THE ECONOMICS OF PRODUCTION AND MARKETING OF POTATOES IN MERU DISTRICT, KENYA

By

STEPHEN GICHOVI MBOGOH

A thesis submitted in part fulfilment for the Degree of Master of Science in Agriculture in the University of Nairobi.

June, 1976.

This thesis is my original work and has not been presented for a degree in any other University.

Signed .....

S.G. MBOGOH

(Candidate)

This thesis has been submitted for examination with our approval as University supervisors.

Signed: (1) .....

Prof. G. LORENZL

(2) .....

Prof. E.T. GIBBONS

TABLE OF CONTENTS

ABSTRACT

Potatoes are an important food in Kenya. However, the market is characterized by large fluctuations in both availability and prices of potatoes, and there is need for more planning at both micro and macro levels. Information on the structure, conduct and performance of the potato industry is somewhat limited and surveys are required to provide the necessary data. Such data for planning purposes must be gathered through surveys in representative potato producing areas.

This thesis gives the findings from a survey conducted in Meru District, where a random sample of 75 growers and 23 traders were interviewed, between September 1975 and January 1976. The major hypotheses tested are:

(i) yield depends on relative share of potatoes in the farm production structure and is proportional to the level of purchased inputs;

(ii) potato acreage is influenced by price levels during the season prior to planting;

(iii) local market prices are influenced by inter-regional prices and will differ by transfer costs;

(iv) net returns to growers in Meru can be increased by shifting potato supplies to the market through storage;

(v) competition in the trade is limited and growers have little bargaining power because there are few

traders so that the growers will be associated with particular traders or outlets;

(vi) growers are willing to cooperate in solving marketing problems.

Kerr's Pink, the commonly grown potato variety in Meru, takes about 3½ months to mature. Two crops are produced during the year, one between February and June (Short Rains season) and the other between August and December (Long Rains season). The competing enterprises include pyrethrum, wheat, vegetables, maize and coffee; livestock is only a minor enterprise. Crop rotation involves any of these enterprises.

The major inputs in potato production are machinery for land preparation, seed, fertilizers, plant protection chemicals and labour. A crop may require 2 to 3 weedings and 3 to 4 sprayings (with Dithane M45 to control blight) before it matures. Production cost per bag of potatoes was found to be Shs. 16/89, shs. 19/79 and shs. 27/66 in Kibirichia, Kiirua and Upper Abothuguchi respectively. Major constraints in production were cash, to pay for inputs such as fertilizers or protection chemicals, and labour, especially at planting, weeding and spraying periods. Blight was the only severe disease limiting production.

Two types of supply systems are involved in marketing Meru potatoes: the local supply system involves trade within Meru District, while the interregional supply system involves

trade between Meru and areas outside the district. Associations between growers and particular traders or outlets, based either on services given to particular growers by the trader they supply or on friendship or kinship ties, tended to reduce competition in the trade. Quantities of potatoes supplied to the market depended on the amounts retained by growers for seed and for family consumption. The amounts retained for seed and for family consumption were estimated to be 25% and 13% respectively; therefore, only about 62% of the output is marketed.

Three types of market available for Meru potatoes were considered: (i) a local market (Kibirichia) in the producing zone; (ii) an urban market (Meru town) within the district; and (iii) a major consumer market (Wakulima, Nairobi) outside the district. Prices in these markets showed the same trend or developments during the year, but there were times when they differed appreciably so that it was possible to ship potatoes between these markets at a profit. Marketing costs included transfer costs, storage costs and fees such as the cess of shs. 1/05 per bag of potatoes taken out of the district. However, storage periods rarely exceeded a month, and the storage costs rarely exceeded a shilling per bag per month.

Hypothesis tests indicated that yield depended on the level of purchased inputs and was influenced by the relative size of potato plot, which was adopted as a measure of

the relative importance of potatoes in the farm. However, the small and variable amounts of fertilizers used did not have significant impact on yield, so that the actual soil fertility condition before farming was significant. No relationship was established between potato acreage in a given season and the prices of potatoes during the previous season. Prices in the local markets differed by transfer costs and were correlated to Nairobi prices, though market integration may have been low. Local markets in Meru were estimated to handle most of the marketed output, but there were inadequate outlets because the prices obtainable were rather low: growers did not get adequate net returns. However, net returns could not be increased by shifting supplies to the market through storage because prices in the Nairobi markets, which were assumed to be major outlets for potatoes so stored in Meru, were found to be at their peak at the time when Meru potatoes are harvested. Growers in Meru would like to form an organization to store, grade and secure markets for their potatoes.

Lack of difference between prices for seed and eating potatoes discouraged storage and sprouting of potatoes to be sold as seed-potatoes at the planting time. Storage was another problem: farm storage facilities could only permit a maximum storage period of 6 weeks, if losses were to be avoided. Roads to the producing zones were rough and inaccessible when wet; besides, means of transport were rare and

expensive. However, growers have to hire transport when supplying the local trading centres.

Two main problems in potato production and marketing are evident: (i) there is need for more and intensive work on yield trials (at varying amounts of inputs) before growers can be advised on the right types and amounts of fertilizers to be used in production; and (ii) an organised potato marketing body is needed to combat the observed inefficiencies or distortions in interregional prices and improve the potato marketing in the country.

LIST OF TABLES

Tables : Page

Tables

Tables

LIST OF FIGURES

CHAPTER I

PROBLEM FORMULATION

1.1. Introduction

Potatoes are a staple food for a large segment of people in Kenya, and this is important because potatoes provide a rich source of carbohydrates. Maize is the competing staple food as a source of carbohydrates. However, potatoes will normally grow best in the high altitude areas where maize may take up to one year to mature. Since potatoes have a life-cycle of about 3½ months, it is sometimes possible to produce two crops of potatoes in a year and obtain more carbohydrates per unit of land than from maize (1, p. 146).

Despite the increasing importance of potatoes in the diets of people in Kenya (11 and 12), potatoes have not always been available to the people at prices most consumers can pay owing to the large fluctuations in production from season to season. The observed price fluctuations imply that the potato growers, who largely fall in the low-income group of population in Kenya, are realizing fluctuating incomes. Besides, the consumers who belong to this low-income group cannot buy potatoes at certain periods of the year when prices are high, so that they cannot benefit from potatoes as a source of carbohydrates at such periods.

Kenya is still in the transitional stages of metrication. Most of the measurements in the farming are still done in the Imperial system. Some of the calculations in

this study are therefore expressed on the basis of an acre rather than a hectare. However, the two terms will be used selectively where appropriate. (1 hectare = 2.47 acres).

1.2. The problem

The high fluctuations in availability and prices of potatoes from season to season and within seasons indicate problems in the production and marketing of potatoes in the country.

To plan the production and marketing of potatoes, it is necessary to get information on the structure, conduct and performance of the potato industry. Taking into account the production seasons in the different producing regions, then production and marketing of potatoes should be planned such that potato supplies to the markets are evened out so as to ensure an even flow throughout the year.

Potatoes are produced mainly in Central, Eastern and Rift Valley Provinces, the estimated area under potatoes in these provinces being 31,500 hectares. However, a fourth province, the Coast Province, is estimated to have 50 hectares of land under potatoes, but this is small enough to be neglected when considering the major potato areas in Kenya. The estimated potato hectarage in Kenya in 1975 is given in the following table.

Table 1: Estimated potato hectarage in Kenya in 1975

AREAS		POTATO HECTARAGE (ha)	
Province	District	Per Province	Per District
Central	Nyandarua	9,000	
	Nyeri	2,000	
	Kiambu	1,800	
	Muranga	700	
	Kirinyaga	1,000	14,500
Eastern	Meru	11,000	
	Embu	2,000	13,000
Rift Valley	Nakuru	1,500	
	Narok	700	
	Uasin Gishu	300	
	Nandi	300	
	Kericho	700	
	Elgeyo Marakwet	500	4,000
Coast	Taita	50	50
TOTAL HECTARAGE FOR KENYA			31,550

Source: C.C. Ballestrem: Report on activities and experiences on potato crops in Kenya, Nairobi, July 1975, page 3.

From Table 1, it may be calculated that Meru and Nyandarua together account for 63.4% of the area under potatoes during 1975, with Meru District alone accounting for 34.9% of the total area. Meru District was selected for this study because it is one of the most important production areas.

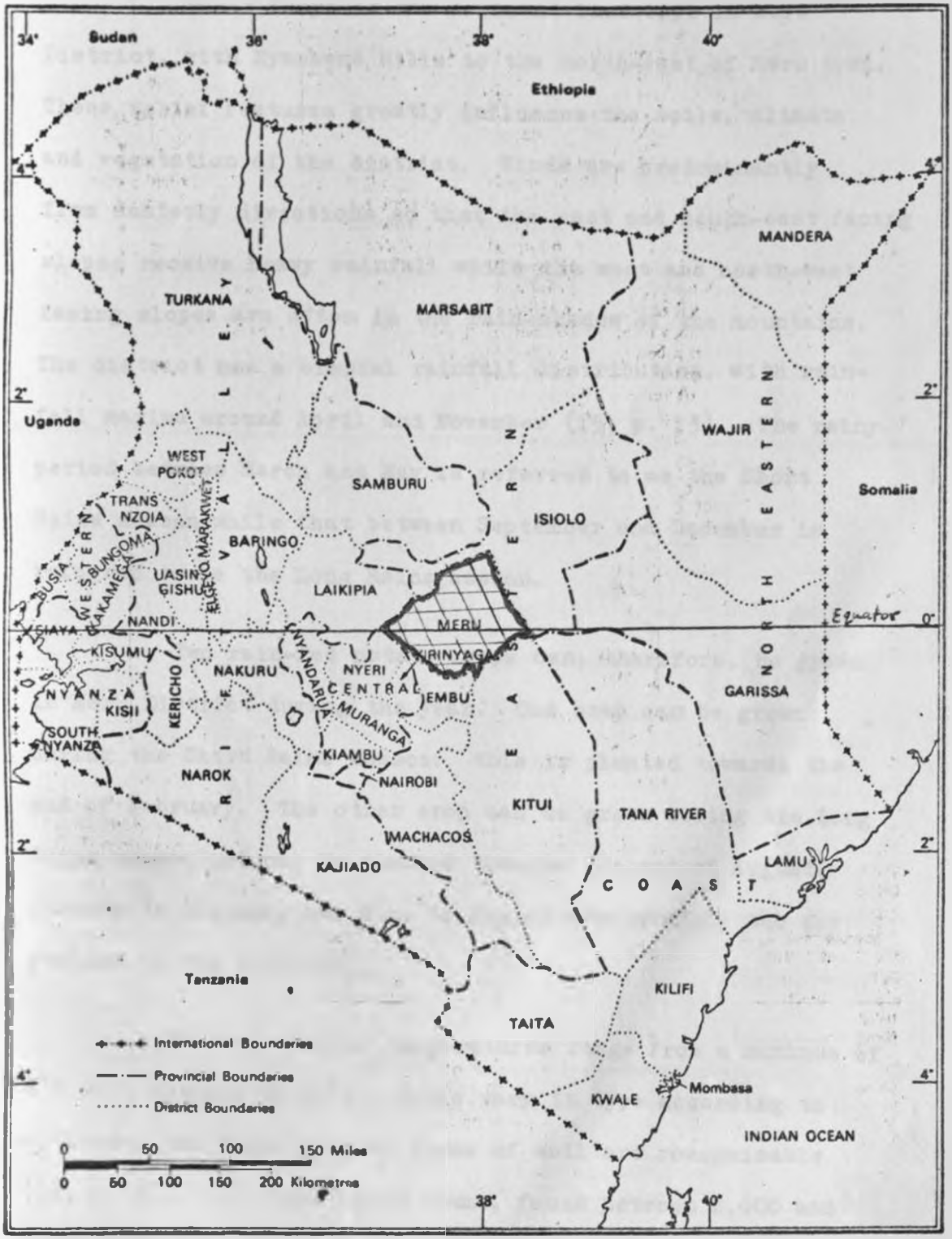
1.3. Area selected for the study

Meru District consists of six administrative Divisions: North Imenti, South Imenti, Igembe, Nithi, Tigania and Tharaka. Potato production is centred around North Imenti, although small amounts of potatoes are produced in the other divisions, except in Tharaka where weather conditions and the stony, sandy soils are unsuitable.

1.3.1. Location of Meru District

Meru District lies in the central region of Kenya and covers about 10,000 sq. km., and is divided roughly into two halves by the Equator as shown in Figure 1 below. The district is linked to the other districts in the country through a network of all-weather roads, including a major tarmacked road which links it to Nairobi, the capital city of Kenya. The district lies about 250 km. away from Nairobi.

Figure 1: Location of Meru District in Kenya.



1.3.2. Climate, soils and ecological zones of Meru District

Mount Kenya is the dominant landscape in Meru District, with Nyambene Hills to the north-east of Meru town. These relief features greatly influence the soils, climate and vegetation of the district. Winds are predominantly from easterly directions so that the east and south-east facing slopes receive heavy rainfall while the west and north-west facing slopes are often in the rain-shadow of the mountains. The district has a bimodal rainfall distribution, with rainfall maxima around April and November (15, p. 13). The rainy period between March and May is referred to as the Short Rains season while that between September and December is referred to as the Long Rains season.

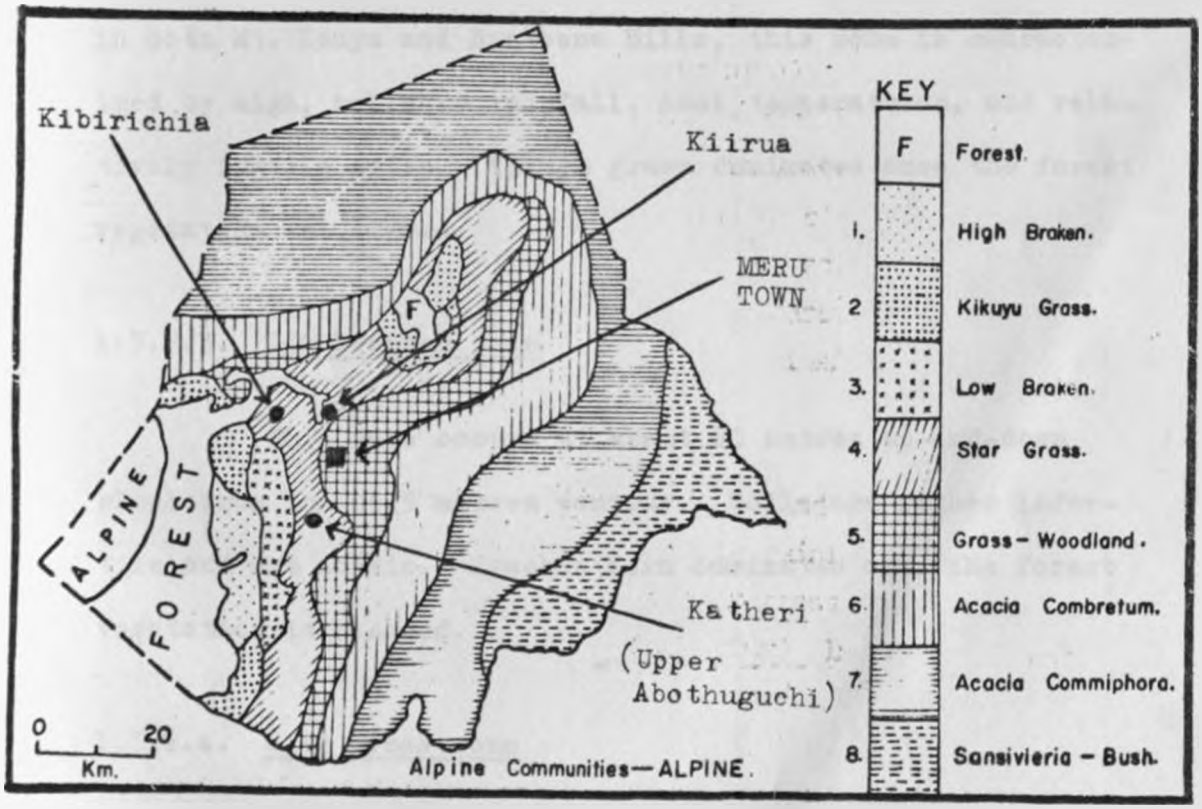
Two rain-fed potato crops can, therefore, be grown in Meru District during the year. One crop can be grown during the Short Rains season: this is planted towards the end of February. The other crop can be grown during the Long Rains season and may be planted towards the end of August. January to February and June to August are normally the dry periods in the district.

The mean annual temperatures range from a minimum of 6°C to a maximum of 26°C; soils vary in type according to altitude, but three general forms of soil are recognisable (14, p. 6): (i) dark brown loams, found between 2,000 and 3,000 metres above sea level; (ii) dark red friable clays with deep humic top soils, found between 1,500 and 2,000

metres above sea level; and (iii) black clays, found below 1,500 metres above sea level. Potatoes will generally grow best in the areas with the dark red friable clays with deep humic top soils.

Meru District can be subdivided into eight ecological zones, based on natural vegetation (15, p. 16 - 18), as shown in Figure 2 and described briefly below:

Figure 2: Meru ecological zones



Source: Kenyatta University College: Student Handbook for Meru Field Course, December 1975, page 17

1.3.2.1. High bracken zone

This zone occurs at altitudes exceeding 1675 metres at the edges of Mt. Kenya and Nyambene Hills and is characterized by light, acidic, structureless, brown loam soils, high rainfall and cool temperatures. Bracken fern dominates after clearing the forest vegetation.

1.3.2.2. Kikuyu grass zone

Occurring at altitudes between 1525 and 2400 metres in both Mt. Kenya and Nyambene Hills, this zone is characterized by high, reliable rainfall, cool temperatures, and relatively fertile soils. Kikuyu grass dominates once the forest vegetation is cleared.

1.3.2.3. Low bracken zone

This zone occurs at about 60 metres up-and-down slope from the 1525 metres contour. Soils are rather infertile and are acidic. Bracken fern dominates once the forest vegetation is cleared.

1.3.2.4. Star grass zone

This zone occurs between 1220 and 1675 metres on Mt. Kenya and between 1220 and 1830 metres on Nyambene Hills, and is the most favourable agricultural zone. Soils are the dark-red friable clays, and a reliable rainfall of 1000 mm to 1500 mm is common. Star grass, among other species,

colonises the zone after forest clearing.

1.3.2.5. Grass-woodland zone

This zone is confined between 900 and 1220 metres, except in the rain-shadow in Northern Meru, and has a low and variable rainfall and soils of volcanic origin.

1.3.2.6. Acacia-Combretum zone

This is a zone of metamorphic soils, occurring between 600 and 900 metres in Eastern Meru, and poorly developed volcanic soils between 1370 and 2130 metres in North and North-west Meru. Low, unreliable rainfall and a vegetation of low thorny trees and bushes, dominated by species of Acacia and Combretum characterize this zone.

1.3.2.7. Acacia-Commiphora zone

This is a zone characterized by poor, sandy soils in the east and boulder-strewn lavas in the north, and a highly unreliable rainfall. Acacia and Commiphora species dominate the vegetation.

1.3.2.8. Sansevieria - Bush zone

This zone covers the semi-desert landscape at the eastern - most section of the district, and is the hottest and driest zone, at an altitude not exceeding 600 metres. The zone rarely receives a rainfall exceeding 500 mm and is

covered with desert-grass (Sansevieria) - bush formations.

The above ecological zones show a gradually declining plane of agricultural potential from west to east in the Mt. Kenya area, from north-west to south-east in the Nyambene Hills, and a sharply declining plane of agricultural potential from south to north on the northern and north-west slopes of both Mt. Kenya and Nyambene Hills. Agricultural potential tends to increase with increasing altitude, except where the relationship is broken by the local soil variations, the drought risk (especially in the lower regions), disease and pests, and the striking rain-shadow in the north (15, p. 19).

Potatoes can be grown at altitudes between 1500 and 2900 metres, but they grow best at cool altitudes, (1800 to 2000 metres), with a steady rainfall of about 250mm per month falling continually throughout the growing period, provided that the soils are free-draining and have adequate supply of nutrients. The soils can therefore be either naturally fertile or fertilised through addition of manures or fertilizers (1, p. 147). Therefore, potatoes are grown mainly in the Bracken fern zones, the Kikuyu grass zone and the Star grass zone in Meru District.

1.4. Literature review

No studies appear to have been conducted specifically on the problem of marketing of potatoes in Kenya. The

literature on potatoes mainly discusses agronomy, diseases and pests aspects of potato production in Kenya. Little information on the structure, conduct and performance of the distributive system for potatoes is given.

However, the results of a recent pilot study by Quinckhardt (14) on potato production in Meru, Kiambu, Kericho and Kisii Districts give some idea of the problems of the potato industry in Kenya.

The Quinckhardt study showed that there were considerable differences in potato production and marketing costs in the different district. Acland (1) deals with production aspects, giving information on cultural practices in potato production and the major diseases and pests that affect potato production in Kenya. Ballestrem (2 and 3) briefly writes on his experiences on potato production in Kenya: he discusses potato agronomy, diseases and pests in some detail and also mentions the problem of the marketing of potatoes in Kenya. He stresses that although Kenya can produce fresh potatoes throughout the year in different ecological zones, it is difficult to utilize this potential due to lack of a well organized marketing scheme which would be able to overcome the big problem of bringing potatoes from remote areas to marketing centres. Ballestrem also asserts that marketing of potatoes is done direct from the farmers or through cooperatives with their own transport facilities so that prices to farmers are subject to individual arrangements between farmers and the

traders. Reports and publications of the Ministry of Agriculture (11, 12, 13), in collaboration with the reports by the staff of the German Agricultural Team (GAT) in Kenya (4, 6, 7), mainly deal with the problem of potato agronomy, disease and pest control; however, they also touch on the problem of horticultural marketing in the country, especially mentioning that there is need for the development of a horticultural crops policy which lays stress on planned production and marketing of these crops. Potato is one of the main horticultural crops earmarked in such development plans (12). Hubert (8) investigated aspects of potato marketing in Nairobi in 1968; although a marketing system is a dynamic phenomenon and the situation may have changed considerably since then, his findings are nevertheless useful as a guideline in understanding the nature of potato trade in Nairobi, which is the main consumer centre in Kenya. He found out that there were about 20 wholesalers engaged in the potato business in the Nairobi area, and that about 14 of them were Africans and the rest Asians. However, the total quantity of potatoes marketed in Nairobi was found to be divided between Africans and Asians in a ratio of about 2:3, with the main places of wholesaling of potatoes being Varma Road (for Africans), Bazaar Street and Grogan Road. Hubert found out that very few wholesalers sold directly in Mincing Lane Market (now Wakulima Market), and that the potato producers and consumers were linked through a number of intermediaries; the estimate was that only about 5% of the total potato turn-over marketed in

Nairobi was handled by small producers who delivered directly to one of the retail markets at the outskirts of the City. Kenyatta University College Students Handbook for Meru Field Course (15) is the main source of data on the description of Meru District as given under section 1.3, and Maritim (10) gives the wholesale selling unit for red potatoes in Nairobi.

The results of the pilot study by Quinckhardt form the major source of guidelines on what requires to be studied in an effort to give information on the problem of potato marketing in Kenya. However, the Quinckhardt results for Meru District were based on a sample of 15 farmers, mainly drawn from one area (Kibirichia) so that these results have to be treated with caution. This study will be based on a larger sample drawn from the major producing areas and is therefore expected to give more representative results for the district.

CHAPTER II

OBJECTIVES OF THE STUDY

2.1. Specific objectives of the study

Production and marketing problems for potatoes in Meru District will be investigated: production and marketing costs will be evaluated, and the structure, conduct and performance of the potato industry in the district will be studied. The results of this study are intended to constitute part of the data which are proposed to be collected from all the representative production areas and which are to be used in planning an equilibrium model for production and marketing of potatoes in Kenya. Since the timing of the major production seasons varies from district to district, then such data are expected to show if it is possible to coordinate planting times so that potato harvesting is spread over as long a period as possible in order to provide less uneven supplies to the market.

2.2. Questions to be answered

Results of the study are expected to give answers to the following questions concerning potato production and marketing in Meru District:

2.2.1. What are the major determinants of yields?

2.2.2. What are the major determinants of supplies to the market?

2.2.3. How do prices vary in the different potato markets?

2.2.4. How can net returns be increased so as to encourage production?

2.2.5. What are the alternative market outlets?

2.2.6. What are the costs associated with supplying potatoes to the different market outlets?

2.2.7. How is the competition in the potato trade?

2.2.8. What are the major problems in production and marketing of potatoes?

2.2.9. What is the farmers' attitude towards cooperation in solving the marketing problems?

2.2.10. What are the possible conclusions and recommendations, and how can these be applied in the development of a potato crop policy?

The above questions reflect both the specific and overall objectives of the study, which are concerned with the development of a production-marketing model which can be simulated in timing production and marketing of potatoes so as to even out fluctuations in supply and prices, without adversely affecting growers or consumers. If possible, growers should achieve returns from the market adequate to cover production costs and give some profit margins while consumers should get potatoes at prices they can afford.

CHAPTER III

METHODOLOGY

3.1. Hypotheses to be tested and their justification

Hypotheses arise out of the objectives of the study, and are based particularly on the questions to be answered. The following hypotheses will therefore be tested:

3.1.1. Potato yields will depend on the importance given to the potato crop in the farm production structure, as can be measured in terms of the relative size of the potato plot. The relative size of the potato plot refers to the ratio of the size of potato plot to the size of the farm, and it is assumed that the major enterprise in the farm will have the biggest share in the farm size and will consequently receive more attention in production. Therefore, potatoes will receive more attention and better husbandry if they are the main enterprise, and higher yields are likely to be realized.

3.1.2. Potato yields are directly related to the level of purchased production inputs. The assumption is that yields vary with the level of purchased inputs, provided that the optimum level is not exceeded. Adequate labour is assumed to be available so that it is not a crucial factor in this hypothesis.

3.1.3. The size of potato plot at any given season will depend on the general level of potato prices achieved during the marketing of potatoes harvested during the previous

season. It is assumed that production is commercial-oriented and that farmers will base their production decisions on the prices which they expect for their output. Therefore, prices achieved by the output during the previous season will form the basis of production decision: a high general level of potato prices encourages more production in the following season, but a low level of potato prices will tend to discourage potato production.

3.1.4. Local markets in Meru District do not constitute the major outlet for potatoes produced within the district. Local markets refer to all market outlets within the district, and the assumption is that most of the potatoes produced at a market-surplus level cannot get enough buyers within the district, and the bulk of this quantity of potatoes is sold outside the district. Here, the words "most" and "bulk" imply anything above 50% of the marketed potato output in the district.

3.1.5. Local potato prices in Meru District differ by transfer costs, and these prices are determined by prices obtainable at the interregional channel levels, as measured by prices in the major consumer centres. The assumption is that there is market transparency and that there are trade links between the Meru local markets and the interregional market outlets for Meru potatoes. Therefore, both growers and traders have market information and arbitrage in space is expected to bring potato prices to such levels that they

differ only by transfer costs associated with the different market outlets.

3.1.6. Net returns to potato growers in Meru District can be increased by shifting potato supplies to the market through storage. The assumption is that Meru potatoes are sold at low prices due to over-supply of potatoes to the market soon after harvesting. Therefore, withholding of some of the potato output after harvesting is expected to maintain balanced potato supplies to the markets, without causing sudden reductions in potato prices which would result in low net returns to the potato growers. The Long Rains potato crop is planted between August and September and harvested between the end of December and February; the Short Rains potato crop is planted between February and March and is harvested between the end of June and July. These are the periods of potato glut in the markets. So, we assume that storage of Meru potatoes for about two or three months after harvesting would enable the Meru potato growers to sell their potatoes at higher prices and, therefore, increase their net returns, assuming that the losses or costs during storage are small and neglible.

3.1.7. There is lack of adequate market outlets for Meru potatoes. The assumption is that the Meru growers are not able to sell all their potato output owing to lack of ready market outlets soon after the crop is harvested and before it starts to perish in storage.

3.1.8. There is limited competition in potato trade in Meru District because there are few potato traders: farmers have low bargaining power and are associated with a particular trader or outlet for any of the following reasons:

a) There exists contractual ties, whether explicit or implicit, between farmers and traders; or

b) Farmers lack market information; or

c) Farmers have difficulties in physical access to the markets.

With few potato traders, who are the immediate buyers of potatoes from the farmers, the degree of buyers' concentration will be high. Each trader is more likely to be associated with certain farmers, and there are only few chances that he will lose or gain his clients or farmers to or from his fellow traders. It is assumed that any of the reasons given above could lead to such associations between the farmers and traders, and this is likely to reduce or limit competition in the potato trade.

3.1.9. Farmers are willing to solve their potato marketing problems collectively by forming a cooperative to store, grade, transport and market their potatoes. The assumption is that the farmers are aware of the marketing problems, and their opinions on the establishment of a cooperative society will indicate if they are willing to solve the potato marketing problem in their district collectively.

3.2. How the hypotheses will be tested

3.2.1. To test if there exists a relationship between variables, regression and correlation analyses will be executed by means of computer (using the ICL 1900 Statistical Analysis XDS3 Package). The correlation coefficients obtained will be tested for significance, by application of the calculated t-statistic values. A confidence level of 95% will be chosen for significance tests: this is a convenient level because it gives a flexible margin of error in the observations, but not large enough to make the results unreliable.

3.2.2. For those hypotheses which do not require tests to determine if relationships exist between variables, the hypotheses testing will be based on the evidence obtained from questionnaire interviews and discussions with the potato growers, traders and government officials in Meru District. However, statistical tests of significance will be applied where possible.

3.3. Organization of the study

3.3.1. Timing

The study was planned to last 10 months according to the following schedule:

a) September - October, 1975: search for and extract basic information on potato production and marketing; prepare and pre-test questionnaires.

b) November - December, 1975: field data collection, taking four weeks to interview growers and four weeks to interview traders and the extension staff of the Ministry of Agriculture in Meru District.

c) January - February, 1976: data analysis and interpretation.

d) March - June, 1976: preparation, writing and presentation of thesis.

3.3.2. Sample selection and field data collection

3.3.2.1. Potatoes are grown in five out of the six divisions of Meru District, but North Imenti is the most important producing division, as will be seen from Table 2.

Table 2: Estimated potato hectarage in the six divisions of Meru District, 1975

DIVISION	POTATO HECTARAGE IN 1975 (ha)		
	Short Rains season (March - May) Crop	Long Rains season (Sept - Nov) Crop	Whole Year (two Crops)
North Imenti	3,500	4,345	7,845
South Imenti	530	500	1,030
Igembe	400	700	1,100
Nithi	113	229	342
Tharaka	-	-	-
Tigania	72	117	189
TOTALS FOR MERU DISTRICT	4,615	5,891	10,506

Source: Ministry of Agriculture: Divisional Monthly Reports, Meru District, December 1975

From Table 2, it can be deduced that North Imenti accounted for 74.7% of the potato hectarage in Meru District in 1975. In North Imenti, potatoes are a major cash crop, especially in Kibirichia and Kiirua locations.[1] This is in complete contrast to other divisions where much smaller crops are utilised chiefly for family consumption. Because of its general and marketing importance, North Imenti was selected for detailed field investigation.

3.3.2.2. North Imenti consists of 8 administrative locations namely Kibirichia, Kiirua, Upper Abothuguchi, Lower Abothuguchi, Ntima, Nyaki, Gaitu and Timau. Potatoes are important only in Kibirichia, Kiirua and Upper Abothuguchi.[1] Timau area is rapidly growing as a potato producing zone, but Kibirichia is likely to remain dominant for the foreseeable future. The following table shows the estimated potato areas in the division.

Table 3: Estimated potato hectarage in North Imenti during the 1975 Long Rains (Sept/Nov) potato crop

	Location	Potato hectarage (ha)
1.	Kibirichia	2,000
2.	Kiirua	1,282
3.	Upper Abothuguchi	360
4.	Other locations	703
	TOTAL FOR NORTH IMENTI	4,345

Source: Ministry of Agriculture: Divisional Monthly Reports, Meru District, December 1975

1. Private communication from District Agricultural Officer, Meru in 1975

From table 3, it may be calculated that Kibirichia, Kiirua and Upper Abothuguchi accounted for 83.8% of the potato hectarage in North Imenti during the 1975 Long Rains season. Therefore, these three locations are the most suitable potato zones for study in North Imenti, and samples of growers were drawn from them.

3.3.2.3. After reviewing the available resources, it appeared feasible for about 50 growers and the same number of traders to be interviewed. In addition, it was decided to interview selected members of the Ministry of Agriculture in Meru District, especially the extension staff in the zones selected for detailed investigation.

The selection of growers to be interviewed was on a random basis, the method employed being as follows:

1. A list of growers having at least 0.2 hectares under potatoes during the 1975 Long Rains season was compiled from the records of the local extension staff of the Ministry of Agriculture. There were 3,500 such growers in Kibirichia, 1,600 growers in Kiirua and 200 growers in Upper Abothuguchi. Based on the relative importance of each zone, the author selected 70 growers in Kibirichia, 40 growers in Kiirua and 20 growers in Upper Abothuguchi as outlined in step 2 below.

2. The names of growers in each location were written on separate pieces of paper; these pieces of paper were then folded and mixed in a container. By drawing lots, the required number of growers was compiled for each zone.

The compiled list of growers was in excess of the planned number to be interviewed so that it would have been possible to interview more if time allowed. The final sample of growers interviewed reflected the relative share of potato hectarage in each of the three zones, which was 55:35:10 when expressed on percentage basis. With a minimum target of interviewing 50 growers, it was possible to actually interview 75 growers and these were distributed in the three zones as shown in Table 4. The table also gives the relative share of the sample potato hectarages for the three zones; for convenience the three zones are enumerated as Zone I, Zone II and Zone III for Kibirichia, Kiirua and Upper Abothuguchi respectively and these zonal numbers will be used where convenient when referring to the three potato zones.

Table 4: Distribution of interviews and potato hectarages in the three sample zones in Meru District, 1975

Details	Zone I	Zone II	Zone III	Totals
Number of growers interviewed	41	21	13	75
Percentage share of interviews	55	28	17	100
Long Rains potato hectarage	2000	1282	360	3642
Percentage share of hectarage	55	35	10	100
Sample potato hectarage	165.5	66	20.5	252
Percentage share of sample hectarage	66	26	8	100

The above table depicts that the proportion of the interviews in the three zones was based on the relative importance of each zone as potato producer.

Selection of traders for the interviews was more difficult than was the case with growers. There are three different types of potato traders in Meru District.

a) Local potato traders in the potato producing zones;

b) Potato traders in Meru town open market; and

c) Interregional potato traders, who engage in trade between Meru District and other consumer centres in the country.

Local traders have shops, kiosks or stores in the local trading centres; those who have shops or kiosks are general merchants, but those having stores are specialized potato traders. Traders who have shops or kiosks are normally retailers:

they buy from the farmers in lots usually of 1 to 5 bags of 84 kg and sell them to local consumers in small amounts, usually in kilogram units. Those traders having stores used exclusively for potatoes are normally wholesalers: they also buy potatoes from the farmers, but usually in quantities of at least 20 bags of 84 kg. These traders will normally store potatoes for periods of 4 to 6 weeks, mainly for speculative reasons, or until they have enough stocks that can be shipped and sold in some other areas away from the local trading centres while minimizing the unit cost of transport. Local traders sometimes supply interregional traders with potatoes; the interregional traders may come from such places like Nairobi and the dry districts (especially Isiolo, Wajir and Marsabit), but they do not necessarily sell the potatoes which they buy from Meru in their places of origin. Interregional traders may supply any towns in the country where they expect highest net returns. A local trader in Meru District can, therefore, become an interregional trader as soon as he starts dealing in trade between Meru and other areas outside the district. The term "local trader" will therefore be used to describe the trader who deals with potatoes within the district. Therefore, traders found in the Meru town open market are local traders, but they have been treated as a different type in view of the nature of Meru town open market. This is the largest and central market in Meru District, and the trade is mainly between growers and consumers or between local traders and consumers.

No special license is needed to trade in potatoes. The number of traders is not fixed, and their frequency in the producing zones or markets cannot be determined. Therefore, prior sampling of traders was not possible. As many traders as could be located during the period of field collection of data were interviewed. Few traders were dealing in potatoes at the local trading centres, and the frequency of the interregional traders in Meru District was low during the time the Short Rains (March/May) potato output was in the local markets. Owing to the low frequency of traders in the potato areas and markets during the period of field data collection, the target of interviewing 50 traders was not achieved; only 23 traders were interviewed. Table 5 gives the categories of the traders who were interviewed. Formal discussions on the problem of potato production and marketing in the three zones were held with selected members of the extension staff of the Ministry of Agriculture in Meru District.

Table 5: Categories of the 23 traders interviewed in Meru District, 1975

Category	Number of traders	Percentage of the total
1. Trading only in the local potato producing zones	3	13
2. Trading both in the local potato producing zones in Meru District and outside the district	12	52
3. Trading only between Meru District and some other districts	3	13
4. Trading in Meru town open market only	5	22
TOTALS	23	100

From the above table, it can be deduced that the local traders in the potato producing zones are the most important middlemen in potato trade in Meru District because they also performed the function of interregional traders, giving the overlap between categories 1 and 3 which is described as category 2. Category 2 accounts for the largest proportion of the traders involved in Meru potato trade. The above table shows that categories 1, 2 and 3 are the most important agents involved in the Meru potato trade.

3.3.2.4. Field collection of data

Collection of data started in late October, 1975, and continued until early January, 1976. In order to facilitate the interviews of the growers, the selected sample of

growers was arranged according to the location of the growers. All those within a certain locality were to be interviewed before proceeding to those in another locality. This, it was hoped, would save time by avoiding haphazard movements in search of the respondents.

The selected growers were interviewed using a structured questionnaire (Appendix I). If a grower was not found at his farm on the day he was listed for an interview, other visits were planned to ensure that all the selected respondents were interviewed.

The number of interviews done per day depended on the physical separation of the farms in terms of distance, accessability of the farms by road and the willingness of the respondents to answer the questions. Those who were willing to give answers straightaway usually took a shorter time to interview. Besides, more interviews were done per day if all the growers scheduled to be interviewed on a given day were found at their farms. It was possible to do an average of four interviews per day.

Interviews were conducted at spots which were considered most appropriate for the different growers or traders. If the grower was found working in the farm, he was interviewed on the spot. Only those found in their houses were interviewed while seated in the houses. The aim was to

get through the interview with each respondent as quickly as possible so as to save working time and also avoid making the respondent feel bored with the interview. This was especially more important when interviewing the traders: they are a busy lot and would like to do as much of their business as possible within a given time. Therefore, it was necessary to make proper introductions and explain the purpose of the study, emphasizing that the study had nothing to do with the government, so as to avoid suspicion and get cooperation from them.

A structured questionnaire was used mainly as a guide in formal discussions with the traders (Appendix II).

The growers were more cooperative and willing to answer the questions than the traders. The traders who did not cooperate, even after proper introduction and explanation of the purpose of the study, were not included in the list of the traders interviewed. This is because such traders refused to say anything on what they were doing as far as potato trade was concerned.

CHAPTER IV

PRESENTATION OF RESEARCH FINDINGS

4.1. Potato production in North Imenti Division, Meru District

4.1.1. Potato varieties

Several varieties of potatoes are available for production in Kenya, but Meru farmers prefer growing a potato variety called Kerr's Pink. This is an early maturing variety but is rather susceptible to blight, a disease caused by a fungus called Phytophthora infestans. Therefore, frequent sprays with a fungicide are necessary to protect the crop against the disease. The Government of Kenya, through the Ministry of Agriculture, is now trying to introduce new varieties in Meru District which are blight resistant, but these do not appear popular to Meru growers (Table 6) because they are considered to be of lower eating quality than Kerr's Pink. So, only the introduction of a red potato variety, similar to Kerr's Pink in eating qualities, but resistant to blight, would meet any real success in adoption by the Meru growers.

Among the recent variety introductions in September/October, 1975, were Anett, Roslin Tana and Roslin Eburru (B_{53}), for which certified seed was sold and distributed through the Ministry of Agriculture. Table 6 shows the proportion of the sample that was growing the different varieties.

Table 6: The different potato varieties grown in North Imenti Division by a sample of 75 growers in 1975

Potato variety	Average plot size under the variety (acres)	Number of growers	Number of growers as percentage of sample size
Kerr's Pink	3.4	75	100
Anett	0.5	8	10.7
Roslin Eburru (B_{53})	0.8	2	2.6
Roslin Tana	0.3	1	1.3

Source: Author's investigation

Anett and Roslin are white potato varieties. The above table shows that Anett had a high trial rate of 10.7% when compared with the trial rate for Roslin varieties. However, it is premature to judge the success of these introductions, although about 14.6% of the growers were trying one or more of these varieties. These new varieties were being grown in small amounts, but in addition to the popular Kerr's Pink variety. The average size of plot under the new varieties was 0.5 acres, compared with 3.4 acres for Kerr's Pink.

No certified seed is available for use in growing of Kerr's Pink variety. Growers, therefore, retain part of their own crop for use as seed. However, a grower may at times decide to buy seed from his neighbours or from the market when he considers his own crop unsuitable.

4.1.2. Potato growing and harvesting periods

Two rain-fed crops are grown during the year in Meru District. A third, but irrigated, potato crop can be produced in the district; however, only a few farmers could produce such an irrigated crop, which is expected to be harvested when the Short Rains potato output is just being used up and there is potato shortage so that it is expected to fetch higher prices than those fetched by the rain-fed potato crops. Potato planting and harvesting periods are given in table 7 below:

Table 7: Potato planting and harvesting periods in North Imenti Division, Meru District

DETAILS		PLANTING PERIOD	HARVESTING PERIOD
Rain-fed crops	Short Rains Season	Feb. - Mar.	June - July
	Long Rains Season	Aug. - Sept.	Dec. - Jan.
Irrigated crops		May	Aug. - Sept.

Source: Author's investigation

4.1.3. Potato yields

Sample potato yields are given in Appendix X; the average potato yields in the three potato producing zones in 1975 showed that potato outputs in the two rainy seasons

only differed slightly, as shown in Table 8.

Table 8: Average potato yields in the sample producing zones in North Imenti Division, Meru District, 1975 (Bags of 84 kg. per acre)

POTATO PRODUCING ZONE	POTATO YIELDS		
	Short Rains (May) output	Long Rains (November) output	Average for 1975
Kibirichia	56.1	61.8	59.0
Kiirua	40.8	40.1	40.5
Upper Abothuguchi	63.2 (56.2)*	50.5 (45.1)*	56.7 (50.7)*

( )* Actual bags of 94 kg. harvested per acre

Source: Author's investigation (Appendix XI)

The slight difference in potato yields during the two rainy seasons may be attributed to variations in weather conditions and other variables not under the farmer's control.

4.1.4. Competitive farm enterprises

In North Imenti Division, the major crop enterprises which compete with potatoes in production for the available resources include wheat, pyrethrum, maize, coffee and vegetables. The farmers also kept one or two cows, sheep or goats primarily for meat and milk for family consumption.

Some poultry were also kept mainly for eggs and meat. Potatoes are said to be the most profitable crop to produce in Kibirichia, but wheat and coffee are considered very competitive to potatoes in Kiirua and Upper Abothuguchi respectively. Table 9 shows the responses given by the sample of farmers when asked which crop they considered most profitable in their farms. Out of the sample of 75 farmers interviewed, 74 kept at least a cow for milk production, 61 kept at least a sheep for meat for family consumption, 55 kept some poultry for eggs and meat, and 25 kept at least a goat for family consumption; none of the farmers kept any of these animals on commercial basis so that they can be regarded as minor enterprises which cannot be said to compete with potatoes for the available production factors.

Table 9: Number of respondents who considered the indicated crop production enterprise as the most profitable in their farms in the three sample potato producing zones in North Imenti Division of Meru District, 1975

CROP PRODUCTION ENTERPRISE	ZONE AND NUMBER OF RESPONDENTS			
	Kibirichia	Kiirua	Upper Abothuguchi	Total
Potato	34	11	7	52
Wheat	3	7	-	10
Pyrethrum	1	2	-	3
Wheat & Pyrethrum	2	-	-	2
Vegetables	1	-	1	2
Maize	-	1	-	1
Coffee	-	-	4	4
Coffee & vegetables	-	-	1	1
TOTAL	41	21	13	75

Source: Author's investigation

The above figures indicate potato to have been the major crop in all the farms surveyed, but the other crops were competing with potatoes particularly for the available land and labour in production. However, available resources did not permit the study of the cost structure and returns for each of these other enterprises so as to give a comparative gross margin analysis for these enterprises

when compared with potato production. A detailed gross margin analysis for potato production in the three zones is given in table 18.

4.1.5. Cultural practices in potato production

Production starts with land preparation, which involves ploughing or hoeing of the land followed by ridging (where practised). Harrowing of the land before ridging was avoided by first planting a crop such as maize or beans on the plot after ploughing or hoeing so that the soil would become loose enough to permit potato production in the following season without harrowing. Growers in the drier areas preferred flat-planting; they considered ridging harmful as it would expose the soil and accelerate the loss of soil moisture. Table 10 shows the different cultural practices in production and the number of growers who were employing these production techniques. Land preparation is followed by fertilizer or manure application (where practised) before planting. Seedpotatoes are normally chitted prior to the planting period so that they would have short, green, healthy sprouts at the time of planting. Chitting can be done by placing the seedpotatoes in a diffusely-lit compartment, such as a room in a house or a carefully dug-out hole in the ground which is later covered by dry grass. Seedpotatoes may be planted, either on ridges or on flat ground, at a spacing of 60 cm between rows and 30 cm between plants along the rows. Kerr's Pink is rather susceptible to blight, and this

disease is controlled by spraying the potato crop with a fungicide called Dithane M45.

Spraying frequency depends on the expected severity of the disease, which in turn depends on the weather condition, especially the rainfall. Three sprays are recommended, but the number of sprays varied from one to five depending on the area. Weeding of the crop also largely depends on the weather condition, particularly the incidence of rainfall; weeding is done to protect the crop against competition for available nutrients and moisture. Weeding frequency varied in different areas, but one to three weedings were observed in the sample farms.

Table 10: Cultural practices in production and the number of growers employing these practices in the sample potato zones in Meru District, 1975

Cultural practice	Growers employing the practice	
	Number	Percentage
Land preparation: i. ploughing/hoeing	75	100
ii. harrowing	0	0
iii. ridging	57	76
Fertility improvement: i. adding fertilizers	49	65
ii. adding manures	8	11
Planting	75	100
Weeding	75	100
Spraying	75	100
Harvesting and grading	75	100

Source: Author's investigation

The first weeding is done about 4 weeks after planting, or as soon as weeds are noticed in the potato plot. The next weedings will be done as and when deemed necessary. Earthing of potatoes, which involves mounding of soil around the base of the plants so as to stimulate and facilitate rooting and tuber formation, is done after the plants have started tuberation, usually during the second month after planting, and is a subsidiary operation to weeding. The following table shows the spraying and weeding frequencies.

Table 11: Weeding and spraying frequencies in the sample zones, Meru District, 1975

Operation	Frequency	Growers involved	
		Number	Percentage
Weeding ..	1	1	1.3
	2	26	34.7
	3	48	64.0
Spraying (with Dithane M45)	1	2	2.7
	2	3	4.0
	3	29	38.7
	4	39	52.0
	5	2	2.7

Source: Author's investigation

The above table shows that 2 to 3 weedings and 3 to 4 sprayings were commonly carried out before the crop matured.

Kerr's Pink takes about 3½ months to mature. Harvesting and grading is the last operation. Potatoes are graded into three, as described in Table 12, at the harvesting time.

Table 12: Potato grades at harvesting time in North Imenti Division, Meru District

Grade	Descriptions
One	Large-sized potatoes: greater than the so called ordinary egg-sized potatoes; usually for home consumption and marketing
Two	Medium-sized potatoes: usually referred to as ordinary egg-sized, and normally used for seed; sometimes used for family consumption.
Three	Small-sized potatoes: smaller than the egg-sized grade; normally fed to animals; constitutes less than 10% of the total harvest

Source: Author's investigation

The bulk of the output goes to grades One and Two; both can be marketed as eating potatoes, but grade One is more marketable and grade Two is popular for seed. After harvesting, the land is prepared for the following cropping season.

4.1.6. Crop rotation

The common crop rotation patterns are given in Table 13 for the three sample zones. Small variations from the given patterns may occur, but the general pattern that was followed holds.

Table 13: Crop rotation in the three sample zones of North Imenti Division, 1975

Zone	Crop rotation pattens
I: Kibirichia	Potatoes ⟶⟵ Maize or Beans ⟶⟵ Pasture or Pyrethrum (1 year) (1 year) (3 years)
II: Kiirua	Potatoes ⟶⟵ Maize or Beans ⟶⟵ Wheat or Pyrethrum (1 year) (1 year) (1 or 3 years)
III: Upper Abothuguchi	Potatoes ⟶⟵ Maize or Beans ⟶⟵ Cabbages, Carrots and Tomatoes (1 year) (1 year) (1 year)

Source: Author's investigation

Crop rotation has both ameliorating effect on the soil (by ensuring even utilization of nutrients and good soil crumb formation) and disease control effect (by introducing non-susceptible, non-host plants on the soil while the disease causing agents are in the soil). Potatoes are preceded by another crop (maize or beans) in the rotation cycle to avoid harrowing if the ground is freshly broken from pastures.

4.2. Production costs

The major farm inputs in potato production are seed-potatoes, fertilizers, chemicals for plant protection, machinery for

land preparation, and labour. The average quantitites and value of these production factors are given in tables 14 and 15 for the three sample zones.

Table 14: Average physical inputs in production in the three sample zones for the Long Rains (September - November) potato crop, Meru District, 1975

Types of inputs	Sample zones and quantitites of inputs		
	Kibirichia n = 41	Kiirua n = 21	Upper Abothuguchi n = 13
Seedpotatoes bag/acre	10.6 (0.9)	8.9 (1.0)	9.2 (1.3)
Fertilizers (kg/acre)	54.8 (38.0)	20.9 (11.9)	90.5 (58.1)
Dithane M45 for plant protection (kg/acre)	4.3 (1.3)	3.2 (1.0)	4.7 (1.5)
Labour (Mandays/acre)	60.4 (17.0)	51.8 (17.5)	64.0 (14.7)

n = sample size, and the figures in brackets indicate the standard deviations.

Source: Author's investigation (Appendices III, IV and V)

Table 15: Average cost of inputs in production in the three sample zones for the Long Rains (September - November) potato crop, Meru District

(Shs. per acre)

Type of input	Sample zones and average costs		
	Kibirichia	Kiirua	Upper Abothuguchi
Seedpotatoes	349/25	307/50	415/40
Fertilizers	152/35	66/85	296/25
Dithane M45	130/15	89/70	151/60
Labour (valued * at Shs. 5 per manday)	302/-	259/-	320/-
Machinery for land preparation	86/35	53/35	34/20
TOTAL PRODUCTION COST	1020/10	776/40	1217/45

* See sub-section 4.2.5.

Source: Author's investigation (Appendices III to VIII))

4.2.1. Cost of seed potatoes

The potato grower normally selects seedpotatoes from his own harvest. No certified seedpotato is used in the growing of Kerr's Pink potato variety in Meru. Therefore, seed-potatoes can be valued at the market price for ware potatoes at the planting period because anyone wishing to buy seed-potatoes then can obtain them at the going market price for ware potatoes (author's investigation).

Based on the local market prices for potatoes in August and September, the planting period for the Long Rains potato crop, the average potato price (in shillings per bag)

were Shs. 32/95, Shs. 34/55 and Shs. 45/- in Kibirichia, Kiirua and Upper Abothuguchi respectively (See Appendices III, IV, and V)

4.2.2. Cost of fertilizers

Different types of fertilizers are used in the three sample potato zones in Meru District. These include diammonium phosphate (DAP), double and triple superphosphates (DSP and TSP), and the compound fertilizers 15-45-0, 15-15-6/4, 17-17-17, 20-20-0, and 23-23-0. Besides, some farmers apply a foliar feed (Murphy's foliar feed or 9-9-7 foliar feed). Appendix II shows the various types of fertilizers, amounts used and their costs.

The costs of fertilizers varied from farm to farm, depending on the type of fertilizer in use and the time of purchase because fertilizer prices have been changed considerably between 1974 and 1975 by the government in an effort to reduce cost of farm inputs so as to encourage more production of crops in the country. Those who had bought their fertilizer stocks early in 1975 paid more for the same quantity and type of fertilizer than those who bought the same type and quantity of fertilizer after September, 1975. Appendices III, IV and V give the various types of fertilizers and their prices before and after September, 1975. Tables 14 and 15 give the average cost of fertilizer (and amount applied) per acre for the three zones, and show that fertilizers are applied in larger quantities mainly in Upper

Abothuguchi.

Some farmers did not apply fertilizers in their potato plots. They either considered fertilizers too expensive and uneconomic to use at the prevailing potato prices or they considered manures adequate and cheapter to use. For example, one application of farm yard manure in the potato plot was considered sufficient to provide nutrients to the crops grown on the same plot for the next three seasons. One farmer from Upper Abothuguchi reported that he was using manures bought at the price of Shs. 260/- per ton. However, most of the other farmers who were using manures had obtained them from their own farms, and therefore did not consider manures as a cost to them. Therefore, it was not possible to evaluate the cost of manures used; the amounts used were not measured before application and were bound to vary from farm to farm, so that what could have been calculated as a fertilizer equivalent cost in terms of manures used was not possible to get. Cost of manures does not, therefore, appear in the gross margin or cost analysis calculations. Advantages of using manures in production are doubtful because the effect of the manures on yield may be offset by the disadvantages due to the fact that not-completely decomposed farm yard manures tend to encourage growth of Rhizoctonia solani, a fungus which causes a disease called black scurf in potatoes (3, p. 4), which may lead to reduced yields. Table 10 shows the proportion of the sample of growers who were using fertilizers and manures.

4.2.3. Cost of plant protection

Blight, a disease caused by a fungus called Phytophthora infestans, is the major problem that requires plant protection measures in potato production in Meru District. Few cases of bacterial wilt and nematode infestations were noticed, but no protection measures, other than through use of disease-free seed and crop rotation, are available. However, these problems were not widespread or serious in the three sample zones (see Table 21).

A chemical called Dithane M45 was used to control blight. The cost of this chemical varied slightly from farm to farm, depending on the time of purchase, source and package. For example, one grower had a stock of Dithane M45 bought before October, 1974 when it used to cost Shs. 21 per kg; few others used stocks from a 25 kg drum of the chemical bought for Shs. 630 so that the cost per kg was Shs. 25/20. However, majority of the growers used small stocks of the chemical bought either from the dealers at the price of Shs. 33/40 per kg tin or from local cooperative societies at the price of Shs. 27 per kg powder.

Average cost of plant protection in the three zones varied depending on the amounts of the chemical applied per spraying and the frequency of spraying. (See Tables 11 and 15). However, the cost range was from Shs. 13/50 per acre for a grower who applied $\frac{1}{2}$ kg. of the chemical per acre and

sprayed once only (Farm No. 47) to Shs. 250/50 per acre for a grower who applied a total of 7½ kg. of the chemical per acre while spraying five times during the growing period (Farm No. 67).

4.2.4. Cost of machinery

The only type of machinery used which could be assigned a cost in potato production was that used in land preparation, which involved breaking of land followed by ridging where practised (Table 10). Tractor-ploughs, ox-ploughs, fork-jembes, or a landmaster (small power-driven ploughing machine) were commonly used in land preparation in the three sample zones (Table 16).

Table 16: Types of machinery used in land preparation in the three sample potato zones, Meru District, 1975

Type of machinery	Number of respondents			Percentage of respondents		
	Kibirichia n = 41	Kiirua n.=21	Upper Abothuguchi n = 13	Kibirichia	Kiirua	Upper Abothuguchi
Fork-jembe	4	8	13	10	38	100
Own landmaster	-	1	-	-	5	-
.Own ox-plough	-	-	-	10	14	-
Hired ox-plough	28	9	-	37	43	-
Own tractor-plough	-	-	-	-	-	-
Hired tractor-plough	24	4	-	32	19	-

Source: Author's investigation

Growers in Kibirichia mainly used hired ox-ploughs and tractor-ploughs; most Kiirua growers either used fork-jembes or hired ox-ploughs. All the sample growers in Upper Abothuguchi used fork-jembes. Growers in Kibirichia and Kiirua sometimes used two or more types of machinery.

The cost of hired machinery also included the payment for the labour in operating the machinery. So, the actual cost of machinery is calculated by subtracting the imputed cost of labour (at an estimate of Shs. 5 per manday - see sub-section 4.2.5) from the total cost for contracting for land preparation. The author has used the same kind of approach for Upper Abothuguchi even though fork-jembes are used in land preparation so as to bring results to comparable levels. Through these types of calculations, the average cost of machinery was Shs. 86/35 per acre in Kibirichia, Shs. 53/35 in Kiirua and Shs. 34/20 per acre in Upper Abothuguchi (see Table 15).

4.2.5. Cost of labour

Labour is necessary in all operations in potato production. Casual labour, paid on daily or contract basis, and permanent labour, employed on monthly basis, may be used in addition to the family labour. Both casual and permanent labour will be referred to as hired labour.

The major operations which need labour include land preparation, fertilizer or manure application, planting, weeding, spraying, harvesting and grading. The average labour

input for each of these operations is given in Appendices VI, VII and VIII.

There was a big variation in payments for hired labour in the different farms surveyed. For example, the lowest and highest payments for hired labour were:

(i) Shs. 3 (in farm No. 63) to Shs. 10 (in Farm Nos. 32 and 33) per day for casual labour.

(ii) Shs. 40 (in Farm No. 47) to Shs. 150 (in Farm Nos. 3, 7 and 72) per month for permanent labour.

Besides, the cost of labour varied greatly if paid on contract basis. For example, the average cost of planting on a contract basis was Shs. 3/50 per bag, while the cost of harvesting and grading was Shs. 3/- per bag. The average cost of hired casual labour is given in the table below.

Table 17: Average cost of hired labour in the three sample zones of Meru District, 1975

Type of Labour	Sample zones and labour costs		
	Kibirichia	Kiirua	Upper Abothuguchi
Casual (Shs/day)	6/65	5/65	4/45
Permanent (Shs/month)	93/30	76/80	97/20

Source: Author's investigation

Based on weighted averages for the three zones, casual labour cost Shs. 5/80 per day, while permanent labour cost Shs. 90/20 per month, besides the provision of food and free accommodation. However, the actual cost of labour varied in the different

areas depending on availability. The average labour input in potato production, expressed in mandays per acre, was 60.4 in Kibirichia, 51.8 in Kiirua and 64.0 in Upper Abothuguchi (Table 18)

Table 18: Average labour input in potato production in three sample zones in Meru District, November, 1975

(Mandays per acre)

Type of labour	Sample zone and labour input		
	Kibirichia	Kiirua	Upper Abothuguchi
Family labour	9.7	26.0	49.3
Hired labour	50.7	25.8	14.7
TOTAL	60.4	51.8	64.0

Source: Appendices VI, VII and VIII

Since the observed average cost of casual labour was Shs. 5/80 per day, and since this is close to the average rate of daily wages for farm labour based on the minimum farm labour wages of Shs. 150 per month as announced by the Government of Kenya on the Labour Day in 1975 (1.5.75), the author has adopted the figure of Shs. 5/- per manday in the evaluation of labour input (Table 15).

4.3. Returns to potato growers: average input and output data and economic calculations

Gross returns to a potato grower will depend on the potato yield and the price at which the potatoes can be

sold. The gross margin will then be the difference between gross returns and production costs. Potato yields will be influenced by the standard of crop husbandry, the land potential and the climate. Tables 8 and 15 give potato yields and production costs in the three sample zones respectively. From Table 8, it can be deduced that the potato yields during the Short Rains (March/May) output are not significantly different from those during the Long Rains (September/November) output.

For the 1975 Long Rains crop, which started being harvested towards the end of December in 1975, the prices showed a steady increase from Shs. 15 per 84 kg. bag in the middle of January, 1976, to Shs. 36 per 84 kg. bag by the beginning of March, 1976, in the local Kibirichia and Kiirua markets. Meru town open market is the most likely outlet for Upper Abothuguchi potatoes, so that the market price for potatoes from Upper Abothuguchi between the middle of January and beginning of March, 1976, was about Shs. 35 per 94 kg bag (see Table 30).

The observed potato price increases were stimulated by the announcement from the Horticultural Crops Development Authority (HCDA) that an export market for Meru potatoes had been established with Britain, at a guaranteed price of Shs. 36 per 80 kg. bag (see "Daily Nation" of 12.2.76, page 9). The HCDA later opened buying centres for potatoes in Meru by the end of February, the buying price for well graded

potatoes being, as promised, Shs. 36 per 80 kg.

Based on the observed potato prices, the average price in January 1976 was Shs. 20 per 84 kg. bag in Kibirichia and Kiirua; the average price in Meru town open market, the outlet for Upper Abothuguchi potatoes, was Shs. 35 per 94 kg at the same time. Since most of the potato output is sold soon after harvesting, these two average prices of Shs. 20 per 84 kg bag (less a transfer cost of Shs. 2 per 84 kg bag) and Shs. 35 per 94 kg bag (less a transfer cost of Shs. 4 per 94 kg bag) have been used in the calculations of gross margins for Kibirichia/Kiirua zones and Upper Abothuguchi zone respectively. It is assumed that growers will orientate the measure of their potato bags to the common weight of a bag of potatoes at their local market. The capital invested in production will be "locked up" for a period of about 4 months while the potatoes are being produced, from the land preparation to the harvesting time. Therefore, an interest on capital has been assumed at the rate of 10% per annum for the four months, and this has been added to the costs of seed-potatoes, land preparation, fertilizers and Dithane M45 (for plant protection) in the gross margin calcullations (Table 19).

Table 19: Gross margins on potato production in three sample zones in Meru District, based on the Long Rains (September - November) output in 1975

Details	Zone I	Zone II	Zone III	QUINCKHARDT Zone I
Gross output per acre:				
(a) Yields:				
(i) 84 kg bags	61.8	40.1	-	69.0
(ii) 94 kg bags	-	-	45.6	-
(b) Returns:				
(i) at shs. 18 per 84 kg. bag	1112.40	721.80	-	-
(ii) at shs. 31 per 94 kg. bag	-	-	1413.60	-
(iii) at shs. 28 per 84 kg. bag	-	-	-	1932.00
Capital costs per acre:				
(a) seedpotatoes	349.25	307.50	415.40	350.00
(b) machinery for land preparation	86.35	53.35	34.20	100.00
(c) Fertilizers	152.35	66.85	296.25	180.00
(d) Dithane M45	130.15	89.70	151.60	63.00
(e) Interest at 10% p.a. for 4 months	23.90	17.25	29.90	21.00
TOTALS	742.00	534.65	927.35	714.00
Gross margin (including labour cost) per acre	370.40	187.15	486.25	1218.00
Labour input per acre: (a) number of mandays	60.40	51.8	64.0	108.0
(b) value at:				
(i) Shs. 5 per manday	302.00	259.00	320.00	-
(ii) Shs. 3 per manday	-	-	-	324.00
Gross margin less labour cost per acre	68.40	(-71.85)	166.25	894.00

Source: Author's investigation and Quinckhardt, M.: Production of potatoes in Kenya: Results of an investigation in four districts in 1974. A pilot study, Table 9

Quinckhardt conducted a survey in Zone I (Kibirichia) in September 1974; his results are fairly comparable to the author's results, except in the cases of labour input, cost of Dithane M45 for plant protection, and prices for potatoes. He recorded a range of 55 to 170 mandays per acre while the author recorded a range of 39 to 95 mandays per acre in the case of labour input. The differences in the cost of Dithane M45 can be attributed to the fact that this chemical used to cost between Shs. 16/50 and Shs. 21/- per kg. during the time Quinckhardt conducted his survey, but the same chemical was costing either Shs. 27/- or Shs. 33/40 per kg. during the author's investigation period. The prices for potatoes in 1974 were much higher than the prices in 1975, and this is evidenced by the price of Shs. 30/- per bag of 84 kg. as recorded by Quinckhardt as opposed to the price of Shs. 20/- per bag of 84 kg. as recorded by the author. The resultant differences have led to differences in gross returns and margins. Labour input differed in all operations.

The above discussion is based on total costs and gross returns per acre. The next table compares the unit cost of production with the price of potatoes. For comparison of results Quinckhardt results column is once again included. The production cost per bag of potatoes, which is the sum of capital and labour costs, is taken as the break-even price for potatoes; this argument is developed later.

Table 20: Net returns per bag of potatoes in the three sample zones in Meru District, based on the Long Rains output in 1975

Details		Zone I	Zone II	Zone III	Quinckhardt: Zone I
Production costs Shs/acre	Capital	742.00	534.65	927.35	714.00
	Labour	302.00	259.00	320.00	324.00
	TOTAL	1044.00	793.65	1247.35	1038.00
Potato yields:					
i. 84 kg bags		61.8	40.1	-	69.0
ii. 94 kg bags		-	-	45.1	-
Production cost per bag (Shs)		16.89	19.79	27.66	15.04
Gross return per bag*:					
for i. 84 kg bag		18.00	18.00	-	28.00
ii. 94 kg bag		-	-	31.00	-
Net return: Shs. per					
i. 84 kg bag		1.11	(-1.79)	-	12.96
ii. 94 kg bag		-	-	3.34	-

* Gross return per bag is the market price for potatoes, less the farm-gate-to-market transportation cost

Source: Table 19

The marketed potatoes in the Quinckhardt results were sold at Shs. 30 per 84 kg bag, and this gives a gross return of Shs. 28 per 84 kg bag.

Table 20 emphasizes the fact that yield and market price for potatoes have great impact on net returns to a potato grower. Quinckhardt net return in these calculations

was the highest owing to the high market price for potatoes. At the observed production level, break-even prices for potatoes in the three zones were Shs. 16/89 in Zone I (Kibirichia), Shs. 19/79 in Zone II (Kiirua) and Shs. 27/66 in Zone III (Upper Abothuguchi), according to the author's investigation. Therefore, growers in Zone I and Zone III could still sell their potatoes at the going local market prices by the end of January 1976 without incurring losses (hence the positive net returns). However, the break-even price for potatoes in Zone II was higher than the local market potato price (less transfer cost) by the end of January, 1976, so that the growers in Zone II were selling their potatoes at a loss (negative net returns) during that period.

4.4. General potato production problems in North Imenti Division, Meru District

4.4.1. Inputs

Growers claimed that they are unable to practise the recommended crop husbandry standards because the cost of inputs, such as fertilizers and plant protection chemicals, are too high and they cannot afford them. However, the author found out that fertilizer prices have been reduced considerably by the government during the last two years. For example, a 50 kg packet of diammonium phosphate used to cost Shs. 205 in early 1975, but its price had been reduced to Shs. 150 by October 1975, this being done by the government in an effort to reduce prices of essential farm inputs so as

to encourage increased production of crops. (See Appendix IX). Despite the reduced prices, growers lack adequate cash to buy inputs before they start growing potatoes, and the extension staff of the Ministry of Agriculture in Meru still consider the standard of crop husbandry in the area as low. It is felt that yields could be improved considerably by optimal applications of such inputs like fertilizers in potato production.

Labour was a problem in some farms; of the 75 sample growers, only 9 growers reported that they had no labour problems. All the others claimed that there was a labour shortage, the critical periods being at the planting, weeding and spraying times. Casual labour was easier to secure than permanent labour, but it was more costly to hire, especially if contracted to do a job on the basis of an acre.

Lack of adequate capital and labour inputs were, therefore, observed to be the main constraint in potato production in the three sample areas.

4.4.2. Other problems

Apart from blight, which is a common disease in all the sample growing zones, the only other diseases and pests of potatoes notices by the author were bacterial wilt, yellowing (suspected to be a virus disease) and potato thrips (a pest). However, none of these other problems was reported or noticed as a serious case. The only pest which was prevalent in some

farms in Kibirichia was the nematode. Table 21 shows the prevalence of these cases in the three sample zones.

Table 21: Other problems in potato production in the three sample zones, North Imenti Division in 1975

(n = number of growers interviewed)

Problem	Zone and numbers reporting the case			
	Kibirichia (n = 41)		Kiirua (n = 21)	Upper Abothuguchi (n = 13)
Bacterial wilt	-		-	8 (61.5%)
Nematodes	9	(22.0%)	-	-
Yellowing (virus)	3	(7.3%)	-	-
Thrips	1	(2.4%)	-	-

Source: Author's investigation

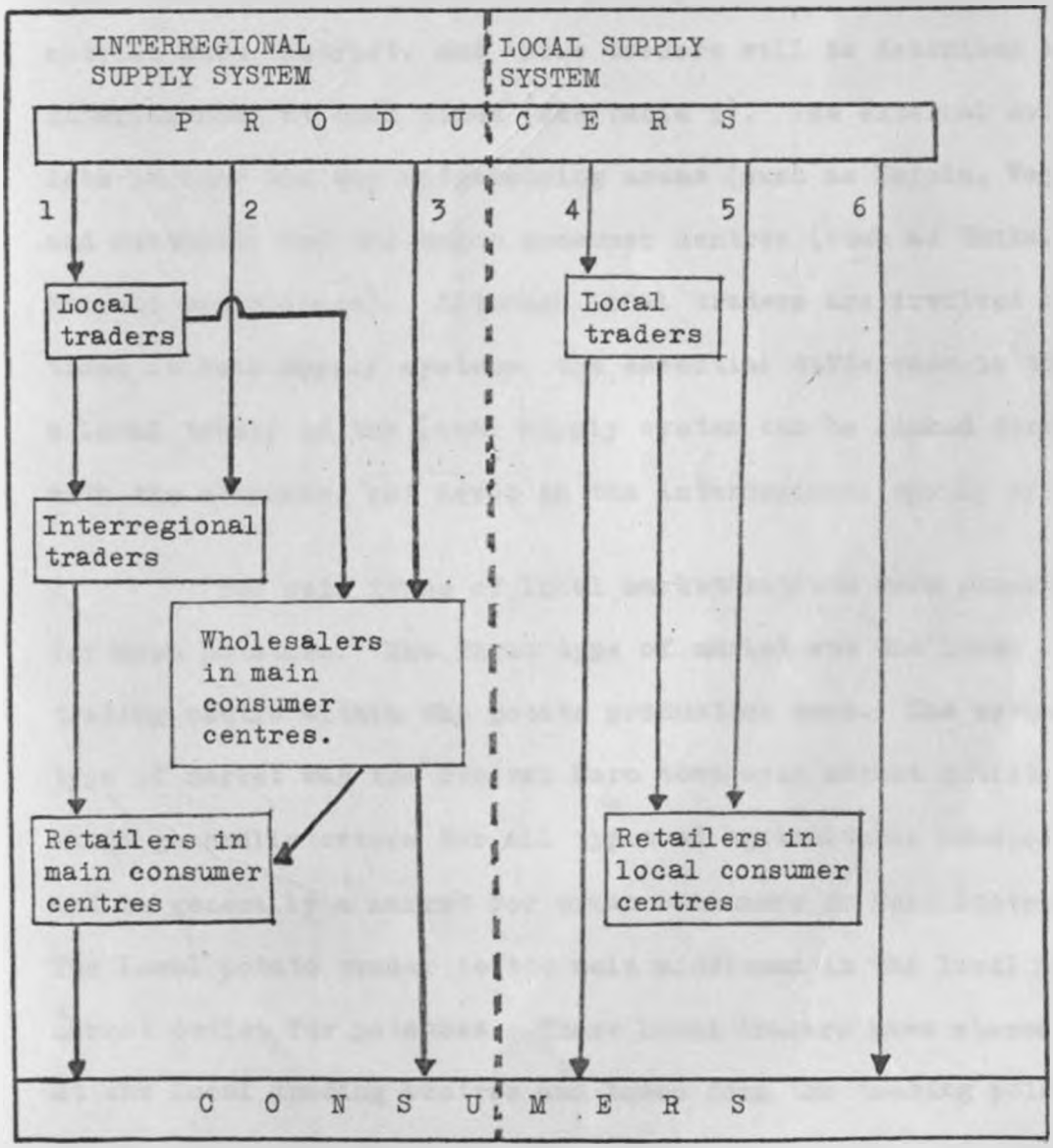
The table shows that Kiirua was free of these diseases and pests, based on a sample of 21 growers. The percentage figures (in brackets) indicate the number of farms having the prescribed problems expressed as percentage of the sample number of farms. Although no serious cases were reported, the high incidence of bacterial wilt in Upper Abothuguchi and the prevalence of nematodes in Kibirichia are causing great concern because these are difficult problems to control or eradicate once they are established in a potato growing zone.

4.5 Potato marketing in Meru District

4.5.1 Market outlets and marketing channels

Two types of supply systems are available for Meru potatoes; six marketing channels are involved, and are indicated by numbers in Figure 3.

Figure 3: Marketing channels for Meru potatoes



Source: Author's investigation, with adoption of the figure from Lorenzl and Tui: The price Information system for the Horticultural Industry in Kenya, page 24.

The local supply system involves potato trade within Meru District while the interregional supply system involves potato trade between Meru District and areas outside the District. So, the two types of supply system are differentiated by the types of market outlets supplied. Local traders generally operate within the producing zones in Meru District while the interregional traders operate between Meru and outlets outside Meru District. However, there are some occasions when the local traders in Meru get involved in trade outside Meru District, and these traders will be described as interregional at such times (see Table 5). The external outlets include the dry neighbouring areas (such as Isiolo, Wajir, and Marsabit) and the major consumer centres (such as Thika, Nairobi and Mombasa). Although local traders are involved at times in both supply systems, the essential difference is that a local trader in the local supply system can be linked directly with the consumer, but never in the interregional supply system.

Two main types of local market outlets were observed for Meru potatoes. The first type of market was the local trading centre within the potato production zone. The second type of market was the central Meru town open market outlet, which generally caters for all types of agricultural produce and is generally a market for urban consumers in Meru District. The local potato trader is the main middleman in the local market outlet for potatoes. These local traders have stores at the local trading centres and these form the trading points

between the potato producers and traders. Potatoes are traded in bags each weighing 84 kg.

A farmer from any part of Meru District may take and sell his potatoes in the Meru town open market; a few specialised potato traders, who have stores within this market, were noticed (Table 5). The weights of bags of potatoes being sold in the Meru town open market varied from about 90 kg to 103 kg, and a sample of 10 bags of potatoes which were picked randomly in this market gave an average weight of 94 kg per bag, as indicated in Table 22.

Table 22: Weights of a sample of 10 bags of potatoes picked randomly in the Meru town open market in October, 1975

Sample numbers	1	2	3	4	5	6	7	8	9	10	Average for sample
Weight: kg. per bag	93	90	101	91	93	103	90	96	93	90	94

Source: Author's investigation

Since Meru town open market is the most likely market outlet for Upper Abothuguchi potatoes, then the average weight of 94 kg bag of potatoes is used in trading the Upper Abothuguchi potatoes (Table 19).

The third type of market outlets available for Meru potatoes was the interregional type. Considering Nairobi as one of the major consumer centres for

potatoes in Kenya, then Wakulima market in Nairobi can be taken to represent the interregional market outlets for Meru potatoes. According to a survey done between September and December, 1975, the average weight of a bag of potatoes traded in the Wakulima market was 105.1 kg., but the monthly mean range was from 101.5 kg per bag to 112.2 kg. per bag, as shown in Table 23 which follows.

Table 23: Monthly mean weights for a bag of red potatoes in the Wakulima market in Nairobi, between September and December 1975

Month	Sept.	Oct.	Nov.	Dec.	Overall Mean
Mean weight kg. per bag	101.5	103.1	112.2	103.6	105.1
Sample size for the month	10	10	10	10	40

Source: Maritim, L.H.K.: Analysis of produce flows to Wakulima market, 1975 (M.Sc. thesis, forthcoming).

From the above observations, prices reported for potatoes being sold in the Nairobi Wakulima Market are taken to be in terms of 105 kg. bags (as normally reported for HCDA), while those reported for potatoes in Meru town open market are in terms of 94 kg. bags. Therefore, when comparing Meru town open market potato prices with the Nairobi market prices for potatoes, the relevant conversion factors must be used so as to express the prices on the same weight basis. It is important to note that the potato prices

in the local markets within the producing zones are further expressed in terms of price per 84 kg bag of potatoes, except in Upper Abothuguchi whose outlet is Meru town open market, where the relevant measure is price per 94 kg bag, as explained earlier.

4.5.2. Market supply determinants

The amount of potatoes supplied to the markets after the crop is harvested depends on the total output and the amounts retained by the growers in their farms. The amounts retained in the farms will be the sum of the amounts retained for family consumption, for seed and for marketing at a later period. Total potato output depends on potato hectarage and the yields achieved. Potato yield will depend on the land potential, climatic conditions, and the level of technology in farming. Proper allocation of inputs will therefore greatly influence yield. The amount of potatoes retained for seed will depend on the planned potato hectarage during the following season. The amounts retained for family consumption will depend on the size of the family and the per capita consumption. The amount retained for marketing at a later period will depend on the prevailing and expected future prices for potatoes.

4.5.3. Marketed potato output

The estimates of production and sales of potatoes in Meru District in 1973 and 1974 are given in Table 24.

The table indicates that potato hectaraged increased 1.7 times between 1973 and 1974 while the actual output increased 3.8 times. However, the percentage of the marketed output appears to have decreased from 82% to 50%. The table is an extract from the District Annual Report by the Ministry of Agriculture in Meru District in 1974.

Table 24: Estimated potato production and sales in Meru District, 1973 and 1974

Details	1973	1974
Hectarage	3,280	8,754
Number of growers	8,100	8,200
Productions in tonnes	22,707	109,425
Sales in tonnes	18,720	54,712
Value in £	280,800	1,313,088

Source: Ministry of Agriculture, District Annual Report, Meru District, 1974

The above table indicates that the number of growers did not change appreciably between the two years. The author, therefore, suggests that there must have been an error in recording production and sales of potatoes for the following reasons:

(i) The 1973 hectarage is less than half of the 1974 hectarage, yet the number of growers is not significantly different during the two years. It is unlikely that the potato hectarage could have

more than doubled without a proportionate increase in the number of growers.

(ii) The production figure for 1973 gives a yield of about 6.9 tonnes per hectare while the figure for 1974 is 12.5 tonnes per hectare. These large variations are unlikely to have occurred within a period of a year. The selling price in 1973 appears to have been about Shs. 25 per 84 kg bag while the price for 1974 was Shs. 40 per 84 kg bag. Such a variation in prices is likely. However, the author's investigation gives a yield figure of about 11 tonnes per hectare, so that the 1974 production is likely to have been accurately estimated. The figure of 82% for marketed potato output in 1973 is too high and unlikely, but the 1974 figure of marketed potato output is comparable to the 1975 figure, which was about 64% (Table 25). The author also suggests that the recorded hectarage figure for 1973 was probably for one season; since it is often possible to produce two crops in Meru, it is likely that the production figure for potatoes in Meru District in 1973 was twice the one given in the table.

The estimated potato hectarage in 1975 was 10,506 (Table 2). This figure indicates that the 1974 figure is likely to have been a reasonable estimate, and it is possible

that potato hectarage could have increased by about 20% between 1974 and 1975. Based on the estimates for 1975, we expect a higher amount of potatoes to be supplied to the market in 1975 than in 1974.

Investigation on the utilization of the Short Rains (March/May) potato output in 1975 showed that the ratio of the amount retained for family consumption to the amount retained for seed to the amount marketed was 1:2:5, based on averages for the sample zones surveyed (Table 25) for 75 growers.

Table 25: Weighted average utilization of potatoes based on the utilization of the Short Rains (March/May) output in the sample zones, Meru District, 1975

(Number of bags per household)

Utilization of potatoes	Sample zones and quantities			Average	Percentag
	Kibirichia	Kiirua	Upper Abothuguchi		
Family consumption	20	12	15	16	14
Seed	47	19	10	25	22
Marketed	99	62	59	73	64
TOTALS	166	93	84	114	100

Source: Author's investigation

From the figures in Tables 24 and 25, it can be calculated that seed demand was about 16 bags per acre in 1973 and 30 bags per acre in 1974. The author found out that seed demand was about 10 bags per acre in 1975 (Table 14). This further suggests inconsistency in the figures in Table 24, and the author asserts that there may have been errors in recording figures used in this table. However, the table has been used as the official guideline on production and sales of potatoes in Meru District by the Ministry of Agriculture.

The marketed Short Rains potato output in 1975 was either sold at farm-gate, local trading centres, Meru town, or at some other outlets. The investigation (Table 26) showed that most of the output was sold at farm-gate and at the local trading centres.

Table 26: Outlets for the 1975 Short Rains (March/May) potato output in the sample zones, Meru District as used by the sample growers

Outlet	*Number of growers, by zones, using the outlet		
	Kibirichia (n = 41)	Kiirua (n = 21)	Upper Abothuguchi (n = 13)
To traders at farm gates	28 (68%)	7 (33%)	6 (46%)
Local trading centres	31 (76%)	17 (81%)	2 (15%)
Meru town to traders	( )	1 (5%)	-
Meru town open market	1 (2%)	6 (29%)	9 (69%)
"OTHER"	5 (12%)	-	-

*Use of one outlet does not exclude the grower from using the others;

- figures in brackets show the number of growers who used the outlet expressed as percentage of the sample size.

n = sample size

Source: Author's investigation

In the above table, "OTHER" refers to any outlet not included in the table; those growers who used "OTHER" as their outlet specified their outlets to be Embu, Thika, or Nairobi. These growers happened to be traders too, so that they also bought from the other growers: they performed both local and inter-regional trade, and one of them had a tender to supply an institution in Embu District.

Out of the sample of growers interviewed, the number who said that they had sold their potatoes to particular traders were 15 in Kibirichia, 7 in Kiirua and 4 in Upper Abothuguchi. This represented 34.7% of the sample, and reasons for supplying particular traders are given in the table below.

Table 27: Sample number of growers supplying particular traders and the reasons

Reasons	Kibirichia	Kiirua	Upper Abothuguchi
Friendship: can get credit or advances	11	1	-
Trader comes to the farm with his transport	3	6	3
Tender (Contract)	1	-	1
TOTAL	15	7	4

Source: Author's investigation

The main reasons for supplying particular outlets appear to be based either on friendship or services such as provision of credit (or advances) and transport. Except for one grower who owned a landrover all the others depended on hired transport when delivering their potatoes to the market. The landrover was the common mode of transport, although two cases of animal-drawn carts were reported.

4.5.4. Marketing costs

4.5.4.1. Transportation costs

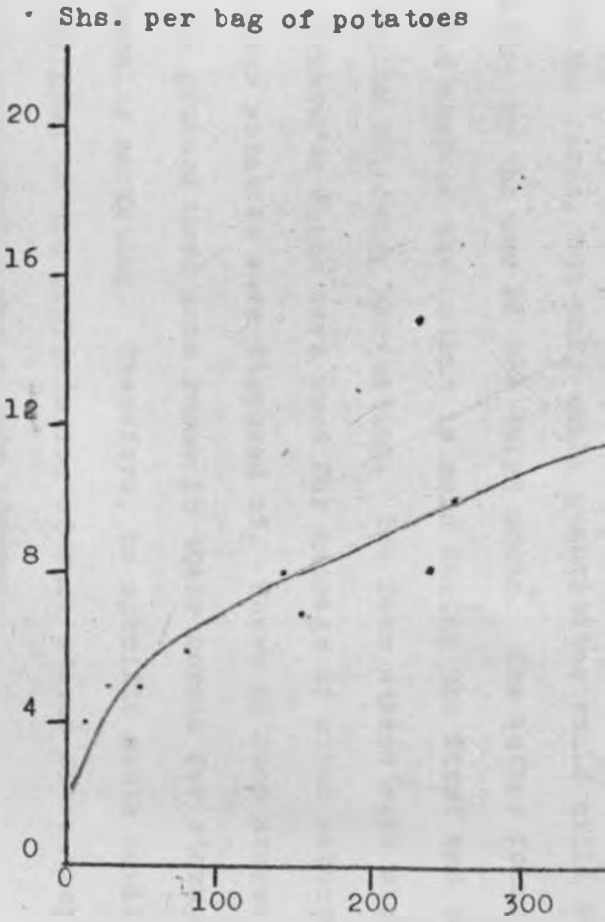
Growers in the three sample zones of Meru District were generally located within a radius of from 0.4 to 4.8 kilometres from the nearest local trading centre. The cost of transporting potatoes to these centres ranged from 1 to 3 shillings per bag, irrespective of the weight of the bag. The sample farms were located from 6.4 to 27.2 kilometres away from Meru town open market, but the cost of transporting a bag of potatoes from these farms to Meru town ranged from 3 to 6 shillings, again irrespective of weights. The cost of supplying interregional outlets varied according to the location of the outlets. The furthest outlet supplied by traders from Meru District was Mombasa, which is about 740 kilometres away from some of the potato farms in Meru. Depending on the contract for use of hired transport, the cost of supplying Mombasa was about 18 shillings per bag. Table 28 gives the transportation costs associated with the different outlets supplied by the sample growers and traders in Meru District.

Table 28: Transportation costs associated with supply of Meru potatoes to different outlets, December 1975

Sources of supply and outlets			Transportation costs	
From	To	Distance km	Shs/bag	Shs/bag/km
Farm-gate (Kibirichia)	Local centre	2.1	2/-	0/95
	Meru town	25.6	5/-	0/20
Farm-gate (Kiirua)	Local centre	1.4	2/-	1/43
	Meru town	20.8	5/-	0/24
Farm-gate (Upper Abothuguchi	Local centre	1.3	1/50	1/15
	Meru town	9.6	4/-	0/42
Local centres in the sample potato zones, MERU	Embu	144	8/-	0/06
	Isiolo	48	5/-	0/10
	Marsabit	240	15/-	0/06
	Nanyuki	80	6/-	0/08
	Nyeri	152	7/-	0/05
	Thika	240	7/-	0/03
	Nairobi	256	10/-	0/04
	Mombasa	740	18/-	0/02

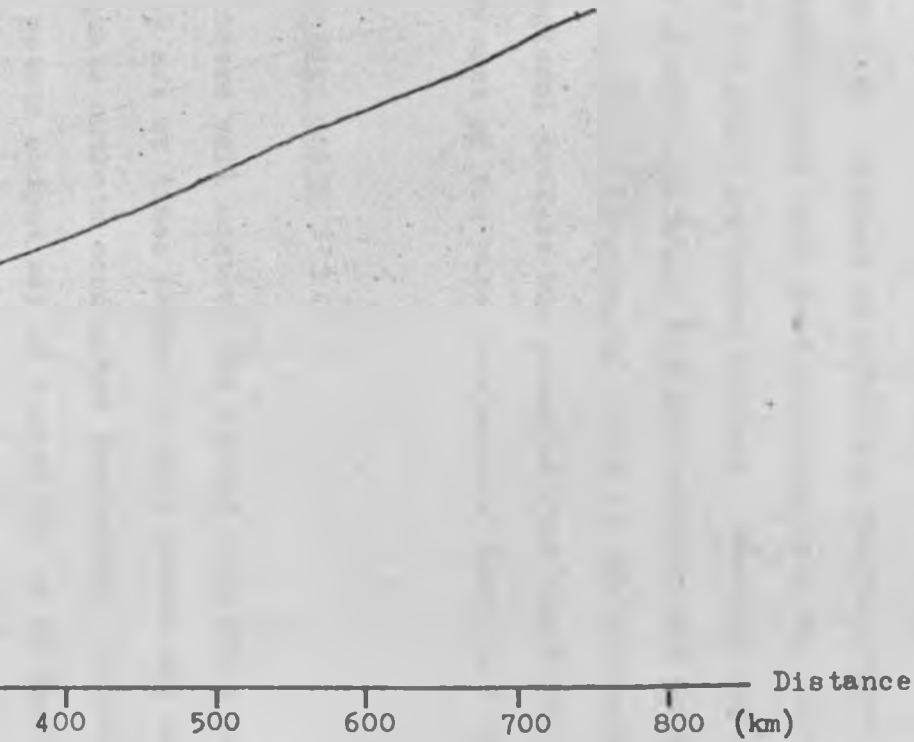
Source: Author's investigation

The transportation cost function (from these results) is a smooth but non-linear curve, except for one point, representing Marsabit, which lies off the curve (Figure 4). Marsabit is rather remote and is linked to Meru through poor roads and limited transportation facilities so that the unit cost per



Source: Table 28

Figure 4: Transportation cost function for potatoes from Meru, 1975



bag is rather high. Except in retailing where potatoes may be sold in small units such as a kilogram or a tin (debe), potatoes are normally delivered in bags. However, the cost of the bags in which potatoes are delivered is met by the traders who buy from the growers. This is the case even when interregional traders buy potatoes from the local traders, the cost of the bags (containers) being met by the former.

4.5.4.2. Storage costs

Growers sell most of the output soon after harvesting, but they are at times forced to sell piecemeal, owing to lack of adequate outlets soon after harvesting. Therefore, part of the potato output may be stored for up to three months in the farms, but only small quantitites would still be in store by the end of the third month. The author found out that most of the output is sold during the first and second months following harvesting. The farm stores were simple structures which were used for storage of other material after potatoes were disposed of. Where no such stores existed, the growers used some rooms in their houses for storage pending marketing. Therefore, no specific costs could be assigned to the depreciation of such stores since they were not specifically for potato storage.

Local traders who had stores at the local centres paid a rent of about Shs. 70 per month for a store of 300 bags

capacity. Most traders stored potatoes for a maximum of one month, and they attempted to sell all what they buy within this period so as to avoid storage losses. Therefore, storage cost for potatoes in these local stores is about Shs. 0/23 per bag per month; this cost is small and negligible for all practical purposes in the local trade, especially in view of the short storage periods.

Sprouting and shrinkage were the main causes of potato losses in storage. Rotting was also common, especially if potatoes were diseased or wounded at harvest or were harvested when wet and were not spread in hot sun to dry before storage. Storage losses could add a cost to marketing if they were significant. However, the author found out that potatoes can be stored for up to 6 weeks without any losses if they have been harvested properly (without injuring) and when dry, and were disease-free. This period conforms to the dormancy period for potatoes, which is about 2 months under the tropical conditions (3, p. 13). Sprouting and shrinkage do not set in before the break of the dormancy period, though some shrinkage due to loss of moisture content is inevitable before then but is not appreciable to cause any remarkable weight losses.

Table 29: Main causes of storage losses and the estimated percentage losses according to the sample growers interviewed, North Imenti Division, 1975

Storage problem	Time when the problem common	Consequence
1. Shrinkage	Any time during storage	Loss in weight of potatoes
2. Sprouting	About two months after storage (dormancy ceases)	Shrinkage, leading to loss in weight
3. Rotting	Potatoes wounded or diseased before storage	Total loss of potato
4. Tuber-moths	Weather warm and dry	Partial losses; may lead to rotting
ESTIMATED POTATO LOSSES	2 - 3 months after storage	Range: 15 - 25% Average: 16%

Source: Author's investigation

Problem numbers 1, 2 and 3 were reported by all the 75 growers interviewed, but only 4 reported mild cases of tuber-moth attacks. The growers also reported that losses of up to 30% may be experienced if potatoes were stored for periods greater than 3 months but less than 4 months. The author estimated an average storage loss of 16% when potatoes are stored for 2 to 3 months, based on the sample results. Since the storage periods rarely approach three months, only a small loss on potatoes in storage may be associated with marketing costs;

North Imenti

the traders rarely stored potatoes for more than a month. The author therefore estimates that the storage loss on potatoes handled by the traders would be about 5%. For a trader renting a store capable of accommodating 300 bags of potatoes at Shs. 70 per month, the rent per bag stored is about Sh. 0/23 per month, and the storage loss will be Sh. 1/- per bag per month. The storage cost then works out to be about Shs. 1/23 per bag per month. At the observed price of Shs. 20 per bag of potatoes, the 300 bags of potatoes in storage are worth Shs. 6000, and this gives a capital cost of about Sh. 0/17 per bag per month, assuming an annual interest rate of 10%. These costs are summarized in Table 30.

4.5.4.3. Other marketing costs

The County Council of Meru levies a cess of Shs. 1/05 per bag of potatoes taken out of the district, and this has to be paid by interregional traders. No such a cost arises if trading at the local centres. One grower at Kibirichia reported that he had to meet the following additional costs per bag of 84 kg:

(a) 30 cents for hiring the weighing balance;

(b) 10 cents for the labour to sew bags after filling and weighing to the 84 kg mark;

(c) 30 cents for loading into a vehicle before delivery to the local centre.

This grower, therefore, met an extra cost of Sh. 0/70 per 84 kg bag, and this cost is classified as a handling fee and added to the transportation cost to give the final cost which is referred to as transfer cost (Table 30). A transfer cost consists of both the terminal or handling costs and the transportation costs.

Table 30: Potato marketing costs in Meru District, 1975

(Shs. per bag of 84 kg)

Descriptions		Average cost
Transportation costs per km.	Within Meru District	0/73
	From Meru to outlets outside the district (Interregional trade)	0/06
Handling cost (weighing, sewing, loading		0/70
Storage cost (rent and storage losses) per month		1/23
Capital cost (interest on stored potatoes) per month		0/17
Cess (for interregional trade)		1/05

Source: Author's investigation

The above table summarizes the costs discussed under section 4.5.3; it shows that a trader could meet a cost of up to Shs. 3/15 per 84 kg bag, disregarding transportation costs, if supplying potatoes outside Meru District after storing them for about a month.

4.5.5. Potato prices and price movements

Three types of potato markets have been selected so as to show the potato price development; price data and graphs based on these data are given to illustrate the price movements. The three types of potato markets considered are:

(a) Local markets in the potato production zones, for example Kibirichia local market, in Meru District.

(b) An urban market in Meru District, i.e. Meru town open market.

(c) A city market, i.e. Wakulima market in Nairobi

In price recording, the wholesale unit is a bag of potatoes while the retail unit is a kilogram (kg) of potatoes. The weight of a bag of potatoes varied in the three types of market, and was found to be 84 kg per bag of potatoes in local markets (Kibirichia), 94 kg per bag of potatoes in the urban market (Meru town open market), and 105 kg per bag of potatoes in the city market (Nairobi Wakulima market). (Tables 22 and 23). The potato prices in the local trading centres were as recorded by potato traders in their daily purchases and sales records (in shillings per 84 kg. bag).

Potato prices in Meru town open market and Nairobi Wakulima market were obtained from the HCDA (Horticultural Crops Development Authority) records.

Potato prices in 1974 and 1975 were analysed and the author is responsible for calculations to express prices on the same weight basis. All average prices are not weighted so that the price does not reflect the quantities traded at that price. Prices at the beginning of 1976 (Table 31) are given to show the initial price development for the 1975 Long Rains (September - November) potato output in Meru District.

Table 31: Potato prices during the first two months of 1976, at 3 local markets, Meru District. (shs per bag)*

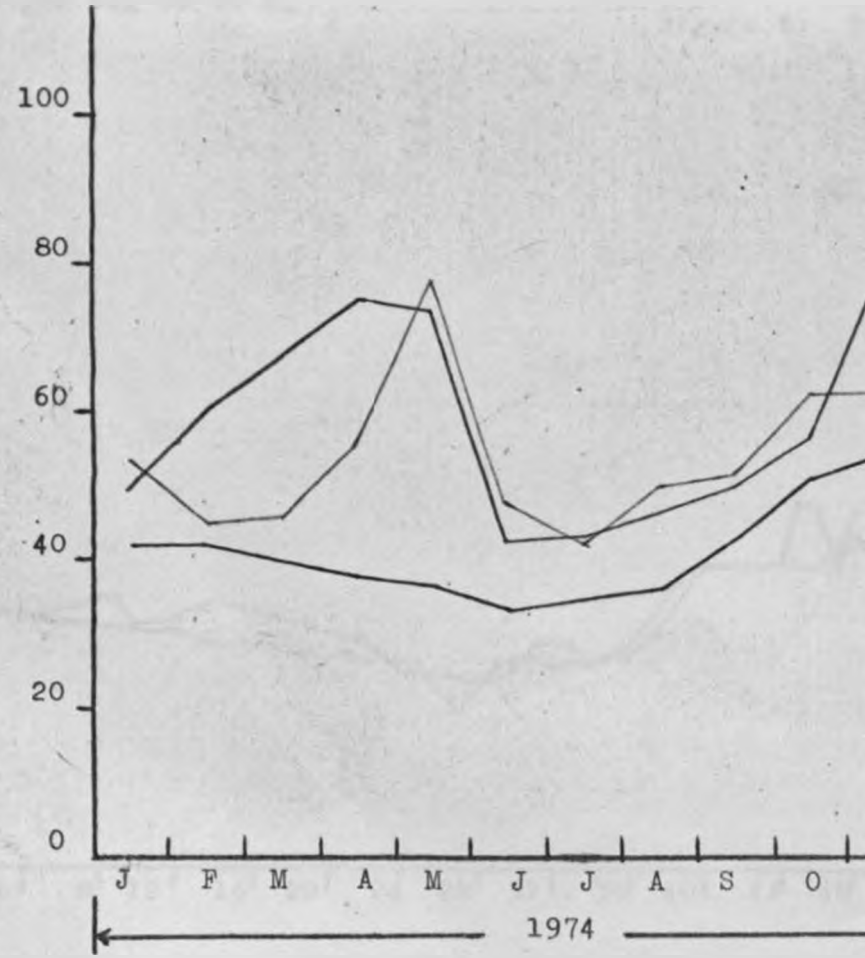
Period	Sample markets and price	
	Kibirichia and Kiirua	Meru town
From: 15.1.76 To: 31.1.76	15/- to 20/-	35/-
From: 1.2.76 To: 15.2.76	20/- to 30/-	40/-

* For Kibirichia and Kiirua, the bag weighs 84 kg., but it weighs 94 kg for Meru town open market, whose price are given only on 15.1.76 and 15.2.76

Source: Appendix XIII

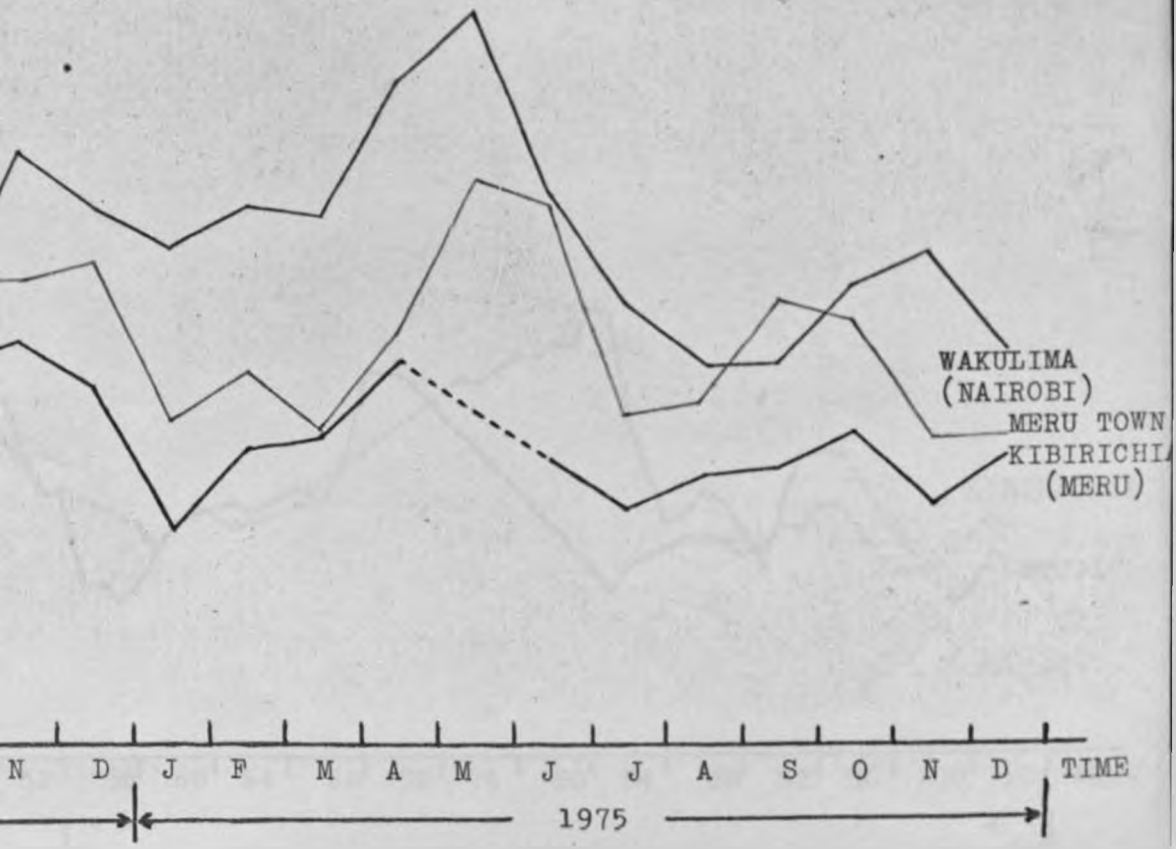
Prices for potatoes at Kibirichia and Ntugi local markets in Meru District were also compared. Ntugi is a small trading centre in Meru; it is located near the main Nairobi - Meru road and is used by growers from both Kibirichia and Kiirua zones. The various price data for potatoes are given in the appendices, but are illustrated by graphs in the following pages.

Figure 5:



Source: Appendices XII, XIV and XVI

Monthly average wholesale prices of red potatoes in three types of markets, 1974 and 1975



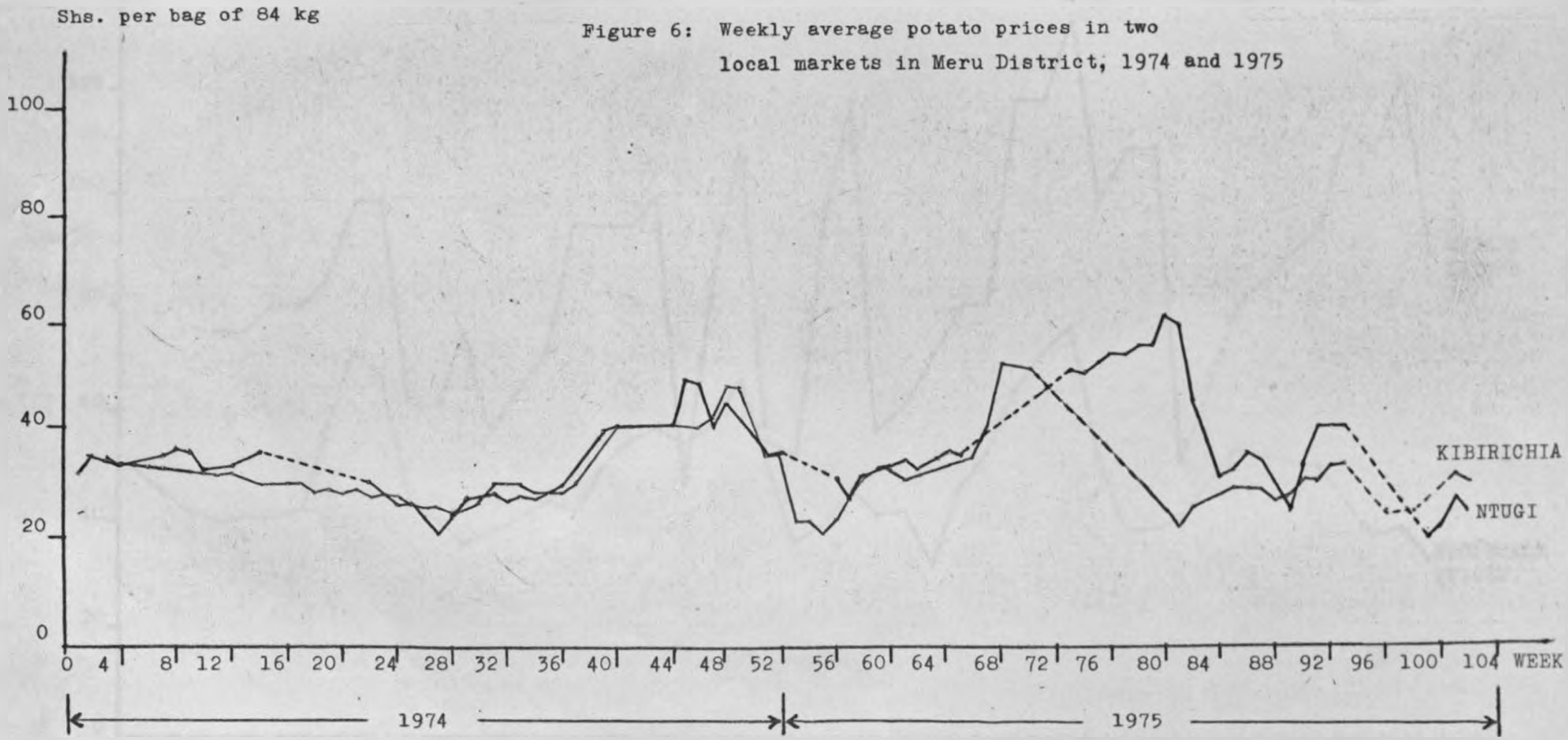
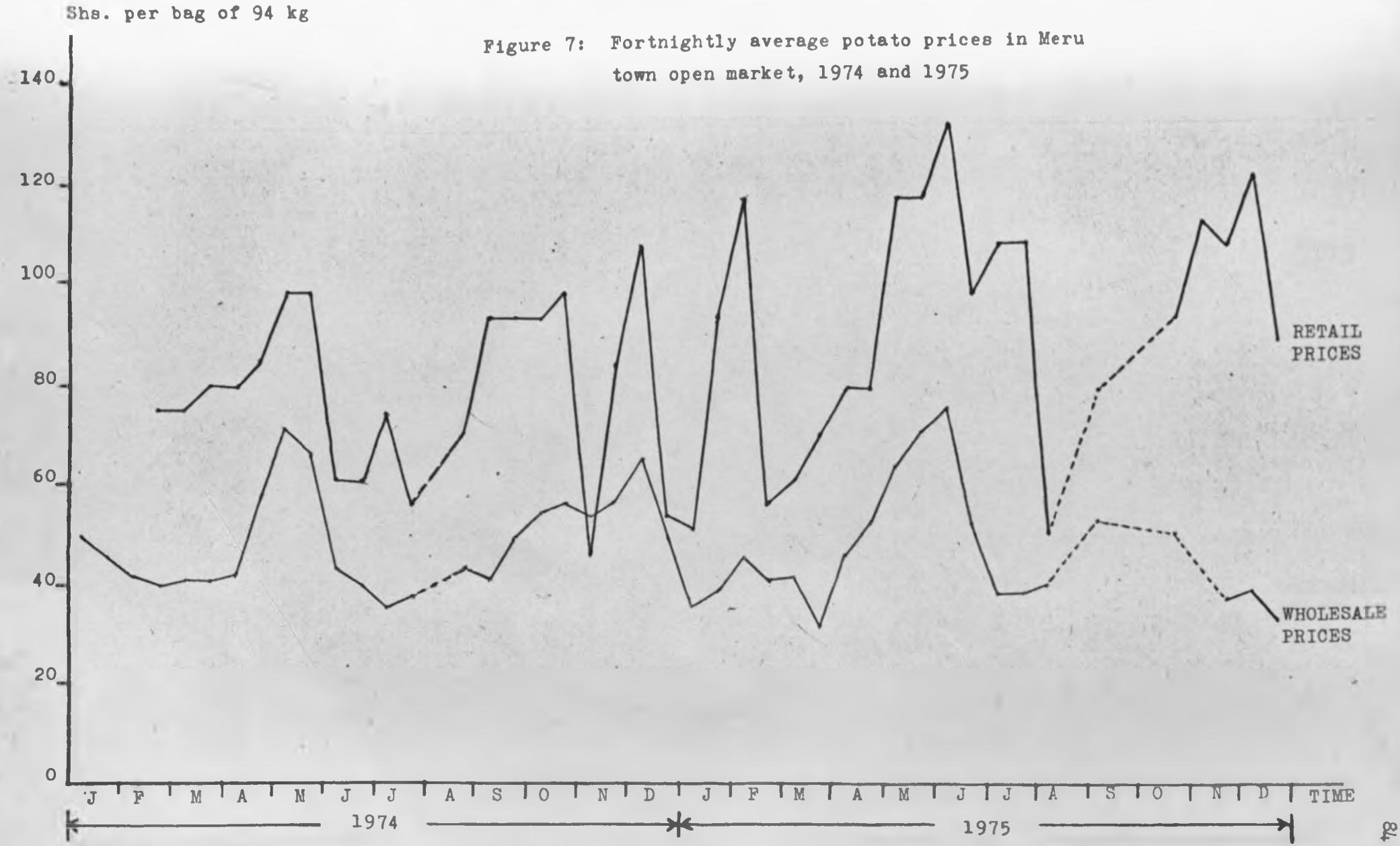


Figure 6: Weekly average potato prices in two local markets in Meru District, 1974 and 1975

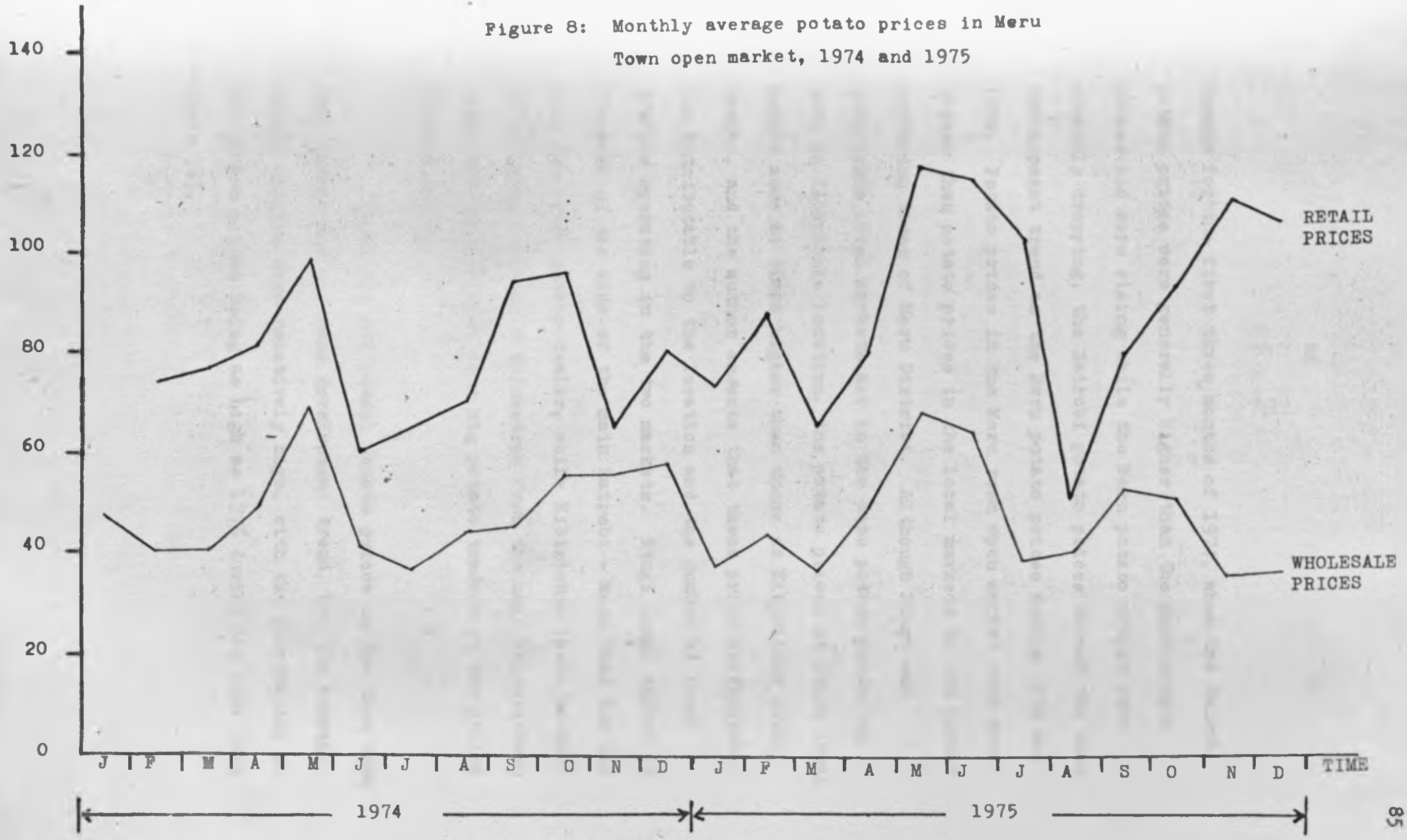
Source: Appendices XIV and XV

Figure 7: Fortnightly average potato prices in Meru town open market, 1974 and 1975



Source: Appendix XVI

Figure 8: Monthly average potato prices in Meru Town open market, 1974 and 1975



Source: Appendix XVI

Except for the first three months of 1974, when the Nairobi potato prices were generally higher than the Meru potato prices and were rising while the Meru potato prices were steadily dropping, the Nairobi potato prices showed the same development trend as the Meru potato prices during 1974 and 1975. Potato prices in the Meru town open market were much higher than potato prices in the local markets in the potato producing zones of Meru District. Although Ntugi and Kibirichia local markets are in the same potato producing zone in Kibirichia location, the potato prices at Ntugi local market were at times higher than those at Kibirichia local market, and the author asserts that these price differences are attributable to the location and the number of local traders operating in the two markets. Ntugi local market is situated by the side of the main Nairobi - Meru road and had only one local potato dealer, while Kibirichia local market is situated at least 8 kilometres from the main Nairobi-Meru road, and had at least four big potato traders at the period of this survey.

Wholesale and retail potato prices in the Meru town open market had the same development trend, but the average retail margins were relatively high, with the fluctuation in the potato prices being as high as 127% during the year (see Table 34).

4.5.6. Trade and trading margins

Trading margins depended on the source and final outlet for potatoes. Association between growers or suppliers and particular traders, either through friendship or kinship ties, or because of services such as credit or transport offered to growers or suppliers by the traders (Table 26), appeared to lower competition in potato trade in Meru District. This association influenced the outlets supplied by the growers. A trader who was able to provide transport to the farms, provide empty bags in which to put potatoes, and pay cash at farm-gate usually attracted more suppliers. So, service competition appeared to be the main type of competition in potato trade in Meru District, although the number of traders was rather small (Table 5). Apart from associations based on services offered and kinship or friendly ties, a case of growers having only one buyer was cited at Ntugi local market, so that the growers had no choice but sell to this only trader, if they were to deliver potatoes at their nearest local centre.

Prices for big-sized potatoes were quoted slightly higher than those for small-sized or egg-sized potatoes in the Meru town open market; no other grade or quality measures were used when selling, although the physically blemished potatoes would be rejected. The terms "wholesale" and "retail" prices should be used cautiously: "wholesale" prices referred to the prices of potatoes when sold directly in bags (each of

84 or 94 kg, depending on the type of market), whereas "retail" prices referred to the prices of potatoes when sold in small units, such as a kilogram of potatoes. It is therefore possible to talk of "wholesale" or "retail" trading margins, depending on the type of deal involved in selling.

Local traders in Meru normally bought potatoes from the growers and then sold them, either at the central Meru town open market or to interregional traders, or to some other outlets outside the district. A bag of potatoes, whether weighed or not, is the trading unit in these transactions, so that "wholesale" trading margins are the appropriate measure of margins in these transactions. Those traders who bought a bag of potatoes (usually the small traders, such as hawkers in Meru town or the shop or kiosk operators) and then sold these potatoes in smaller amounts, usually in kilogram units, would then be associated with "retail" trading margins. The following three tables illustrate the general levels of trading margins realised in the potato trade in 1975, when three different types of outlets are considered, ignoring other marketing costs.

Table 32: Wholesale gross margins for potatoes bought at Kibirichia and then sold in Meru town open market, 1975

(Shs. per 94 kg bag)

Month	Kibirichia wholesale prices	Meru town wholesale prices	Wholesale gross margins mark-up	
			Shs/bag	%
Jan.	25/80	38/20	12/40	48.1
Feb.	34/85	44/-	9/15	26.3
Mar.	36/20	37/-	0/80	2.2
Apr.	45/45	49/50	4/05	8.9
May	-	67/65	-	-
Jun.	33/60	64/35	30/75	91.5
Jul.	28/15	39/-	10/85	38.5
Aug.	31/90	40/70	8/80	27/6
Sep.	32/30	53/30	21/-	65.0
Oct.	37/15	51/-	13/85	37.3
Nov.	28/-	36/-	8/-	28.6
Dec.	34/70	36/60	1/90	5.5

Source: Author's investigation (based on price records by local traders and HCDA, Meru District).

Table 33: Wholesale gross margins for red potatoes bought at Kibirichia (Meru) and then sold in Wakulima market (Nairobi) in 1975

(Shs per 105 kg bag)

Month	Kibirichia wholesale prices	Wakulima market wholesale prices	Wholesale gross margins mark-up	
			Shs/bag	%
Jan.	28/84	66/50	37/66	130.6
Feb.	38/93	71/25	32/32	83/0
Mar.	40/44	70/50	30/06	74.3
Apr.	50/78	88/50	37/72	74.3
May	-	98/75	-	-
Jun.	37/50	73/33	35/83	95.5
Jul.	31/45	58/50	27/05	86.0
Aug.	33/65	50/63	16/98	42.0
Sept.	36/05	50/83	14/78	41.0
Oct.	41/48	61/30	19/82	47.8
Nov.	31/25	65/38	34/13	109.2
Dec.	38/75	52/50	13/75	35.5

Source: Author's investigation (based on price records by local traders, Meru, and HCDA, Nairobi).

The average level of wholesale gross margins associated with potato trade between Kibirichia local market, Meru, and Wakulima market, Nairobi, in 1975 was 74.5%. However, the gross margins fluctuated from 35.5% (in December) to 130.6% (in January), and this reflects the large differences between Kibirichia (Meru) and Nairobi potato prices during the year. The table shows

that it may be possible to trade between Meru and Nairobi most of the year, since transportation cost is only about Shs. 10 per bag (Table 28).

Table 34: Retail gross margins for potatoes traded in the Meru town open market in 1975

(Shs per 94 kg)

Month	Wholesale prices	*Retail prices	Retail gross margin mark-up	
			Shs/bag	%
Jan.	38/20	73/35	35/15	92.0
Feb.	44/-	86/95	42/95	97.6
Mar.	37/-	65/80	28/80	77.8
Apr.	49/50	79/90	30/40	61.4
May	67/65	117/50	49/85	73.7
Jun.	64/35	115/15	50/80	78.9
Jul.	39/-	103/40	64/40	165.1
Aug.	40/70	51/70	11/-	27.0
Sept.	53/30	79/90	26/60	49.9
Oct.	51/-	94/-	43/-	84.3
Nov.	36/-	110/45	74/45	206.8
Dec.	36/60	105/75	69/15	188.9

* Recorded in Shs per kg, but multiplied by 94

Source: Author's investigation (based on the price records of HCDA, Meru District).

The preceding tables on gross margins were designed to depict the levels and variations of trading margins when potatoes are bought from one type of market and then sold in another. The case of retail margins within Meru town open market depicts price variations within the same market. Trade within Meru was found to be lucrative especially just before the fresh crop was harvested when the difference between prices in Meru town and those in the producing zones (Kibirichia) was as high as Shs. 30/75 per bag of 84 kg (June). The transportation cost for potatoes from these zones to Meru town was only about Shs. 5 per bag. Differences between Nairobi prices and Meru prices for potatoes were high throughout the year, with an average gross margin of Shs. 27/12 per bag of 105 kg, which is in excess of the transportation cost of about Shs. 10 per bag. It would therefore appear that trade between Meru and Nairobi would be profitable throughout the year. It was estimated that the total marketing cost for traders within Meru could be about Shs. 8/15 when trading between Meru town and the producing zones while the cost for trade between Meru and Nairobi could be around Shs. 13/15 per bag (see Table 30), when transportation costs are added to the other costs. Since the net margins arise out of the differences between gross margins and total marketing costs, it appears that net margins would have been positive throughout the year if potatoes were bought from Kibirichia (Meru) and sold in Wakulima market (Nairobi) in 1975. However, net margins for trade between producing zones

and Meru town were positive only for about three months after each crop was harvested. Generally, the net margins will vary depending on the types of markets or outlets supplied.

4.5.7. General marketing problems

The author found no differences between prices for eating potatoes and those for seedpotatoes. This lack of price differentiation discouraged farmers from storing potatoes to be sold later as seedpotatoes when they have sprouted. Growers who buy seedpotatoes are not prepared to buy and store soon after harvests; they aim at buying sprouted seeds just before the planting period starts (3, p. 14). This depicts the problem of marketing of seedpotatoes, whereby the two parties involved are not willing to share the additional costs involved in storage of seedpotatoes.

Kenya can produce potatoes throughout the year in different ecological zones. However, this potential is not fully utilized due to lack of a well organized marketing system for fresh potatoes (3, p. 14). Storage of ware potatoes is made difficult by the perishability of the produce, but studies and observations indicate that potato storage can be improved by considering ripening of tubers before harvesting, elimination of diseased and damaged; tubers before storage, storage temperature and light, and sprouting of tubers (3, p. 14). To avoid potato

storage problems, the sample growers said that they aim at selling their potatoes soon after harvesting, provided that prices offered by traders are considered adequate to cover production costs. They did not consider storage of potatoes to be sold later as profitable, especially because of the observed lag in the increse of potato prices and the lack of adequate outlets for the Short Rains (March - May) potato output in 1975. Lack of assured markets is a major problem facing the growers in Meru District. This does not encourage them to produce more, as they are uncertain of being able to sell all their output before it perishes in storage.

Some access roads to the producing zones were not only rough but were inaccessible when wet. In such zones, means of transport were also scanty and expensive. Donkey carts, pick-ups or landrovers were the common means of transport available for supplying potatoes to the local markets. The growers considered the transportation costs too high, and they claimed that they did not get adequate returns from their marketed potato output to enable them cover production and marketing costs.

4.5.8. General Remarks

The data presented in this thesis were obtained through questionnaire interviews. The questionnaires were structured, and not disguised as it was felt that there was no sensitive information being sought. However, the author feels that the growers may have made slight errors in

reporting yield and input figures, especially because they depended on memory. No records are kept. There is always a tendency to inflate production costs, and somehow quote lower outputs. However, no direct valuations of outputs were sought, and any bias could be attributed to poor memory. Since the data from different farms were observed to vary only slightly within a given zone, the author considers the data and results adequate and reliable. The traders could have been sceptical about the study, but no direct questions about their incomes were sought. They mainly provided records of daily purchases and sales from which price data were extracted. These records appeared properly kept and the data extracted are therefore considered reliable. Other general information sought was given willingly and there was no reason for doubting it.

CHAPTER V

HYPOTHESES TESTING

5.1 Yield determinants

Correlation and regression analyses of potato yields (Y) on:

(i) relative potato plot size (S),

(ii) cost of fertilizer used per acre (F),

(iii) cost of Dithane M45 applied per acre (D),

(iv) weeding labour input in mandays per acre (L), and

(v) soil fertility condition (SF) were executed by means of a computer (results are given in Table 35).

From the author's investigation, Kibirichia is a more fertile zone than Kiirua, but Kiirua is, in turn, more fertile than Upper Abothuguchi. So, Kibirichia: Kiirua: Upper Abothuguchi were given the soil fertility condition ratio 3:2:1 respectively in this analysis. The computer regression model was:

$$Y = a + b_1S + b_2F + b_3D + b_4L + b_5SF + e,$$

Where: e represents the error term;

a = constant; and

b_1, b_2, b_3, b_4, and b_5 are the coefficients of regression.

Yields were correlated to each of the variables, and combinations of them; when combined, some variables may have been dropped so that some results were the same as those obtained when the variables dropped were not included. The results of the analyses are given in Table 35.

Table 35: Results of regression and correlation analyses of yields on the various selected variables at 95% level of significance

(Model: Y = f (S, F, D, L, SF), as above)

Y =	RN	a	b_1S	b_2F	b_3D	b_4L	b_5SF	r^2	D-W value
f_1	1	39.0	40.12	-	—	-	-	0.31	1.78
	2	52.8	-	0	-	-	-	0.06	1.48
	3	19.9	-	-	0.30	-	-	0.49	1.72
	4	45.3	-	-	-	0.43	-	0.13	1.54
	5	27.3	-	-	-	-	10.73	0.35	1.71
f_2	6	15.2	24.16	-	0.27	-	-	0.52	1.89
	7	22.5	28.56	-	-	-	8.61	0.41	1.87
	8	0	-	-	0.28	-	9.16	n/a	n/a
	9	19.6	-	-	-	0.44	0.76	0.38	1.78
f_3	10	16.5	28.65	-	-	0.36	8.76	0.42	1.91
f_4	11	0	14.66	-	0.26	0	8.0	n/a	n/a

Key: i. n/a = not available, since value of constant under column "a" is zero.

ii. D - W value = Durbin - Watson statistic.

iii. Zeros indicate that coefficients are not significant, or are nearly zeros at 95% level of significance.

iv. Dashes indicate variables not considered in the regression

v. f_i = number of variables in the regression set is i.

The above results indicate that the principal determinants of yield were the relative size of potato plot (S), the chemical input (Dithane M45) for plant protection (D), and the soil fertility condition (SF) in a given zone. In isolation, the relative size of potato plot explained 31% of the observed variance in yields; Dithane M45 spray explained 49% of the observed variance while the soil fertility condition explained 35% of the observed variance in yields. The other variables included in the regression set were fertilizer application (F) and weeding labour input (L). However, both of these inputs were not significant as yield determinants at 95% level; fertilizer input alone only explained 6% of the observed variance in yields while weeding labour input explained 13% of the observed variance in yields. Regression coefficients in all cases were significantly different from zero, except in the case of fertilizer application where the coefficient was zero.

5.1.1. Hypothesis that yield depends on the relative size of potato plot

When the relative size of potato plot was combined with the chemical input (Dithane M45), the two explained 52% of the observed variance in yield. Since the relative size of potato plot alone had explained 31% of the observed variance in isolation, while Dithane M45 had explained 49% of the variance, it appears that the relative size only contributed 3% in explaining the variance when

combined with Dithane M45. Since the effect of other variables not included in the regression set is not separable and in view of the low correlation coefficient between yield and the relative size of potato plot, the hypothesis that yield depends on the relative size of potato plot is rejected.

5.1.2. Hypothesis that yield is directly related to the level of purchased inputs

The main purchased input in potato production was found to be Dithane M45, a chemical for plant protection. In this case, labour is considered abundant and not a purchased input. Fertilizers were not commonly used; those growers who used fertilizers only applied small quantities (Table 14), whose effect on yield appears to have been small and negligible (Table 35). When combined with the other two main yield influencing variables, regression coefficients were significantly different from zero. Dithane M45 contributed 21% of the observed variance in yield when combined with the relative plot size: the combination explained 52% of the observed variance in potato yields.

Dithane M45 appears to have been a highly significant yield determinant on its own: it explained 49% of the observed variance in yields, the regression coefficient was significantly different from zero and the Durbin-Watson coefficient of 1.72

was obtained. Since Dithane M45 was the main purchased input, and was related to yield at a significant level, the hypothesis that yield is directly related to the level of purchased inputs is accepted.

5.2. Acreage determinant

The assumption is that potato acreage during any given season will be influenced by the general level of prices attained during the marketing of the potatoes produced during the previous season. The level of prices just prior to the planting period is crucial. Therefore, prices between May and July will influence the acreage for the Long Rains crop, which is planted in August, while the prices between December and February will influence the acreage for the Short Rains crop, which is planted towards the end of February, in Meru District.

Since Kibirichia is the most important potato producing zone in Meru (Table 3), the local potato prices in Kibirichia for each of the three months prior to the planting period for the three potato crops considered in 1974 and 1975, as given in Table 36 below, were compared with the average size of potato plots in Kibirichia, during each of the three seasons.

Table 36: Potato prices three months before planting of potatoes versus average size of potato plots at Kibirichia, 1974 and 1975

(Price: Shs. per bag of 84 kg; Size: acres)

Year	Month	Potato prices	3-month average price	Season influenced by prices	Potato acreage during the season
1974	May	28/80	27/63	Long Rain, 1974	3.30
	June	26/65			
	July	27/45			
	Dec.	38/-	30/75	Short Rain, 1975	3.07
1975	Jan.	23/10			
	Feb.	31/15			
	May*	-	27/60	Long Rain, 1975	4.04
	June	30/-			
	July	25/20			

* Although the price figure during this month was not recorded the price was apparently declining towards Shs. 30 mark.

Source: Appendices X and XIV

The general level of potato prices was measured by the average for the three months prior to planting. It was found that the general level of prices was higher between December 1974 and February 1975 than the levels between May and July in both 1974 and 1975 (Table 36). However, the table shows that potato acreages during the three seasons considered were highest following low levels of prices. This was true even for the other two potato zones,

i.e. Kiirua and Upper Abothuguchi, where the respective but corresponding acreages were as shown in the table below.

Table 37: Average size of potato plots at Kiirua and Upper Abothuguchi, Meru District, 1974 and 1975

Season and Year	Zone and plot sizes (acres)	
	Kiirua	Upper Abothuguchi
Long Rain, 1974	2.73	1.47
Short Rain, 1975	2.36	1.37
Long Rain, 1975	3.05	1.62

Source: Appendix X

From the results given in the above two tables, it is seen that potato acreages were inversely related to the general level of potato prices prior to planting. The hypothesis was that potato acreages would be expanded if the general level of potato prices prior to planting was high. This hypothesis is therefore rejected.

5.3 Prices

5.3.1 Hypothesis that potato prices in local markets in Meru District differ by transfer costs

Transfer cost consists of both transportation and terminal costs. The author found out from the local traders that they aim at obtaining a margin of Shs. 2 per bag of potatoes sold. This is considered adequate to cover operational costs and give a small profit

margin, so that the author took the Shs. 2 per bag to be the terminal cost per bag. Kibirichia local market is the main local market within the producing zones; Meru town open market is the central regional market for agricultural produce in Meru District. Therefore, the above hypothesis was tested by comparing Kibirichia potato prices with Meru town potato prices, all prices being wholesale and expressed on the basis of shillings per bag of 94 kilograms - see prices in Appendices VIII and X. Since the transportation cost from Kibirichia to Meru town is Shs. 5 per bag of potatoes, irrespective of the weight, this cost was added to the Shs. 2 to give a transfer cost of Shs. 7 per bag of potatoes bought at Kibirichia and resold in Meru town.

Differences between Meru town and Kibirichia prices for potatoes in 1975 (Table 38) were tested to determine if they were significantly different from the transfer cost of Shs. 7 per bag of potatoes.

Table 38: Comparison of monthly wholesale potato prices at Meru town and Kibirichia in 1975

(Shs. per bag of 94 kg)

Month	Potato prices		Price differences
	Meru town	Kibirichia	
Jan.	38/20	25/82	12/98
Feb.	44/-	34/85	9/15
Mar.	37/-	36/20	-/80
Apr.	49/50	45/46	4/04
May	67/65	-	-
Jun.	64/35	33/57	30/78
Jul.	39/-	28/16	10/84
Aug.	40/70	3-/92	8/78
Sep.	53/30	32/27	2-/03
Oct.	51/-	37/13	12/87
Nov.	36/-	27/98	8/02
Dec.	36/60	34/69	1/91
Mean price difference			10/96

Source: Appendices VIII and X

The data in Table 38 was used in testing the significance of the observed price difference using the following formula:

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$

where $\bar{x}$ = mean price difference (Shs. 10/96);

μ = transfer cost (Shs. 7);

s = standard error of x_i from $\bar{x}$, where x_i are the observed monthly price differences;

n = sample size (11 sets of monthly price differences).

The result of the calculation was that t = 1.52 (at 10 degrees of freedom). The expected t - value is 2.228 at 95% confidence level for 10 degrees of freedom. Therefore, the observed t - value is not significantly different from the expected t - value at 95% level of significance. Hence, the observed price differences are not significantly different from the transfer cost, and the above hypothesis is accepted.

5.3.2. Hypothesis that local prices in Meru are determined by prices obtainable for potatoes at the interregional channels, as measured by potato prices in the major consumer centres

Weekly wholesale prices for potatoes at Kibirichia were selected to represent local prices in Meru and the weekly wholesale prices for red potatoes in Wakulima market, Nairobi, were selected to represent interregional channel prices.

The HCDA price records are compiled on Wednesdays and released for press or broadcasting on Fridays. Therefore, Nairobi potato prices in Week 1 will be made known in the other consumer centres in the following week. Nairobi prices in Week 1 would therefore be expected to influence Meru prices in Week 2, and those in Week 2 to influence those in Week 3, and so on.

Having expressed the weekly wholesale potato prices at Kibirichia (Appendix XIV) on the basis of a bag of 105 kg, the

Kibirichia (Meru) and Wakulima (Nairobi) prices were correlated, pairing this week's price at Kibirichia with the last week's price at Wakulima market. This was done for all weekly prices in 1974 and 1975. Meru potato prices were found to be correlated to the Nairobi market potato prices with correlation coefficients of 0.56 and 0.66 in 1974 and 1975 respectively. These are highly significant correlation coefficients; since Nairobi market potato prices are generally higher than the Meru market potato prices, it appears that the Nairobi prices may have influenced the level of Meru prices. The hypothesis that Meru prices for potatoes are determined by prices obtainable at the interregional channels is acceptable.

5.4. Market outlets

5.4.1. Hypothesis that local markets in Meru do not constitute the major outlet for Meru potatoes

Table 25 indicates that 36% of the total output of the crop grown during the Short Rains season in 1975 was retained in the farms for seed and family consumption. The hypothesis is that most of the output is not sold or consumed in Meru, where "most" implies anything greater than 50%. Investigations showed that 88% of the growers had sold their potatoes within Meru District. Since local traders are the main agents who buy from the growers (Table 5), and in view of the fact that 36% of the output was retained in the farms, it appears logical that at least 50% of the output was consumed or utilized within Meru. The survey

figures indicate that local markets in Meru District are the major outlets for Meru potatoes. So, the above hypothesis is rejected.

5.4.2 Hypothesis that there is lack of adequate market outlets for Meru potatoes

The situation or adequacy of market outlets is likely to vary with time, according to fluctuation in demand and supply within and outside the district. The author found out from the growers and the Ministry of Agriculture officials in Meru that potatoes appeared to have a higher demand in 1973 and 1974 than in 1975, because the growers were able to market all their output prior to 1975. They claimed that there was lack of adequate outlets for the Short Rains (March - May) potato output in 1975, and that what was sold was actually given away at prices which they considered too low to give adequate returns to cover production costs and give some profit margins to the growers.

Average yields were 59.0 bags in Kibirichia, 40.5 bags in Kiirua, and 50.7 bags in Upper Abothuguchi in 1975 (Table 8). Production costs in these zones were Shs 16/89 per bag in Kibirichia, Shs 19/79 per bag in Kiirua, and Shs 27/66 per bag in Upper Abothuguchi (Table 20); the measure of potato bag in Kibirichia and Kiirua was 84 kg, while that for Upper Abothuguchi was 94 kg. For planning purposes, a target net farm income of Shs 500 per acre is assumed. In order to achieve this target income, Kibirichia growers have to make a net margin of Shs 8/47 per bag of potatoes; Kiirua growers have to make a net margin of Shs 12/35 per bag of potatoes;

finally, the Upper Abothuguchi growers have to make a net margin of Shs 9/86 per bag of potatoes, assuming the observed average potato yields. Therefore, these net margins have to be added to production costs before arriving at a target price at which the grower would consider selling his potatoes profitable. The target prices will, therefore, be Shs 25/36 in Kibirichia, Shs 32/14 in Kiirua, and Shs. 37/54 in Upper Abothuguchi, per bag of potatoes sold. If the growers can obtain these target prices from the market, then the hypothesis that there are adequate market outlets for potatoes would be verified.

In the sample zones, most of the potatoes are sold within a month after harvesting, and the average level of prices then is Shs 20 per bag for Kibirichia and Kiirua and Shs 35 per bag for Upper Abothuguchi (Meru town) at this time. (See Table 19 and notes under section 4.3.). These prices are much below the target prices, as calculated above.

Based on the reports by growers and government officials in Meru, and on the basis of the calculation of the target prices as outlined above, the hypothesis that there is lack of adequate market outlets for Meru potatoes is accepted.

5.5 Hypothesis that net returns to growers in Meru can be increased by shifting potato supplies to the market through storage

First, it is assumed that Nairobi markets would be the outlet for potatoes so stored in Meru District. Secondly, it is assumed that prices in Nairobi would be inelastic to potato supplies

from Meru District.

Kibirichia local market prices were selected to represent prices at which Meru growers sold their potatoes and Wakulima market prices in Nairobi were selected to represent prices at which the stored potatoes in Meru District could be sold . 1974 and 1975 potato prices in the two types of market were compared, and the following table gives the price differences between the two markets, all prices being the wholesale prices for red potatoes on the basis of bags of 105 kg.

Table 39: Monthly price differences between wholesale red potato prices at Wakulima (Nairobi) and Kibirichia (Meru) markets in 1974 and 1975

(Shs. per bag of 105 kg)

Month	Price differences	
	1974	1975
Jan.	8/-	37/66
Feb.	18/61	32/32
Mar.	26/69	30/06
Apr.	37/55	38/02
May	37/14	-
Jun.	9/21	35/83
Jul.	8/47	27/05
Aug.	10/12	14/98
Sept.	6/98	14/78
Oct.	6/46	19/82
Nov.	25/50	34/13
Dec.	23/80	13/75

Source: Appendices XII and XIV

Meru potatoes are harvested in January and July, for the Long Rains and Short Rains crops respectively. The above table shows that the price differences did not show the same trend during similar periods in the two years. Gross margins between Nairobi and Meru prices in 1974 were fairly low in January, but they increased steadily until they were at their peak in April and May; however, they decreased steadily between May and October. The picture was different in 1975: the gross margins were at their peaks during the periods when Meru potatoes are harvested. So, it would have paid to store the potatoes harvested in January, 1974 for about three months because these could have been shipped to Nairobi when gross margins were at their highest level; however, the situation has changed since then. This is important because it shows that the marketing system is dynamic, and the testing of the above hypothesis will be based primarily on the most recent situation. Except for the crop harvested in January 1974, the following potato crops have been harvested when the gross margins between the Nairobi and Meru potato prices are at their peaks. Assuming a maximum storage period of about three months for potatoes, then the January harvest would be released from storage in April, and the gross margin then is not significantly different from that in January in 1975; similarly, the July harvest would be released from storage in October, and the gross margin then is much less than that in July. So, it appears that it would be more profitable for Meru growers to market their potatoes in Nairobi markets immediately following harvesting. Therefore the hypothesis that net returns to growers in Meru could be increased by shifting supplies to the market through storage is rejected.

5.6 Trade and the potato marketing problems in Meru District

5.6.1 Hypothesis that competition in potato trade in Meru District is limited because there are few traders and the farmers have no bargaining power and will be associated with a particular trader or outlet for any of the following reasons:

a) contractual ties between farmers and traders;

b) farmers lack market information;

c) farmers have difficulties in physical access to the markets.

Table 27 gives reasons why certain farmers sold their potatoes to particular trader: friendship or kinship relations, or provision of services such as credit or advance to the farmers by traders were the major reasons for the associations, and these can be summed up by (a) above. Owing to lack of means of transport, some farmers preferred to sell their potatoes at farm-gate, so that they were associated with those traders who went to buy directly at the farms: only one out of the 75 farmers interviewed owned a vehicle, so that all the others depended on hired transport when taking potatoes to the local markets. This shows that there were difficulties in physical access to markets, so that most farmers either sold their potatoes either at farm-gate or at the nearest trading centre (Table 26). This may lead to association with particular outlets. Only 5 out of the 75 farmers had information on Nairobi potato prices, and these are the farmers who were also partly involved in potato trade. So, it can be said that typical growers had no information on

prices outside their areas. Hence, this may partially explain the high incidence of big price differences between potato prices in the local markets in the potato producing areas in Meru and the Nairobi markets (Table 39). Finally, the author noticed that there were few established traders dealing in potatoes (4 at Kibirichia, 3 at Kiirua, and one at Ntugi) in Meru local trading centres in the potato producing zones. For this reason, competition in the potato trade is likely to be limited, especially because these few traders have to handle large quantities of potatoes from all the growers. Therefore, the hypothesis advanced under 5.6.1. is accepted.

5.6.2 Hypothesis that farmers are willing to solve potato marketing problems collectively by forming a marketing cooperative to store, grade and market their potatoes

Out of the 75 sample farmers, only 2 said that they would not need such a cooperative for marketing potatoes. This was because they were not producing enough that could be sold through the cooperative. All the others were willing to be members of a potato marketing cooperative, if established. Therefore, the above hypothesis is accepted.

CHAPTER VI

INTERPRETATION OF RESEARCH FINDINGS

6.1 Potato yield determinants

Relative size of the potato plot, the amount of capital input in plant protection and the soil fertility were found to be the major determinants of potato yields in North Imenti, Meru District (see Table 35). The author realizes that some other variables, particularly those not under the farmer's control (such as adverse weather or disease and pest outbreaks) may invalidate the above relationship, so that the other factors must be held constant when stating that any given variable is a yield determinant.

The share of a given crop in the farm production structure reflects the importance of this crop as a farm enterprise, and the main cash earner for the farmer is expected to have a bigger share in the farm. Hence, this main enterprise will get more attention from the farmer: more intensive and proper husbandry techniques will be devoted to this enterprise so as to maximize output and get more returns. Therefore, the relative size of potato plot is an indicator of the importance of the potato production as an enterprise in the farm, and this will influence the potato yields as shown under 5.1. Use of chemicals (Dithane M45) in plant protection saves potatoes from destruction by blight, so that higher yields are expected when potatoes are completely protected against this disease. Therefore, capital input in buying the chemicals for plant protection is an important potato yield determinant, provided that the chemicals are

not applied beyond optimal levels, depending on the seriousness of blight incidence in a given area. Soil fertility determines if crops planted in a given zone can grow and mature healthily: the author suggests that soil fertility will be more important as a potato yield determinant where right amounts and types of fertilizer nutrients are not added to the soils. Although some growers in North Imenti Division were using fertilizers in potato production, the amounts and types used were limited, and their impact as yield determinant appears to have been marred by the impact of soil fertility and the small amounts of farm yard manures used in those farms where the farmers do not apply fertilizers. The author asserts that the growers in North Imenti are probably using the wrong types and amounts of fertilizers, and some yield trials on different types and amounts of fertilizers in North Imenti in potato production may help determine the right types and amounts of fertilizers that should be used.

6.2 Determinants of market supplies

Growers in Meru retained about 36% of their potato harvest for family consumption and for seed to be planted in the next season (see Table 25). So, the amount of potatoes marketed was the difference between the total output and the sum of amounts of potatoes retained for seed and family consumption.

It was found that potato acreages were inversely related to the general level of potato prices achieved during the marketing of the output from the previous season (Tables

36 and 37). Since potatoes were the main cash earner for most of the sample growers interviewed (Table 9), then one would expect them not to base their production decisions directly on the ruling prices, especially because they have few alternative enterprises. However, the ruling prices are expected to influence their decisions in the long run. Since an acre of land requires a certain amount of seedpotatoes (Table 14), then the amount of potatoes retained for seed by the farmers will depend on the planned potato acreage for the following season.

6.3 Prices

Local prices for potatoes in Meru were found to differ by transfer costs and were correlated to the Nairobi market prices for potatoes (Proof: sections 5.3.1 and 5.3.2). Although the actual market integration may have been low, it can, therefore, be said that local markets in Meru were integrated and were also linked to interregional markets, such as Nairobi markets, through trade. The author found out that local traders in Meru get information of potato prices in main consumer centres such as Nairobi through telephone calls to their agents in such centres. Growers largely depend on these local traders for information on prices for potatoes in other areas.

Price differences between Nairobi market potato prices and Meru local market potato prices were found to be at their peak just when the Meru growers are harvesting their crops. Therefore, it would not pay for Meru growers to store their potatoes after

harvesting in anticipation of selling them later in the Nairobi markets.

6.4 Market outlets for Meru potatoes

Meru District consists of six administrative divisions, but only North Imenti Division is the most important potato producer (Table 2). Therefore, the other five divisions may be expected to form the main local outlets for potatoes grown in North Imenti.

The author found out that only about 64% of the potato output in North Imenti was marketed and that 88% of this marketed output was sold by the growers locally (Table 25). Since most of it was handled by the local traders, the author suggests that the local markets are the main outlet for Meru potatoes. However, some of the output is sold outside the district; the dry areas, such as Isiolo, Wajir, Marsabit and Garbatula, and the main consumer centres such as Nairobi, Thika and Mombasa were also found to be important outlets. However, it was estimated that less than 50% of the marketed output reaches these interregional outlets, so that the bulk of the potatoes in Meru is marketed locally.

6.5. Marketing costs

Transportation costs incurred shen supplying local markets from the farms in Meru were found to be relatively higher than those incurred when supplying interregional market outlets from the Meru local trading centres. (Table 29). This may be attributed to the fact that roads between the local markets and the farms in Meru were rough and inaccessible when wet. Means of transport were therefore rare and expensive in such rough areas. However, growers still had to hire transport when supplying the local markets. On the other hand, the interregional markets are linked to the local Meru markets through better roads, and transportation facilities are not limiting so that transportation costs are likely to be lower in this case.

Growers used general purpose farm stores for their potatoes prior to marketing. However, most output was sold soon after harvesting and no storage costs were assigned to farm storage of potatoes. On the other hand, traders stored potatoes for an average of one month after buying them; such traders were estimated to incur a storage cost of Shs. 1/23 per bag per month (See Table and and subsection 4.5.3.2.).

Other marketing costs reported to the author by the growers and traders included the Meru County Council cess of Shs. 1/05 per bag (irrespective of weight of potatoes taken out of the district. Additional costs, especially in loading of

potatoes to the vehicles, were reported, amounting to about 70 cents per 84 kg. bag of potatoes.

Market supply costs could, therefore, consist of transportation costs, handling costs, storage costs where potatoes were stored before being supplied to the final outlets, and the County Council cess for potatoes taken out of the Meru District.

6.6 Potato marketing problems in Meru District

The author found out that few traders were trading in potatoes at the local centres during the period when the potatoes harvested after the Short Rains (March - May) potato crop in 1975 were in the markets. There were no established potato traders at the local trading centres in Upper Abothuguchi, and growers in this zone depended on Meru town open market as the main local outlet for their potatoes. At Kiirua, only three established local potato traders were found while there were four established traders having potato stores at Kibirichia. So, ignoring the many hawkers and potato retailers in the Meru town open market, the number of potato traders in Meru was small and this is likely to result in low competition in the potato trade because few traders have to handle large volumes of potatoes from the producing zones of Meru. However, traders from other areas outside Meru District were also found to be buying potatoes, either directly from the growers or from the local traders, and these may have increased the level of competition in potato trade in Meru. Owing to the small number of potato traders, these traders were associated with certain growers or suppliers.

These associations were based on any or more of the following reasons (see Table 27):

(a) the trader, using his own transport, went and bought potatoes directly from the farms;

(b) the trader offered certain services or facilities to his suppliers: these facilities could be credit or cash advances;

(c) there were friendship or family ties between the trader and the growers or suppliers.

The above reasons may have contributed to the limited competition in the potato trade in Meru.

Meru growers are aware of the problem of potato marketing in the country. They are keen to have a processing plant established in the country so that it is at least possible to preserve potatoes, especially when the output is greater than can be sold to the final consumer directly. This would help alleviate potato losses in storage. Formation of a potato marketing cooperative in Meru is also considered necessary, and the growers are keen to be members if such a cooperative would secure markets for their potatoes and be able to sell their output efficiently. The growers feel that the cooperative would succeed only if there are adequate storage and transportation facilities and when the managerial staff are technically well trained. This would ensure that the potatoes are marketed efficiently.

CHAPTER VII

CONCLUSION: THE PROBLEM OF PRODUCTION AND MARKETING OF POTATOES

There are two seasons during the year when rain-fed potato crops can be produced in Meru District.

(i) Short Rains season starts in March and ends in May

(ii) Long Rains season begins in September and ends in December.

The Short Rains potato crop is planted towards the end of February and is harvested towards the end of June, while the Long Rains potato crop is planted in early September and is harvested towards the end of December. The two seasons are equally favourable for potato production in Meru, and the potato yields observed for the two seasons were not significantly different, although the Short Rains potato yields were found to be slightly higher than the Long Rains potato yields (Table 8). Therefore, assuming favourable weather conditions and holding other factors constant, Meru District can be expected to provide an even supply of potatoes to the markets during the two seasons.

Weather condition may be expected to cause variation of potato yields in a given area from one season to another; other potato growing areas in Kenya may not realize the Meru pattern of potato yields during the two cropping seasons in the year. Therefore, the pattern of potato yields in the other districts should be studied so as to combine the results of studies in these areas with those from the study in Meru so as to have information needed before

one can formulate a potato production and marketing policy for the country as a whole.

As far as potato production and marketing in Meru District is concerned, two problems have clearly been observed: first, there is a problem in production extension, and secondly there is lack of organized marketing of potatoes. The problem of production extension refers to the dissemination of technical information on potato production techniques and husbandry to the farmers by the extension staff employed by the Ministry of Agriculture. At present, the information given to farmers on types and amounts of fertilizers to be used in potato production is not based on experimental data or observations; farmers use fertilizers in a haphazard manner and small amounts of fertilizers which do not seem to have significant impact on yield of potatoes are applied. It would be necessary to determine what levels of fertilizers are signicant as yield determinant in potato production. More and intensive research work based on potato production in the local zones in Meru is needed before proper production extension can be given to growers in Meru. The aspect of potato marketing in Meru needs more attention. Organization of proper market outlets for Meru potatoes, through the establishment of an active marketing organization that is able to compete with the other marketing organizations in the country, and be able to take advantage of the observed interregional distortions in potato prices, is a prerequisite in planning of a potato production and marketing policy.

It was assumed that Nairobi potato prices were inelastic to potato supplies from Meru District while testing the hypothesis under 5.5. However, potato prices are observed to decline rapidly within two months after Meru potatoes are harvested. So, a planned marketing of potatoes, with buffer stocks bought from the main producing districts at periods of glut and stored to be released in the markets when the potato prices are rising due to potato scarcity, will be expected to even out the current high fluctuations in availability and prices of potatoes in Kenya. Therefore, there is a need to plan the periods when large quantities of potatoes will be expected from the various producing districts in Kenya; Meru potatoes can be expected in Nairobi markets in large quantities between June and July and between January and February. The responsibility of holding potatoes in storage so as to even out supplies to the markets cannot be left to the growers. The growers do not have adequate storage facilities for potatoes and their aim is to sell their potatoes soon after harvesting so as to avoid potato losses in storage. Therefore, there is a need to establish a national potato marketing organization which can be entrusted with the overall responsibility of executing and regulating potato marketing in Kenya. Such an organization could fix floor prices for potatoes, based on potato production costs; it could then handle potatoes supplied to it by the growers at this floor potato price. Since no potato flow equilibrium model can be achieved without having a continuous flow

of supplies to the markets from the different growing districts, then production should be coordinated so that growers in the different districts are encouraged to produce potatoes at periods when potatoes are cheapest to produce when compared with the other farm enterprises. Besides, proper storage facilities are needed so that potatoes can be stored at glut periods and released in the markets at scarcity periods. This would ensure that potatoes are produced and marketed while minimizing costs so that they could be sold at prices consumers can pay while the growers get adequate returns to enable them cover production costs and make some profit.

VIII : REFERENCES

1. ACLAND, J.D.: East African Crops. FAO, 1971. Longman Group Ltd., London.

2. BALLESTREM, C.C.: Experiences with the Potato Production in Kenya. German Agricultural Team (GAT) in Kenya, Nairobi, 1974

3. BALLESTREM, C.C.: Report on Activities and Experiences on Potato Crops in Kenya. GAT in Kenya, Nairobi, July, 1975.

4. BALLESTREM, C.C.and HOLLER, H.J.: Potato Atlas of Kenya. Frankfurt, 1974

5. FRIEDRICH, K.G: The Collection and Analysis of Microeconomic Data in Developing Countries. FAO, Rome, 1974

6. GAT IN KENYA: Growing of potatoes in Kenya. Frankfurt, 1974

7. HOLLER, H.J.: Report on Potato Agronomy in Kenya. NHRS, Thika/Ministry of Agriculture, Nairobi, 1972/73

8. HUBERT, D.K.: Aspects of Potato Marketing in ... Nairobi, 1968

9. LORENZL, G. and TUI, L.: The Price Information System for the Horticultural Industry in Kenya. Nairobi, 1974

10. MARITIM, L.H.K.: Analysis of Produce Flows to Wakulima Wholesale Market, 1975 (M.Sc. Thesis, forthcoming).

11. MINISTRY OF AGRICULTURE: Horticulture Working Party: Draft Report and Recommendations. Nairobi, 1970

12. MINISTRY OF AGRICULTURE: Horticultural Development Guidelines, Nairobi, 1974

13. MINISTRY OF AGRICULTURE: Meru District Annual Report, 1974

14. QUINCKHARDT, M.: Production of Potatoes in Kenya: Results of an Investigation in four districts in 1974 A Pilot Study. Nairobi, 1974/75

15. UNIVERSITY COLLEGE: Kenyatta University College Student Handbook for Meru Field Course. Department of Geography, December 1975.

IX: APPENDICES

APPENDIX I : QUESTIONNAIRE ON THE PROBLEM OF POTATO PRODUCTION AND MARKETING IN MERU DISTRICT

01. Interview running number (IRN).....

02. Name of potato grower .....

03. Location .....

04. Sublocation .....

05. Date interview done .....

06. Time interview started .....

Brief introduction and explanation by the interviewer to the potato grower on the aim of the study, especially explaining that the study is part of the University field practicals, so as to seek confidence and cooperation from the potato growers during the course of field data collection.

07. What varieties of Irish potatoes do you grow?

a) .....

b) .....

c) .....

08. How many acres of each variety are you growing this Long Rains season?

a) .....

b) .....

c) .....

09. How many acres of each variety did you grow last Short Rains season?

a) .....

b) .....

c) .....

10. How many acreas of each variety did you grow last Long Rains season?

    a) .....

    b) .....

    c) .....

11. Do you use certified seedpotato?

    a) Yes ..... (Go to Q. 12)

    b) No ..... (Go to Q. 15)

12. What is the cost of certified seedpotato?

    ..... shs. per bag

13. What problems do you have in getting certified seedpotato?

    .....

14. Why do you use certified seedpotato?

    .....

15. Since you do not use certified seedpotatoes, what type of seedpotato do you use? (Tick)

    a) Own potatoes selected from last season's potato harvest

    .....

    b) Bought potatoes from last season's potato harvest

16. Why do you not use certified seedpotato?

    .....

17. At which month or period do you plant seedpotato during the two different seasons?

    a) Long.Rains season ..... (Month)

    b) Short Rains season ..... (Month)

18. How many bags of potatoes did you harvest:

    a) Last Short Rains season? ..... bags

    b) Last Long Rains season? ..... bags

19. Out of the total potato harvest of last Short Rains season, how many bags were:

    a) Consumed by family? ..... bags

    b) Kept as seedpotato? ..... bags

    c) Sold? ..... bags

20. Out of the total potato harvest of last Long Rains season, how many bags were:

    a) Consumed by family? ..... bags

    b) Kept as seedpotato? -..... bags

    c) Sold? ..... bags

21. For the potatoes you sold last Short Rains season, at what period(s) and price(s) did you sell?

	Period (Month)	Price (shs/bag)
a)	.....	.....
b)	.....	.....
c)	.....	.....

* To get an idea of costs involved and problems in potato production, please tell me the following:

22. Do you apply fertilizer in your potato plot?

    (Tick) (a) Yes .....

    (b) No .....

23. What is the name of the type of fertilizer that you use?

    .....

24. How many bags of fertilizer did you apply in your potato plot for this Long Rains season?

..... bags of ..... kg. each

25. What is the cost of this fertilizer? ..... shs per bag

26. Do you spray your potato crop with chemicals

Tick (a) Yes ..... (continue)

(b) No .....,(Go to Q. 30)

27. How many times did you spray during:

(a) Long Rains season ..... times (when rains heavy)

(b) Short Rains season ..... times (when rains light)

28. For each time you sprayed, how much chemical did you apply in your potato plot?

(a) First spray ..... kg. per acre

(b) Second spray ..... kg. per acre

(c) Third spray ..... kg. per acre

(d) Fourth spray ..... kg. per acre

(e) Fifth spray ..... kg. per acre

29. How much did you pay for the chemicals?

..... shs per .....kg

30. How did you prepare the potato plot this season?

(Tick) By: a) Hoeing (with jembe) .....

b) Own tractor plough .....

c) Hired tractor plough .....

d) Own oxplough .....

e) Hired oxplough .....

31. How many times do you do weeding in your potato plot?

..... times

32. In case of using family or hired labour for your potato plot how many days per acre did you need for each of the following operations?

OPERATION	DAYS PER ACRE	
	Family labour	Hired Labour
(a) Hoeing (Jembe)	.....	.....
(b) Ploughing	.....	.....
(c) Ridging	.....	.....
(d) Fertilizer Application	.....	.....
(e) Planting	.....	.....
(f) Weeding	.....	.....
(g) Spraying	.....	.....
(h) Harvesting and grading of potatoes	.....	.....

33. In case of hiring or contracting labour for your potato plot, how much did you pay for:

(a) Ploughing/hoeing ..... shs per .....

(b) Ridging ..... shs per .....

(c) Fertilizer application ..... shs per .....

(d) Planting ..... shs per .....

(e) Weeding ..... shs per .....

(f) Spraying ..... shs per .....

(g) Harvesting and grading ..... shs per .....

34. Normally, what do you pay for hired labour?

    (a) Permanent ..... shs per month

    (b) Casual ..... shs per day

35. What problems do you get in securing labour?

    .....

36. For this Long Rains season, how many mandays of labour did you spend on your whole potato plot for each of the following operations?

OPERATION	TOTAL NO. OF MANDAYS
(a) Hoeing (by jembe)	.....
(b) Ploughing (by .....)	.....
(c) Ridging (by ....)	.....
(d) Fertilizer application	.....
(e) Planting	.....

37. For last Short Rains season, how many mandays of labour did you spend on your whole potato plot for each of the following operations?

OPERATION	TOTAL NO. OF MANDAYS
(a) Weeding	.....
(b) Spraying	.....
(c) Harvesting and grading	.....

34. Normally, what do you pay for hired labour?

(a) Permanent ..... shs per month

(b) Casual ..... shs per day

35. What problems do you get in securing labour?

.....

36. For this Long Rains season, how many mandays of labour did you spend on your whole potato plot for each of the following operations?

OPERATION	TOTAL NO. OF MANDAYS
(a) Hoeing (by jembe)	.....
(b) Ploughing (by .....)	.....
(c) Ridging (by ....)	.....
(d) Fertilizer application	.....
(e) Planting	.....

37. For last Short Rains season, how many mandays of labour did you spend on your whole potato plot for each of the following operations?

OPERATION	TOTAL NO. OF MANDAYS
(a) Weeding	.....
(b) Spraying	.....
(c) Harvesting and grading	.....

38. At which place(s) did you sell your potatoes harvested last Short Rains season, according to the three periods (a), (b), and (c) reported under Q. 21?

PLACE	PERIOD (a)	(b)	(c)
(a) At farm gate	.....	.....	.....
(b) Local trading centre	.....	.....	.....
(c) Meru town to traders	.....	.....	.....
(d) Meru town open market	.....	.....	.....
(e) "OTHER"	.....	.....	.....

* Specify "OTHER".

39. Did you sell your potatoes to any particular people or traders, and (if so) why? .....
.....

40. When selling your potatoes, what kind of transport do you use to the different selling places? .....
(a) To local trading centre by .....
(b) To Meru town by .....
(c) To "OTHER" (specify where) by .....

41. What is the distance from your farm to these selling places?
(a) Local trading centre ..... miles
(b) Meru town ..... miles
(c) "OTHER" (specify) ..... miles

42. What is the cost of transporting a bag of potatoes to these selling places?
(a) Local trading centre ..... shs per bag
(b) Meru town ..... shs per bag
(c) "OTHER" (specify) ..... shs per bag

43. Do you sell or deliver potatoes to these selling places by bags or debes? (tick)

    (a) bags ..... (b) debes .....

44. What do you pay for these bags or debes?

    (a) ..... shs per bag

    (b) ..... shs per debe

    (c) Nothing (tick).....

45. What is the price of a bag of potatoes in this area today?

    ..... shs per bag

46. In case you know, what are the potato prices in Meru town and Nairobi today?

    (a) Meru town ..... shs/bag

    (b) Nairobi ..... shs/bag

    (c) Do not know ..... (tick)

47. How do you get price information about potato prices in Nairobi?

    (a) By or from .....

    (b) I do not get price information (tick) .....

48. In case you do sell your potatoes directly in Nairobi, what kind of transport do you use, and to whom do you sell?

    (a) By .....

    (b) Sell to .....

49. In case you do store potatoes after harvesting, what type of storage facility do you use?

    .....

50. For how long do you store potatoes? ..... months

51. How many bags of potatoes can your storage facility hold?

..... bags

52. How many bags of potatoes did you store from the harvest of the last Short Rains season? ..... bags

53. How many bags of potatoes did you store from the harvest of the last Long Rains season? ..... bags

54. In case you do get potato losses during storage, what type of storage problems do you experience, and what is the number of bags lost out of every 100 bags stored for the period mentioned under Q. 50?

(a) Problems .....

(b) Magnitude of losses .....

55. Do you think that it pays to store potatoes after harvest and then sell them later? .....

56. For how long do you feel that potatoes can be stored without getting a major loss? ..... weeks.

57. If one stored potatoes for about 3 months, what do you think will be the loss, for example, out of every bag of potatoes stored? .....%

58. What advice do you get from the Ministry of Agriculture extension staff in regard to potato production?

(a) Time of planting: i) Long Rains ..... (month)

ii) Short Rains ..... (month)

(b) Spacing ..... feet

(c) Fertilizer application ..... kg/acre

(d) Spraying ..... times per crop period at the rate of ..... kg/acre per one spraying

59. Do you plan to increase, decrease (or maintain the present) size of your potato plot, and why?

(a) No change .....

(b) Increase .....

(c) Decrease .....

(d) Reasons .....

60. What do you consider to be the major problems in growing potatoes in your farm? .....

.....

61. If a potato marketing cooperative society were formed, having both storage and transportation facilities, it appears that this might improve the marketing of potatoes in Meru District. Would you be willing to join such a cooperative society?

(a) Yes ..... (Go to Q. 67)

(b) No ..... (Continue)

62. Why would you not be willing to join such a cooperative society? .....

63. How many acres is your whole farm? ..... acres

64. What other major crops do you grow in your farm?

(a) .....

(b) .....

(c) .....

(d) .....

(e) .....

(f) .....

65. What crops do you grow in rotation and in which sequence, with the potatoes? .....

66. What crops do you consider more profitable than potatoes in your farm? .....

67. For the other crops that you grow in your farm, what average yields and prices do you get?

Crops	September - November (Long rains season)		March - May (Short rains season)	
(a)	Yield	Price	Yield	Price
(b)				
(c)				
(d)				
(e)				
(f)				

68. If you do keep livestock in your farm, what kind and numbers do you have?

Type of livestock	Number
(a)	
(b)	
(c)	
(d)	

69. After I have been asking you all these questions, what would you like to inform or ask me, especially about potato production and marketing? .....

.....

* Thank you very much for your cooperation and help in answering all my questions.

70. Time interview finished .....

71. Signature of interviewer .....

APPENDIX II : QUESTIONNAIRE ON POTATO TRADE

01. Interview running number .....

02. Name of potato trader .....

03. Address (and brief description) of the potato trader

.....

04. Date interview made .....

05. Time interview started .....

* Brief introduction by the interviewer on the nature and purpose of the potato trade survey, emphasizing that the survey is for study purposes, so as to seek and win confidence and cooperation from the potato trader.

06. Areas (source of potatoes) from which the potato trader is currently buying potatoes and the prices offered to the potato suppliers.

Areas (source of potatoes)	Prices offered (shs per bag)
1.	
2.	
⋮	
n.	

07. If there is any type of ties between the potato trader and those supplying him with potatoes, indicate the types of ties.

.....

08. How the potato trader gets information on whether potatoes are available in a certain area before he goes to buy potatoes in that area .....

.....

09. Where the potato trader sells his potatoes, the selling prices and transport costs (in shs. per bag) and other marketing costs.

Market outlets	Transport cost (shs per bag)	Selling prices (shs per bag)	Other marketing costs, with specifications
1.			
2.			
3.			
4. ...			
n			

10. Potato traders' opinions and remarks on the situation of potato trade and problems of potato marketing, especially as far as Meru potatoes are concerned.

.....

.....

11. Time interview finished .....

12. Signature of interviewer .....

Appendix III: Potato production costs for the Long Rains (September - November) crop in Kibirichia zone, Meru Distirct, in 1975.

Farm No.	Potato acreage	Seedpotatoes			Fertilizers				Dithane M45				Total Cost shs/acre
		Bags per acre	Price shs/bag	Cost shs/acre	Type	Amount kg/acre	Price shs/per 50kg	Cost shs/acre	No. of sprays	Amount kg/acre	Price shs/kg	Cost shs/acre	
1	5	12	45/=	540/=	20:20:20	20	120/=	48/=	4	5¼	33/40	175/35	763/35
2	4	10	40/=	400/=	15:15:6/4	100	92/50	185/=	4	7	33/40	233/80	818/80
3	3	12	40/=	480/=	DAP	33.3	205/=	136/67	3	3	27/=	81/=	697/67
4	2½	12	35/=	420/=	20:20:0	100	110/=	220/=	3	3	27/=	81	721/=
5	3	10	35/=	350	-	-	-	-	3	3½	27/=	94/50	444/50
6	2½	11	33/=	363/=	-	-	-	-	3	2¾	27/=	74/25	437/25
7	5	11	35/=	385	-	-	-	-	4	5½	27/=	148/50	533/50
8	4	11	35/=	385/=	TSP (4) DAP (2)	50 25	130/= 150/=	205/=	4	7	27/=	189/=	779/=
9	4	12	30/=	360/=	17:17:17	25	85/=	42/50	4	6½	27/=	175/50	578/=
10	6	10	30/=	300/=	DAP	8.3	160/=	26/67	4	5¼	27/=	141/75	468/42
11	4	12	30/=	360/=	-	-	-	-	4	7	27/=	189/=	549/=
12	5	10	30/=	300/=	DAP	20	205/=	82/=	4	4	33/40	133/60	515/60
13	5	9	30/=	270/=	-	-	-	-	3	3	27/=	81/=	351/=

(continued)

Appendix III Continued.

Farm No.	Potato acreage	Seedpotatoes			Fertilizers				Dithane M45				Total Cost
		Bags per acre	Price shs/bag	Cost shs/acre	Type	Amount kg/acre	Price shs/per 50kg	Cost shs/acre	No. of sprays	Amount kg/acre	Price shs/kg	Cost shs/acre	shs/acre
14	4	10	35/=	350/=	—	-	-	-	4	4	33/40	133/60	483/60
15	4	10	32/=	320/=	-	-	—	-	4	5¼	27/=	141/75	461/75
16	3	12	30/=	360/=	-	-	--	-	4	4	33/40	133/60	493/60
17	4	10	30/=	300/=	-	-	-	-	4	5¼	33/40	175/35	475/35
18	4	10	35/=	350/=	20:20:0	62.5	110/=	137/50	3	3	27/=	81/=	568/50
19	4	10	33/=	330/=	—	-	-	-	4	5½	33/40	183/70	513/70
20	3	10	35/=	350/=	-	-	--	-	3	4½	33/40	150/30	500/30
21	5	12	30/=	360/=	15:15:6/4	60	92/50	111/=	4	5¼	27/=	141/75	612/75
					15:45:	66.7	200/=						
22	3	10	30/=	300/=	15:15:6/4	66.7	85/=	380/=	4	5	27/=	135/=	815/=
23	2	10	34/=	340/=	-	-	-	-	3	4	27/=	108/=	448/=
24	4	12	30/=	360/=	DAP	87.5	205/=	358/75	4	4	25/20	100/80	819/55
25	4	11	30/=	330/=	17:17:17	50	85/=	85/=	4	5¼	27/=	141/75	556/75
26	3	10	33/=	350/=	DSP	16.7	125/=	41/67	4	5½	27/=	148/50	540/17
27	3	10	33/=	330/=	-	-	-	-	4	4	27/=	108/=	438/=
28	2	10	30/=	300/=	20:20:0	100	110/=	220/=	3	3	27/=	81/=	601/=
29	6	10	30/=	300/=	-	-	-	-	3	4	33/40	133/60	433/60
30	5	12	30/=	360/=	20:20:0	100	110/=	220/=	4	4	33/40	133/60	713/60
31	12	10	35/=	350/=	20:20:0	66.7	110/=	146/67	4	5¼	27/=	141/75	638/42

.(continued)

Appendix III Continued.

Farm No.	Potato acreage	Seedpotatoes			Fertilizers				Dithane M45				Total Cost
		Bags per acre	Price shs/bag	Cost shs/acre	Type	Amount kg/acre	Price shs/per 50kg	Cost shs/acre	No.of sprays	Amount kg/acre	Price shs/kg	Cost shs/acre	shs/acre
32	5	10	30/=	300/=	DAP	20	165/=	66/=	4	5½	27/=	148/50	514/50
33	4	10	35/=	350/=	DAP	37.5	165/=	123/75	4	5½	27/=	148/50	622/25
34	3½	12	40/=	480/=	-	-	-	-	4	5½	33/40	183/70	663/70
35	1	10	35/=	350/=	DAP	50	165/=	165/=	4	5½	27/=	148/50	663/50
36	5	10	28/=	280/=	-	-	-	-	3	3	27/=	81/=	361/=
37	3	10	30/=	300/=	-	-	-	-	3	3	27/=	81/=	381/=
38	3	10	30/=	300/=	20:20:0	33.3	110/=	73/33	3	3¾	27/=	101/25	474/58
39	5	10	35/=	350/=	DAP	20	150/=	60/=	3	3	27/=	81/=	491/=
40	3	10	33/=	330/=	-	-	-	-	3	3	27/=	81/=	411/=
41	5	12	30/=	360/=	DAP	90	205/=	369/=	4	4	27/=	108/=	837/=
AVERAGE	4.0	10.6	32/95	349/25	-	54.8	139/01	152/35	3.6	4.3	30/27	130/15	631/75

Source: Author's investigation.

Appendix IV: Potato production costs for the Long Rains (September - November) crop in Kiirua zone, Meru District, in 1975.

Farm	Potato	Seedpotatoes			Fertilizers				Dithane M45				Total
No.	acreage	Bags per acre	Price shs/bag	Cost shs/acre	Type	Amount kg/acre	Price shs/per 50kg	Cost shs/acre	No.of sprays	Amount kg/acre	Price shs/kg	Cost shs/acre	Cost shs/acre
42	4	9	30/=	270/=	C.A.N Foliar feed	4 TINS	10/= per TIN	10/=	3	3	33/40	100/20	380/20
43	2	9	35/=	315/=	-	-	-	-	4	3½	33/40	116/90	431/90
44	7	10	40/=	400/=	17:17:17	14.3	135/40	38/69	3	3	25/20	75/60	514/29
45	5½	11	35/=	385/=	-	-	-	-	3	3	33/40	100/20	485/20
46	2	8	35/=	280/=	-	-	-	-	4	4	27/=	108/=	388/=
47	2	8	30/=	240/=	-	-	-	-	1	½	27/=	13/50	253/50
48	3½	8	35/=	280/=	-	-	-	-	1	1	27/=	27/=	307/=
49	3	8	35/=	280/=	-	-	-	-	2	2	27/=	54/=	334/=
50	2½	10	30/=	300/=	17:17:17	40	135/40	108/32	3	3	33/40	100/20	508/52
51	2	8	45/=	360/=	23:23:0	20	144/90	57/95	4	4	33/40	133/60	551/55
52	1	8	35/=	280/=	-	-	-	-	3	3	33/40	100/20	380/20
53	2	8	35/=	280/=	-	-	-	-	3	3	21/=	63/=	343/=
54	2	8	35/=	280/=	-	-	-	-	2	2	33/40	66/80	346/80
55	2	10	35/=	350/=	-	-	-		4	4	27/=	108/=	458/=
56	4	8	35/=	280/=	TSP	37.5	129/=	96/75	3	4	33/40	133/60	510/35

(continued)

Appendix IV: Continued.

Farm No.	Potato acreage	Seedpotatoes			Fertilizers				Dithane M45				Total Cost shs/acre
		Bags per acre	Price shs/bag	Cost shs/acre	Type	Amount kg/acre	Price shs/per 50kg	Cost shs/acre	No.of sprays	Amount kg/acre	Price shs/kg	Cost shs/acre	
57	2½	10	35/=	350/=	C.A.N. Foliar feed	3.2 TINS*	10/= per TIN	32/=	3	3¼	33/40	108/55	490/55
58	4	10	35/=	350/=	15:45:0	25	198/=	99/=	3	3	33/40	100/20	549/20
59	3½	9	35/=	315/=	20:20:0	28.6	110/=	62/86	3	3	33/40	100/20	478/06
73	2½	10	40/=	400/=	DAP	30	160/=	96/=	3	2¾	27/=	74/25	570/25
74	4	8	28/=	224/=	-	-	-	—	2	2	33/40	66/80	290/80
75	3	8	28/=	224/=	-	-	-	-	4	4	33/40	133/60	357/60
AVERAGE	3.1	8.9	34/55	307/50	-	64.8	159/93	66/85	2.9	3.2	28/03	89/70	464/05

* Each TIN contains 0.4 kg of C.A.N. foliar feed.

Source: Author's investigation.

Appendix V: Potato production costs for the Long Rains (September - November) crop in Upper Abothuguchi zone, Meru District, in 1975.

Farm No.	Potato acreage	Seedpotatoes			Fertilizers				Dithane M45				Total Cost shs/acre
		Bags per acre	Price shs/bag	Cost shs/acre	Type	Amount kg/acre	Price shs/per 50kg	Cost shs /acre	No. of sprays	Amount kg/acre	Price shs/ kg	Cost shs/acre	
60	5	10	40/=	400/=	17:17:17 D.A.P	70 30	135/40 150/=	279/56	4	4	33/40	133/60	813/16
61	1	10	45/=	450/=	17:17:17 DAP	100 20	135/40 205/=	270/80	4	4	33/40	133/60	804/40
62	2½	8	45/=	360/=	17:17:17 DAP	20 33.3	135/40 150/=	136/16	4	4	33/40	133/60	629/76
63	1½	10	35/=	350/=	17:17:17	50	135/40	370/80	3	3	33/40	100/20	821/=
64	2	10	45/=	450/=	-	-	-	-	4	4	33/40	133/60	583/60
65	2	10	50/=	500/=	DAP	50	150/=	150/=	4	6½	33/40	217/10	867/10
66	1	8	45/=	360/=	DAP	100	205/=	410/=	5	6½	33/40	217/10	987/10
67	1	8	45/=	360/=	17:17:17	150	135/40	406/20	5	7½	33/40	250/50	899/80
68	1	10	45/=	450/=	17:17:17	150	135/40	406/20	4	4	33/40	133/60	989/80
69	¾	8	45/=	360/=	DAP	33.3	205/=	136/67	3	3	33/40	100/20	596/87
70	1	8	45/=	360/=	DAP	50	160/=	160/=	4	4	33/40	133/60	653/60
71	1	10	50/=	500/=	DAP	150	205/=	615/=	4	5½	33/40	183/70	1298/70
72	¾	10	50/=	500/=	DAP	66.7	160/=	213/33	3	3	33/40	100/20	813/53
AVERAGE	1.6	9.2	45/=	415/40	-	90.5	163/67	296/25	3.9	4.5	33/40	151/60	830/35

Source: Author's investigation.

APPENDIX VI: LABOUR INPUT IN POTATO PRODUCTION IN KIBIRICHIA, MERU DISTRICT, IN 1975.

(Mandays per acre)

FARM NO.	LAND PREPARATION		FERTILIZER APPLICATION		PLANTING		WEEDING		SPRAYING		HARVESTING & GRADING		SUBTOTALS		COMBINED TOTALS
	F	H	F	H	F	H	F	H	F	H	F	H	F	H	F + H)
1	-	4	2	-	-	8	-	9	-	4	-	24	2	49	51
2	-	7	-	2	-	10	-	30	4	4	9	10	13	63	76
3	-	2	-	2	2	2	-	28	3	-	6	6	11	40	51
4	-	2	2	-	3	4	9	18	-	6	12	16	26	46	72
5	2	4	-	-	-	5	-	9	-	3	7	14	9	35	44
6	-	3	-	-	-	5	-	15	3	-	-	17	3	40	43
7	-	4	1	-	4	-	9	15	4	-	7	16	25	35	60
8	-	2	-	2	-	6	-	21	-	8	-	25	-	64	64
9	-	11	4	-	8	-	-	18	8	-	10	14	30	43	73
10	-	2	2	-	6	-	-	18	-	8	-	24	8	52	60
11	-	6	-	-	3	3	-	15	-	4	-	26	3	54	57
12	-	2	-	2	-	5	-	18	-	4	-	22	-	53	53
13	-	2	-	-	-	5	-	8	-	8	-	17	-	40	40
14	-	2	1	-	6	-	-	12	-	8	-	17	7	39	46
15	-	2	-	-	4	-	-	7½	-	3	4	20	8	32½	40½

APPENDIX VI: (continued)

FARM NO.	LAND PREPARATION		FERTILIZER APPLICATION		PLANTING		WEEDING	
	F	H	F	H	F	H	F	H
16	-	2	-	-	6	-	-	12
17	-	1	-	-	-	5	-	15
18	-	3½	-	2	-	4	-	24
19	-	4	-	3	-	5	-	24
20	2	2	-	-	-	5	-	21
21	-	4	3	-	-	5	-	30
22	-	1	1	-	-	5	-	21
23	-	4	-	-	5	-	24	-
24	-	4	1	-	-	6	-	12
25	21	-	3	-	6	-	24	-
26	-	2	1	-	6	-	-	12
27	-	4	1	-	-	4	-	21
28	-	8	-	2	-	7	-	8
29	-	1	-	-	10	-	-	21
30	-	2	3	-	-	4	-	30

	SPRAYING		HARVESTING & GRADING		SUBTOTALS		COMBINED TOTALS
	F	H	F	H	F	H	F + H)
	4	-	-	13	10	27	37
	-	4	10	23	10	48	58
	-	3	-	20	-	56½	56½
	-	4	28	30	28	70	98
	3	-	20	27	25	55	80
	-	4	-	34	3	77	80
	-	4	-	38	1	69	70
	4½	-	-	29	33½	33	66½
	-	4	-	12	1	38	39
	4	-	10	22	68	22	90
	-	4	-	72	7	88	95
	4	-	-	32	5	61	66
	-	6	-	15	-	46	46
	-	6	-	12	10	40	50
	-	3	-	31	3	75	78

APPENDIX VI: (continued)

FARM	LAND PREPARATION		FERTILIZER APLICATION		PLANTING		WEEDING		SPRAYING		HARVESTING & GRADING		SUBTOTALS		COMBINED TOTALS
	F	H	F	H	F	H	F	H	F	H	F	H	F	H	F + H
31	-	1	-	2	-	10	-	15	-	4	-	29	-	61	61
32	-	2	-	2	-	6	-	12	-	4	-	18	-	44	44
33	-	4	-	2	-	5	-	12	-	4	-	29	-	56	56
34	-	3	-	1½	-	4	-	12	-	6	-	15	-	41½	41½
35	14	4	-	1	-	5	-	24	-	4	-	39	14	77	91
36	-	2	-	-	-	5	-	12	-	3	-	51	-	73	73
37	-	2	-	-	3	-	9	-	3	-	-	8	15	10	25
38	-	4	-	3	-	5	-	18	-	3	-	23	-	56	56
39	-	2	-	1	-	4	-	15	-	3	-	39	-	64	64
40	-	4	-	-	4	-	-	12	-	3	-	15	4	34	38
41	-	2	2	-	-	5	-	24	-	4	-	23	2	58	60
Total average	4.1		1.9		5.6		17.7		4.6		26.5				60.4

H = Hired Labour

F = Family Labour.

Source: Author's investigation.

APPENDIX VII: LABOUR INPUT IN POTATO PRODUCTION IN KIIRUA, MERU DISTRICT, IN 1975

(Mandays per acre)

FARM NO.	LAND PREPARATION		FERTILIZER APPLICATION		PLANTING		WEEDING		SPRAYING		HARVESTING & GRADING		SUBTOTALS		COMBINED TOTALS
	F	H	F	H	F	H	F	H	F	H	F	H	F	H	(F + H)
42	3	3	-	-	6	-	-	24	-	3	-	32½	9	62½	71½
43	-	2	-	-	5	-	15	-	4	-	11	-	35	2	37
44	-	2	-	3	-	5	-	12	-	6	-	36½	-	64½	64½
45	-	2	-	-	-	5	-	42	-	3	-	10	-	62	62
46	8	-	-	-	4	-	12	-	4	-	26	-	54	-	54
47	-	2	-	-	-	4	-	16	-	1	-	6	-	29	29
48	-	2	-	-	4	-	16	-	2	-	-	8½	22	10½	32½
49	-	7	-	-	-	5	-	10	-	2	-	12	-	36	36
50	-	1	2	-	-	6	-	24	6	-	-	21½	8	52½	60½
51	10	-	4	-	7	-	24	-	8	-	43	-	96	-	96
52	2	4	-	-	8	-	-	8	-	3	-	19	10	34	44
53	-	5	-	-	-	4	-	10	-	3	-	20	-	42	42
54	2	-	-	-	8	-	16	-	2	-	12½	-	40½	-	40½
55	-	2	-	-	4	-	18	-	8	-	-	17	30	19	49
56	-	4	1	1	-	4½	-	8	-	3	11	16	12	35½	47½

APPENDIX VII: (continued)

FARM	LAND PREPARATION		FERTILIZER APPLICATION		PLANTING		WEEDING		SPRAYING		HARVESTING & GRADING		SUBTOTALS		COMBINED TOTALS
	F	H	F	H	F	H	F	H	F	H	F	H	F	H	(F + H)
57	4	-	-	-	5	-	16	-	3	-	6	-	34	-	34
58	-	2	2	2	-	5	18	-	3	3	-	28½	23	38½	61½
59	7	-	½	1½	-	4	-	18	-	3	-	8	7½	34½	42
73	6	-	1½	-	4	-	4	-	6	-	13	-	34½	-	34½
74	14	-	2	-	5	-	16	-	2	-	16½	-	55½	-	55½
75	8	-	-	-	4	-	16	-	4	-	24	-	56	-	56
Total average	4.9		2.6		5.1		16.3		3.9		19.0				51.8

H = Hired Labour

F = Family Labour

Source: Author's investigation.

APPENDIX VIII: LABOUR INPUT IN POTATO PRODUCTION IN UPPER ABOTHUGUCHI, MERU DISTRICT, IN 1975

(Mandays per acre)

FARM NO.	LAND PREPARATION		FERTILIZER APPLICATION		PLANTING		WEEDING		SPRAYING		HARVESTING & GRADING		SUBTOTALS		COMBINED TOTALS
	F	H	F	H	F	H	F	H	F	H	F	H	F	H	(F + H)
60	8½	8½	2	-	-	4	-	27	12	-	-	15	22½	54½	77
61	18	-	3	-	6	-	8	-	8	-	17	-	60	-	60
62	8	3	2	1	3	2	18	6	4	4	23	12	58	28	86
63	11	-	3	-	6	-	24	-	6	-	20	8	70	8	78
64	4½	9	-	-	1	2	6	15	4	8	2	6	17½	40	57½
65	10	5	2	1	5	2	10	5	2	2	5	10	34	25	59
66	8	-	1	-	4	-	18	-	10	-	36	-	77	-	77
67	15	-	2	-	4	-	20	-	10	-	10	-	61	-	61
68	14	-	3	-	6	-	21	-	8	-	13	-	65	-	65
69	14	-	2	-	5	-	20	-	6	-	6	-	53	-	53
70	7	-	1	-	3½	-	9	-	4	-	4½	-	29	-	29
71	19	-	1	-	5	-	18	-	8	-	26	-	77	-	77
72	3	17	2	2	3	3	6	8	8	8	8	-	30	38	68
Total average	12.7		2.3		5.0		18.4		8.6		17.0				64.0

H = Hired Labour

F = Family Labour

Source: Author's investigation

APPENDIX IX Prices for the commonly used types of fertilizer in potato production in Meru district, 1975.

TYPE OF FERTILIZER		OLD PRICE (Before Sept.,1975)	NEW PRICE (After Sept., 1975)
Diammonium phosphate (DAP)		205/= per 50kg bag	150/= per 50kg bag
Double superphosphate (DSP)		155/35 per 50kg bag	127/50 per 50 kg bag
Triple superphosphate (TSP)		155/35 per 50 kg bag	127/50 per 50 kg bag
COMPOUND FERTILIZERS	15:15:6/4	-	170/= per 100 kg bag
	15:45:0	198/60 per 50kg bag	155/= per 50 kg bag
	17:17:17	135/40 per 50 kg bag	80/= per 50 kg bag
	20:20:0	120/= per 50kg bag	87/50 per 50 kg bag
	23:23:0	115/90 per 40 kg bag	97/= per 40 kg bag
FOLIAR FEED	9:9: 7	10/= per 400 of tin	10/= per 400 g tin.

Source: Author's investigation (from KFA and Fertilizer dealers in Meru District, 1975)

APPENDIX X: Sample potato plot sizes (in ACRES) in North Imenti Division of Meru District.

1: KIBIRICHIA ZONE: (n=41)

FARM NO.	POTATO		ACREAGE	FARM NO.	POTATO		ACREAGE
	LRS 1975	SRS 1975	LRS 1974		LRS 1975	SRS 1975	LRS 1974
1	5	4	4	26	3	3	2
2	4	3	2½	27	3	3	3
3	3	1	2½	28	2	2½	3
4	2½	1½	1½	29	6	2½	3
5	3	2	2	30	5	3	2
6	2½	2	2	31	12	8	10
7	5	3	4	32	5	4	4
8	4	4	3	33	4	3	2½
9	4	3	2½	34	3½	2½	2
10	6	3	8	35	1	1	2
11	4	3	3	36	5	5	4
12	5	4	5	37	3	2½	2½
13	5	5	6	38	3	2	2
14	4	3	3	39	5	4	4
15	4	2	3	40	5	3	2½
16	3	1½	4	41	5	3	2
17	4	2	2½				
18	4	3	3	AVERAGE	4.04	3.07	3.30
19	4	3	2½				
20	3	4	3				
21	5	4	5				
22	3	2	2				
23	2	3	1				
24	4	3	4				
25	4	5	6				

LRS = Long Rains Season (September - November)

SRS = Short Rains Season (March - May).

APPENDIX X (CONTINUED):

2. KIIRUA ZONE (n=21)

FARM NO.	POTATO ACREAGE LRS 1975	SRS 1975	LRS 1974
42	4	2	2
43	2	4	2
44	7	7	8
45	5½	5	6
46	2	1½	2
47	2	1	1
48	3½	1	1
49	3	2	2
50	2½	2	2
51	2	3½	3½
52	1	2½	3
53	2	0	1
54	2	1	1½
55	2	2	¾
56	4	2	3
57	2½	1½	3
58	4	2	2
59	3½	1	2
73	2½	1½	1½
74	4	4	7
75	3	3	3
AVERAGE	3.05	2.36	2.73

3. UPPER ABOTHUGUCHI ZONE (n=13)

FARM NO.	POTATO ACREAGE LRS 1975	SRS 1975	LRS 1974
60	5	2½	3½
61	1	2	3
62	2½	1	1
63	1½	2	1
64	2	½	1
65	2	1½	3
66	1	2½	2
67	1	¾	1
68	1	1½	1
69	¾	1	⅜
70	1	½	¼
71	1½	1½	1½
72	¾	½	½
AVERAGE	1.62	1.37	1.47

4. SAMPLE TOTAL ACREAGES (n=75)

Kibirichia	65.5	126.0	135.5
Kiirua	64.0	49.5	57.25
Upper Aboth.	21.0	17.75	19.13
AVERAGE (North Imenti)	3.34	2.58	2.83
		1975	1974

Source: Author's investigation.

APPENDIX XI: Sample potato yields in North Imenti Division of Meru District in 1975

(Bags per acre)

1; KIBIRICHIA ($n = 41$)

Farm No.	Bags of 84kg		Farm No.	Bags of 84kg	
	SRS	LRS		SRS	LRS
1	88	83	26	33	97
2	58	40	27	38	57
3	100	57	28	8	15
4	73	48	29	52	30
5	60	60	30	50	71
6	75	80	31	73	75
7	67	78	32	50	38
8	45	80	33	50	69
9	45	46	34	68	46
10	97	83	35	40	66
11	105	99	36	32	66
12	50	53	37	38	15
13	54	44	38	50	43
14	67	113	39	25	58
15	80	75	40	50	31
16	100	62	41	50	55
17	75	100	Average	56.1	61.8
18	67	53			
19	28	69			
20	15	65			
21	75	106			
22	50	90			
23	20	40			
24	67	38			
25	32	38			

n = Sample size
LRS = Long Rains season.
SRS = Short Rains season.

Appendix XI (continued):

2. KIIRUA ZONE (n=21)		
Farm No.	Bags of 84kg SRS	LRS
42	35	55
43	63	35
44	43	62
45	64	47
46	53	76
47	60	30
48	30	12
49	5	20
50	30	28
51	23	69
52	12	32
53	-	28
54	30	26
55	70	50
56	48	53
57	80	32
58	60	71
59	40	15
73	48	45
74	13	31
75	11	26
Average	40.8	40.1

3. UPPER ABOTHUGUCHU (n= 13)		
Farm No.	Bags of 94 kg SRS	LRS
60	60	45
61	60	50
62	40	60
63	55	77
64	80	35
65	49	50
66	29	50
67	93	60
68	47	30
69	55	24
70	32	20
71	70	59
72	60	26
Average	56.2	40.1

n = Sample size
LRS = Long Rains season.
SRS = Short Rains season.

Source: Author's investigation.

Appendix XII Weekly prices for red potatoes in Wakulima market, Nairobi, 1974 and 1975.

(Shs per bag of 105 kg)

Week	1974	1975	Week	1974	1975
1	52/50	60/=	27	42/50	67/50
2	47/50	65/=	28	43/50	57/50
3	49/=	72/=	29	42/50	57/50
4	52/50	67/50	30	42/50	52/50
5	47/50	62/50	31	42/50	57/50
6	52/50	72/50	32	42/50	55/=
7	62/50	72/50	33	47/50	52/50
8	62/50	70/=	34	47/50	47/50
9	63/50	70/=	35	50/=	47/50
10	67/50	70/50	36	52/50	57/50
11	67/50	70/=	37	47/50	47/50
12	71/=	72/50	38	47/50	47/50
13	62/50	69/=	39	-	-
14	76/50	74/=	40	50/=	64/50
15	73/=	77/50	41	55/=	62/50
16	72/50	95/=	42	65/=	55/=
17	77/50	102/50	43	67/50	57/50
18	87/50	95/=	44	80/=	67/50
19	82/50	100/=	45	75/=	67/50
20	70/=	100/=	46	-	67/50
21	-	95/=	47	82/50	64/=
22	52/50	100/=	48	80/=	62/50
23	52/50	90/=	49	82/50	-
24	37/50	72/50	50	62/50	-
25	42/50	-	51	75/=	52/50
26	37/50	57/50	52	65/=	-

Source: Horticultural Crops Development Authority (HCDA) price records, Nairobi.

Appendix XIII: Potato prices during the first quarter of 1976 at Kibirichia and Kiirua local Markets, Meru District.

(Shs per bag of 84 kg)

Date	Price	Date	Price
January: 15	15/=	March: 1	28/=
16	15/=	2	28/=
17	15/=	3	27/=
18	16/=	4	27/=
19	16/=	5	27/=
20	17/=	6	27/=
21	17/=	7	27/=
22	18/=	8	27/=
23	18/=	9	26/=
24	18/=	10	26/=
25	18/=	11	26/=
26	18/=	12	25/=
27	20/=	13	25/=
28	20/=	14	-
29	20/=	15	25/=
30	20/=	16	25/=
31	20/=	17	25/=
February: 1	20/=	18	25/=
2	20/=	19	25/=
3	20/=	20	25/=
4	20/=	21	-
5	21/=	22	23/=
6	21/=	23	23/=
7	23/=	24	24/=
8	23/=	25	24/=
9	23/=	26	26/=
10	28/=	27	26/=
11	30/=	28	26/=
12	30/=	29	26/=
13	30/=	30	27/=

Source: Ministry of Agriculture, Meru District, April 1976.

Appendix XIV. Weekly average potato prices at Kibirichia local market, Meru District, 1974 and 1975

(Shs per bag of 84 kg)

Week	1974	1975	Week	1974	1975
1	31/67	22/67	27	25/48	28/=
2	35/=	23/=	28	25/=	25/33
3	34/33	21/=	29	26/=	22/=
4	34/=	23/21	30	26/71	25/50
5	34/=	27/14	31	30/50	26/67
6	33/25	31/14	32	30/=	28/17
7	33/=	32/14	33	30/=	29/=
8	38	32/=	34	28/33	29/=
9	32/50	30/67	35	28/14	28/71
10	32/=	31/=	36	28/50	27/33
11	32/=	32/83	37	30/33	28/29
12	31/75	33/=	38	33/43	30/60
13	31/=	33/57	39	37/40	30/80
14	30/=	34/40	40	40/=	33/=
15	30	39/33	41	40/36	33/40
16	30/=	51/33	42	40/=	-
17	30/=	-	43	40/14	-
18	29/=	50/=	44	40/29	25/=
19	29/=	-	45	40/=	-
20	29	-	46	40/=	25/=
21	29/25	-	47	42/14	-
22	28/=	-	48	47/86	-
23	28/=	-	49	47/=	31/50
24	27/86	-	50	40/71	30/=
25	26/29	-	51	35/=	-
26	25/43	30/=	52	35/=	-

Source: Local traders' price records, Kibirichia in Meru District.

Appendix XV Weekly average potato price at Ntugi market, Meru District, 1974 and 1975.

(Shs per bag of 84 kg)

Week	1974	1975	Week	1974	1975
1	-,		27	21/=	55/=
2	-		28	24/=	60/20
3	35/=		29	27/40	59/=
4	34/=	30/50	30	28/=	45/=
5	34/40	28/16	31	28/20	37/33
6	34/50	31/=	32	27/=	31/50
7	35/=	32/=	33	27/33	32/33
8	36/=	33/=	34	27/25	35/=
9	35/50	33/50	35	28/=	34/33
10	32/83	32/60	36	29/80	30/=
11	32/85	33/75	37	32/66	25/80
12	33/30	35/=	38	36/=	33/25
13	35/=	35/=	39	39/=	40/=
14	35/75	-	40	40/=	40/=
15	-	-	41	40/=	40/=
16	-	-	42	40/=	-
17	-	-	43	40/=	-
18	-	-	44	40/=	-
19	-	-	45	48/75	-
20	-	-	46	47/50	-
21	-	50/=	47	40/=	20/=
22	30/50	50/=	48	44/16	22/85
23	28/=	51/75	49	41/15	27/33
24	26/50	53/75	50	38/67	25/=
25	26/=	53/60	51	35/40	-
26	24/20	55/=	52	35/=	-

Source: Local trader's records, Ntugi in Meru District.

Appendix XVI Fortnightly average potato prices in Meru town open market, Meru District, 1974 and 1975.

(shs per bag of 94 kg)

Month	Wholesale Prices		*Retail prices	
	1974	1975	1974	1975
JAN.	50/=	36/70	-	51/70
	46/=	39/70	-	94/=
FEB.	41/70	46/30	-	117/50
	40/=	41/70	75/20	56/40
MAR.	41/=	42/30	75/20	61/10
	41/=	31/70	79/90	70/50
APR.	42/30	46/30	39/90	79/90
	58/=	52/70	84/60	79/90
MAY.	71/70	64/30	98/70	117/50
	66/70	71/=	98/70	117/50
JUN.	43/70	76/=	61/10	131/60
	40/70	52/70	61/10	98/70
JUL.	36/30	39/=	75/20	108/10
	38/30	39/=	56/40	98/70
AUG.	-	40/70	-	51/70
	44/-	-	70/50	-
SEP.	41/70	53/30	94/=	79/90
	55/=	-	94/=	-
OCT.	54/70	-	94/=	-
	56/70	51/=	98/70	94/=
NOV.	54/70	34/30	47/=	112/80
	56/70	37/70	84/60	108/10
DEC.	66/=	39/60	108/10	122/20
	50/=	33/60	54/52	89/30

* Retail prices have been converted from shs per kg to shs per bag of 94 kg

Source: HCDA price records, Meru District.