THE ECONOMICS OF WAREHOUSING OPERATIONS IN SUB-SAHARAN AFRICA

by Jonathan Coulter, Peter Oldham, George Day, Jagdish Sondhi, Robin Boxall and Paresh Kotecha

Report completed under the ODA Crop Post-Harvest Research Programme
Project No. A0610, contract ZB00070

July 1997

LIST OF CONTENTS

ACKNOWLEDGEMENTS

The author acknowledges the considerable inputs by the co-authors of the Zambian and Ghanaian case-study reports, whose names are shown on the front cover.

The authors acknowledge the considerable interest and openness shown by all those we met during our two visits, to Zambia and Ghana. In Zambia, particular thanks are due to Mr Frans van de Ven, of FAO/MAFF Zambia, for his assistance in arranging initial contacts, and Dr George Gray, of the Zambia National Farmers' Union, for organising a valuable meeting to discuss findings with grain traders and millers. In Ghana, thanks are due to Mr Jimmy Edwards, Mrs Comfort Ofosu-Anim and other staff of GFDC for their participation, as well as Dr Edward Asante who provided valuable assistance in setting up the visit.

GLOSSARY OF TERMS AND ABBREVIATIONS

CIDA	Canadian International Development Agency
EU	European Union
GFDC	Ghana Food Distribution Corporation
NRI	Natural Resources Institute
ROCE	Return on capital employed
ROE	Return on equity
DFID	Department for International Development

SUMMARY

This is a report on the first component of a three-year study concerned with the role that third party and "public" warehousing services can play in the development of agricultural marketing systems in Africa.

The specific purpose of this component is to better understand the economics of organising such services in Africa. Two case studies were carried out, in Zambia and Ghana, involving extensive participation of local stakeholders, including parastatal institutions, traders and warehouse operators. In each country the research team identified and costed out model warehousing scenarios which might be feasible in the immediate future.

Demand for third-party storage of grains was found to be much higher in Zambia - around 100,000 tonnes per annum vis a vis 12,000 tonnes in Ghana. However the consistent and extraordinary degree of inter-seasonal price variability in Ghana suggests that the potential for growth is very large. Returns on equity for inventory credit operations in Ghana are likely to be 120% or more in real terms, on an annualised basis[1]. This estimate is based on an analysis of past seasonal price data; notwithstanding the advent of inventory credit since the end of the 1980s, price variability does not appear to have abated.

Similar calculations for Zambia suggest that seasonal storage may be even more profitable than in Ghana. However, market behaviour has varied greatly from year to year, and given that the available price series is short, and traders have been adapting to recent changes policy environment, it is not possible to forecast future levels of price variability in Zambia.

From the financial analyses of warehousing operations in the two countries, the following general conclusions were drawn about the economics of running warehouses for seasonal grain storage:

- By international standards, storage costs in Sub-Saharan Africa (excluding South Africa) are generally high, though this is often mitigated by the availability of surplus storage capacity remaining from the parastatal era. The lower costs in developed countries are mainly a function of economies of scale, lower production variability, skilled labour, local availability of plant and equipment and lower cost financing.
- Building warehouses tends to be unprofitable in port and urban areas, unless there is substantial property appreciation. In rural areas, storage charges for new privately-built warehouses and silos have to be in line with full costs.
- It is often cheaper to rent warehouses, but the cost of renting is sensitive to capacity utilisation which, due to production variability, is often low in African countries.

[1] This assumes produce is stored in the main surplus-producing region, and that the borrower puts up equity worth 25% of the produce stored. If the borrower puts up 50%, the annualised return on equity is still 70% or more. All calculations assume no incremental management overheads

- It is difficult to establish profitable warehousing services on their own, because of the risks of low capacity utilisation, low stock turnover and high overheads.

However, warehousing services may be profitable if they are provided *in conjunction with other services* which help absorb the overheads and increase the volume of stock handled. These include:

(a) Combining warehousing services with trading, a typical practice of grain companies in Europe and North America;
(b) Combining warehousing services with freight forwarding;
(c) Collateral management services, i.e. by guaranteeing the physical integrity of the stock to a lender;
(d) Linking warehouses to brokerage operations or commodity exchanges.

A study of the last of these concepts, in Zambia, indicated that the latter may be technically and financially viable. NRI's mission created considerable private and public sector interest, and led to a more in-depth EU study, reaching similarly positive conclusions.

Based on the findings concerning the economics of warehousing, the research team has defined a series of warehousing options which will be studied in the next phase of this work. Economic findings will also be published.

INTRODUCTION

Background

This study is concerned principally on the provision of "third-party" and "public" warehousing services. Public warehousing has a narrower meaning than third party warehousing, and involves the provision of services to the public in general, whereas the latter term also covers situations where warehousemen store under exclusive arrangements with particular clients.

NRI's work on grain market liberalisation, since 1990, highlighted the potential role of public warehousing services in creating efficient agricultural markets. Such services could assist in breaking down the barriers which typically exist between the formal banking and indigenous trading sectors in African countries, and allow traders and farmers access to more capital and at more reasonable cost. In situations where there is a lack of business confidence and a shortage of creditworthy borrowers, the role of third party/public warehouse operators is particularly interesting since they can, as independent parties, ensure the integrity and quality of stocks involved in transactions, and provide security for loan collateral.

Warehousing is also of interest because of the abundance of warehouses which remain from the period of State monopolies, and which were usually built with donor funding. Tanzania has approaching 2 million tonnes of such storage capacity, and Zambia about 900,000 tonnes. With market liberalisation these facilities generally remain in public hands, but are only being used to a very limited degree, as grains are increasingly stored by the farmers themselves. To make more effective use of these structures in support of the private trading systems is therefore an interesting challenge.

In the light of this situation, NRI has proposed a three year research project to identify optimal design features for warehousing services in the African context, involving a mixture of methodologies, including the ex-ante financial appraisal of alternative warehousing systems and the ex-post monitoring of initiatives seeking to develop warehousing services. This report is the result of an interim study designed to carry of the first component of this work, concerned with the financial appraisal of warehousing systems.

Methodology

The main focus is on storage of foodgrains, but this is examined within the wider context of warehousing services in general, whether for foodgrains, cash crops or non-food products. Warehousing services are normally most developed in port areas, involving both bonded and non-bonded cargo entering international trade. Warehousing skills developed in this environment are largely transferable to up-country storage situations, and while in the past, the latter has been a preserve for parastatals, it is not inconceivable that port or urban warehousing concerns will get involved in the future. Comprehensive market liberalisation opens up the perspective of a

warehousing profession, with professional standards and skills which are applicable to a number of commodities.

For this reason, we included in our team a warehousing specialist - the Managing Director of a warehousing company in Mombasa. Other participants included an economist (team leader), a post-harvest technologist and local participants working in the grain trading and storage business in Zambia and Ghana. The main activities were to:

- Gather information on the state and economics of warehousing services currently available for agricultural produce;
- Identify and as far as possible quantify sources of demand for warehousing services and ability to pay;
- Analyse the economics of seasonal storage under varying assumptions about warehousing charges, using a spread-sheet model developed for this purpose at NRI;
- Produce financial profiles for public warehousing scenarios which might realistically be implemented in the future, identifying key fixed and variable cost factors influencing viability.

Information was collected and analysed locally during two-week visits to the countries concerned, while the analysis of seasonal storage economics was carried out in the UK, using a spreadsheet model which two NRI economists (Peter Oldham and George Day) developed for this purpose. Based on the information and analysis assembled, the team drew implications for the role of warehousing in improving marketing systems, and identified features for incorporation and testing in future schemes.

We sought maximum involvement of local stakeholders, both in carrying out the research and feeding back the findings, with the dual objectives of: (a) testing our findings against the local business and institutional scene, and; (b) ensuring that the exercise was of the most immediate practical use. Our findings are presented in two case-study documents targeted at stakeholders in the individual countries and this research report which specifically addresses the terms of reference agreed with the client (see details under "References"). The reader should treat the case-study documents as appendices to this report, and they should be drawn upon to be drawn upon for more detailed information bearing on the final conclusions.

In drawing up the conclusions, we also benefited from our participation in a separate Dutch-funded consultancy assignment in Mozambique, which involved formulating a project for the development of warehousing and inventory credit in Nampula Province (Coulter and Sondhi, 1996).

BACKGROUND INFORMATION ON THE CASE-STUDY COUNTRIES

There are many differences in the circumstances of the two cases studied:

BOX 1: COMPARISON OF CASE-STUDY COUNTRIES

	Zambia	Ghana
Location with respect to the sea	landlocked	coastal
Rainfall pattern	unimodal	bimodal*
Primary motive for production of maize	subsistence	cash*
Annual prod'n of maize (approx)	0.8 -1.6 m tonnes	1.0 m tonnes
Position of maize among foods	national staple	one of several staples
Former grain trading structure	public monopoly	highly fragmented
Current grain trading structure	private & fairly concentrated	highly fragmented
Seasonal price variability	variable	very high
Available storage capacity	massive over-capacity	adequate at present
Influence of large grain users	large	limited

* this reflects the situation in the "Maize Triangle", part of Ghana's transitional zone, which produces most of the country's marketable surplus. As indicated below the situation in northern Ghana is different.

Zambia's rainfall pattern is unimodal and though the rains end in April, most maize is left in the field to dry until June. In the key surplus-producing area of Ghana, the "Maize Triangle" of Brong-Ahafo and Ashanti Regions, rainfall is bimodal, and maize from the largest of the two crops is harvested wet. Storage represents more of a problem for farmers, particularly when quantities are large; by contrast, Northern Ghana experiences a unimodal rainfall pattern and, as in Zambia, maize is left to dry in the field.

Zambia has major over-capacity in warehousing, sufficient to store 900,000 tonnes of maize, with most of it built for parastatals and official co-operative movements prior to liberalisation. Ghana has more moderate storage capacity, though here too donors have equipped the country with a network of parastatal sites, including drying facilities and/or silos. The Maize Triangle has about 11 usable sites with a usable storage capacity of about 21,000 tonnes (Coulter *et al.*, 1997).

Both countries have relatively liberalised marketing systems, but Zambia formerly had, until the beginning of this decade, a quasi-public maize marketing monopoly; in Ghana, the parastatal Ghana Food Distribution Corporation (GFDC) never marketed more than 10% of the country's marketed surplus. Nevertheless, Zambia's post-liberalisation economy

appears more open to international capital flows than is Ghana's; there is much more involvement of international commodity traders who, working with locally-based companies, have since 1995 marketed a significant percentage of the crop.

By contrast, most of Ghana's maize trade is carried out by a myriad of small informal traders, each of them moving an insignificant portion of the crop. No Ghanaian grain trader markets as much as 10,000 tonnes of domestic grain a year, but there are at least two Zambian traders who move 50,000 tonnes or more of domestically produced maize, soybeans and wheat. At the consumer end of the market chain, Zambia has industrial mills which between them use upwards of 200,000 tonnes per annum of maize, but Ghana has no such milling industry; the total consumption of larger users, including feed-millers/poultry farmers, brewers and food processors, is estimated at around 50,000 tonnes.

Another feature of Zambia is its landlocked position and consequent price swings between years of regional surplus and deficit. The deficit scenario is illustrated by 1995/96, when wholesale maize prices spiralled up to import parity levels of $300 per tonne and more. The surplus scenario was illustrated by 1996/97, when prices in the region fell back towards export parity, though this movement appears to have been restrained by strong Government procurement in Zimbabwe and Malawi, which mopped up much of the surplus.

While *inter-annual price variability* seems to be a feature of Zambia's new maize marketing system, Ghana's is characterised by a very high degree of *inter-seasonal price variability*. This can be seen from Figures 1 and 2 which show how monthly prices (in constant US$ terms) have varied in Techiman, the main trading centre in Brong-Ahafo Region, over the period from 1985/86 to 1995/96[2]. There is a very predictable pattern with prices bottoming out in September and October 86, and peaking in May and June, or occasionally in July when there are poor forecasts for the forthcoming crop. The price increase over this eight month period has typically been over 100%, in real terms. Only in three out of the eleven years, were increases less than 100%.

[2] The reader will notice that the prices levels for 1985/86 to 1987/88 are generally higher than for the remaining years. This is probably because the Ghanaian economy was more closed in then than it is now, and local prices were more out of line with international prices than they are now.

Figure 1

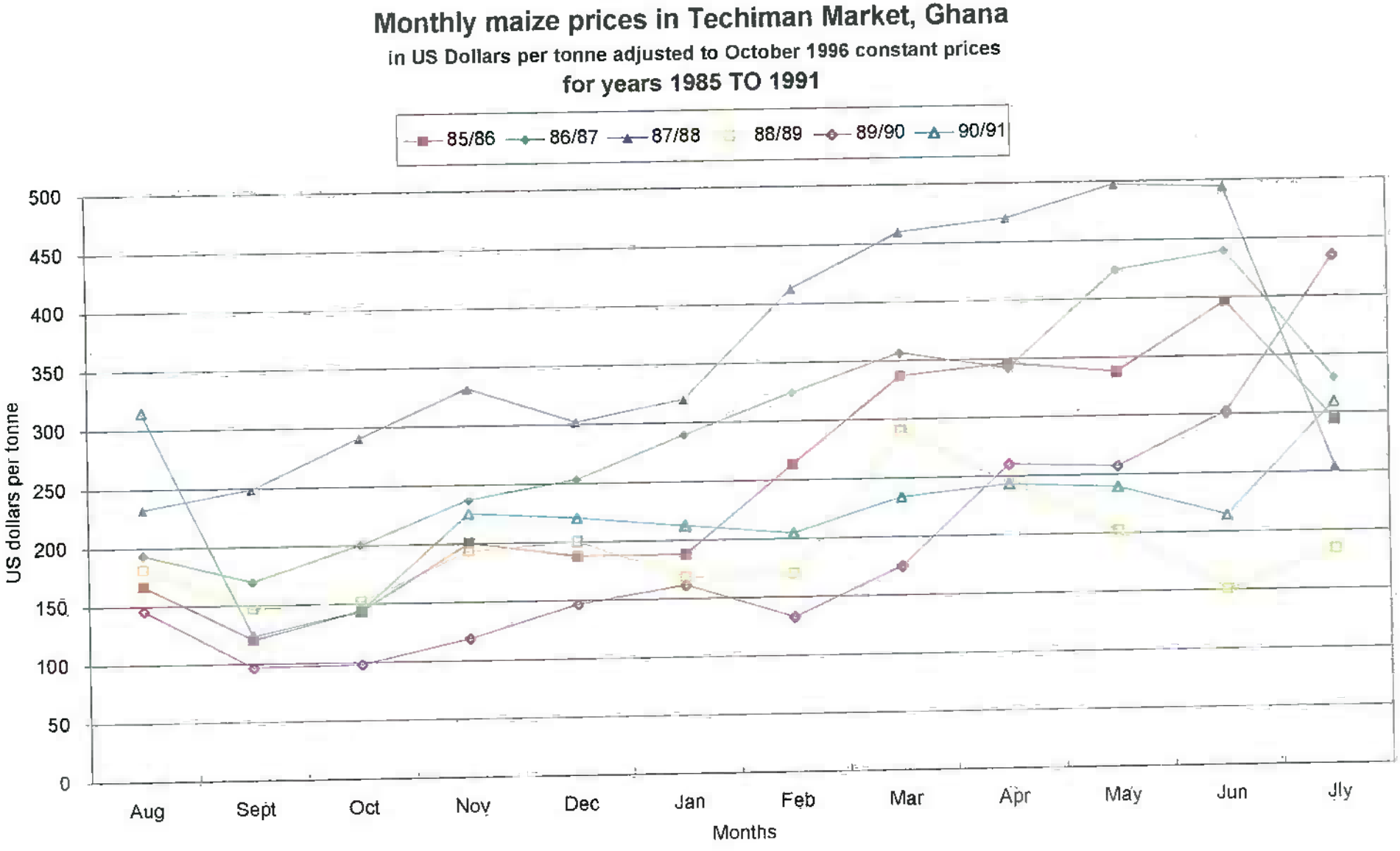

Monthly maize prices in Techiman Market, Ghana
in US Dollars per tonne adjusted to October 1996 constant prices
for years 1985 TO 1991
85/86
86/87
87/88
88/89
89/90
90/91
US dollars per tonne
500
450
400
350
300
250
200
150
100
50
0
Aug
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jly
Months

Figure 2

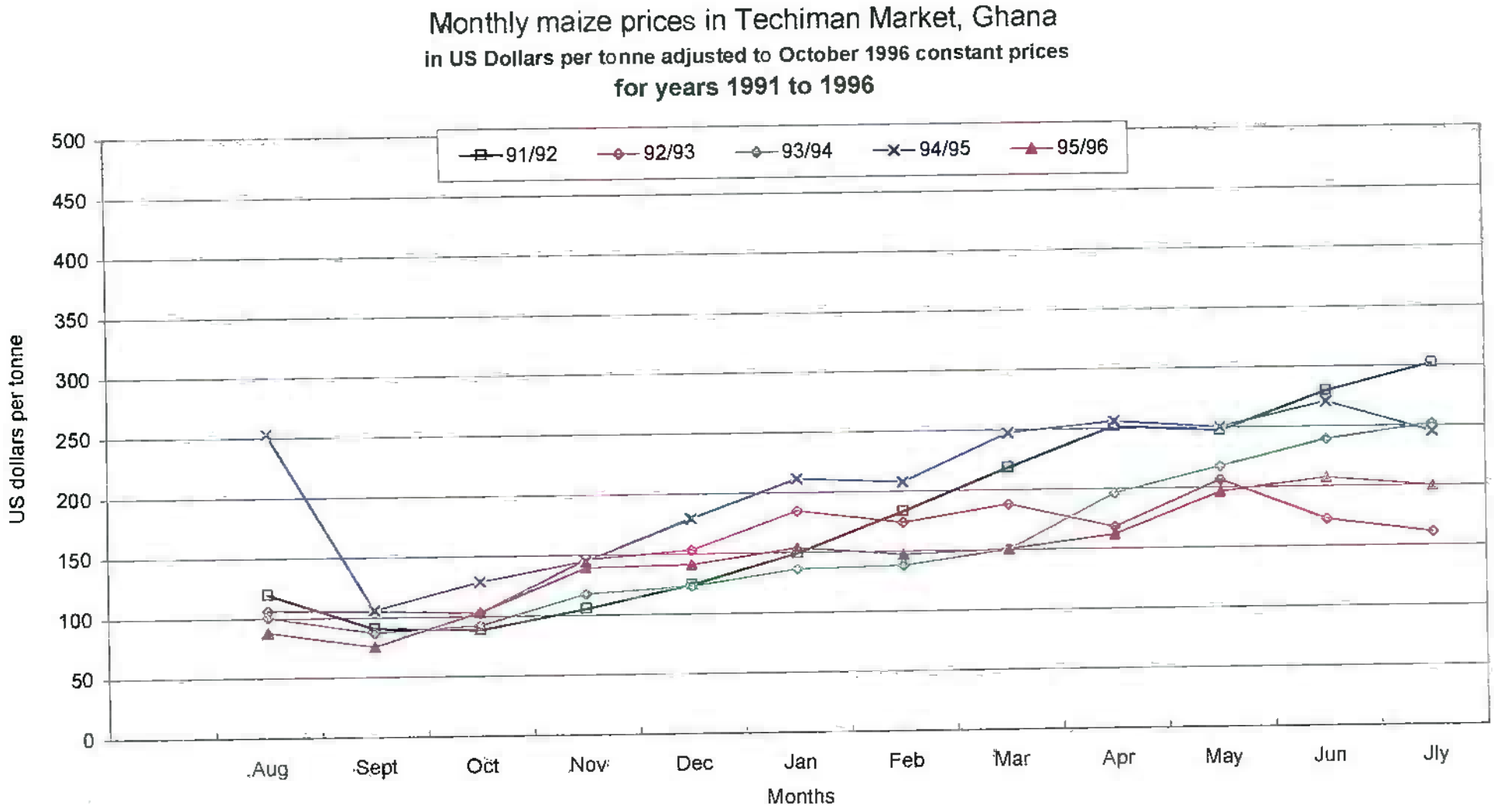

Monthly maize prices in Techiman Market, Ghana
in US Dollars per tonne adjusted to October 1996 constant prices
for years 1991 to 1996
91/92
92/93
93/94
94/95
95/96
US dollars per tonne
500
450
400
350
300
250
200
150
100
50
0
Aug
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jly
Months

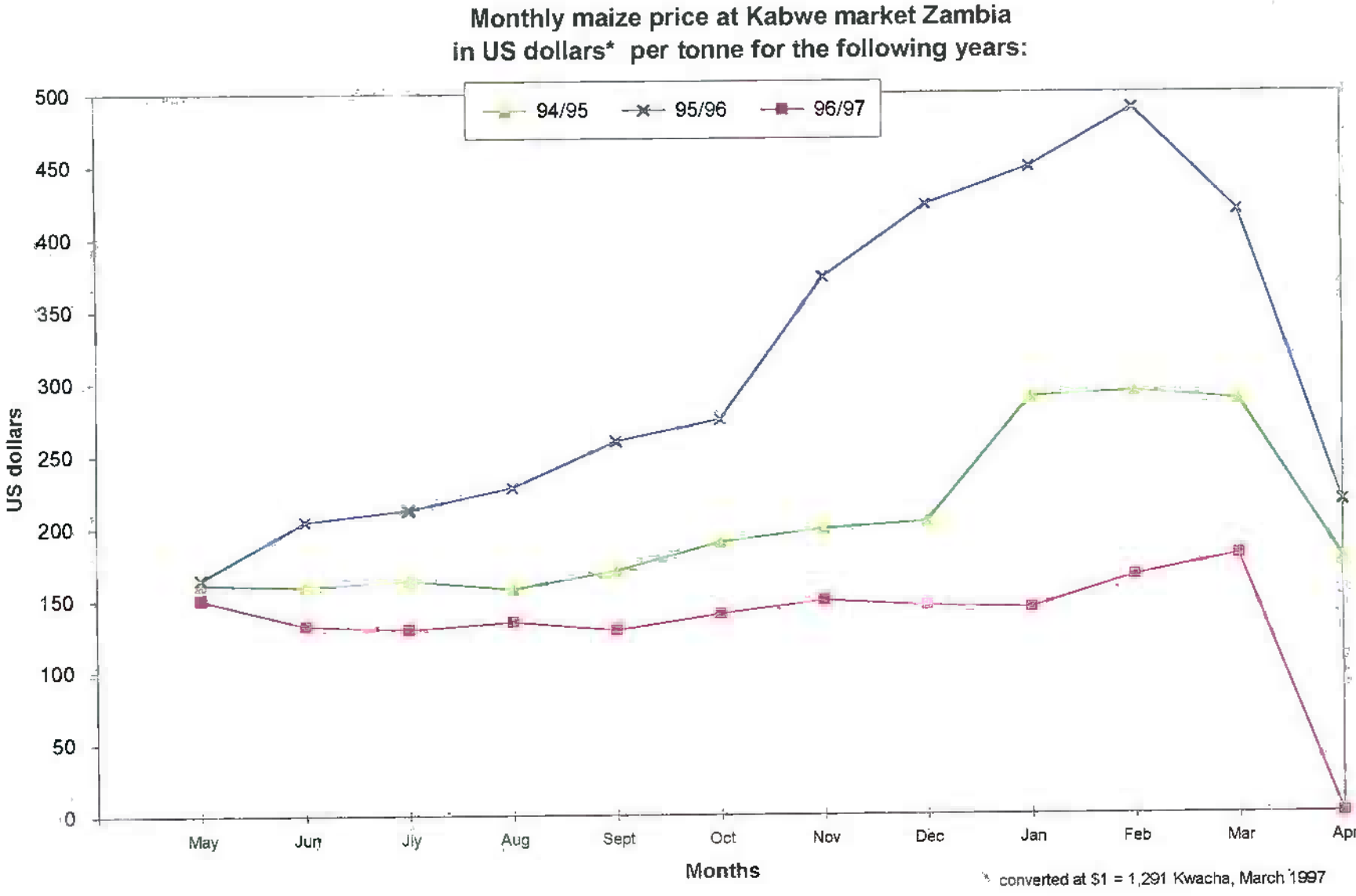
Figure 3 shows seasonal price variability in Kabwe, Zambia, over the three years since the State effectively withdrew from the market. The contrast between these three years is worthy of note. In 1994/95 prices increased by about 80% over the six months between August and February, in 1995/96 by about 120%, and in 1996/97 by about 20%. The seasonal variability between 1995/96 and 1996/97 can largely be attributed to inter-annual factors. With a poor harvest in 1995, the whole southern African Region swung to an import-parity situation and this greatly increased the seasonal price swing beyond the level of the previous year. In 1996, the Region experienced a surplus and prices fell, particularly in the centre of the continent, and this neutralised much of the seasonal price pattern which one would otherwise have expected. As we can see from Figure 3, the seasonal price rise was relatively modest.

Both countries are insufficiently developed in the area of "seasonal arbitrage", i.e. investment in storage to take advantage of seasonal price rises. In Ghana, the level of seasonal price variability is quite extraordinary if one considers the foregone speculative opportunities. In Zambia, seasonal price swings would be less pronounced if traders took earlier positions in the market, as exemplified by events in 1995/1996. Before the harvest, i.e. in March/April 1995, a regional shortage was fully forseeable, and it could be expected that prices would approach import parity (i.e. the cost of bringing maize in from other continents) within the next year. Nevertheless, most of the price rise occurred after October of the same year. With a more fully developed system of seasonal arbitrage, traders would have made larger speculative purchases earlier in the year, to the benefit of domestic producers, many of whom must sell while the roads are passable, i.e. before the onset of the rains (October).

DEMAND FOR WAREHOUSING SERVICES

In Zambia, there seems to be considerable demand for third-party warehousing and related services in both surplus and deficit years, for storage of grain and fertiliser. Government and donors are the main clients for fertiliser storage, but the level of demand is difficult to predict from year to year. Government's Food Security Reserve is also likely to be a significant customer. It was estimated that in 1995/96, approaching 100,000 tonnes of maize were stored by third parties; only a limited part of this was held by companies offering a public warehousing function, in all cases as adjuncts to trading businesses (in tobacco, cotton and grain) or inspection services. The bulk is accounted for by traders holding stock on behalf of their international clients, and Government-sponsored credit co-ordinators holding stock on behalf of borrowers prior to repayments.

Figure 3


Monthly maize price at Kabwe market Zambia
in US dollars* per tonne for the following years:
94/95
95/96
96/97
US dollars
500
450
400
350
300
250
200
150
100
50
0
May
Jun
Jly
Aug
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apr
Months
* converted at $1 = 1,291 Kwacha, March 1997

In Ghana demand for the storage of domestic produce is much smaller, but since 1993, has been growing due to inventory credit facilities and the changing role of the parastatal (GFDC), which now dries and stores for private sector clients. The total quantity stored by GFDC and SGS (Ghana) Ltd. rose to an estimated 12,000 tonnes in 1995/96[3]. However the extraordinary degree of inter-seasonal price variability in Ghana suggests that the potential for growth is very large.

In Ghana there is also substantial demand for storage in and around port areas for exported and imported commodities such as rice, sugar and coffee, some of it collaterally funded under inventory credit arrangements.

THE QUALITY OF WAREHOUSING SERVICES

In both countries the quality of warehousing is variable.

In Zambia, we found some shortcomings in record keeping, accuracy of weighing, stacking, store hygiene, use of dunnage (pallets), pest control, and fire-safety arrangements. These seemed to reflect a lack of training and experience, and limited specialisation in the warehousing function. Notwithstanding, warehousing staff and managers were responsive to suggestions and willing to learn, so it is likely that training would have an immediate impact on the quality of services.

In Ghana, there is a core of professional people involved in warehousing, and this was particularly evident in public sector stores. However, in the industry as a whole there is a need for training in storage and handling of goods, and for the standardisation of documentation and inventory control.

THE ECONOMICS OF INTER-SEASONAL STORAGE

We have developed a spreadsheet model to analyse the economics of inter-seasonal storage, by farmers or traders in receipt of inventory credit, at three locations: Techiman (Ghana Maize Triangle), Tamale (northern Ghana) and Kabwe (Zambia). Tamale differs from Techiman in that it lies in a zone of unimodal rainfall, bordering on Burkina Faso to the north.

Appendix 1 shows the methodology used to construct the spreadsheet. The main findings are shown in Table 1.

[3] Most maize storage continues to be carried out by farmers however.

TABLE 1: ESTIMATED PROFITABILITY OF STORING MAIZE USING INVENTORY CREDIT, IN GHANA AND ZAMBIA*

Market	Month into store	Month out of store	Annualised return on equity (approx.), assuming:			
			Base case	Storage charge + 50%	Interest charge + 100%	Equity contribut'n + 100%
Techiman, Ghana	Sept/Oct Dec/Jan	May/June May/June	138% 128%	82% 74%	90% 74%	80% 70%
Tamale, Ghana	December January	June July	128% 88%	53% 44%	79% 46%	72% 52%
Kabwe, Zambia	July August	January February	346% 242%	290% 204%	245% 175%	179% 138%

* Note: Ghana - data for 1985/86 to 1996/97; Zambia - data for 1994/95 to 1995/96

Rates of return are very high in Ghana. Under the base case assumptions, rates of return are upwards of 88% on an annualised basis. With the sensitivity scenarios, the lowest rate obtained (44% in real terms) is far superior to the rates paid on Treasury Bills (42-45% per annum in money terms). Taking account of inflation in the range of 30%-50% per annum, profitability easily compensates for the speculative risk and management charges associated with inventory credit.

Notably rates of return are somewhat higher in Techiman than in Tamale, and this suggests that the quickest way to stabilise prices may be to promote greater storage in Ghana's Maize Triangle, rather than in the North of the country. Given the high level of spatial integration which characterises Ghana's maize market, increased storage in the Maize Triangle can be expected to stabilise prices throughout the country.

The rates of return for Kabwe, Zambia, are even higher than for Ghana, but it is difficult to draw any generalised conclusions from this comparison, since the data only covered three years - with major variations between these years (see above discussion) - as opposed to 11 for Ghana. Given that Zambia has only just emerged from State-controlled marketing of maize, the new private sector may be considered to be on a "learning curve", which may in the future lead to better inter-temporal market integration. Part of the higher profitability in Zambia is also due to our assumption that future storage charges will be lower there, i.e. $2.50 per tonne-month vis a vis $4 in Ghana.

However, in both Zambia and Ghana, wide inter-seasonal price variability is evidence of markets where there is very poor integration between the financial and agricultural sectors. This is in complete contrast to most western countries and much of Asia, where funds from banking and non-banking sources are readily available to those seeking to take advantage of speculative opportunities. In the West considerable resources also flow into

the grain trade through forward and futures markets, which allow buyers and sellers to take positions on commodities in the light of future price expectations and their transactional requirements. Of the two countries studied, Zambia has better links with these markets than does Ghana, due to the high level of currency convertibility and strong relationships with the South African economy.

THE ECONOMICS OF WAREHOUSING

We obtained information on existing warehousing economics, and studied the economics of storage enterprises which might feasibly be established in the future in Zambia and Ghana:

- In Zambia, we considered a provincial warehousing company operating two 5,000 tonne capacity storage sheds. Two turnover scenarios were considered involving throughput of 10,500 tonnes and 21,000 tonnes respectively.
- In Ghana, we took the view that the most effective way of developing warehousing services was through restructuring and privatisation of GFDC, which cannot perform to the full of its capabilities under the present regime of public ownership. We then assumed that a restructured and privatised GFDC would operate 11 sites in Brong-Ahafo and Ashanti Regions, with quantities dried and stored rising from 30,000 tonnes and 15,000 tonnes respectively in the first year to 55,000 tonnes and 27,500 tonnes in the fifth year.

Different scenarios are assumed for each country. In Zambia, there would be various provincial storage companies each operating in a different province or district. In Ghana, there would be a single larger company running a series of sites.

Based on the information assembled, and comparisons with other parts of the World we can make the following general observations.

Storage costs are generally high by international standards: In major grain producing countries, the costs and charges for storing grains are generally very low. In the UK, commercial rates for storage (excluding handling and pest-control charges) are typically around US$1.5 per tonne-month, while in South Africa they are about $15 per tonne-year. By contrast we estimate that to successfully run warehousing businesses in Zambia on a more substantial scale than at present, storage charges may need to be upwards of $2.0 per tonne-month, and $3 to $4 per tonne-month in Ghana[4]. Even $4 per tonne-month would not allow Ghana to cover the replacement costs of plant installed under donor assistance programmes.

[4] Both these charges include insurance of the stock

The relatively low charges in Zambia reflect the abundance of storage capacity in that country[5]. However, there are other cost factors which make storage cheaper in the developed economies than in Zambia, Ghana and countries in similar circumstances, i.e.:

- local availability of plant and equipment
- more skilled building labour and maintenance services
- economies of scale in large-scale handling and storage. Millions of tonnes are handled at large scale storage sites in countries like UK and the Republic of South Africa, compared to tens of thousands of tonnes - up to 100,000 tonnes - in countries like Ghana and Zambia. A single storage facility in Kent has a capacity of 40,000 tonnes, compared to an average of 2,000 tonnes for GFDC sites in central Ghana.
- past subsidies or tax-breaks which have encouraged Western industry to invest in stores and equipment
- more efficient financial systems, involving easier access to credit and lower cost of capital
- lower variability in production resulting in higher usage of available storage capacity - see above discussion.
- generally speaking, theft is less of a problem in the developed countries, and security arrangements need be less rigorous. Ghana appears to be an exception in this regard, with many warehousing sites making do with a single night-watchman.

Building warehouses tends to be unprofitable from an operational viewpoint: Much of the existing warehousing business in Africa is in and around ports such as Mombasa and Greater Accra, or for holding internationally traded commodities at inland locations. Kenyan and Ghanaian experience bears out the proposition made by Jenkins (199X) that building of warehouses for storage is generally unprofitable, per se, unless the owner can gain from property appreciation. Indeed urban growth usually guarantees that warehouse properties appreciate over time, in real terms.

One cannot assume that the same logic automatically applies to agricultural warehousing in up-country locations of Africa. In such places, prospects for property appreciation are more limited, and services may have to be priced at a level which guarantees a reasonable return on capital. However the availability of surplus ex-parastatal warehouses often means that rentals are low and there is no need to build new stores. In the case of Zambia we found that rentals for the large CIDA sheds were about $0.48 per sq m per month. Assuming that maize can be stacked 2.5 tonnes per square m per month, the monthly cost per tonne-month capacity is $0.196, or $2.35 per tonne year.

To provide an acceptable return to an investor erecting a new storage structure would require a much higher rate. Where there is a reasonably efficient local building industry, we estimate storage structures cost about $80 per tonne capacity (see Box 2). Let us assume a useful life of 30 years, and

[5] Some donors are still willing to build stores for African Governments, as exemplified by the Chinese Government which built two structures in Ghana in the mid-1990s.

that an investor needs a minimum return on capital employed (ROCE) of 10% per annum, exclusive of the appreciation in real estate. The corresponding annuity factor is 9.427, and the annual cost per tonne capacity is $8.49, i.e. 3.6 times the Zambian rental rate. If the investor needs a return on capital employed of 15% per annum, the annual cost per tonne is $12.18, i.e. 5.2 times the Zambian rental.

BOX 2: THE COST OF STORAGE STRUCTURES

When all costs including land, access roads, perimeter fences, office space and engineering services are taken into account, it is difficult to get warehouses built on a turn-key basis for much less than $200 per sq m. Warehouses can be built more cheaply by direct labour, but in this case the true costs are likely to be hidden in company overheads. For this reason it is best to take $200 per sq m capacity as a rule of thumb for building warehouses in rural Africa, assuming the local building industry is reasonably efficient. In some urban areas, e.g. Mombasa and Nairobi, costs can range up to $340 per sq m, due to high cost of land. In some countries, the ravages of war and economic adjustment have left a legacy of weak building services; this is evident in up-country areas of northern Mozambique, where we were quoted prices up to $350 per sq m.

If we assume a cost of $200 per sq m, and a capacity of 2.5 tonnes per square metre, the cost per tonne of storage capacity is around $80. In the Ghanaian case this was similar to the cost of building additional storage capacity in steel silos, using small units of 200 capacity each. If one builds larger units of, say 1,000 tonne capacity, it may be possible to reduce this cost.

It is often cheaper to rent warehouses, but the cost of renting is sensitive to capacity utilisation, which is likely to be low in many African countries

Fixed warehouse costs can be reduced by leasing or renting, and rates are often very low due to surplus capacity generated by donor largesse and urban building booms. However, even here costs can be high due to the variations in throughput from year to year, and consequently, low capacity utilisation. Many African countries (e.g. Zambia, Zimbabwe and South Africa) are subject to very high inter-annual production variability, and this increases the cost of storage capacity, vis a vis the situation in North America and Europe.

It is difficult to establish warehousing services on their own, without linking them to some other business. As a "stand-alone" business concept, the warehousing of cereals in up-country producing areas is unlikely to be profitable in Africa.

Enterprises of this kind must survive on fixed charges for in/out handling, storage, pest control, and (sometimes) drying and cleaning, and face significant risks of: (a) not being able to generate the sufficient volume of business to cover fixed costs, and; (b) theft and embezzlement. *At the same time they must compete with their own customers*, i.e. traders, millers etc. who may alternatively store the produce themselves, while making more efficient use of their fixed staff complement, which can be employed in both storage and trading activities. By contrast when there is little storage activity, the staff of a public warehousing company is likely to be largely idle.

An added disadvantage is that the owners and managers of trading companies are sometimes unaware or only partly aware of the incremental overhead costs associated with running their own stores, but simply treat them as a general cost of their trading business.

The low profitability of the "stand-alone" warehousing activity is illustrated by our Zambian case study (see page 20, Table 5, scenario (a)). The company has capacity for 10,000 tonnes of maize, and achieves 70% occupancy for 6 months, with stock being turned over 1.5 times. The return on capital employed is 0% and return on equity is -25%.

TABLE 2: PROFITABILITY OF PUBLIC WAREHOUSING UNDER ALTERNATIVE OCCUPANCY AND TURNOVER SCENARIOS

	Scenario (a)	Scenario (b)
Occupancy	70% for 6 months	70% for 6 months (high season 30% for 6 months (low season)
Turnover of stock	1.5 times	3 times in high season 3 times in low season
Capital employed	$ 98,182	$120,824
Annual revenue	$136,500	$270,000
Return on capital employed	0%	70%
Return on equity (50% of cap. employed)	- 25%	81%

Source: Coulter *et al.* (1996)

Warehousing can be profitable, if services other than storage are provided

Companies providing warehousing services often combine warehousing services with other activities, and this allows them to spread their overheads over a larger volume of business. This is demonstrated by **two** Zambian examples:

- The trading company Amanita Zambiana which, apart from trading on its own account, procures and stores on behalf of international grain traders.
- The Tobacco Association of Zambia which uses its surplus warehousing capacity to store for grain traders and processors. Warehousing is essentially an adjunct to tobacco trading and this allows the Association to spread its overheads over a larger volume of business.

Apart from *being traders in their own right*, there are other ways in which warehousing can be made profitable within a broader range of services. One way is *by combining warehousing with freight forwarding:* the freight forwarder derives income both from storing produce, and by forwarding it to other locations. This is one of the approaches proposed for northern Mozambique in the consultancy for the Netherlands Government. A freight forwarder would establish warehouses along the 500 km stretch of rail between Malawi and the port of Nacala. For the freight forwarder, there were various possible advantages:

- by extending its operation back inland to highly productive agricultural zones, which are being opened up after the end of the war, it could increase its forwarding turnover. It could handle a variety of exported or imported products, including tea, tobacco, cement, sugar, rice etc.
- it could make fuller use of a largely unutilised warehouse in Nacala. This could be opened up to goods forwarded from inland.
- it could enhance its eligibility to run the railway, which might eventually be privatised or put under a management contract.

Another way of enhancing profitability is by *providing collateral management services* - in this case the warehouse operator not only stores on behalf of the owner of the goods, but manages them on behalf of a lender. For this reason, a warehouse operator in Greater Accra can charge about three times as much as can competitors offering no collateral management service.

In our Ghanaian case study, we considered the case of a restructured and privatised parastatal providing collateral management services. In order to obtain an average return on equity of 24% over the first five years, the company must increase its storage charges vis a vis current (pre-privatisation) levels by 70%. This increase seems eminently feasible because of the attractions of inventory credit which would be available to companies if storing with a reputable warehousing company.

A further way of enhancing profitability is by *linking warehouses to a commodity exchange or to a brokerage*. In these cases, the depositor uses the warehouse not just to store but to find a market for his/her produce. This increases the demand for the warehouse's services, and increases its turnover-related income. This is demonstrated in Scenario (b) of the Zambian case study (see page 20, Table 5). We are considering the same company as above, with a storage capacity of 10,000 tonnes. It again achieves 70% occupancy in the high season, but now it also achieves 30% occupancy in the low season, and turns over its stock twice as fast as before. The return on

capital jumps from 0% to 70% and the return on equity from -25% to 81%. The increase in profitability is largely due to the doubling in the speed of stock turnover, and the extra handling charges derived from this.

BAG VERSUS BULK HANDLING

One issue which is often raised in discussions about warehousing economics is whether private warehouse operators should use bulk handling systems, or stay with bags, which is currently the general method of storage and handling in Sub-Saharan Africa (see Friendship and Compton, 1991.

In cases involving long-term storage of grain, there are usually powerful reasons for remaining with bags. They are convenient, due to the cheap cost of manual handling, while mechanical equipment is expensive to acquire and is subject to mechanical failure. However, bulk handling is already used: (a) in situations where grain is bulked for mechanical drying, as in Ghana, and; (b) in receiving and handling grain at industrial premises, particularly maize and feed mills. In these cases there may be some scope for gradual forward and backward integration with a view to achieving handling economies.

A strong case can be made for bulk handling at port installations, and sometimes at railheads, because it allows faster loading and unloading, speeding up the ship or the train's turn-around time and reducing demurrage. In this way it becomes a cost-saving feature. Not surprisingly, as countries' grain trade becomes more tied to international trade, as in the case of Kenya today, we see more silos being built.

Notwithstanding cases where bulk handling and storage is justified, caution is needed to avoid its premature introduction into countries with an abundance of cheap labour suitable for bag handling, and a shortage of skilled labour and repair facilities such as are required to operate and maintain bulk facilities.

THE FUTURE OF WAREHOUSING IN AFRICA

Warehouses linked to commodity exchanges

This economic analysis and earlier work shows that warehousing services potentially have a key role to play in the development of African agriculture. One of the main characteristics of agriculture in Africa is illiquidity, both at the level of smallholder farmers and market of intermediaries. The logical providers of the liquidity are: (a) banks and; (b) agribusinesses who finance against future delivery. Unfortunately both these parties are less active in rural lending than one would normally expect - while this can be partly attributed to the policy environment and to weaknesses in the organisations themselves, it is above all a consequence of the lack of collateral and confidence that contracting parties will perform as agreed.

Some African countries have an abundance of ex-parastatal warehouses, and these may have a role to play in addressing these problems. Firstly, warehouses run by reputable operators can provide credible collateral for the banks, and thereby give traders and farmers access to increased working capital in the post-harvest period. Secondly, warehouse operators can guarantee the performance of a contract between contracting parties, even in situations where they have never seen one another.

It is on the latter principle that the concept of the exchange-linked warehouse is based. In Zambia, such arrangements could have a high social pay-off, by overcoming remaining uncertainties and inefficiencies in the existing marketing system, notably performance risk (failure by sellers to deliver quantity and quality as per contract), and payment risk (failure by buyers to effect payment as per contract).

A scheme involving a network of "commodity exchange-linked" public warehouses would also provide a system of price discovery and increase competition, and attract greater liquidity into agricultural markets. It would benefit all farmers, and peasant farmers would probably be the primary beneficiaries, given that it would assist in bulking up and marketing small dispersed lots. It could also be linked to the provision of inventory credit and agricultural inputs (on the basis of credits secured against stored produce).

In Zambia, we produced an outline and preliminary costing for a commodity exchange linked to a network of warehouses (Coulter *et al*, 1996, p38-56). The concept proved to be of considerable interest to various parties, including the Zambia National Farmers' Union (ZNFU), various traders and millers, the Government's new Food Reserve Agency and the EU. Such was the interest that these parties have met several times to discuss the concept and the EU has commissioned a more in-depth study, the conclusions of which were also positive. We wait to see if this initiative develops further, and in what direction.

Warehouses linked to brokerages

Linking warehouses to brokerage operations is conceptually similar to grain marketing co-operatives in the UK and other developed countries. Depositors are attracted to the store because they can store and are assured a market for their produce, while at the same time they can receive an advance based on the value of the stock.

In the Mozambican case, Coulter and Sondhi (1996) recommended the consideration of a second option, in addition to the above-mentioned freight forwarder option. In this alternative scenario, local groups with an interest in agricultural trade in northern Mozambique - farmers, traders, banks and others, would set up a public warehousing company. The company would take a lease on, and operate, donor-built warehouses. Then, to ensure adequate turnover and profitability, the company would contract a broker to sell depositors' stock on the basis of a fixed commission.

The main difference from the agricultural co-operative model is that the company would be owned by a larger range of interested parties, and that farmers, due to their small scale of operation, would be represented and acquire shares through primary-level organisations. The other parties (banks and traders) would be needed to ensure an adequate equity base.

Clearly it is not easy to engineer alliances between the interests involved in this kind of model, and largely for this reason the authors expressed a preference for the freight forwarder option. What eventually is implemented in Mozambique depends largely on Government policy and decisions abour the future of the parastatal enterprise, the Instituto de Cereais.

Improving the performance of warehouse operators

Demand for warehousing services is closely linked with user perceptions of the quality of those services, but as we saw in both Zambia and Ghana, quality often leaves much to be desired in terms of physical handling, store hygiene and administration. There are few private warehousing firms in whom depositors and banks feel they can place their entire confidence - and as a consequence they often prefer to use the services of local subsidiaries of international firms whose performance is implicitly underwritten by their parent companies, the best example of this being the international inspection company Société Générale de Surveillance (SGS) which has developed a healthy market niche in the collateral management business related to international trade.

An enhancement of the reputation and performance of local warehousing companies could given them access to a greater share of trade-related collateral management business, and to new agricultural warehousing business in up-country areas. This could be done by a combination of training in warehouse operation and management, the setting of industry-wide standards linked to an inspection system, and bonding instruments to

underwrite warehouse performance. One useful step to advance this process would the establishment of local warehousing associations, which would in effect set minimum standards for accreditation of warehouse operators.

Other ways of developing warehousing services

During our work, we have identified various other possible approaches to warehouse development, including:

- An export-based approach. Here a warehousing system is developed around higher value export crops (e.g. coffee), and services are gradually extended to lower value crops mainly destined for local consumption. The initial focus on high crops which can bear relatively high storage charges allows the warehousing company to quickly reach its break-even point - after which it may extend its operation with lower-value crops. Uganda is designing a system to work around export crops.
- The "Common Trust Banking System for Commodities and other Goods", a concept developed by J. Burns. His idea is to create a multinational warehousing company and thereby overcome some of the problems commonly associated with lending to developing countries, notably weak legal systems and "sovereign risk", e.g. contract frustration by export bans or other sudden or arbitrary acts of Government. Rather than adapting to the country's legal and regulatory system, an extra-territorial entity is created by agreement with Government and disputes are settled under international law and referring to courts in Europe or USA. If this system were implemented, it would need the backing of International Financial Institutions, which would provide insurance facilities and policy leverage to prevent reversal in agreements provided by Government. The major advantage to developing countries is that it would allow them to finance trade through direct access to low-cost international capital markets.
- Warehousing in conjunction with commodity bonds. This approach appears ambitious given Sub-Saharan Africa's present circumstances, though a Ghanaian company with a successful track-record in bonds claims it is to launch a maize bond this September. Brazil has experience with commodity bonds.

In the next phase of the research project, we shall to investigate the viability of some of the options discussed above, as well as alternative approaches to the privatisation of Government warehouses.

We shall also publish our findings on the economics of warehousing. This will require some more desk work, particularly with a view to refining our comparisons between international and African grain handling and warehousing costs.

REFERENCES

COULTER, J., SONDHI, J., KOTECHA, P. and BOXALL, R. (1996) *The Economics of Warehousing in Zambia and its Role in Agricultural Development.* NRI research report R2323(S) to DFID Crop Post-Harvest Research Programme, under contract ZB00070.

COULTER, J., SONDHI, J. and BOXALL, R. (1997) *The Economics of Warehousing in Ghana and its Role in Agricultural Development.* NRI research report to DFID Crop Post-Harvest Research Programme, under contract ZB00070.

COULTER, J. and SONDHI, J. (1996) *Warehousing and Inventory Credit in Northern Mozambique; Project Formulation Mission, 15 September-18 October 1996.* NRI consultancy report No. R2340(C) - prepared for the Netherlands Ministry of Development Co-operation

FREINDSHIP, C.A.R. and COMPTON, J.A.F. (1991) Bag or bulk? A decision-making checklist. *Natural Resources Institute Bulletin* No. 45, iii + 19pp

JENKINS, C.H (199X) *Complete Guide to Modern Warehousing Management.* New York. Prentice Hall.

APPENDIX 1: METHODOLOGY USED IN THE SPREADSHEET ANALYSIS OF THE ECONOMICS OF INTER-SEASONAL STORAGE

Methodology

We started with a system of nominal monthly wholesale prices for maize in certain key markets - Kumasi and Tamale in Ghana, and Kabwe in Zambia. As indicated earlier in the report these locations differ in their rainfall patterns, so that whereas in Kabwe and Tamale, grain is normally marketed when it is fairly dry, in Techiman artificial drying is necessary for much of the year. Cost of drying therefore has to be included in the Techiman calculations.

In the case of Kabwe we had two price series, market prices and into-mill prices, and we chose whichever was the lower of the two on the understanding that low prices are associated with greater availability. Market prices are lower early in the marketing year, but as supplies become scarce, the mills become the major buyers and are able to secure grain more economically than on the open market. Only three crop years were used in the case of Kabwe - 1994/95 to 1996/97 - these being the years when agricultural marketing has been effectively liberalised, and where price variability may provide some idea of future trends.

In Ghana, the State has never effectively controlled prices, and there is wholesale market price data going back to the beginning of the 1980s. An eleven year period, 1985/86 to 1995/96, was used for this analysis.

To make figures comparable, all price data was converted into constant 1996/97 US dollar values. This was done through a three-stage process:

1. Historical prices for each marketing year were converted to constant monthly prices by using the annual Consumer Price Index (CPI) for each country[6].
2. These annualised constant monthly prices were then converted into constant 1996/97 prices in the local currency, using the same index.
3. These constant 1996/97 prices were then converted into dollars using the exchange rate corresponding to the same date as the 1996/97 CPI used:

	Ghana	Zambia
CPI base year	100 (July 1985)	100 (May 1994)
CPI (latest)	1,947 (Oct 1996)	238 (March 1997)
Exchange rate 1 US$ =	1,718 cedi (Oct 1996)	1,291 Kwacha (March 1997)

This allows all cost and revenue data to be standardised in US dollars. Historical price datea was then averaged for each market, and the costs of purchasing grain in each month, and storing it for variable periods prior to disposal, were computed[7]. Handling, storage, drying and

[6] Monthly rates of inflation were estimated on the basis of annual intervals in the CPI in order to avoid errors which might result from seasonal correlation between monthly maize prices and the CPI.

[7] In Techiman it was assumed that maize would be stored in the period September to July, in Tamale from December to July, and in Kabwe from June to March. In reality grain could be dried and stored from August in Techiman but the statistical price data for August does not distinguish between dry old crop and wet new crop maize, so one cannot make a meaningful analysis of this scenario.

financial costs were assumed to be as follows:

- costs of procurement and handling of grain in and out of store of $9 per tonne in Techiman, and $7 in Kabwe and Tamale[8];
- a standard 2% weight loss due to handling, regardless of how long the grain was stored
- for Techiman only, a scale of drying losses, ranging from 12% to 0%, according to the month in which the grain was purchased. Drying is charged at $2.50 per percentage point of moisture removed.
- monthly storage costs $4 per tonne in Techiman and Tamale, and $2.50 per tonne in Kabwe. This difference reflects the relative abundance of storage capacity in Zambia, and the need for higher charges in Ghana to cover costs.
- 25% of the crop stored was financed with owner's equity and 75% by loan;
- monthly loan interest is 1% in real terms, i.e. assuming no inflation in the local currency;
- bank charges are 1% of the loan value.

We then computed the return on the equity (ROE) the trader invests in storing grain using inventory credit, as follows:

$$ROE = \frac{S \times (100 - W) - TC \times (100 + Int)}{TC \times (E + Int \times (100 - E)/100)} \times 100\%$$

where S = sales price per tonne
W = weight loss percentage (during drying and storage)
TC = total physical costs per tonne, including procurement, handling and storage
Int = interest and bank charges to the date of sale (percent)
E = trader's equity as a percentage of the value of grain procured

Return on equity figures were then plotted, showing the month of initial purchase and month of sale - see Figures 1.1, 2.1 and 3.1. Examiing the graphical detail, assumptions were then made about the most likely speculative scenarios (i.e. during which months traders were most likely to store), and *annualised* return on equity figures were then estimated using the graphical data.

Sensitivity analysis was then applied to the base case, and annualised return on equity figures were then estimated in the same way. The assumptions were as follows.

	Base case	Sensitivity
Monthly storage charges		
Ghana	$4.00 per tonne month	$6.00 (+ 50%)
Zambia	$2.50 per tonne month	$3.75 (+ 50%)
Equity percentage	25%	50% (+ 100%)
Interest charges	1.0% per month	2.0% (+ 100%)

ROE data for each case are plotted in the Figures 1.2 to 1.4, 2.2 to 2.4, and 3.2 to 3.4.

[8] Here we are talking of "incremental" compared to the alternative of buying and selling the grain immediately without storing it. Only direct costs are included - incremental managerial and other overhead costs are not included

FIGURE 1.1

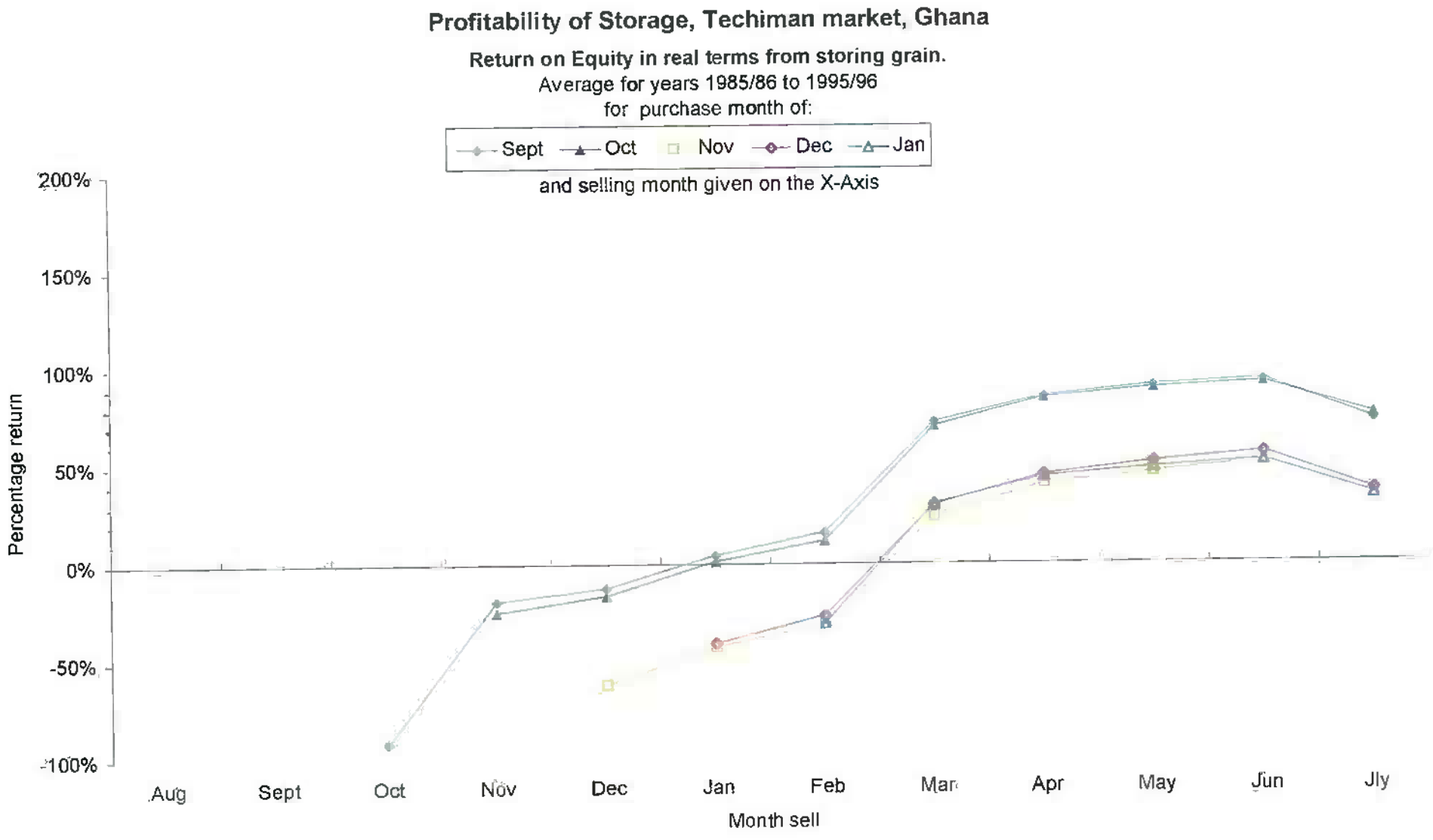

Profitability of Storage, Techiman market, Ghana
Return on Equity in real terms from storing grain.
Average for years 1985/86 to 1995/96
for purchase month of:
Sept
Oct
Nov
Dec
Jan
and selling month given on the X-Axis
200%
150%
100%
50%
0%
-50%
-100%
Percentage return
Aug
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jly
Month sell

FIGURE 1.2

Profitability of Storage, Techiman market, Ghana

SENSITIVITY : increase storage charge by 50%

Return on Equity in real terms from storing maize.
Average for years 1985/86 to 1995/96
for purchase month of:

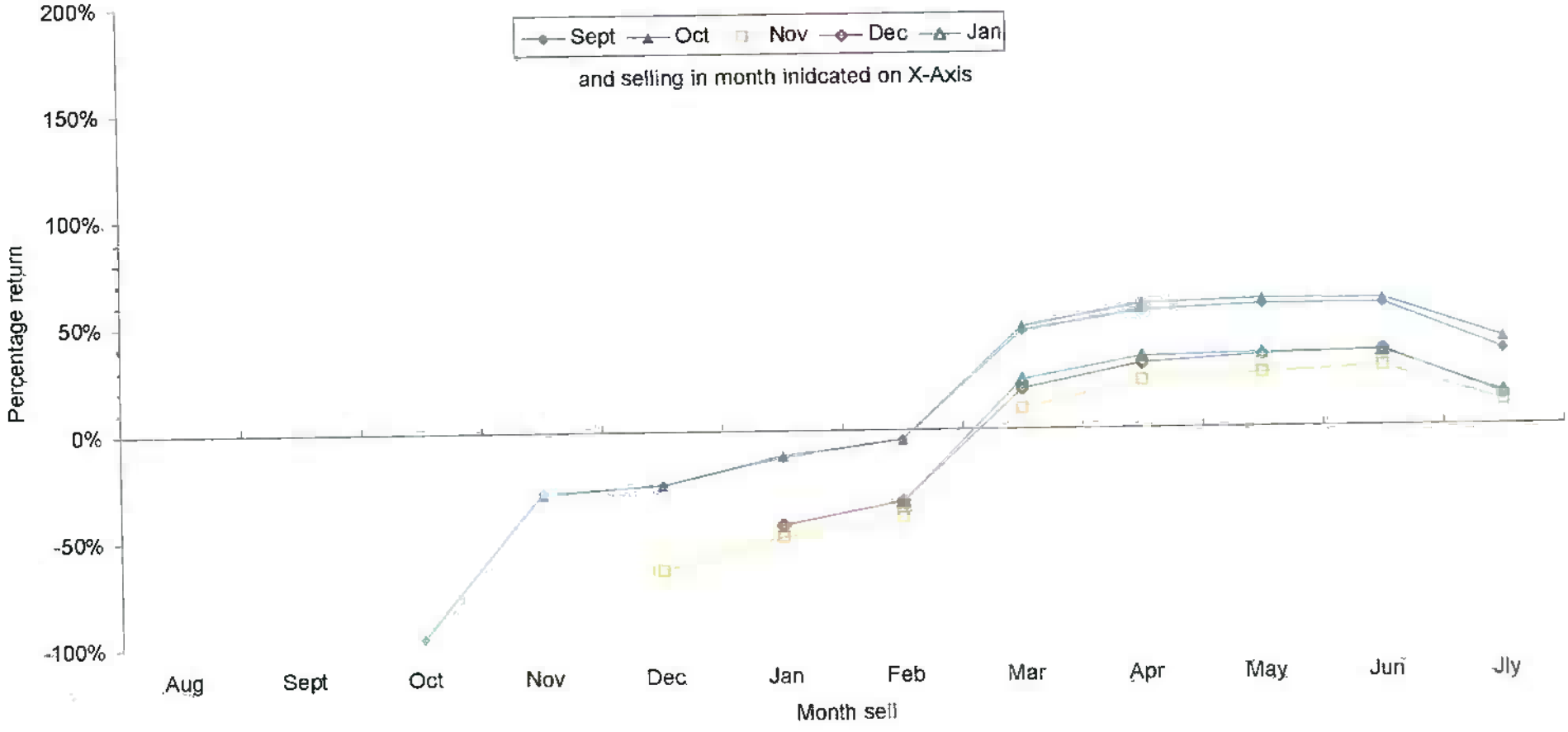


FIGURE 1.3

Profitability of Storage, Techiman market, Ghana

SENSITIVITY : interest charges double from 1% to 2% per month

Return on Equity in real terms from storing grain

Average for years 1985/86 to 1995/96

for purchase month of:

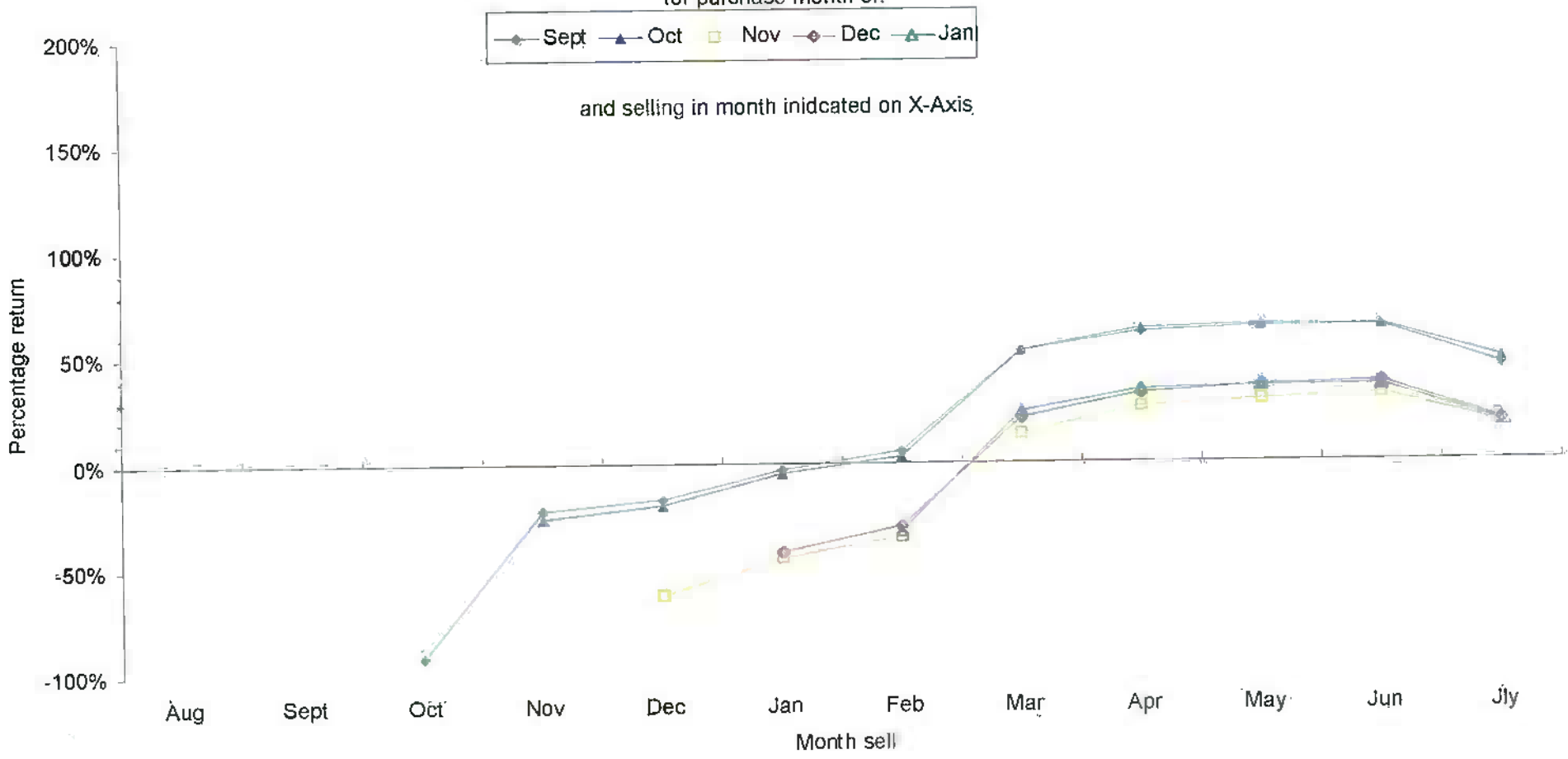


FIGURE1.4

Profitability of Storage, Techiman market, Ghana

SENSITIVITY : Equity increased to 50%
Return on Equity in real terms from storing maize.
Average for years 1985/86 to 1995/96
for purchase month of:

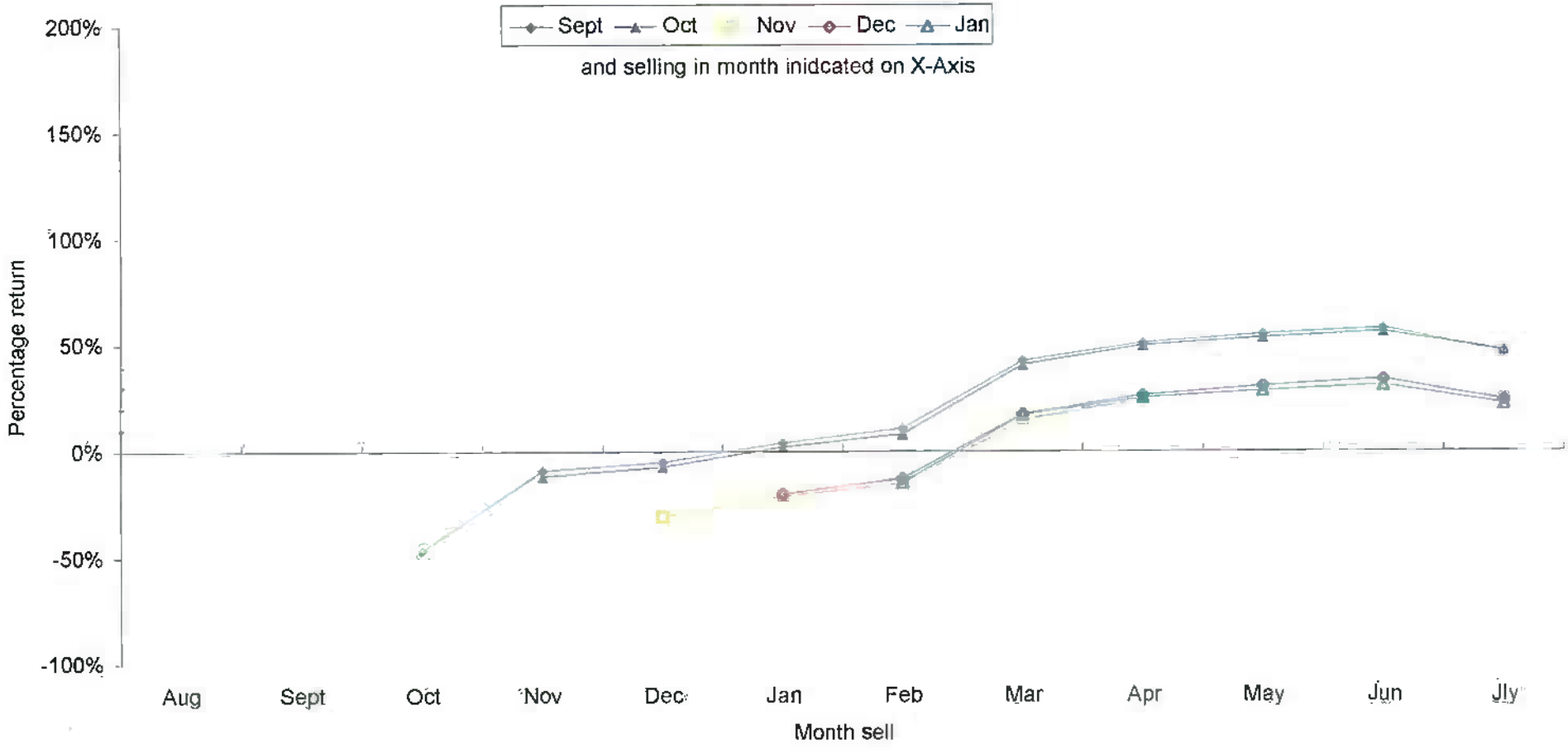


Figure 2.1

Profitability of maize storage, Tamale market, Ghana

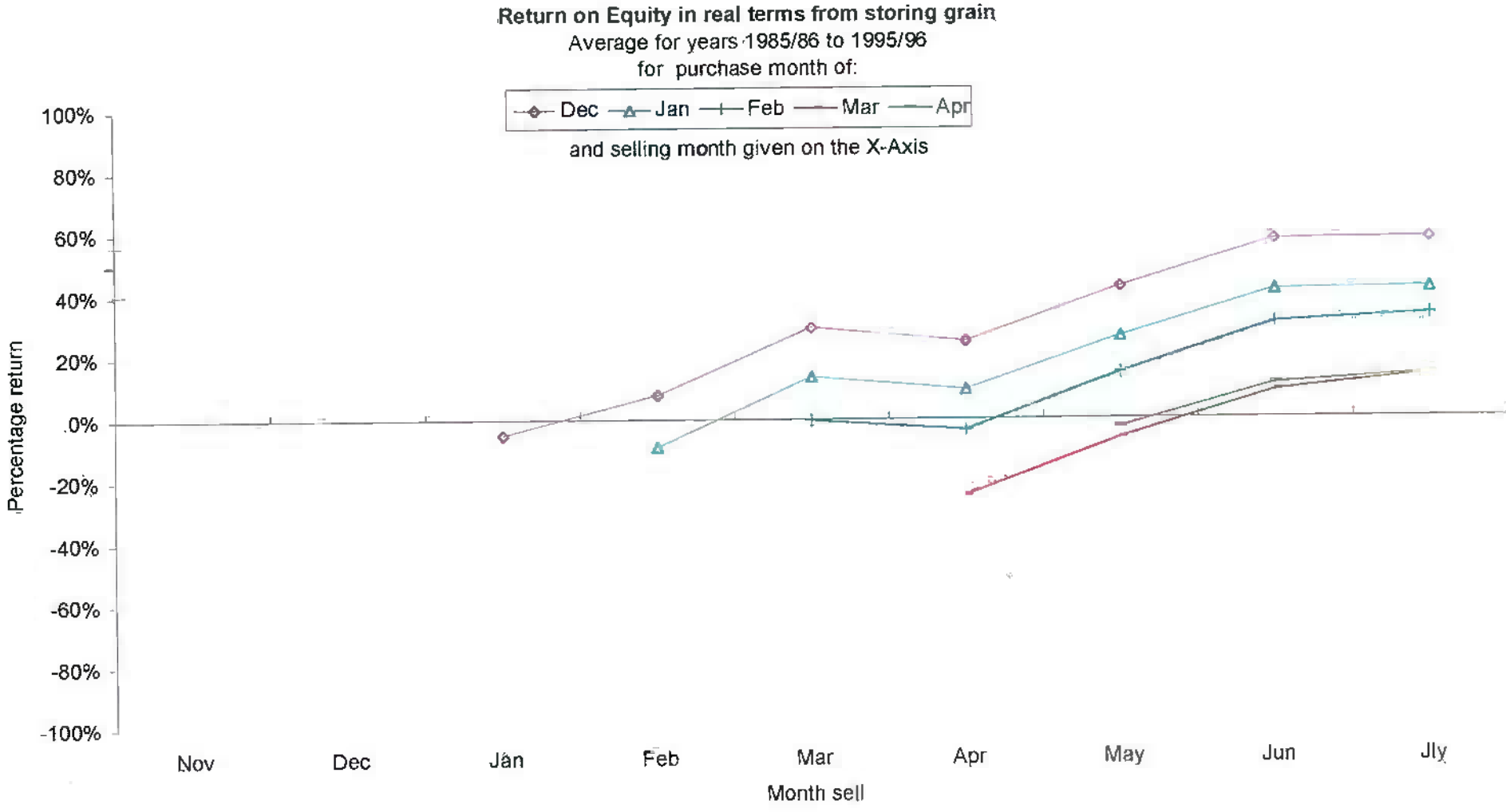


Figure 2.2

Profitability of maize storage, Tamale market, Ghana

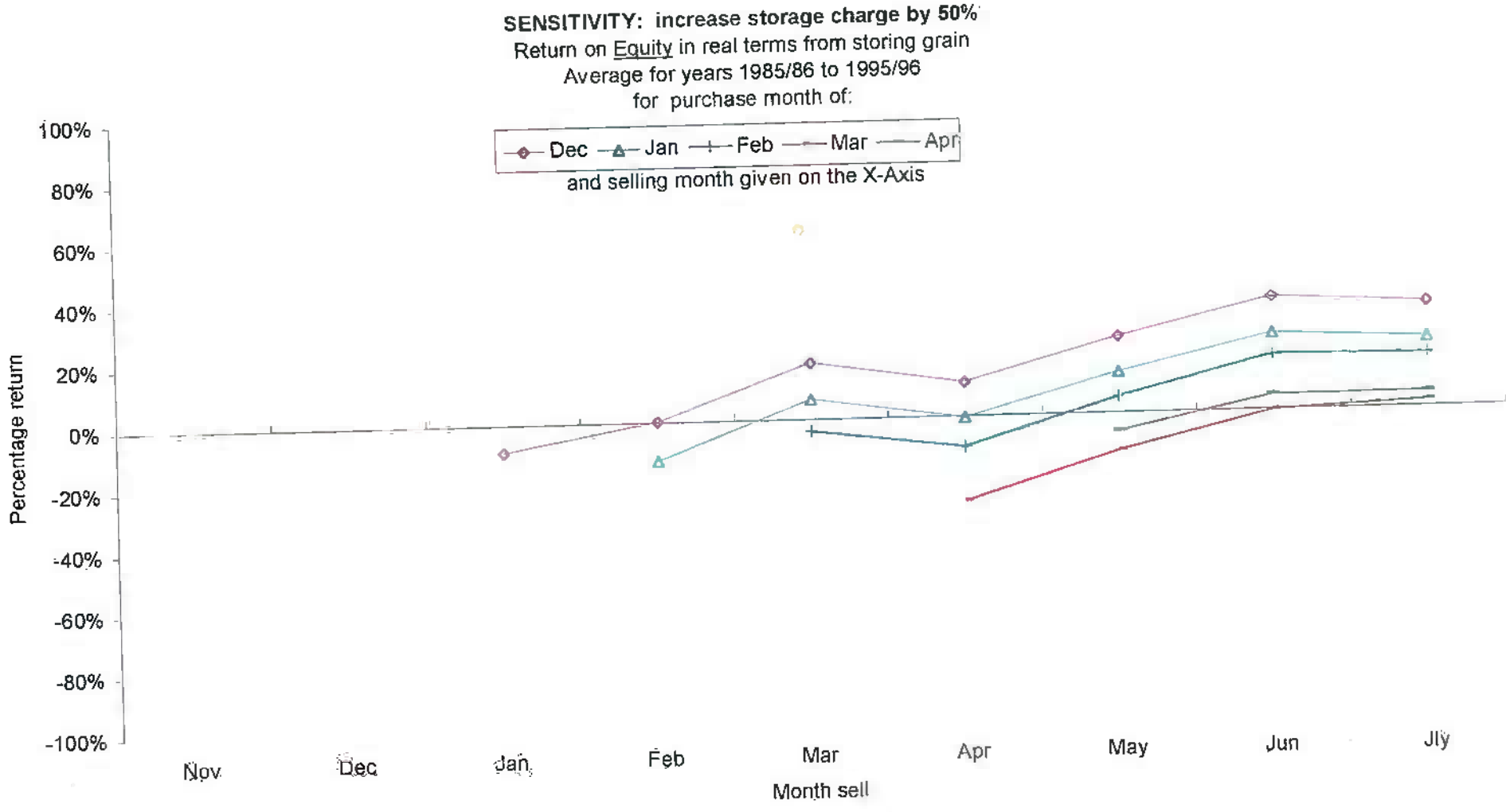


Figure 2.3

Profitability of maize storage, Tamale market, Ghana

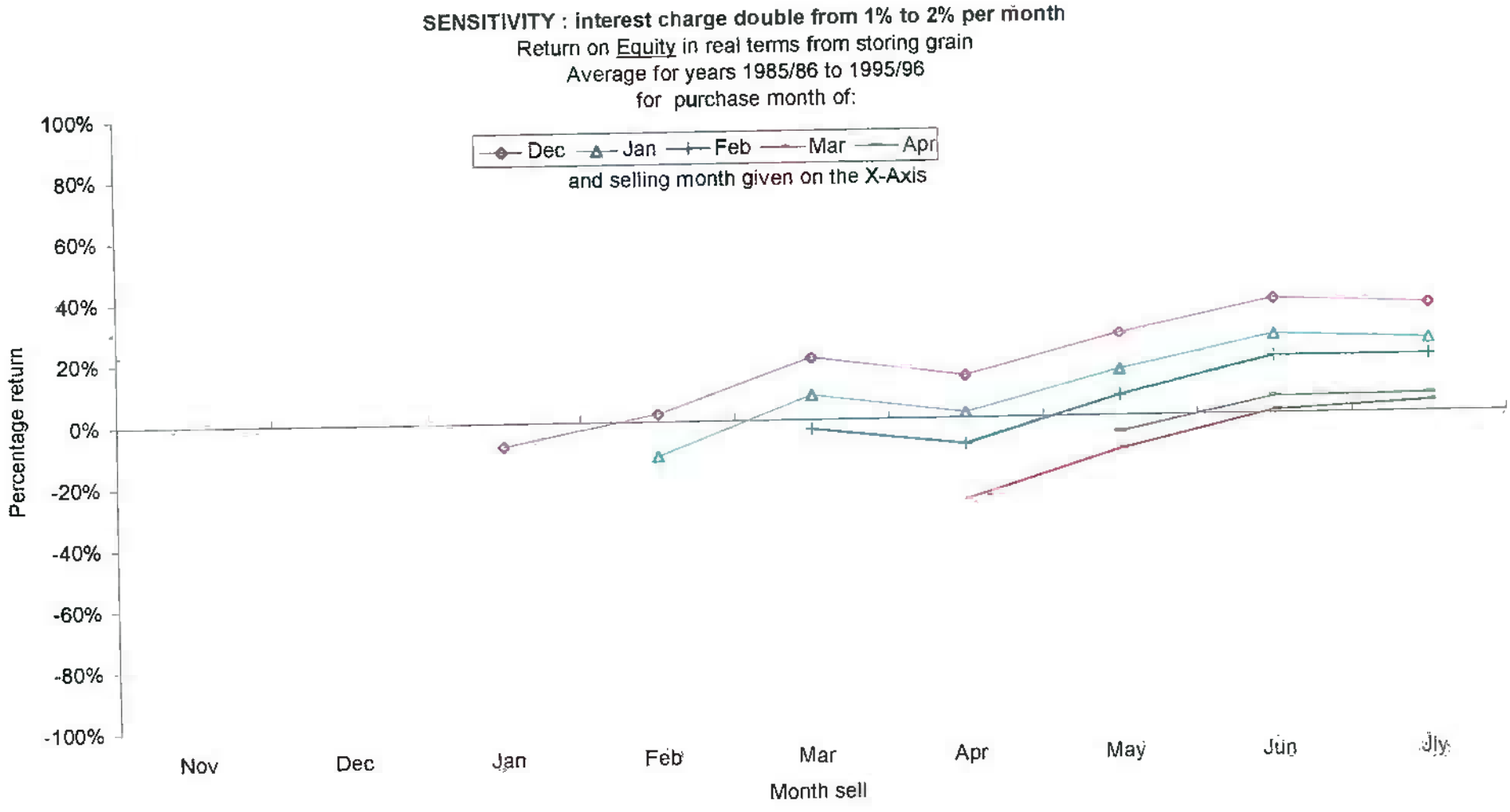


Figure 2.4

Profitability of maize storage, Tamale market, Ghana

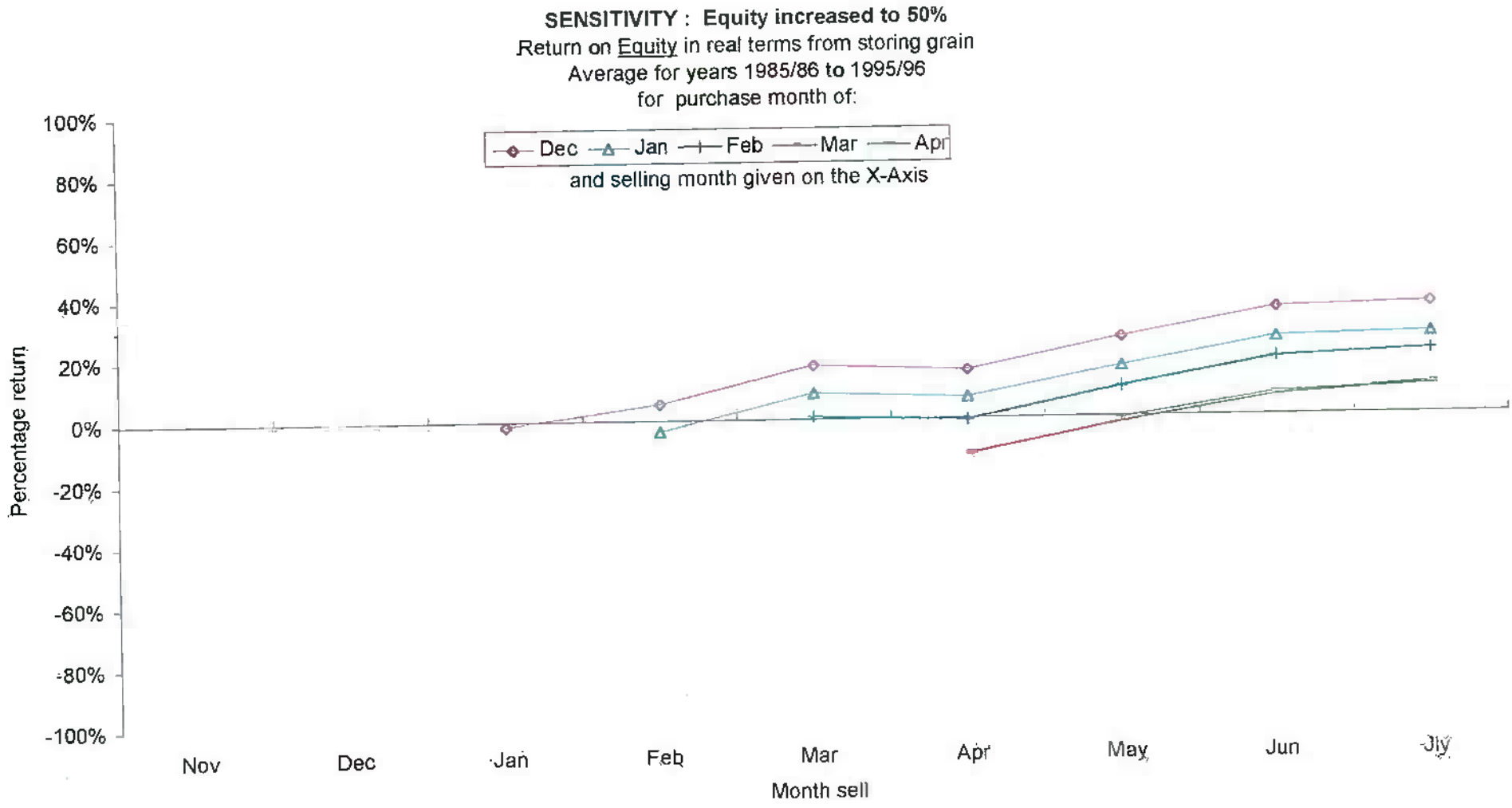


Figure 3.1

Profitability of maize storage, Kabwe market, Zambia

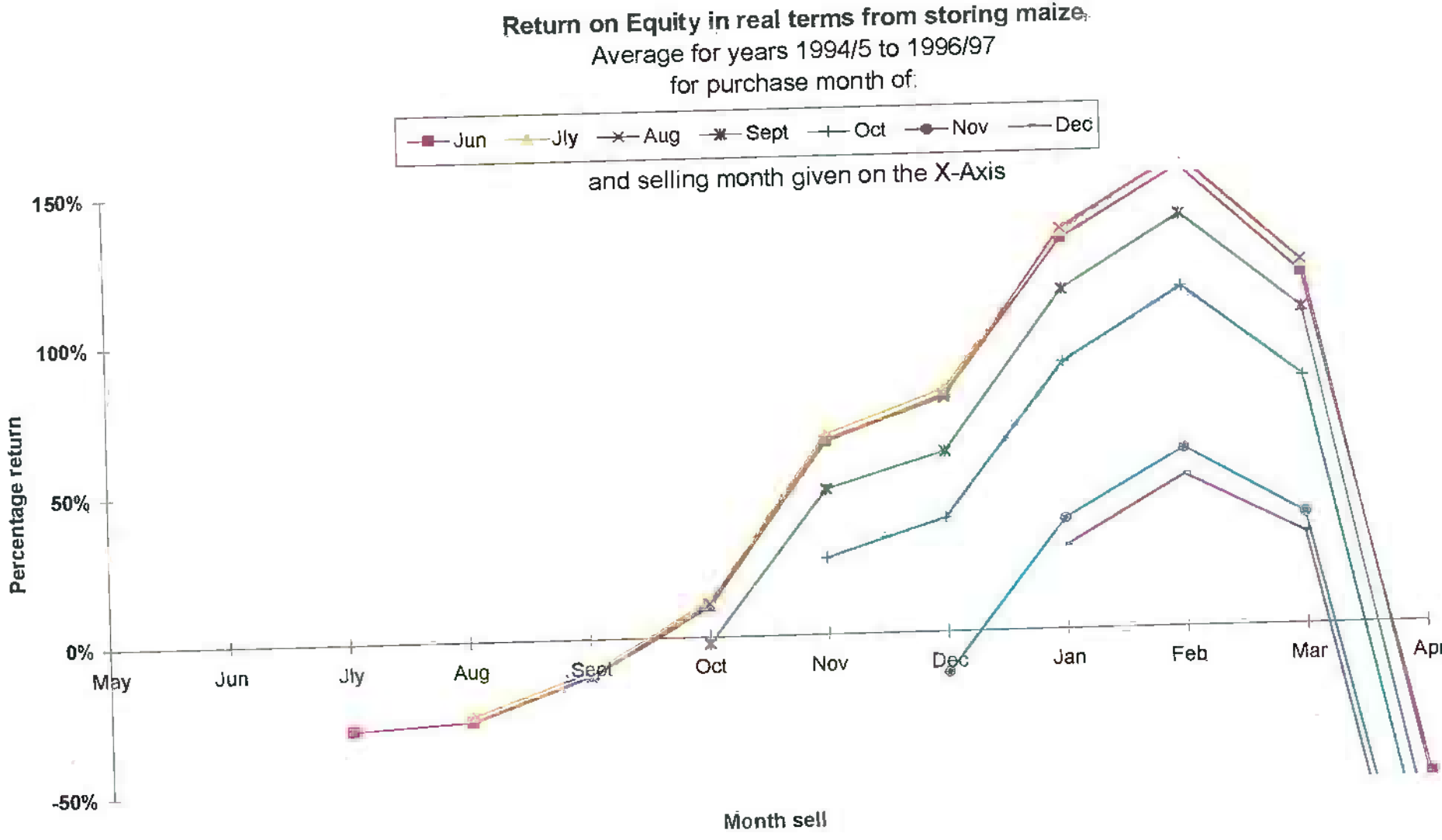


Figure 3.2

Profitability of maize storage, Kabwe market, Zambia

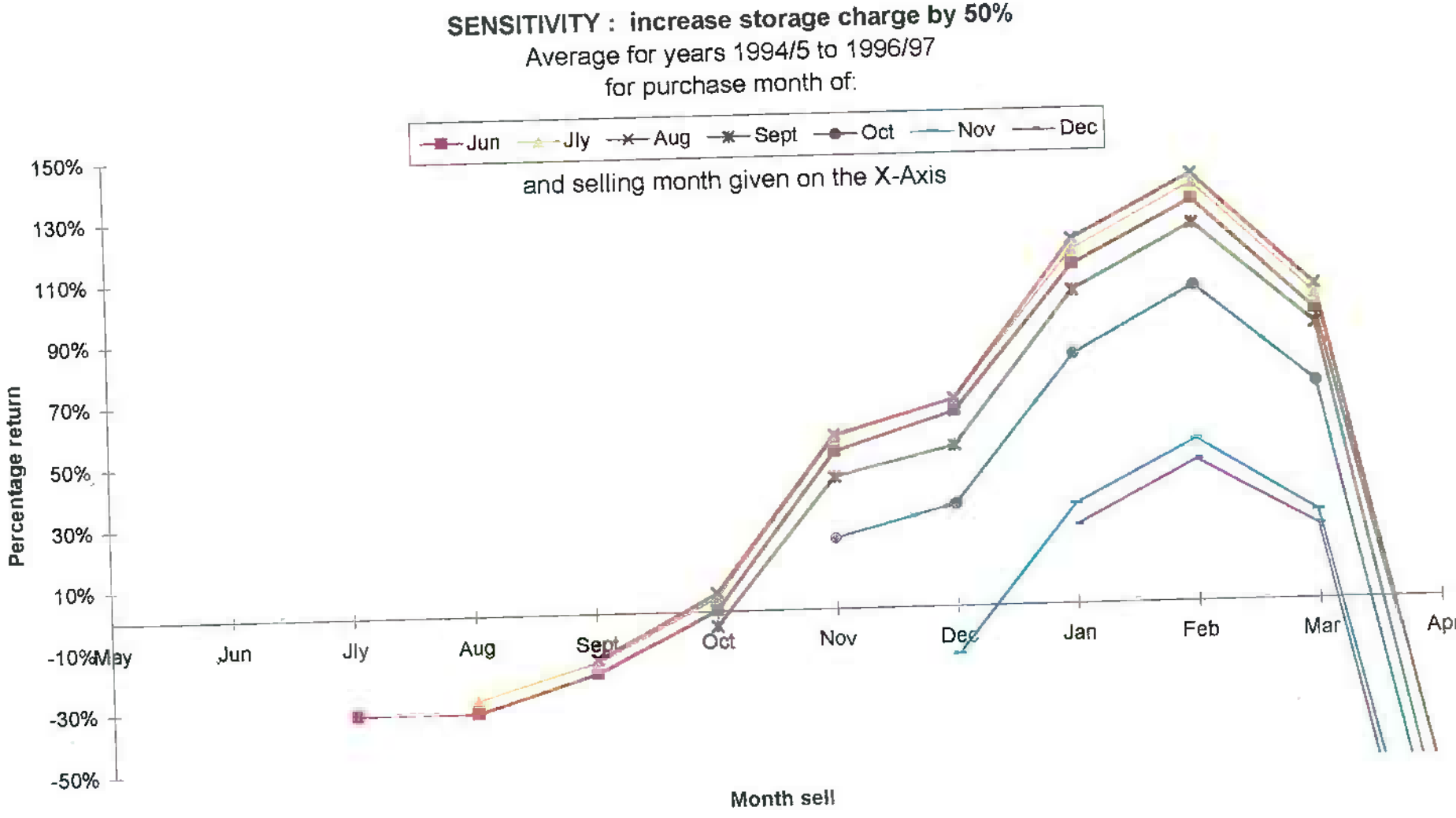


Figure 3.3

Profitability of maize storage, Kabwe market, Zambia

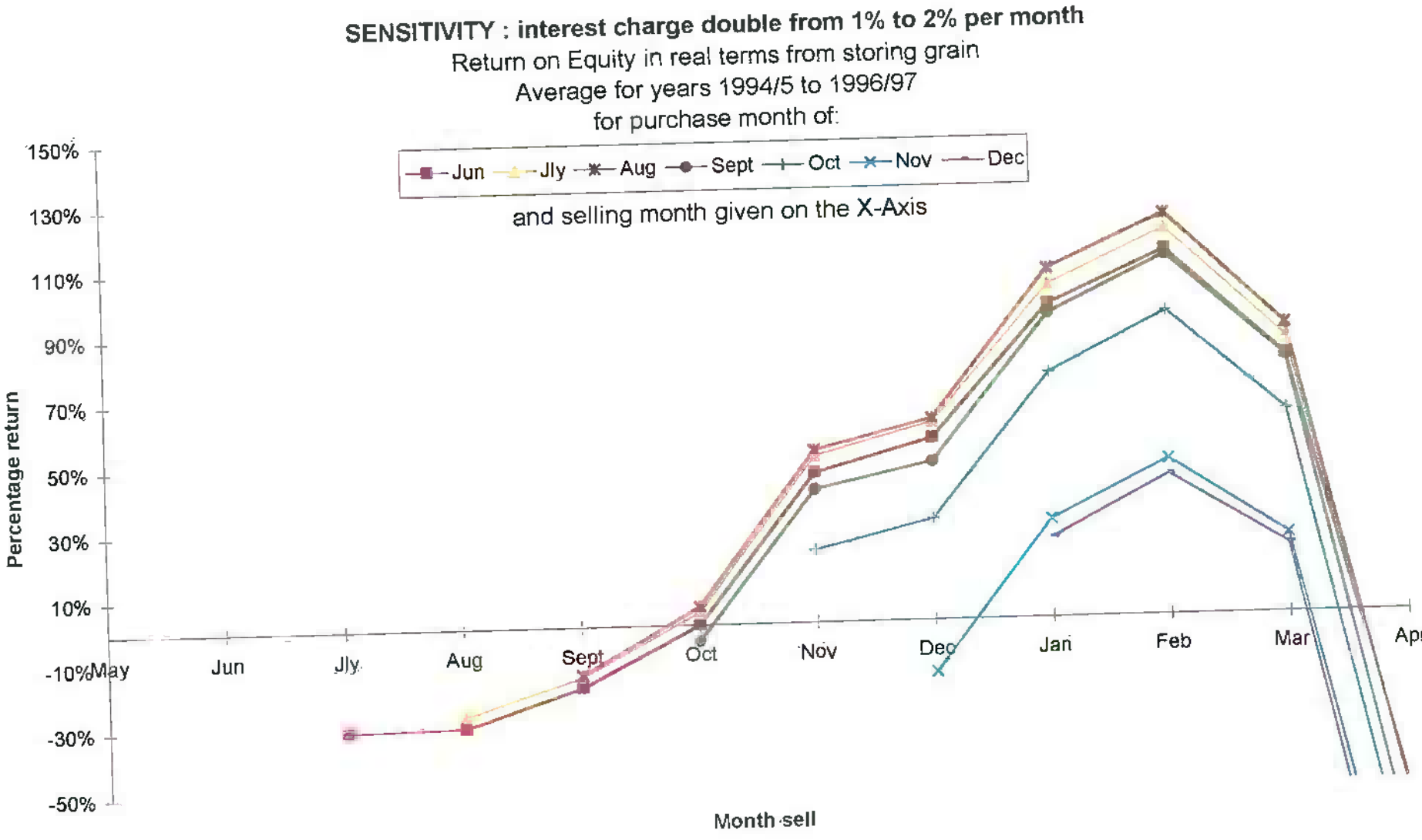


Figure 3.4

Profitability of maize storage, Kabwe market, Zambia