	7.4	0	0.4	0.2	0.8	0
33	0	0	0	0	0	60	1	1	0	-	-	1	2	2	2	0	12.4	0	0.6	0	1	0
34	0	1.5	0	5	0	30	1	1	0	-	-	2	2	1	1	60	10	0	0	0.5	0	0
35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	2.9	0	0.1	0	0	0
36	1	0	0	0	0	60	1	1	0	-	-	2	2	1	1	14	6	0	0	0	0	0
37	13	4	5	6	0	90	1	1	0	-	-	1	1	2	2	150	29	0	2	2	20	2
38	0	0	0	0	0	30	1	1	0	-	-	2	2	1	1	10	20	0	0	2	4	2
39	0	10	0	0	0	60	1	1	0	-	-	2	1	1	1	90	6	0	0	0	2	0
40	0	2	1	1	0	30	1	1	0	-	-	1	2	1	2	27	16	0	0	1	0	1.5
41	1	0	0	0	1	30	1	1	0	-	-	2	2	1	1	15	18.6	0	0	0.4	3	0
42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	14.8	0	0.2	0.1	0	0
43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	11.8	0	0.2	1	1	0
44	1	0	2	0	0	4	1	1	0	-	-	2	2	1	1	20	14	0	0.6	1.4	1	0
45	0	0	0	0	0	.	1	1	0	-	-	1	2	2	1	0	13	0	0	1	0	0
46	0	0	2.8	1	0	30	1	2	6	2	100	2	2	1	1	20	18	0	0	0	0	0.4
47	0	0	0	1.5	0	60	3	1	0	-	-	2	2	2	1	30	23	0	0	0	2	1
48	0	0	0	0	0	.	1	3	0	-	-	2	2	1	2	0	23	0	0	0	0	0
49	0	0	2	1	0	30	1	3	8	4	400	1	1	2	1	38	14	0	0	2.6	1	0
50	3	1	0	1	0	20	1	2	3	3	100	3	3	1	1	35	17.6	0	0	1	6	0.2
51	1	3	0	0	0	60	3	2	2	3	50	1	2	1	2	30	29.6	0	0	0	3.4	0
52	0	0	0	0	0	60	1	1	0	-	-	2	1	1	1	10	7.6	0	0	1	1.2	0.6
53	0	0	0	0	0	30	3	1	0	-	-	2	2	2	1	20	13	0	0	0	0	0
54	0	0	0	0	0	30	1	1	0	-	-	2	3	1	1	20	17	0	0	2	4	0
55	2	0	0	2	0	30	1	1	0	-	-	2	2	2	1	40	20	0	0	2	4.5	0
56	0	1	1	0	0	60	3	1	0	-	-	1	2	1	2	10	11.3	0	0	0.2	2	0
57	0	0	0	0	0	30	1	1	0	-	-	1	2	2	1	2	2.8	4	0.2	0	0	0
58	0	0	0	0	0	30	1	2	2	2	200	2	3	2	1	10	5.8	7	0	2	0.2	0
59	0	0	0	0	0	7	1	1	0	-	-	1	2	1	1	5	5.6	1	0.1	1.2	1.1	0
60	0	0	0	0	0	3	1	1	0	-	-	2	2	2	2	5	8.5	3.4	0.1	0	0	0
Total	24.5	23.6	13.8	18.5	1.5	-	-	-	-	-	-	-	-	-	-	681	406	15.4	4.9	21.6	58.4	7.7
Mean	0.9	0.9	0.5	0.7	0.1	38	-	-	0.8	-	170	-	-	-	-	22.7	13.5	0.5	0.2	0.7	2.0	0.3
Cv(%)	-	-	-	-	-	-	-	-	248	-	82	-	-	-	-	138	52	304	237	115	194	227

"-" Means not applicable. "." = Missing information or no response.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm	Question																				
No.	36h	36i	36j	36k	36l	37a	37b	37c	37d	37e	37f	37g	37h	38a	38b	39a	39b	39c	39d	39e	39f	39g
61	2	0	0	0.5	0	-	1	1	0	-	-	1	1	1	2	10	19.7	4	0.3	0.8	0	1
62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1.8	0	0.2	0	0	0
63	0	0	1	2	2	.	1	1	0	-	-	2	2	3	2	35	5.5	0.2	0.1	0	0	0.4
64	0	0	0	0	0	.	1	1	0	-	-	3	1	1	1	0	1.5	4	0	0	0	0
65	0	0	0	0	0	28	3	1	0.3	1	20	3	1	1	1	2	8.8	0	0.2	0	0	0
66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0	2	0.8	0	0	0.2	0
67	0	0	0	0	0	60	1	1	0		-	2	3	1	1	3	6.7	0.7	0.1	0.3	0	0
68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	4.7	0	0.3	0	0	0
69	0	1.5	0	0.5	0	.	1	1	0	-	-	3	1	1	4	8	13.8	2	0.2	0	0	0.8
70	0	0	0	0	0	60	3	1	0	-	-	2	1	1	1	2	4.1	1	0.2	0.2	0	0
71	0	0	0	0	0	.	1	1	0	-	-	2	2	1	1	0	13.4	0.3	0.5	0.8	0	0
72	0	0	0	0	0	28	1	2	2	4	400	2	2	1	1	4	7	0	0	0	0	0
73	0	0	0	0	0	1	1	1	0.5	1	50	3	1	1	1	1	3.1	0.8	0.1	0	0	0
74	0	0	0	0	0	7	1	1	0.5	1	50	3	1	1	1	0.5	10	1.1	0	0	0.2	0
75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	9.5	0.7	0	0	0	0
76	0	0	0	0	0	30	1	1	0	-	-	2	1	1	1	6	15	3	1	0.6	0	0
77	0	0	0	0	0	90	1	1	0	-	-	3	1	1	1	9	9.2	1	0.3	0	0.5	0
78	0	0	0	0	0	60	1	1	0	-	-	3	3	1	1	4	2	0.3	0.3	0.4	0.5	0
79	0	0	1	0	0	60	1	1	0	-	-	2	1	2	1	8	8.1	1.3	0.2	0.4	0	0.3
80	0	0	0	0	0	60	1	1	0	-	-	3	2	1	3	1	13.3	0.7	0.3	0.7	0	0
81	0	2.5	1.5	0	0	120	3	1	0.3	3	20	3	1	2	2	10	6.5	3	0	0	0	0
82	2	0	0	1	0	60	1	1	0	-	-	2	1	1	1	15	11.5	0.5	0.5	0	0.5	0
83	1	1	0	1	0	90	1	1	0	-	-	3	1	1	1	15	15.6	0.2	0	1.2	2	0
84	0	0	0	0	0	.	1	1	0	-	-	2	3	1	1	2	5.4	0.6	0.3	0	0.3	0
85	0	0	0	0	0	.	1	1	0	-	-	2	1	1	2	3	14.5	0.7	0.3	0	1	0
86	1	0.5	0	0.5	0	90	1	1	0	-	-	3	1	1	1	9	4	1.8	0	0.8	0.7	0
87	0	0	0.5	0	0	150	1	1	0.5	1	100	3	2	3	1	7	12.2	1.5	0	0	0.3	0
88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	5.1	1.3	0.3	0	0	0
89	0	0	0	0	0	60	1	1	0	-	-	2	1	1	1	2	2.7	2	0.3	0	0	0
90	0	0	0	0.5	0	30	1	1	0	-	-	3	3	1	1	19	9.1	0	0.3	1.1	2.1	0
Total	6	5.5	4	6	2	-	-	-	-	-	-	-	-	-	-	176	246	33.5	6.3	7.3	8.3	2.5
Mean	0.2	0.2	0.2	0.3	0.1	59	-	-	0.6	-	107	-	-	-	-	5.9	8.2	1.1	0.2	0.2	0.3	0.1
Cv(%)	-	-	-	-	-	-	-	-	812	-	137	-	-	-	-	129	59	101	101	154	197	289

"-" Means not applicable. "." Missing information or no response.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm No.	Question																					
	36h	36i	36j	36k	36l	37a	37b	37c	37d	37e	37f	37g	37h	38a	38b	39a	39b	39c	39d	39e	39f	39g
91	0	0	1	0	0	30	3	1	0	-	-	3	2	1	1	10	10.6	0	0	0.4	0	1
92	1	0	0	0	0	60	1	1	0	-	-	2	2	1	1	5	5.8	1	1	0.2	0	0
93	0	3	0	0.5	0	30	3	1	0	-	-	2	1	1	1	20	9.8	0	0.4	0.8	0	0.4
94	1	0	0	0	0	60	1	2	5	3	10	2	2	1	1	7	3.6	0	0.4	0	0	0
95	3	0	1.5	0	0.5	60	1	1	0	-	-	2	2	1	1	15	13.6	1	2	0.4	1.5	0.6
96	0	1	0	0	0	120	3	1	0	-	-	2	2	1	1	8	5.8	0	0.2	0	0.8	0
97	0	0	0	0	0	.	2	1	0	-	-	2	2	1	1	2	10.3	1.4	0.3	0	0	0
98	0	0	0	0	0	30	3	1	0	-	-	2	2	3	1	2	16.5	1.6	0.5	0.4	0	0
99	0	0	0	0	0	30	1	1	0	-	-	2	2	1	1	3	6	0.2	0.3	0.2	0.4	0
100	0	0	0	0	0	30	1	1	0	-	-	2	2	3	1	3	11.2	0	0	0.8	1.1	0
101	0	1	0	0	0	30	1	1	0	-	-	2	1	1	1	8	8.2	1.6	1.4	0.2	0	1
102	0	0	0	0	0	-	1	1	0	-	-	2	2	1	1	3	11.8	0.9	1.4	0	0.2	0
103	0	1.5	0	0	0	60	3	1	0	-	-	2	2	1	1	20	14	0	1.2	0.8	0.8	0
104	1	0	0	0	0	60	1	2	1	3	100	2	2	1	1	4	9.3	0	0.1	0	0.8	0.4
105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	5	0	0	0	0	0
106	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	5.2	0.8	0	0	0	0
107	0	0	0	0	0	30	1	1	0	-	-	2	2	1	1	2	5.9	1	0.1	0	0	0
108	0	0	0	0	0	90	3	3	8	4	100	2	1	1	1	4	5.8	0	0.3	0	0	0
109	2	0	0	0	0	60	1	1	0.5	3	400	2	2	1	1	11	11.6	0	0.2	0.2	1.2	0.2
110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	0.9	0	0.1	0	0	0
111	0	1	0	0	0	14	1	1	-	3	25	3	2	3	1	15	10.5	0	0.2	0	0.2	0
112	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	11	2	0	0	0	0
113	0	0	0	0	0	30	1	1	1	3	100	2	2	1	1	3	3.2	1	0.4	0.2	0	0
114	0	0	0	0	0	14	1	1	0	-	-	2	2	1	1	5	6.2	0	0.2	0	0	1
115	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	11.7	1.5	0.8	0	1	0
116	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	3	1.4	0	0	0.6	0
117	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	8	2	0	0	2.5	1
118	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1.9	1	1	0	1	0
119	0	0	0	0	0	.	1	1	0	-	-	2	2	1	1	2	5	3	0	0	0.5	0
120	0	0	0	0	0	30	1	1	0.2	3	100	2	2	1	1	4	12	0	0	0	1	0
Total	8	7.5	2.5	0.5	0.5	-	-	-	-	-	-	-	-	-	-	156	243	21.4	12.5	4.6	13.6	5.9
Mean	0.4	0.3	0.1	(.)	(.)	46	-	-	0.7	-	119	-	-	-	-	5.2	8.1	0.7	0.4	0.2	0.5	0.2
Cv(%)	-	-	-	-	-	-	-	-	244	-	109	-	-	-	-	112	48	115	126	167	135	190

"-" Means not applicable. "." = Missing information or no response. (.) = Negligible (< 0.1) value.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm No.	Question																	
	39h	39i	40a	40b	40c	41	42a	42b	42c	42d	42e	43a	43b	43c	43d	43e	43f	44a	44b
1	8	4	1	-	-	0	0	0	-	-	-	14.5	0	0	0	0.5	0	2	2
2	7	4	1	-	-	4	0	0	-	-	-	14	12	0	1.1	26.5	3	2	2
3	9	5	1	-	-	0	0	0	-	-	-	1	0	1.2	4.4	1.1	0	2	2
4	9	4	1	-	-	0	0	0	-	-	-	15	0	0	3	1	2	2	2
5	7	5	1	-	-	0	0	0	-	-	-	100	4.8	0	0	43	35.6	2	2
6	9	3	2	8	2	0	0	1	10	1	1	15	0	15	0	15	4	2	2
7	9	4	2	4	1	1	0	0	-	-	-	5	0	0	0	1.7	3.8	2	2
8	7	4	2	8	2	0	0	0.4	9	3	1	0	0	0	50	40	81	2	2
9	11	5	1	-	-	0	0	0	-	-	-	120	0	5	60	16	59.2	1	2
10	8	3	1	-	-	0	0	0.2	11	3	1	1.8	0	0	0	1.8	0	2	2
11	10	4	1	-	-	4	0	0	-	-	-	30	10	6	10	30	0	1	1
12	7	7	1	-	-	0	0	0	-	-	-	0	0	0	3	0	5	1	2
13	10	4	1	-	-	3	0	0	-	-	-	46	17	0	22.6	23	16	1	2
14	9	4	1	-	-	0	0	0	-	-	-	50	20	12	4	0	0	2	2
15	10	4	1	-	-	0	0	0	-	-	-	30	9	0	0	4.5	25	1	2
16	8	11	2	4	2	0	1	3	1	1	1	7.5	0	0	7	1.2	3	2	2
17	10	3	2	7	2	2	0.6	1.3	4	3	1	10	5	0	1	4.5	2.5	1	2
18	10	4	1	-	-	3	0	0	-	-	-	15	0	0	5	1.4	0	1	2
19	8	4	1	-	-	0	0	0	-	-	-	15	0	0	200	0	0	2	2
20	9	3	1	-	-	0	0	0.6	12	3	1	0	20	0	0	15	24	1	1
21	10	2	2	6	2	8	2	3.5	2	1	1	21	12	0	31.9	1.9	14.7	2	2
22	9	4	2	4	2	0	0	0	-	-	-	-	-	-	-	-	-	2	2
23	8	3	2	5	2	0	0	0.8	1	3	1	0	0	0	0	0	4	2	2
24	12	5	1	-	-	0	0	0	-	-	-	0	75	0	15	0	0	2	1
25	9	6	1	-	-	0	1	0	3	3	1	20	0	4	6.5	0	90	1	2
26	8	3	2	4	4	0	1.5	3	2	1	2	0	0	0	0	0	4.5	1	2
27	10	5	1	-	-	0	0	0	-	-	-	19	6	0	8	20	0	2	2
28	10	5	1	-	-	4	0	1	4	1	1	150	0	0	6.5	0	0	2	2
29	9	12	2	4	3	0	1.2	4	2	3	1	0	0	0	0	43	0	2	2
30	9	4	2	4	2	0	0	0.2	8	1	1	2.5	0	0	27	5.7	32.1	2	1
Total	-	-	-	-	-	29	7.3	19	-	-	-	727	191	43.2	466	297	409	-	-
Mean	-	-	-	-	-	1	0.2	0.6	-	-	-	24.2	6.6	1.5	16.1	10.2	14.1	-	-
Cv(%)	-	-	-	-	-	198	220	183	-	-	-	154	223	248	239	138	172	-	-

"-" Means not applicable.

Cont. Appendix 7.1 **Summary information for farmer questionnaire**

Farm No.	39h	39i	40a	40b	40c	41	42a	42b	42c	42d	42e	43a	43b	43c	43d	43e	43f	44a	44b
	Question																		
31	7	2	2	3	2	0	0	2	2	1	1	0	0	0	0	4.5	0	2	2
32	10	2	1	-	-	0	0	1	9	1	1	50	30	0	0	0	0	1	2
33	7	3	1	-	-	0	0.2	0.4	10	2	1	0	0	40	0	0	0	2	2
34	10	4	2	3	2	0	0	0.4	11	1	2	150	0	20	6	50.5	35	2	2
35	7	4	2	4	4	0	0	4	8	1	1	0	0	0.8	8.5	0	0	2	2
36	9	4	2	2	4	0	0	0.2	12	1	1	32.2	0	42	0	22	0	2	2
37	8	4	1	-	-	7	0	0	-	-	-	375	24	28	7.8	32	0	2	2
38	9	4	1	-	-	0	0	0	-	-	-	30	0	0	80	0	80	2	2
39	8	2	2	2	10	0	0	2	1	1	1	225	0	100	0	0	0	1	2
40	8	5	2	1	6	0	0	0	-	-	-	70.2	0	0	0	8	180	2	2
41	7	4	1	-	-	0	0	1	2	1	1	29.4	0	0	0	0	0	2	2
42	6	2	2	3	10	0	1.2	3	12	2	1	0	0	0	0	0	46.8	2	2
43	9	2	2	3	7	0	0	1	3	2	1	0	0	18	0	0	0	1	2
44	7	4	2	3	-	0	0	0.2	4	1	1	45	0	3	0	0	56	1	2
45	8	3	2	2	1	1	0	7.2	7	1	1	0	24	0	0	0	0	2	2
46	8	4	1	-	-	0	0	0	-	-	-	43	0	22	3	21	0	1	2
47	8	4	1	-	-	0	0	0	-	-	-	90	170	10	0	87	0	2	1
48	7	3	1	-	-	0	0	0	-	-	-	0	18	0	0	2.4	8	2	1
49	8	4	1	-	-	0	0	0	-	-	-	91.2	0	0	0	100	0	1	2
50	9	4	1	-	-	0.6	1	0	9	1	1	83	36	0	4	0	300	2	2
51	8	2	2	2	4	0	0.5	2.6	4	1	2	90	0	30	0	25	0	2	2
52	8	4	1	-	-	0	0	0	-	-	-	20	0	0	0	0	0	1	2
53	7	3	1	-	-	0	0	0.6	10	1	1	60	0	0	0	0	0	1	2
54	8	4	1	-	-	0	0	0	-	-	-	85	45	25	20	68.6	100	1	2
55	8	4	1	-	-	0	0	0	-	-	-	109	0	0	0	0	0	1	2
56	8	3	2	2	2	0	0	0	-	-	-	23	0	0	0	0.3	1.5	2	1
57	9	5	2	2	6	0	2.8	3	10	1	1	4	0	0	0	0	60	2	2
58	8	5	2	2	10	0	0.4	2	12	1	1	40	0	0	5	0	0	2	2
59	9	2	2	2	2	0	0	0.8	11	1	1	10	21	3	0	0	25	2	2
80	7	3	1	-	-	0	0	0.2	12	1	1	11	0	0	0	0	52	2	2
Total	-	-	-	-	-	8.6	6.1	31.4	-	-	-	1766	368	342	134	421	944		
Mean	-	-	-	-	-	0.3	0.2	1.1	-	-	-	58.9	12.3	11.4	4.5	14	31.5		
Cv(%)	-	-	-	-	-	448	281	154	-	-	-	134	264	187	332	194	206		

"-" Means not applicable.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm	Question																		
No.	39h	39i	40a	40b	40c	41	42a	42b	42c	42d	42e	43a	43b	43c	43d	43e	43f	44a	44b
61	11	5	1	-	-	0.2	0	0	-	-	-	50	12	0	0			2	2
62	10	2	2	3	4	0	0.1	0.5	2	1	1	-	-	-	-	-	-	2	1
63	9	5	1	-	-	1	0	6	9	1	1	130	0	0	0	0	0	1	1
64	7	7	2	9	6	0	0.6	3.5	12	1	1	0	0	0	0	0	20	2	1
65	8	12	2	5	2	0	2.2	5	9	1	1	4	0	0	21.6	12.6	135	2	2
66	7	1	2	2	4	6	0	0.2	2	1	1	0	4	0	0	0	0	1	2
67	6	1	2	4	8	0	0.8	0.2	8	1	1	6	0	0	4	0	0	1	1
68	9	4	2	2	2	0	0.4	2	2	1	1	0	0	0	86.5	4.8	29.4	2	2
69	8	4	2	2	9	0	0	0	-	-	-	27	40	0	0	4	0	2	2
70	9	4	1	-	-	6	0	0	-	-	-	4	11.1	1.6	0	0	0	1	2
71	8	3	1	-	-	0	0	0	-	-	-	-	-	-	-	-	-	2	2
72	9	1	2	1	3	0	0	1	10	2	1	1	12	0	0	0.7	0.2	2	2
73	10	4	1	-	-	0.8	0	0	-	-	-	2	0	0	0	0.4	7	2	1
74	9	4	1	-	-	1	0	0	-	-	-	12	9	0	0	1.6	0	2	2
75	9	4	1	-	-	0	0	1	12	1	1	0	0	0.8	0	0	0	2	1
76	10	4	1	-	-	5	0	0	-	-	-	1.8	12	0	0	666	0	2	2
77	10	4	2	3	2	2	0	0	-	-	-	23	6	0	0	30.7	0	1	2
78	9	12	2	5	2	2	0.6	1	9	1	1	12	0	0	0	0.5	0	1	2
79	10	5	1	-	-	6	0	0	-	-	-	16	4	0	0	1.8	0	2	2
80	7	3	1	-	-	0	0	0	-	-	-	2.2	0	0	0	0	0	2	2
81	9	3	1	-	-	4	0	0	-	-	-	30	0	0	0	37.5	0	2	1
82	9	4	1	-	-	0	0	0	-	-	-	-	-	-	-	-	-	2	2
83	10	4	1	-	-	0	0	0	-	-	-	45	45	0	4		0	1	2
84	10	2	1	-	-	3	0	0	-	-	-	0.5	0	0	0	0.7	10	1	2
85	10	2	1	-	-	2	0	1	10	1	1	9	3	0.8	0	1.1	22	2	2
86	11	4	1	-	-	0	0	2	11	1	1	27	20	0	0	0.8	0	2	2
87	12	3	1	-	-	0	0	0	-	-	-	18	0	0	0	34	10.1	2	2
88	8	1	2	2	6	0	1.5	2	3	1	1	0	0	0	16.5	0	2	2	2
89	10	4	2	1	4	4	0	0.2	11	1	1	8	0	7.2	0	0	29.9	2	2
90	9	4	1	-	-	2	0	0.6	12	1	1	47	26.5	0	0	12.1	30	1	2
Total	-	-	-	-	-	45	6.2	26.2	-	-	-	528	205	10.4	133	844	303		
Mean	-	-	-	-	-	1.5	0.2	0.9	-	-	-	17.6	7.6	0.4	4.9	31.3	11.2		
Cv(%)	-	-	-	-	-	4.3	243	174	-	-	-	154	161	366	348	408	329		

"-" Means not applicable. "." = Missing information or no response.

CONT. APPENDIX 7.1 SUMMARY INFORMATION FOR FARMER QUESTIONNAIRE

Farm	Question																	
No.	39h	39i	40a	40b	40c	41	42a	42b	42c	42d	42e	43a	43b	43c	43d	43e	43f	44a	44b
91	9	3	1	-	-	0	1	0	8	1	1	23	0	0	12	0	0	1	2
92	7	2	1	-	-	1	0	0	-	-	-	27	0	14	0	0	0	1	2
93	8	4	1	-	-	0	0.2	0	9	1	1	36	0	7	22	22	0	2	2
94	9	3	2	5	4	0.5	0	0	-	-	-	14	1.6	0	0	0	0	2	2
95	8	5	1	-	-	0	0	0	-	-	-	30	0	50	12	1.8	0	2	2
96	10	2	1	-	-	0	0	0	-	-	-	16	0	45	0	0	0	1	1
97	8	1	1	-	-	2	1	0	10	1	1	0	5	0	0	26	0	2	2
98	8	1	1	-	-	0	0	0	-	-	-	2.4	0	0	0	0	2	2	2
99	11	2	1	-	-	4	0	0	-	-	-	7.5	0	0	0	2	0	1	2
100	7	4	1	-	-	0	0.6	0	11	1	1	6	0	36	0	0.6	0	1	2
101	10	3	1	-	-	0	1	0	12	1	1	13.6	0	50	2	0.9	0	1	2
102	9	3	2	4	2	3	0	0	-	-	-	7.5	0	20	0	21.6	0	2	2
103	10	2	1	-	-	0	0	0.4	1	1	1	40	0	88.2	0	0	0	1	2
104	8	4	1	-	-	0	0	0	-	-	-	7.2	0	0	8	0	13	2	2
105	9	2	2	2	4	0	0	0	-	-	-	0	0	0	0	0	3	2	2
106	7	1	1	-	-	0	0	0	-	-	-	-	-	-	-	-	-	2	2
107	9	2	1	-	-	0	0	0	-	-	-	4	0	4.5	0	4.8	0	2	2
108	9	2	2	3	2	0	0	1.2	2	1	1	8	0	0	0	7.9	9.7	2	2
109	9	4	1	-	-	0	0	0	-	-	-	19.2	0	18	0	0.4	0	1	2
110	5	4	1	-	-	2	0	0	-	-	-	-	-	-	-	-	-	1	2
111	8	2	1	-	-	0	0	0.8	3	1	1	30	0	10	0	2	0	1	1
112	10	3	2	1	9	0	0.8	4	4	1	1	0	0	0	0	0	108	1	1
113	9	1	2	3	4	0	0	3	9	1	1	9	0	2.4	0	3.5	113	2	1
114	10	6	1	-	-	0	0	0	-	-	-	12.5	0	0	0	1	0	2	1
115	8	3	1	-	-	1	0	0	-	-	-	0	0	0	4	0.9	120	1	1
116	9	12	2	3	7	0	0	0	-	-	-	-	-	-	-	-	-	2	2
117	8	4	2	5	1	3	5	5	8	1	1	0	40	5	0	250	0	2	1
118	7	2	2	2	6	0.5	0	1	8	1	1	-	-	-	-	-	-	2	1
119	8	1	2	4	1	2	0	0.6	12	1	1	10	30	16	12	0.5	0	2	2
120	8	2	2	2	4	0	1	3	2	1	1	12	8	4	3.3	53.4	69.1	2	1
Total	-	-	-	-	-	19	10.6	19	-	-	-	386	84.6	370	75.3	399	437		
Mean	-	-	-	-	-	0.6	0.4	0.6	-	-	-	12.9	3.3	14.2	2.9	15.4	16.8		
Cv(%)	-	-	-	-	-	177	269	209	-	-	-	91	296	155	194	322	227		

"-" Means not applicable. "." = Missing information or no response.

Source: Own survey, 1992/93.

APPENDIX 7.2

SUMMARY INFORMATION FOR THE TRADER QUESTIONNAIRE

Trader No.	Question 1	2	3a	3b	3c	4	5	6a	6b	7a	7b	7c	8	9
1	32	7	2	3	2	2	6	1	2	400	460	320	·1	1
2	38	11	3	11	1	1	6	2	3	33000	300	0	13	12
3	55	14	3	13	1	2	7	2	2	2500	0	0	2	1
4	26	7	1	5	2	2	6	1	2	250	30	0	1	1
5	34	7	1	6	2	2	6	1	2	200	0	0	1	1
6	25	7	5	4	2	1	6	2	23	350	0	0	1	1
7	29	0	2	3	2	1	6	2	2	960	50	0	1	1
8	35	7	3	5	1	1	6	2	2	970	50	0	1	1
9	42	7	1	8	2	2	6	1	2	60	90	20	1	1
10	30	2	1	5	2	1	6	1	2	320	0	0	1	1
11	34	0	1	7	2	2	6	1	2	200	0	0	1	1
12	27	8	2	6	2	1	6	13	2	80	150	70	1	12
13	33	5	2	4	2	2	6	2	2	120	0	0	1	1
14	33	7	1	7	2	2	7	1	2	40	270	0	1	1
Total	-	-	-	-	-	-	-	-	-	39450	1400	410	-	-
Mean	33.8	6.4	-	-	-	-	-	-	-	3069	102.7	30	-	-

"-" Means not applicable

Cont. Appendix 7.2

Trader No.	Question 10	11	12	13	14	15a	15b	15c	16a	16b	17	18	19	20	21
1	2	1,5	100	5	1	1	2	80	2200	2750	2	25	2	7,5	0
2	4	12	250	5	5	2	3	110	2100	4000	2	130	2	3,5	150
3	4	26,6	200	356	3	1	2	0	2650	3400	3	90	2	7,5	90
4	1	0	40	6	1	1	2	5	2500	3400	3	30	2	7	40
5	1	0	49	6	1	1	2	5	2400	3400	3	50	23	1,3	0
6	4	10	15	5	5	1	2	0	3200	5100	2	30	2	1,1	250
7	3	27,3	70	25	5	1	2	0	2750	3500	2	40	2	12	200
8	3	18,3	15	5	5	1	2	0	3250	5400	2	25	2	12	150
9	1	0	15	2	4	2	23	64	2300	3000	2	30	2	8,5	0
10	1	0	50	2	2	1	2	45	2090	2900	2	30	2	6,6	125
11	1	0	55	25	2	1	2	45	2350	2750	2	50	2	6,6	0
12	4	8	80	245	2	2	13	32	2000	2500	3	30	2	10	15
13	2	65	20	6	1	1	2	40	2400	2800	3	30	2	10	50
14	1	0	40	2	2	1	2	60	2400	3250	2	30	2	11,6	11,6
Total	-	-	999	-	-	-	-	-	-	48150	-	-	-	-	-
Mean	2.3	12.1	71.4	-	2.8	1.2	4.4	34.7	2471	3436	-	44-3	-	7.5	77.3

"-" Means not applicable.

Cont. Appendix 7.2

Trader No.	Question 22	23	24	25	26a	26b	27a	27b	28a	28b	28c	29	30a	30b	30c	30d
1	100	3	2	6	7	11	1	2	1	30	3	200	250	3	5	20
2	200	3	2	6	6	11	2	1	1	60	3	100	300	2,6	60	60
3	200	14	2	6	6	10	2	2	1	30	3	200	300	3	0	0
4	40	3	2	2	7	3	2	2	2	-	-	-	275	3	30	0
5	9	2	2	2	7	3	1	2	2	-	-	-	250	2,5	22	0
6	13	4	1	5	7	3	2	2	2	-	-	-	250	3	0	0
7	75	10	1	6	7	3	2	2	1	140	3	70	250	3	70	0
8	20	4	1	4	7	3	2	2	1	30	1	15	300	3	0	0
9	20	14	1	2	8	2	2	2	1	8	3	20	200	3	10	0
10	50	3	2	2	8	2	2	2	1	8	3	40	240	2,5	100	0
11	60	7	2	1	8	10	2	1	1	2	3	600	300	3	10	0
12	80	5	3	1	6	12	1	2	1	4	3	80		3	10	0
13	50	7	2	2	6	12	2	2	2	-	-	-	250	3	30	0
14	40	14	2	1	6	10	2	2	2	-	-	-	250	3,5	30	30
Total	-	-	-	-	-	-	-	-	-	-	25	1325	-	-	-	-
Mean	68.4	6.6	-	3.3	-	-	-	-	-	34,7	2,8	147.2	265.3	2.9	26.9	7.8
"-" Means not applicable.																

Cont. Appendix 7.2

Trader No.	Question 31	32	33	34	35	36	37a	37b	38	39	40	41	42a	42b
1	1	3	1	800	2	3	2	-	2	1	15	3	125	22,5
2	1	1	14	50000	2	1	2	-	13	3	1	12	2000	60000
3	1	12	1	10000	2	-	1	1	2	12	1	13	2050	24000
4	-	-	1	200	2	-	2	-	1	1	2	1	0	98,4
5	-	-	1	400	2	-	2	-	1	1	0	13	10	150
6	-	-	1	200	2	2	1	2	4	2	5	3	30	42,5
7	1	2	1	500	2	2	2	-	24	2	4	3	210	650
8	2	2	1	700	2	2	2	-	1	2	3	13	60	5,3
9	1	1	1	1000	2	-	2	-	4	2	3	3	500	15
10	1	2	2	800	2	-	2	-	1	2	3	1	140	0
11	1	1	1	3000	2	-	1	1	2	3	0	3	400	2260
12	1	2	1	2000	1	1	1	1	24	2	4	1	900	355
13	-	-	1	300	2	2	2	-	4	1	3	13	0	20
14	-	-	1	300	2	-	1	1	4	1	2	1	680	0
Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	-	-	-	5014	-	-	-	-	-	-	-	-	-	-
"-" Means not applicable.														

Source: Own survey, 1992/93.

APPENDIX 8.1

WEEKLY PRICE DATA FOR MAIZE, SUMBAWANGA DISTRICT, JULY 1992-JUNE 1993. (TSh/kg)

Date	Case No.	Sumbawanga		Farm gate prices			
		Wolesale	Retail	Kankwale	Lula	Mkima	Mtutumbe
1992.7.1	1	30.00	35.50	32.00	18.50	22.10	23.10
2	2	28.60	33.30	28.70	19.10	21.90	22.00
3	3	28.40	30.00	27.80	19.70	21.40	21.30
4	4	27.00	30.00	27.60	20.00	22.10	21.60
8.1	5	27.00	31.60	24.60	20.80	22.10	22.20
2	6	27.80	30.90	25.80	21.70	21.10	21.10
3	7	26.30	30.60	25.50	22.50	22.40	21.90
4	8	25.80	30.60	26.90	22.20	22.30	22.20
5	9	27.80	30.00	27.90	20.60	22.20	22.20
9.1	10	30.00	30.00	27.00	21.70	21.10	25.90
2	11	30.00	30.00	26.40	22.50	24.10	26.20
3	12	30.70	33.00	27.70	22.10	23.60	25.70
4	13	30.00	33.00	28.40	22.40	22.20	23.90
10.1	14	32.00	35.00	28.20	23.80	27.90	25.30
2	15	34.00	35.00	31.90	24.20	28.60	25.90
3	16	38.00	42.10	31.70	26.20	29.80	29.40
4	17	42.00	45.00	32.20	27.90	32.50	30.90
11.1	18	45.50	50.00	34.20	30.90	34.30	38.00
2	19	50.00	51.00	39.70	32.20	38.90	37.40
3	20	49.50	52.50	39.70	36.70	41.20	38.90
4	21	50.00	55.60	40.70	36.50	44.20	40.00
12.1	22	51.30	56.20	45.30	42.30	44.50	44.40
2	23	53.50	58.70	47.30	40.20	44.40	43.20
3	24	55.00	60.00	55.60	42.80	44.20	46.50
4	25	55.00	60.00	47.50	41.50	41.20	46.70
1993.1.1	26	50.00	55.00	47.50	41.80	43.20	51.80
2	27	53.00	55.60	49.50	44.90	45.50	55.60
3	28	50.00	56.60	52.30	44.40	44.40	55.30
4	29	52.60	58.00	55.60	45.50	44.70	56.30
5	30	55.60	57.90	55.60	44.40	44.40	55.60
2.1	31	55.00	61.10	55.60	48.50	49.30	57.30
2	32	55.60	60.00	53.10	53.80	47.80	55.60
3	33	61.10	70.00	55.60	52.80	50.80	55.30
4	34	59.90	70.00	55.80	52.80	50.30	56.80
3.1	35	63.70	72.20	64.10	53.60	58.10	56.10
2	36	62.30	70.00	68.60	54.50	57.00	55.60
3	37	66.70	75.00	72.20	62.60	56.10	52.30
4	38	72.20	75.00	74.40	62.60	61.10	54.30
4.1	39	66.70	67.80	70.40	60.90	53.30	39.20
2	40	60.00	61.50	60.40	65.60	53.80	33.30
3	41	55.60	61.50	52.50	65.10	46.20	33.30
4	42	55.60	56.40	50.80	67.10	44.00	28.70

CONT. APPENDIX 8.1 ... SUMBAWANGA DISTRICT ...

Date	Case No.	Sumbawanga		Farm gale prices			
		Wolesale	Retail	Kankwale	Lula	Mkima	Mtutumbe
5.1	43	52.60	50.00	47.20	53.80	38.90	27.80
2	44	50.00	50.00	40.00	46.90	37.70	32.40
3	45	40.00	44.40	35.30	40.20	27.80	32.90
4	46	40.00	42.10	33.40	39.20	30.10	27.80
5	47	38.10	40.00	30.00	33.30	22.20	27.80
6.1	48	30.00	33.30	30.50	35.00	27.70	25.00
2	49	30.00	33.30	28.00	30.00	30.00	26.00
3	50	25.00	27.80	25.00	25.00	28.70	28.70
4	51	25.00	25.00	25.00	25.00	29.00	25.00
5	52	25.00	27.80	25.00	25.00	25.00	25.00

Source: Own survey, 1992/93.

CONT. APPENDIX 8.1

WEEKLY WHOLESALE PRICE DATA FOR MAIZE FOR D'SALAAM, IRINGA AND MBEYA TOWNS, JULY 1992-JUNE 1993 (TSh/kg)

Month/week	Case No.	D'salaam	Iringa	Mbeya
1992.7 1	1	58.00	46.50	35.00
2	2	58.00	40.00	35.00
3	3	58.00	38.70	35.00
4	4	56.00	39.00	36.30
8.1	5	56.00	39.00	35.70
2	6	52.70	35.00	32.90
3	7	53.85	37.35	32.30
4	8	55.00	39.70	31.70
5	9	55.00	35.50	31.30
9.1	10	55.00	35.30	31.20
2	11	55.00	35.80	28.20
3	12	55.00	35.70	30.00
4	13	55.00	36.70	29.10
10.1	14	58.00	35.50	29.30
2	15	55.00	35.00	31.90
3	16	55.00	35.80	33.80
4	17	58.00	35.00	33.80
11.1	18	54.00	36.50	35.50
2	19	55.00	37.00	41.00
3	20	55.00	38.70	41.00
4	21	57.20	40.80	41.00
12.1	22	62.50	45.00	41.00
2	23	66.50	45.00	43.40
3	24	67.00	45.00	41.70
4	25	67.00	45.00	42.50
1993.1.1	26	68.00	45.00	45.30
2	27	72.70	45.00	43.30
3	28	74.00	49.80	43.30
4	29	75.00	49.30	45.00
5	30	70.00	53.50	44.20
2.1	31	70.00	54.00	45.00
2	32	70.00	55.70	45.00
3	33	71.30	50.80	47.50
4	34	75.00	58.20	45.00
3.1	35	76.00	55.00	54.00
2	36	76.00	52.50	54.00
3	37	74.00	55.00	54.00
4	38	73.00	53.50	54.00
4.1	39	71.00	52.70	46.20
2	40	65.00	52.50	48.20
3	41	65.00	53.00	47.50
4	42	65.00	52.50	42.90

CONT. APPENDIX 8.1 ...D'SALAAM ...

Month/week	Case No.	D'salaam	Iringa	Mbeya
5.1	43	64.50	52.80	36.30
2	44	58.00	50.70	41.30
3	45	59.30	51.00	42.00
4	46	62.00	53.30	39.00
5	47	59.30	55.00	37.50
6.1	48	57.20	54.20	36.00
2	49	58.00	48.50	33.00
3	50	58.80	46.40	32.30
4	51	60.00	44.00	32.00
5	52	60.00	44.00	30.00

Source: MDB Price Data Files for 1992/93.

APPENDIX 8.2

WORKSHEET FOR CALCULATING STORAGE COSTS

(a) LULA VILLAGE AT 10% ANNUAL INTEREST RATE AND WITHOUT PESTICIDE USE.

		Unit	Months after storage							
A	**Assumptions**		1	2	3	4	5	6	7	8
1	Investment in storage facility	TSh	2,236	2,236	2,236	2,236	2,236	2,236	2,236	2,236
2	Life expectancy	yr.	5	5	5	5	5	5	5	5
3	Capacity of facility	bags	16	16	16	16	16	16	16	16
4	Interest on investment[a]	% per year	10	10	10	10	10	10	10	10
5	Interest on working capital	% per year	10	10	10	10	10	10	10	10
6	Market price at harvest (August)	TSh/bag	2,196	2,196	2,196	2,196	2,196	2,196	2,196	2,196
7	Market price in release month	TSh/bag	2,214	2,553	3,408	4,170	4,420	5,198	5,833	6,468
8	Handling and treatment	TSh/Stored	190	190	190	190	190	190	190	190
9	Weight loss	%/Stored	0.20[b]	0.40[b]	0.54	1.50	1.94	2.33	3.53	3.90
10	Costs of production	TSh/bag	1,067	1,067	1,067	1,067	1,067	1,067	1,067	1,067
B	**Operating costs/unit/month**									
11	Depreciation on storage facility	TSh/bag/m	27.95	13.98	9.32	6.99	5.59	4.66	3.99	3.49
12	Interest on investment	TSh/bag/m	6.99	3.49	2.33	1.75	1.40	1.16	1.00	0.87
13	Interest on working capital	TSh/bag/m	18.40	18.40	18.40	18.40	18.40	18.40	18.40	18.40
14	Handling and treatment	TSh/bag/m	11.88	5.94	3.96	2.97	2.38	1.98	1.70	1.48
15	Total operating capital	TSh/bag/m	65.22	41.81	34.00	30.10	27.76	26.20	25.09	24.25
C	**Cumulative storage costs/month**									
16	Operating costs	TSh/bag	65.22	107.03	141.02	171.13	198.89	225.09	250.18	274.43
17	Weight losses	TSh/bag	0.44	1.02	18.40	62.55	85.75	121.11	205.90	252.25
18	Total storage cost per month	TSh/bag	65.66	108.05	159.42	233.67	284.63	346.20	456.08	526.68
19	Storage cost + harvest price[b]	TSh/bag	2,262	2,304	2,355	2,430	2,481	2,542	2,652	2,723
D	**Profit/loss when maize is sold**									
20	Market price at release	TSh/bag	2,214	2,553	3,408	4,170	4,420	5,198	5,833	6,468
21	Cost of production	TSh/bag	1,067	1,067	1,067	1,067	1,067	1,067	1,067	1,067
22	Total storage cost per month[b]	TSh/bag	66	108	159	234	285	346	456	527
23	Net profit from production and storage	TSh/bag	1,018	1,378	2,182	2,862	3068	3,785	4,310	4,874
24	Net gain over sale at harvest	TSh/bag	-48	249	1,053	1,740	1,939	2,656	3,181	3,745
25	Storage profit ratio	-	0.99	1.11	1.45	1.72	1.78	2.04	2.20	2.38

[a] Charged on half of investment cost. [b] Estimated. [c] Rounded to nearest shilling.

Source: Own survey, 1992/93.

CONT. APPENDIX 8.2

WORKSHEET FOR CALCULATING STORAGE COSTS

(b) MKIMA VILLAGE AT 10 % ANNUAL INTEREST RATE AND WITHOUT PESTICIDE USE.

		Unit	Months after storage							
A	**Assumptions**		1	2	3	4	5	6	7	8
1	Investment in storage facility	TSh	1,956	1,956	1,956	1,956	1,956	1,956	1,956	1,956
2	Life expectancy	yr.	5	5	5	5	5	5	5	5
3	Capacity of facility	bags	13	13	13	13	13	13	13	13
4	Interest on investment[a]	% per year	10	10	10	10	10	10	10	10
5	Interest on working capital	% per year	10	10	10	10	10	10	10	10
6	Market price at harvest (August)	TSh/bag	2,202	2,202	2,202	2,202	2,202	2,202	2,202	2,202
7	Market price in release month	TSh/bag	2,275	2,970	3,965	4,358	4,444	4,955	5,808	4,933
8	Handling and treatment	TSh/Stored	184	184	184	184	184	184	184	184
9	Weight loss	%/Stored	0.20[b]	0.40[b]	0.54	1.50	1.94	2.33	3.53	3.90
10	Costs of production	TSh/bag	1,067	1,067	1,067	1,067	1,067	1,067	1,067	1,067
B	**Operating costs/unit/month**									
11	Depreciation on storage facility	TSh/bag/m	30.09	15.05	10.03	7.52	6.02	5.02	4.30	3.76
12	Interest on investment	TSh/bag/m	7.52	3.76	2.51	1.88	1.50	1.25	1.07	0.94
13	Interest on working capital	TSh/bag/m	18.47	18.47	18.47	18.47	18.47	18.47	18.47	18.47
14	Handling and treatment	TSh/bag/m	14.15	7.08	4.72	3.54	2.83	2.36	2.02	1.77
15	Total operating capital	TSh/bag/m	70.23	44.36	35.73	31.41	28.82	27.10	25.86	24.94
C	**Cumulative storage costs/month**									
16	Operating costs	TSh/bag	70.23	114.59	150.32	181.73	210.55	237.65	263.51	288.45
17	Weight losses	TSh/bag	0.46	1.19	21.41	65.37	86.21	115.45	205.02	192.39
18	Total storage cost per month	TSh/bag	70.69	115.78	171.73	247.10	296.76	353.10	468.53	480.84
19	Storage cost + harvest price[b]	TSh/bag	2,273	2,318	2,374	2,449	2,499	2,555	2,671	2,683
D	**Profit/loss when maize is sold**									
20	Market price at release	TSh/bag	2,275	2,970	3,965	4,358	4,444	4,955	5,808	4,933
21	Cost of production	TSh/bag	1,067	1,067	1,067	1,067	1,067	1,067	1,067	1,067
22	Total storage cost per month[b]	TSh/bag	71	116	172	247	297	353	469	481
23	Net profit from production and storage	TSh/bag	1,137	1,787	2,726	3,044	3,080	3,535	4,272	3,385
24	Net gain over sale at harvest	TSh/bag	2	652	1,591	1,909	1,945	2,400	3,137	2,250
25	Storage profit ratio	-	1.00	1.28	1.67	1.78	1.78	1.94	2.17	1.84

[a] Charged on half of investment cost. [b] Estimated. [c] Rounded to nearest shilling.

Source: Own survey, 1992/93.

CONT. APPENDIX 8.2
WORKSHEET FOR CALCULATING STORAGE COSTS
(c) DESCRIPTION OF CALCULATED VARIABLES

Figures in this appendix are calculated using equations from Homman and Zettelmeyer (1980:50-54), Goetz and Weber (1986:101-105) and Scarborough and Kydd (1992:86-88) as summarised in chapter four.

Section A contains the main assumptions as outlined in section 8.2. Thus row 1 represent the cost of building the store in the respective villages. Rows 2 and 3 gives the life expectancy and capacity of storage facilities. Rows 4 and 5 are the interests on investment and on working capital adapted. Rows 6 and 7 give the market prices at harvest and at release month respectively. These are derived from appendix 8.1 and are based on weekly price data collection from the survey villages. Row 8 contains information on handling and treatment costs which includes items like costs of filling granary and price of pesticides. Row 9 shows the percentage weight losses determined by our monthly maize sampling exercise. Row 10 presents the costs of maize production.

Section B describes the operating costs per bag per month. Row 11 is obtained by using equation 6. The other rows with the equations used to derive them in brackets are: row 12 (equation 8), row 13 (equation 9), and row 14 (equation 10). Row 15 is a sum of rows 11 through 14.

Section C displays the cumulative storage costs per month. Row 16 shows the cumulative operating costs obtained by horizontally adding total operating costs in row 15. Row 17 is for storage losses and is calculated by multiplying the price of maize at the release month by the percentage loss.

Finally section D shows the net profit from production and storage (row 23) and net gain over sale at harvest (row 24). Row 23 is obtained by subtracting rows 21 and 22 from row 20. Row 24 is obtained by calculating the profit which could have been obtained if maize was sold at harvest (that is, row 6-row 10) and subtracting this value from row 23). Row 25 shows weather storage is profitable or not and is derived by means of equation twelve.

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Verlag Dr. Köster Hilbertstr. 9 12307 Berlin
Fax-Bestellung: 030/ 7449052