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Potato Production and Utilization in Kenya

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POTATO PRODUCTION AND UTILIZATION IN KENYA

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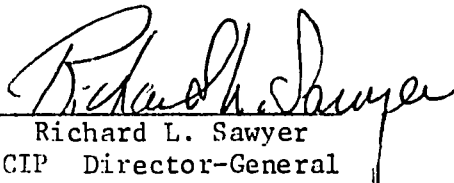
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PREFACE

Few comprehensive studies are available on potato production, distribution and use in developing countries. In order to begin filling gaps in knowledge about the present and potential role of the potato in the developing world, CIP's Social Science Department is conducting a series of Country Studies on potato production and utilization, in collaboration with national institutions. These studies are written by specially contracted social scientists following a similar outline. The main topics included are production, distribution, utilization and public programs related to the crop. An attempt is made to place current situations in historical perspective. Sources of information for the studies include secondary materials, interviews with key informants and, in some cases, formal surveys of potato producers, merchants and consumers.

The purpose of the Country Studies is to present a comprehensive picture of the potato industry in selected countries with diverse patterns and trends of potato cultivation, marketing and use in distinct institutional settings. Country Studies have been completed in Ecuador and Chile, two South American countries with relatively high consumption levels but distinct ecological and socio-economic conditions. This Kenya Study documents the historical and present role of the potato in an East African country where potatoes have only recently achieved the importance of a major highland crop. Studies being prepared on Rwanda and Costa Rica will illustrate potato production and use systems in two small countries with more tropical growing conditions. An India Study will analyze factors behind the rapid expansion of the potato crop in this major Asian country, where production crossed the ten-million-ton mark in 1979.

We hope that the studies' conclusions, which are of use to CIP, will also be useful to the national institutions involved and to others concerned with exploiting the potential role of the potato as a foodcrop in developing countries. In addition, we hope that the approach applied in these studies of potatoes might be useful for research on other commodities, leading to a better understanding of overall crop production and use in the developing world.


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FOREWORD

This report has its own unique history. It is one result of a research project with various institutional components. In need of teaching material, the Department of Agricultural Economics, University of Nairobi, employed students to study various aspects of the potato industry. Later, the International Potato Center proposed the writing of a general baseline study on potatoes in Kenya and sponsored a survey on potato production in major potato growing areas. The preliminary results of this study aroused the interest of the Kenyan Government, encouraging the Market Development Project to take a closer look at aspects of potato marketing. This effort was supported by the German Agricultural Team in Kenya.

Little by little the body of information grew until it was possible to draw a reasonably consistent picture of the potato industry. We hope that we have managed to come near to the true picture, despite the many questions still to be answered.

Thanks go to all institutions and individuals cooperating with this Project. We bothered more than 500 farmers, 250 consumers, 100 traders, 50 Government officers, an unknown number of students and quite a few others on whom we tried our ideas.

The manuscript was edited by CIP's Social Science Department.

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I. INTRODUCTION AND SUMMARY

This report serves three purposes: (a) to describe comprehensively the potato industry in Kenya, (b) to point out deficiencies in the potato industry and put forward some proposals for improvement, and (c) to provide useful information for technical assistance programmes concerned with the potato industry.

Though not a stated objective, the surveys were expected to help integrate diverse groups concerned with the potato industry. Many persons with different interests got to know each other, and they are now in a better position to understand themselves as well as the Kenyan potato production and consumption system. As a consequence, the political basis for change in the potato industry has most likely improved.

Most information provided in this report is primary information collected by students, research fellows and government officers. Some of it is still controversial and inconsistent. Nevertheless, one gets a fairly clear picture of the state of affairs in the potato industry as outlined in the following paragraphs.

Potatoes have been grown in Kenya for over 70 years. Initially the crop was grown primarily by European farmers for their own community and for export to Southern Africa and Asia. Over time potato production and use has expanded rapidly and the potato now plays a noticeable role as a foodcrop in producer areas and as a consumer good in urban centres.

A general analysis of the agricultural sector indicates that the potato crop is still rather unimportant. Its contribution to Kenya's agriculture, expressed in terms of marketed value, production or employment is in the range of only 1-3%. As a food item, if measured in terms of daily calory intake per capita, its share is similarly low. The national averages are misleading however, and a disaggregated approach gives a somewhat different picture. At present, the total number of potato growers is estimated at around 450,000, which is about one-third of all farmers in Kenya. These farmers grow some 75,000-100,000 hectares of potatoes per year in two seasons. Total production is estimated at 400,000-500,000 tons per year, of which 230,000-250,000 tons are consumed within the producing areas and 80,000-100,000 tons are marketed, mainly to urban centres; the remainder is retained on the farm for seed. The total value of the annual production is estimated at about K £ 5 million.¹

About 35-40% of Kenya's population consumes potatoes regularly. Consumption is limited to certain rural areas in the central highlands; and to urban centres. Per capita consumption is highest in producing areas, where it is estimated at 70-100 kg per year; in urban centres,

per capita consumption is around 50 kg per year; consumption in rural non-potato producing areas is negligible. A national average of 20-25 kg consumption per capita, per year, seems reasonable.

Ecological conditions restrict potato production to the highlands of Kenya, which comprise less than 10% of Kenya's total area. Agricultural production within this high-potential zone is regionally diversified. Major potato growing areas are in the central highlands in the Districts north and northwest of Nairobi (Kiambu, Murang'a, Nyeri and Nyandarua Districts in Central Province, Meru District in Eastern Province and Molo Division, Nakuru District, Rift Valley Province). In these areas, almost every farmer grows potatoes. In the highlands in western Kenya, potatoes are not a popular crop although ecological conditions appear favourable.

Potatoes are grown mainly on small family farms (2 ha. or less) where foodcrop production is geared primarily towards securing food for subsistence and only surpluses are marketed; additional income is obtained from "cash crops." On most farms, potatoes are grown as a foodcrop with only a small share marketed. Other major foodcrops are maize, various types of sorghum and millet, beans and vegetables. Commercial crops include tea, coffee, pyrethrum and to some extent wheat and barley. Dairy cattle also play an important role for farmers.

The average size of potato plots on these farms is less than one-half hectare. The crop is grown twice per year coinciding with the rainfall pattern. Yields are generally low. An average yield level of about 5 ton/ha. has been maintained since the crop was introduced in the country, although yields of more than 20 ton/ha. are achieved as well. Major production problems appear to be poor seed quality, inadequate disease and pest control and low soil fertility. Application of purchased inputs for intensive production differs between the various producing areas.

Extensive production methods with no or few purchased inputs are generally applied by farmers growing potatoes for their own food supply. Production on such farms is in the range of 1 ton per crop. Most of the potato producers in Central Province fall into this category. More commercially oriented producers are found in Meru District, where potato plots are larger and average production per farm amount to about 12 tons per season. Yields in this area are about 10 tons per ha. (twice as high as in the other areas) and 60% of the crop is sold on the market. The high yields are most likely due to effective application of fungicides for blight control and the high quality of seed. A third type of producer is in forest areas, where cultivators clear the indigenous vegetation to grow potatoes and maize. Here potatoes play an important role as an early source of food and cash, since the alternative crop (maize) takes twice or three times as long to mature. No purchased inputs are used in crop production and yields are around 5 ton/ha.

Use of certified seed is not common in any area. Government programmes have produced small amounts of certified seed for blight resistant varieties, but these varieties have not been widely accepted. Their major shortcomings are reported to be long maturing time and poor marketability. Furthermore, the certified seed has been expensive and difficult to obtain in time for planting.

Major market outlets for potato producers are local and interregional traders who channel the produce to urban centres, such as Nairobi and Mombasa. Here, the commodity is channelled, partly through a wholesale market, to retailers.

The potato is a widely accepted food item for urban consumers, although it contributes only about 5% of the calory intake (as compared to about 50% from maize). Costs for both energy and protein provided in potatoes are relatively high compared to major staples (maize, rice and beans).

Prices fluctuate according to the seasonality of supply, and are particularly low during harvesting time. Consumers prefer certain red-skinned varieties, and these have about 30% higher prices than white-skinned varieties.

At present price and income level and the price elasticity of demand for potatoes is assumed to be rather low and the income elasticity high. An expansion of the urban market can be expected to come from population growth with an additional minor expansion due to higher incomes. The present growth rate of the urban potato market is estimated at 8% annually, which is equivalent to about 1-2% of the present total production.

Potato improvement programmes should be directed towards reducing and stabilizing urban retail prices, increasing yields in areas where land is a limiting resource for subsistence oriented production, and increasing the overall productivity of the potato enterprise in areas where potatoes are primarily a commercial crop.

Improvement measures should be differentiated by target groups. Commercial producers are likely to accept capital intensive input packages but more subsistence oriented producers with extremely scarce resources need technologies which do not involve large quantities of purchased inputs. To facilitate commercialization of production all improvement programmes should take into account the quality requirements of the market.

Footnotes

1. One Kenyan pound (K £) = 20.00 Kenyan Shillings (K Shs)
In 1979 approximately 7.00 K Shs = US\$ 1.00 or
14.00 K Shs = 1 U.K. £ Sterling

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II. HISTORY OF THE POTATO INDUSTRY

A. 1900 to 1920

The white potato (Solanum tuberosum) was brought into the protectorate of Kenya from Europe during the late Nineteenth Century, most likely by the British East Africa Trading Company, which represented the British Government's interests. While settlers, mainly originating from South Africa, started growing potatoes in the "White Highlands," which the government had reserved for European settlement. Because of its origin, in Kenya the potato is generally referred to as English, or Irish potato.

During the early period of establishing the potato crop in Kenya, it was grown only by European farmers and for the consumption of the European community. As a result, expansion of the crop was rather limited. However, during World War I, Kenya's potato industry was viewed as a potential source of food for the British armies in Africa and Asia. The government made efforts to establish an export market to Southern Africa and in 1912 managed to export potatoes worth about 70,000 Rupees. Further exports were carried out during the following years. However, trade was severely impeded by a fungus disease (Nectaria solani), which caused the potatoes to rot during shipment. To improve the situation, the government established an extension service to assist producers and imported seed to provide healthy planting material to growers. Despite these efforts, the government's opinion at that time was, that "the prospects for developing a potato industry are not hopeful." ¹

B. Period Between World War I and II

Towards the end of the First World War, there was a severe shortage of potatoes on the market and prices rose to K Shs 8.00 per bag (80 kg).² The government expanded the Department of Agriculture and established the Scott Agricultural Laboratories and the Plant Breeding Station in Njoro. These institutions introduced new varieties, conducted agronomic studies and attempted to produce healthy seed locally. Their efforts to provide a sufficient quantity of healthy seed to growers were hampered by adverse weather conditions and more seed had to be imported.

According to a 1921 report, a total of 229 acres of potatoes were grown by white settlers, and the value of the potato exports was K£ 8,042.00.³ The government continued to promote potato seed production in conjunction with better varieties and expansion of export markets. With this support, the potato began to establish itself among the main crops in the country.

During the years after World War I, African farmers in Kenya started to grow potatoes. Production was concentrated in certain parts of the Rift Valley and was for domestic purposes only. Around 1923 the first export standards were set up, with three grades for potatoes requiring sanitary certificates. In 1927 grading of potatoes for export became compulsory and an inspector was posted to Kilindini in Mombasa to impose the regulations. The major disease to be observed in export trade was Wart Disease (Synchytrium endobioticum); others considered were Early Blight (Alternaria solani), Late Blight (Phytophthora infestans) and virus diseases such as Leaf Roll, Mosaic and Streak.⁴

After 1923 African producers qualified to enter the export market, and a degree of specialization evolved, with most of the export crop being provided by the African growers. European farmers continued to produce seed and for the domestic waremarket.

The main destination for potato exports was India, with other markets in Southern Africa.⁵ The quantities exported were in the range of 2,000 to 4,000 tons per year (Table 1).

Table 1: Potato Exports 1925 - 1930

Year	Quantity (Tons)	Value K£
1925	1,690	7,726
1926	2,206	10,999
1927	2,155	10,036
1928	2,865	16,990
1929	4,138	27,050
1930	2,251	11,138

Source: Waithaka, J. H. G., Potato Cultivation in Kenya.

Prices derived from Table 1 are between K Shs 8.00-12.00 per bag (80 kg) During the mid-1930s the potato industry experienced a setback. Production was severely affected by locust attacks and adverse climatic conditions and the export market in India faced difficulties due to competition from Europe; Indian consumers preferred round, white potatoes, whereas the varieties offered by Kenyan growers were long and yellow, with dark skins.⁶ Prices dropped to K Shs 3.00-4.00 in 1935-37 and to K Shs 1.00 per bag in 1938.⁷ African farmers reduced potato production and looked for alternative crops. Production moved from the Rift Valley into Kiambu, Murang'a and Nyeri districts. The main variety grown during that period was Kerr's Pink.⁸

C. During the Second World War (1937-1947)

During the Second World War, potatoes were again among the commodities required for supplying British armies. In order to "obtain military requirements, to ensure equitable distribution of the balance available and to prevent price inflation" control of the potato crop was introduced through the "Supply Board Potato Control" (SBPC).⁹ The flow of ware potatoes to major consumer centres was controlled. Buying centres were set up where African farmers were to deliver their marketable surplus. European growers made individual arrangements with the SBPC. Prices were fixed; in 1940 they were K Shs 6.00 for African potatoes, Europeans, who delivered the produce in bags received K Shs 7.50. The Board controlled all produce which was marketed outside the producing area, trade within producer areas and seed potato markets were not affected. The Board sold lots of 10 tons or more to appointed agents; smaller quantities could be obtained through the local markets.

The Board's selling price was K Shs 8.85 per bag. In case demand exceeded supply, deliveries were to be made from available stocks. If supply was available over and above local requirements, the purchase price for export potatoes was to be fixed separately by the Supply Board.¹⁰

Prices fixed by the Board moved up steadily as the war went on and reached K Shs 16.50 per bag in 1946. During that year, prices were seasonally differentiated. For the main season, from July to November, the price was set at K Shs 12.00 per bag, for December to March K Shs 15.00 and for April to June K Shs 16.50. In 1947, prices were increased to K Shs 20.50 per bag (April to June).¹¹

The Supply Board faced difficulties in maintaining quality standards. Buying agents were engaged to do the handling of the produce and inspectors were employed to impose the regulations. Since prices for poor quality potatoes were very low, there were strong temptations to mix grades.

During the War plants were put up at Kerugoya and Karatina to dehydrate potatoes and other vegetables for army supply. In 1946 the two plants processed about 5,000 tons of potatoes within a 6 month period.¹² In 1940 the total area under potatoes was estimated at 2,400 ha, producing 16,000 tons.¹³ These figures correspond to a yield of about 7 tons per ha, which was considered low. With good seed and appropriate cultivating methods, a yield of 18 tons per ha. had been achieved. This was considered realistic as a long term goal for the potato industry in Kenya.¹⁴

D. Period Up to Independence (1948-1963)

As a legacy of the war period, the potato planting material was badly deteriorated and had to be cleaned from virus diseases and from Bacterial Wilt (Pseudomonas solanacearum).¹⁵ The government supported research efforts in controlling various diseases and assisted farmers in their production programmes. Major emphasis was put on disease control. At the same time the industry relied on imports of new seeds, searching for varieties which showed resistance against various diseases. Among the varieties imported during this time was Rosylin Eburu, or B 53, which is now one of the most widely grown varieties.¹⁶

In 1958 the government created the post of Colony Potato Officer, whose task was to establish a potato seed certification scheme and to introduce and test new varieties. Since bacterial wilt had affected production seriously (particularly in Central Province) the government designed a programme to control this disease through control of potato movements.¹⁷ Production in Central Province declined and farmers planted their good land with coffee. The main potato producing regions at this time were Elburgon and Meru.¹⁸

Meru in particular appears to have experienced a rapid expansion of production. Most of the crop was sold on the domestic market. However at the same time, due to the high quality of the produce from there, Meru potatoes featured prominently in Kenya's potato export market.

There were a number of problems on Meru's potato market at that time. Harvesting periods were highly seasonal. This seasonality was aggravated by poor road conditions, which forced farmers and traders to move the crop before the onset of rains. Lack of storage, coupled with supply fluctuations resulted in very low prices during harvesting periods. Interregional trade was in the hands of Asian traders, who also controlled retail markets. Lack of competition and poor market information allowed the traders to manipulate prices to the disadvantage of both producers and consumers.¹⁹

In order to ease marketing problems, a number of proposals were made:

- (a) provide sufficient storage capacity in cool areas;²⁰
- (b) improve roads and provide capital to societies, who plan to store farmers produce for higher prices;
- (c) adopt a consumer oriented marketing policy by selling attractive pre-packed and weighed good quality potatoes.²¹

These market improvements, to be implemented by cooperative societies or associated growers, were expected to raise producer prices from around K Shs 8.00 per bag to K Shs 20.00 or 25.00. At the retail level, prices in Nairobi were to be between K Shs 36.00 and 45.00 per bag.²²

Furthermore, it was expected that potato exports from Meru could relieve the domestic market and raise domestic prices, during the major harvesting seasons. Exports of Kenyan potatoes fluctuated considerably between 1947 and 1960, as shown in Table 2. Major reasons for this fluctuation were difficulties in production²³ but also irregularities in supply due to political unrest.

Table 2: Potato Exports 1947-1960

Year	Quantity (Tons)
1947	4,000
1948	1,688
1949	2,490
1950	2,200
1952	5,285
1954	800
1956	906
1958	4,250
1960	7,000

Source: Waithaka, J.H.G., Potato Cultivation in Kenya.

During the emergency situation forest areas were closed and production there, as well as exports, were greatly reduced. After 1957 production in forest areas, mainly Elburgon and Aberdares, increased again.²⁴ In 1960, the government designed a "New Potato Development Programme" with the following main points: New varieties should be bred in Kenya for Kenya conditions rather than imported from other countries. Selecting criteria should be disease resistance (Bacterial Wilt, Blight, Leaf Roll Virus), and quality (yield, marketability, keeping quality).²⁵

Emphasis was put on disease resistance followed by high yield potential. Marketability and maintaining quality were of secondary importance, although it was recognized that "the possibility of disease susceptible varieties being grown and if necessary being sprayed, is not precluded if it is found that the increased market value attached to these varieties justifies the increased production costs."²⁶

The area under potatoes was estimated at 18,000 ha, of which 2,000 ha. were grown by European farmers, 8,000 ha. in so-called African Reserves and 8,000 ha. in forest areas.

In 1961 a Potato Research Advisory Committee was formed which identified disease control, seed multiplication and marketing of ware potatoes as important problems. Neither the efforts to breed disease resistant varieties²⁷ nor the attempt to establish a local seed certification scheme proved very successful.²⁸ In the field of storage, trials were carried out to test various storage methods, the results were quite encouraging.²⁹

E. After Independence (1964-1975)

Shortly after Independence, many expatriates who had been involved in the national potato programme left the country, and it took time to replace them with Kenyan professional staff.

To overcome the serious shortage of clean seed, some varieties were imported from West Germany in 1966. These introductions were not very successful, because of unsatisfactory organizational arrangements and disease problems. Reminders of the programme are the varieties Annett and Maritta.³⁰

In 1967, the Kenyan Government prepared a potato development project. A six-man team of potato specialists, consisting of a plant pathologist, breeder, virologist, bacteriologist, horticulturist and agronomist was established.³¹ Their major activities were to screen local varieties for their disease resistance, establish a maintenance breeding programme for locally tested varieties, establish a seed multiplication scheme and test agronomic practices.

In 1968, the government acquired a new farm on which it established a station for disease-free potato propagation work; three sub-stations were also established. Maintenance breeding of numerous varieties was underway and basic seed was provided for seed bulking. The seed certification scheme has not been successful because of organizational deficiencies.³² In 1972-74, extensive trials were carried out on climatical and ecological suitability for potatoes, which provided sound data base for extension.³³

During the period after Independence, export of potatoes from Kenya continued, but with a declining trend (Table 3). The exceptionally high amount

Table 3: Potato Exports 1965-1976

Year	Quantity (Tons)
1965	1,350
1966	1,829
1967	2,004
1968	907
1969	521
1970	1,038
1971	609
1972	519
1973	705
1974	560
1975	548
1976	3,719

Source: Republic of Kenya, Statistical Abstract 1975 (p. 59) and 1977 (p.64).

for 1976 is explained by unusual exports to Europe, where extremely favourable prices³⁴ attracted Kenyan traders. Usually exports are directed only towards countries in East Africa and Middle East.

F. Review of Past and Present State of the Potato Industry

Since its introduction to Kenya as a foodcrop for European farmers, the potato has experienced a tremendous expansion in production and utilization as a food; it is now an essential staple food in some areas. This expansion took place mainly through an increase in the overall production areas, and at the same time the number of farmers growing the crop increased. During the entire period, forest areas were important production regions. Within the traditional African farming areas, potatoes were adopted mainly East of Aberdares and around Mt. Kenya. The potato has not become an established crop in the Western highlands.

Considering the performance of the crop in terms of yield (tons/ha.) no significant improvement has taken place during the entire eighty year period. Low yields are generally explained in terms of various diseases and the poor quality of seed potatoes used by growers. These two factors have been the focus of every potato improvement programme set up over the years, and they are the major problems for governmental institutions dealing with potatoes at present.

Looking at the use of potatoes, a shift has taken place from commercial production for export, to production for home and domestic consumption. Most of the crop is now consumed within the production areas; the market surplus is channelled into domestic food markets and constitutes an important item in urban food supply.

The volume of exports has remained stable or declined over the years. In relation to the increasing production and domestic potato market exports have declined to a point of insignificance.

The economic performance of the crop, in relation to competing food and commercial crops is difficult to appraise. The introduction of tea and coffee in "African Reserves," caused a shift of potato production from there into forest areas.³⁵ Furthermore, price ratios between potatoes and maize have moved against potatoes over time,³⁶ adversely affecting the competitiveness of the potato enterprise.

G. Government Programmes and Services

1. General Extension and Integrated Agricultural Development Programme

In Kenya, the potato is classified as horticultural crop and has, unlike maize, wheat, coffee, tea or pyrethrum, not been given much attention in government extension programmes. Within the extension service of the Ministry of Agriculture, it has been dealt with as a minor foodcrop, with only sporadic efforts to promote it.

More recently, potato has been included in the Integrated Agricultural Development Programme (IADP) of the Ministry of Agriculture, which attempts to improve production of food and industrial crops.³⁷ This programme offers extension, credit and improved input supply and provides infrastructure such as cattle dips and sheds for marketing farm produce. It attempts to develop entire farm units rather than improving individual enterprises, by offering inputs for a package of enterprises.³⁸ The potato is included in the package with maize and in some areas beans.

The programme intends to provide seed, fertilizer and chemicals in kind as well as cash to meet part of the labour costs. The scheme is to operate in Meru, Kirinyaga, Nyeri, Muang'a, Kiambu and Kisii Districts. In most cases, each unit is to provide inputs for 0.4 ha. of potatoes. The overall target for 1978/79 is to grow 2,346 ha. of potatoes. However, the aim will not be achieved due to serious shortage of improved seed.³⁹

In the 1978/79 budget, the programme intends to provide funds to The Horticultural Crops Development Authority (HCDA) to establish an air ventilated potato store in Kibirichia/Meru District with the following objectives: (a) serve as a storage facility for potato marketing; (b) serve as a trial for management of such stores to show the possibility of fully exploiting their technical and economical potential; (c) improve the price information system in this sector to the level required for an efficient monitoring of market development by store operators, producers and traders in general.

The store's capacity will be in the range of 100 to 150 tons.⁴⁰

2. Potato Research and Seed Production Schemes

Provision of improved planting material to the potato industry has been the task of the governmental potato research programme with centres at the National Agricultural Laboratories (NAL) in Nairobi and at The National Potato Research Station at Tigonj, Lumuru. Sub-stations have been set up at Mirandas, Molo Division, Nakuru District, at Njabini, South Kinangop, Nyandarua District and Marimba in Kibirichia, Meru District.⁴¹ While the NAL concentrates on breeding of disease-resistant varieties, the Potato Research Station is in charge of clonal selection and basic seed production.

The present maintenance breeding programme includes ten varieties, originating mainly from the U.K., Netherlands and West Germany. The proportion of each variety taken in the breeding programme is governed by farmer demand and the acreage available for clonal development and basic seed production in the various stations.²

Raising of clonal material, generation A to D, is conducted at the Potato Research Station, Tigonj, which has been equipped with the necessary facilities to ensure disease-free, high quality material. Bulking of Basic Seed is done at Tigonj as well as the three sub-stations. Present capacity is about 14 ha. of clonal D material, which gives approximately 200 tons of Basic Seed.³ If multiplied further, this amount of seed is sufficient to provide improved planting material for about 10,000 ha.

Multiplication and distribution of certified seeds continues to pose major problems. In theory, the procedure has been to supply basic seed to small-scale commercial farmers who multiply it once to produce Certified Seed I, which is, in turn, sold to other growers for multiplication up to Certified Seed II, before final release as planting material for ware potato growers. In practice, the Research Station has been unable to maintain control of the multiplication procedure after the first sale of basic seed to the stage 1 multipliers. There are no contracts with the multipliers and the basic seed is simply sold to the farmers on the understanding that after multiplication it will be resold as seed. As a result, the present multiplication programme has failed to produce regular supplies of certified seed.⁴

Besides the difficulties in producing certified seed, there are problems in pricing and distribution. There is no established policy which links seed potato prices to either production costs or ware potato prices.⁵ Nor are there effective regulations to prevent seed potatoes from being sold for consumption, when ware prices are high. Furthermore, there is no established system to distribute the seed to ware potato farmers. When contacted by prospective buyers, the Research Stations give the names of seed growers, but this is not sufficient to ensure a smooth seed marketing system. Most ware growers have no information on official seed sources and most seed producers face difficulties in channelling their produce to the intended users.

To overcome the problem of seed multiplication and distribution the government has plans to give these responsibilities to the Kenya Seed Company, a publicly owned body which now produces hybrid maize and improved seeds for wheat, barley, sunflower and grasses. The plans are to establish a production scheme for some 6,000 tons of Certified Seed II at Molo, Nakuru District. Production is to be done on a contract basis by a few large farms.⁶ Handling, storage⁷ and distribution of the seed will be the Seed Company's responsibility.⁸

Inspection and certification of all seeds, including potatoes, is done by an independent governmental body, the National Seed Quality Control Service (NSQCS). In potato seed certification a major problem for the NSQCS

has been that a large number of growers, each producing a small amount of seed, had to be inspected. This led to extraordinarily high inspection costs.

The planned potato seed production system, with responsibilities divided between the Potato Research Station (handling production of Basic Seed) and the Kenya Seed Company (taking charge of seed multiplication) looks promising, since a similar system for grains and grasses has been highly successful.

H. New Sources of Data on the Potato Industry

In the past, there has been very little information available on the potato crop, but in recent years a number of public-sponsored activities have generated new sources of data on the potato industry.

One of the main new sources is the Central Bureau of Statistics (CBS) in the Ministry of Finance and Planning.⁵⁹ Here a "National Integrated Sample Survey" was established in 1974, which includes a number of sub-surveys that yielded interesting results in a number of fields. The "Integrated Rural Survey"⁵⁰ deals with households in rural areas and, with respect to potatoes, provides information on production, marketing and consumption at that level. The "Agricultural Marketing Survey," initiated in 1975, analyses the internal marketing system for agricultural commodities, including potatoes. It provides data on producer marketing and consumer purchasing patterns and investigates both rural and urban enterprises trading and processing agricultural food products.⁵¹ These surveys are to be carried out periodically, in various ways, and will provide more information on the potato industry in the future.

As part of the government's research on agricultural marketing, a trial was established to determine potato storage losses under small farm conditions.⁵² This trial was carried out by various parties, including the Marketing Section and Planning Division of the Ministry of Agriculture, the Potato Research Station at Tigonj and The International Potato Center's Regional Office in Nairobi. In addition, work on potato production, marketing and storage (in Meru District) has been done by the Department of Agricultural Economics, University of Nairobi.⁵³ Earlier, within the same Department small studies on potato production and consumption were conducted.⁵⁴ Finally, the International Potato Center office in Nairobi has carried out surveys of potato production and trade. At the producer level, in 1976/77 a survey with emphasis on production and marketing was carried out in six areas; 460 producers were contacted. Another survey was organized to investigate rural assembly and interregional trade, emphasizing Nairobi as the major consumption centre; about 50 wholesalers in rural areas and in Nairobi were contacted. First results of the producer survey were made available in preliminary reports,⁵⁵ and the survey results were used extensively in the present report, especially in Chapter V.

Footnotes

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III. CONTEXT OF POTATO PRODUCTION

A. National Relevance of Potatoes

In order to assess the importance of potatoes in Kenya and to understand the little attention it has received in politics, the crop has to be put into the national context. Three indicators are chosen for this purpose: contribution to the economy, to employment and to human nutrition.

1. Economic Role of the Potato

In most sources of National Statistics the potato does not appear as a separate item, but is considered a horticultural crop within the category "other temporary crops."

The agricultural sector has accounted for some 35-40% of Gross Domestic Product (GDP) and approximately 75% of total employment in Kenya during the period 1964-1974.¹ The 35-40% of GDP figure compares with just 10-12% from manufacturing, 10% from commerce and 13-15% from the government sector. In recent years agricultural exports made up about 70% of Kenya's total exports (see Table 4).

For many good reasons, high priority is given to the development of the agricultural sector in Kenya. Over 90% of the population lives in rural areas and depends primarily on agriculture for its living. This rural population is growing at a rate of about 2.8% per annum. Like most African countries, per capita income in Kenya remains low (about US\$120) by international standards, despite the country's recent record of steady, if not spectacular economic growth. It is widely recognized that a prosperous agricultural sector is an asset to the whole economy in that it provides a growing market for the goods and services produced by other sectors, as well as producing the food and raw materials on which successful growth of other sectors depends. The rate and pattern of agricultural development will determine in large measure the welfare of Kenyans for many years to come.

The value of potatoes marketed is about 2% of the gross value of marketed agriculture production. In 1972 and 1975, the officially recorded farm revenue from potatoes was about 1.5% of the total farm revenue. In recent years this amounts to about K£ 2.5 million. Since local and intra-district sales of commodities is not taken into account, cash revenue from potato sales must be higher than indicated by these figures. However, at the national level potatoes are rather unimportant in terms of generation of cash income. The potato industry in total might now market about K£ 5 million worth of potatoes each year. In addition to this marketed production, about 70% of production is for subsistence needs.

Table 4: Some Facts About Kenya's Agricultural Sector

	1964 ^a	1972 ^b	1977/78 ^c	
			At Current Prices	At Constant 1972 Prices
<u>GDP at factor costs (K£m)</u>	330.1	666.2	1,620	827
Agriculture (K£m)	126.6	210.2	612	232
- Non-monetary (K£m)	73.5	115.8	233	120
- Monetary (K£m)	53.1	94.4	379	112
Agricultural's Share of Total GDP (%)	38.4	31.6	37.7	28.1
<u>Net Capital Outflow from Agriculture (K£m)</u>	50.4	123 ^d		
<u>International Trade</u>				
Exports (K£m)		128	502	
Food and beverage (K£m)		62	315	
Share of Food and Beverage (%) [*]	90 ^d	51	64	
<u>Gross Marketed Production in Agriculture (K£m)</u>	81 ^e	106	415	
Permanent Crops		45	293	
Livestock Products		31	47	
Cereals		13	36	
Potatoes		1.7		2.4 ^{**}
<u>Economically Active Population 1975 (millions)</u>		6.4		
In Agriculture (%)		75		
In Potato Production		150,000 (rough estimate)		
In Potato Distribution		1,000 (rough estimate)		

* excluding re-exports.

** 1975.

- Sources: a. Republic of Kenya, Economic Survey 1974.
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2. Employment

Out of the total economically active population, estimated at 6.4 million in 1975, only 15% (or 1 million) were engaged in the modern sector of the economy. Over 80% of the total were either in rural areas engaged mainly in small-scale agriculture and other informal occupations, or in the urban areas seeking gainful employment.

Wage employment has increased steadily in recent years, amounting to about 900,000 persons in 1977. About 200,000 of these are employed in the agricultural, and 375,000 in the public sector.²

It is estimated that the potato industry provides self or wage-employment for about 151,000 persons. This figure is reached as follows: An estimated acreage of 75,000-100,000 ha. under potatoes in two seasons, requires about 330 man-days per ha. This gives work to about 150,000 persons in production. Marketing activities for potatoes employ an additional 1,000 people.

At the national level, about 3% of the total agricultural labour force is employed in potato production. Of the 150,000 in production 20-30% are estimated to be hired casual or contractual labour. However, as will be shown in later chapters, in some districts potato production provides a much higher share of employment.

3. Nutritional Contribution

According to FAO sources (see Table 43) Kenya's national average consumption of roots and tubers is about 110 kg per capita, per year, providing about 15% of the total calory supply. There is some evidence that in Kenya potatoes contribute a major share of the calories supplied by all roots and tubers. Assuming an urban consumption of 50 kg per capita, per year, 7-10% of the total calory intake might come from potatoes.

The nutritional role of the potato is greatest in rural potato growing areas where this tuber has become a staple food. The average annual consumption of about 75-100 kg per capita is, in fact, concentrated mainly during the two harvesting periods, when potatoes are the major dish, determining the structure of food supply and thus the structure of the nutritional components. In brief, it can be stated that the nutritional impact of the potato crop is fairly marked in urban areas and most significant in rural producing areas, especially during the two harvesting seasons. On the other hand, there seems to be hardly any impact for about two-thirds of the population (rural non-producers) for whom potatoes do not yet belong to the regular diet. Any figures showing national averages for potato consumption and nutritional role are, therefore, misleading.

Table 5: Selected Data on Kenya's Potato Industry 1974/75

Item	E s t i m a t e *			
	Rural/Urban Surveys by CBS	Extreme Values		Most Probable Value (Own Estimate)
		Low	High	
<u>Production</u>				
Total Potato Area (000 ha.)	261 ^a	32 ^a	-	75-100 ^b
Share of all Foodcrops (%)	7 ^d	-	-	-
Total Production (000 t)	333 ^e	160 ^h	300 ^c	400-500 ^b
Volume Excl. Seed (000 t)	-	112 ⁱ	- ^c	280-350 ^b
No. of Producers (000)	480 ^f	-	-	400-500 ^b
Share of All Farmers (%)	32 ^g	-	-	-
<u>Population</u>				
Total Rural	11,917 ^j	-	13,922 ^k	-
Total in Potato Producing Districts	-	-	-	3,500 ^m
Total on Potato Producing Farms	3,297 ^l	-	-	3,300 ⁿ
Total Urban	1,672 ^j	-	1,695 ^k	1,700 ^k
<u>Per Capita Consumption</u> (kg/year)				
Urban	15 ^q	-	60 ^q	50 ^r
Total Rural	21 ^q	21 ^q	70 ^q	-
Potato Producing Households	-	-	116 ^q	70 ⁿ
Non Potato Producing Rural Households	-	-	-	- ^p
Total	20 ^q	10 ^s	-	-
<u>Total Consumption (000 t)</u>				
Urban	24 ^p	24 ^p	100 ⁿ	50-100 ⁿ
Rural	246 ^p	-	-	230-250 ⁿ
Total	270 ^t	-	-	280-350 ⁿ

Source: * Numbers of pages and Tables refer to this report unless stated otherwise, ^a Table 19. ^b same Table. ^c Figure 4. ^d derived from Table 15. ^e Table 12. ^f Table 14. ^g derived from Table 14. ^h 32,000 ha. x 5 tons/ha. ⁱ 32,000 x 3.5 tons/ha. ^j Shah, M.M., op. cit., Table 18. ^k derived from Republic of Kenya, Central Bureau of Statistics, Integrated ..., op.cit., Tables 6.1 and 9.5. ^m derived from Tables 9 and 19. ⁿ page 85, ^p page 85, ^q Table 44. ^r page 85, compromise between 44 and 60 kg. ^s page 84, ^t 24,000 t + 246,000 t.

B. Brief Description of Kenya's Agriculture

1. Geography and Climate

Kenya extends along the Equator, at a longitude of 34° to 42° east (Figure 1) and covers a total of 582,600 square kilometres.³ Due to the wide topographical and climatical differentiation, Kenya features a number of ecological patterns which range from glaciated mountains with permanent snow in the central highlands to true desert in the north and humid tropics along the coast. The central plateau lies mainly at an altitude of around 2,000 metres and is crossed by the Great Central Rift. The eastern parts reach a peak of 5,199 metres (Mt. Kenya) and slope down towards the east to reach sea-level at the Indian Ocean. The highlands west of Rift range up to 3,000 metres (Timborua) and decrease towards the west to reach the Lake Basin at an altitude of 1,200 metres.

Rainfall is to some extent determined by the topography, and increases with altitude. Exceptions are the Lake Basin and the high rainfall belt along the coast. The seasonal rainfall pattern is highly differentiated by regions. In the western highlands it is unimodal, ranging from March to November with peak rains in August (for example "Eldoret" in Table 6). The highlands east of Rift, the Lake Basin and the coastal area have a bimodal rainfall pattern, with peaks in April/May and October/November. Usually the first peak brings highest rainfall, whereas the second is less distinct. An exception is Meru, where the pattern is reversed (Table 6). In drier areas, seasonality almost disappears and rainfall become unpredictable.

The annual movement of temperatures shows a slight peak at the beginning of the year (generally also the period with least rainfall). Temperatures are lowest in July/August and in some areas (Nyandarua, Molo and Timborua), frost may cause damage to agricultural crops. In the highlands, daily temperatures show a marked difference of some 12-15° C between day and night (Table 7). On the coast this difference is reduced to some 8° C.

2. Agricultural Production Zones

Depending on rainfall, Kenya's land is classified into one of three categories of agricultural potential. The low potential area with less than 612.5 mm, comprises 42 million ha. or 74% of the total. Medium potential land, with an annual rainfall between 612.5 mm and 857.5 covers 3 million ha. or 6%. High potential areas, with more than 857 mm, amount to about 7 million ha. or about 12%.⁴

To determine agricultural production zones, land potential can be more usefully classified in terms of ecological land units, which are derived from combinations of climate, soil, and topography equated with vegetation

Table 6: Average Monthly Rainfall at Selected Stations (mm)

	Kiambu ¹	Nyeri ¹	Meru ¹	Embu ¹	Mom-basa ¹	Eldoret ¹	Kisumu ¹	Kinangop ²	Molo ³
January	47	48	41	23	34	15	60	43	39
February	49	46	79	23	17	7	84	53	39
March	110	69	109	88	55	54	156	85	67
April	238	182	257	293	159	72	213	163	171
May	165	165	132	214	235	103	174	155	130
June	46	32	29	30	74	151	91	108	96
July	26	37	9	48	67	161	63	73	138
August	28	38	11	41	64	281	91	89	99
September	30	91	24	43	77	70	79	103	97
October	74	94	234	149	97	41	75	95	60
November	142	116	354	201	93	27	117	89	92
December	81	74	53	55	66	18	100	69	64
Total	1,036	992	1,332	1,208	1,038	1,000	1,303	1,114	1,092

Sources: ¹ Republic of Kenya, Central Bureau of Statistics. Statistical Abstract 1977, pp. 6,7.

² East African Meteorological Department, Station No. 9035093.

³ East African Meteorological Department, Station No. 9036025.

types. Using these indicators, six broad ecological zones can be delimited⁵ (Figure 3). Zone I comprises less than 1% of Kenya's land area, at high altitude above the tree line. Land use is limited to water catchment and tourism. Zone II comprises Kenya's high potential agricultural area. It covers some 53,000 square km (9% of Kenya) and its vegetation is forests, both indigenous and planted.

At higher altitudes, coffee, tea and pyrethrum are important cash crops. Zone III which also covers about 53,000 square km (9% of Kenya's land areas), represents medium potential land with maize, wheat, barley, cotton, pulses and oilseed as major crops. Zone IV is again about 53,000 square km. This zone presently has only marginal agricultural potential. Subsistence crop farming and livestock rearing are the important occupations of the smallholder farmers. Zone V covers over 300,000 square km (52% of Kenya's land area). It is an area of moderate range land development potential; wildlife is important in many places. Zone VI extends to approximately 112,000 square km (20% of Kenya's total area) and comprises most of northern Kenya where rainfall is sparse and erratic. Vegetation includes mainly annual grass species which spring up after the rains; livestock is kept by the nomadic pastoral people who inhabit this zone.

Table 7: Average Monthly Maximum and Minimum Temperatures at Selected Stations (° C)

	Nairobi	Nakuru	Eldoret	Kisumu	Mombasa
January					
Max.	27	27	25	31	32
Min.	12	7	8	17	23
February					
Max.	28	28	26	31	32
Min.	13	7	8	17	24
March					
Max.	28	28	26	30	33
Min.	14	8	9	18	24
April					
Max.	26	26	25	29	31
Min.	14	12	11	18	24
May					
Max.	25	25	24	28	29
Min.	14	10	10	17	23
June					
Max.	24	25	23	28	29
Min.	11	8	8	16	21
July					
Max.	23	24	22	28	28
Min.	11	9	10	16	20
August					
Max.	23	24	22	28	28
Min.	11	9	9	16	20
September					
Max.	26	25	24	29	29
Min.	11	7	9	16	21
October					
Max.	27	25	24	31	30
Min.	13	8	10	17	22
November					
Max.	25	24	24	30	31
Min.	13	9	10	17	23
December					
Max.	26	25	24	30	32
Min.	13	8	9	17	23

Source: Republic of Kenya, Central Bureau of Statistics.
Statistical Abstract 1977, p. 8.



Figure 1 ADMINISTRATIVE MAP OF KENYA.

Source : International Labour Office. *Employment, Incomes, and Equality. A Strategy for Increasing Productive Employment in Kenya.* International Labour Office, Geneva 1972, p. X.

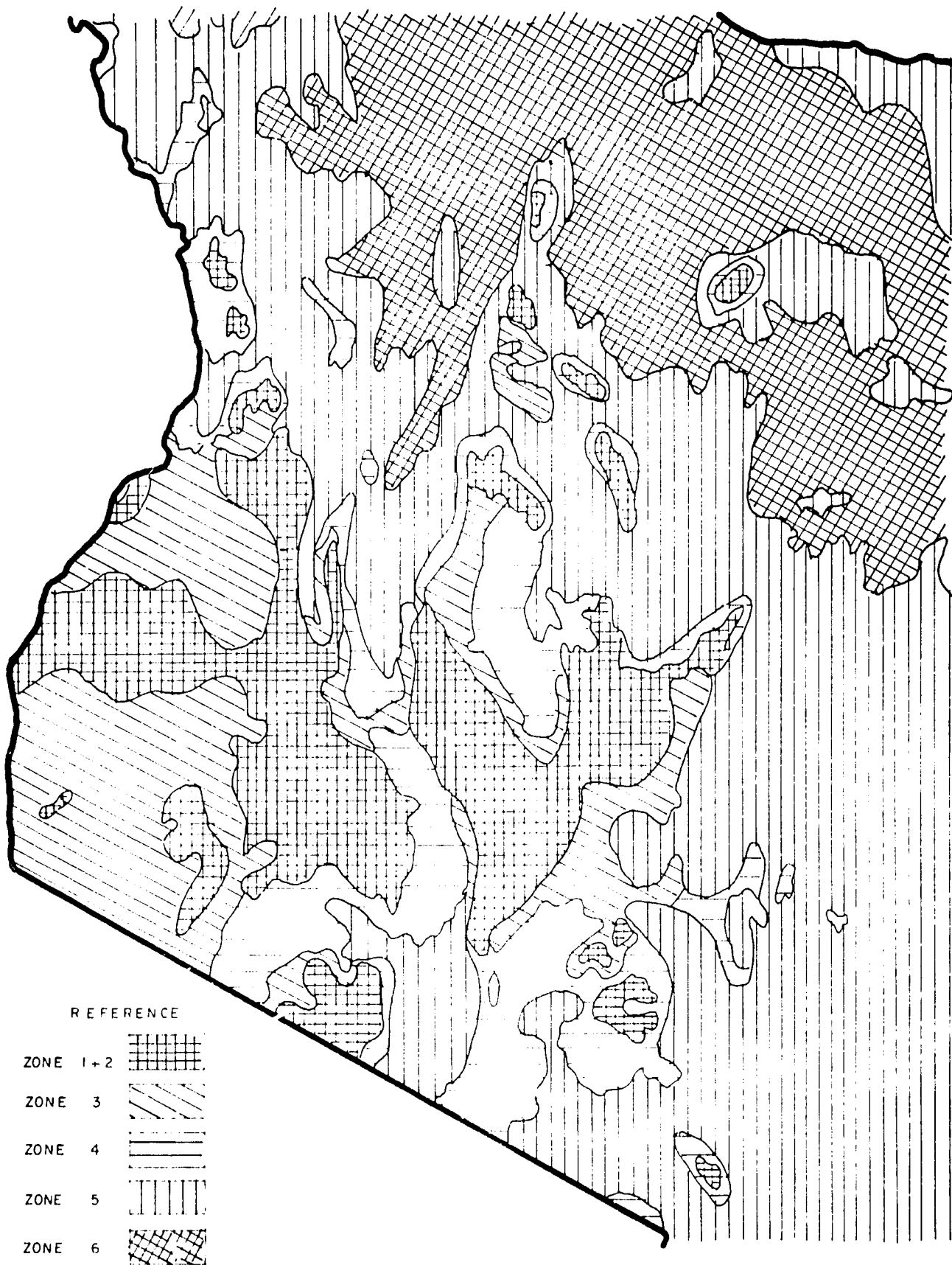


Figure 3 ECOLOGICAL ZONES OF KENYA

SOURCE : Republic of Kenya, Survey of Kenya . National Atlas de Kenya 1970 p 29.

A third type of land classification has been established on the basis of ecological aspects in connection with the major commercial crops. The resulting agro-ecological zones follow:

- A. East of the Rift
 - 1. Tea Zone
 - 2. Coffee Zone
 - 3. Upper Cotton Zone
 - 4. Lower Cotton Zone
- B. West of the Rift
 - 1. Tea Zone
 - 2. Coffee Zone
 - 3. Upper Cotton Zone
- C. Coast of Rain Zone
- D. High Altitude Grassland Zone

These three types of classification overlap each other, and unfortunately, statistics do not relate to any of these, but to the administrative structure of the country.

The areas, which can be considered suitable for potato production are Zone II and to some extent Zone III (Tea and Coffee Zone on both sides of the Rift). In particular, these areas are located along the slopes of Mt. Kenya in Meru, Embu, Kirinyaga and minor parts of Laikipia Districts. They are also on both sides of the Aberdares Range, thus including Nyeri, Murang'a, Kiambu and Nyandarua Districts. Along the Mau Range are Nakuru and Kericho Districts, the mountainous range along Tinderet, Timborua and Cherangani with Nandi, Uasin Gishu. Some small areas are found in Elgeyo-Marakwet Districts and in the highlands of western Kenya, which extend up to Mt. Elgon, including Kisii, Kakamega, Bungoma, Busia and Trans-Nzoia Districts (Figure 1 and Table 8).

3. Population

Kenya's total population is estimated at 13.8 million in 1976 (Table 9). Of the total, 12% live in cities and towns, the largest ones being Nairobi and Mombasa. Population densities vary greatly by region and generally follow the agricultural production potential. In the central highlands, where production conditions are most favourable, the population (excluding Nairobi) amounts to 7.1 million, or 50% of the national population (Table 9).

The average population density of the central highlands is 146 persons/sq km, compared to 24 persons/sq km for the whole country. In some locations density reaches more than 400 persons/sq km.

Table 8: District Sizes by Land Category for Districts with Potato Growing Potential (000 ha)

District	Land Category			Total
	Farmland	Forest	Others	
Bungoma	249	55	4	307
Busia	163	-	14	177
Kakamega	314	33	5	352
Kisii	217	-	3	219
Kericho	368	105	16	489
Nakuru	537	133	50	720
Nandi	233	40	2	275
Trans Nzoia	194	23	30	247
Uasin Gishu	316	53	10	378
Murang'a	204	28	16	248
Kiambu	177	45	23	245
Kirinyaga	92	30	21	144
Nyandarua	266	56	31	353
Nyeri	169	97	62	328
Embu	248	17	6	271
Meru	713	140	140	992
Total	4,459	855	432	5,745
Total for Kenya	48,340	1,622	8,303	58,265

Source: Republic of Kenya, Central Bureau of Statistics. Statistical Abstract 1977, pp. 4,5.

4. Land Tenure

There are three main types of land in Kenya: Government Land, Trust Land and Private Land. The Trust Land areas are vested in country councils with responsibility to preserve the trust land for the benefit of those people having a customary right to it.⁶ A rapid transition from customary to private landholding is taking place in trust land areas, since a programme for adjudication of customary rights and interest in land is enabling people to become private land owners with the security of registered freehold land titles. At present about 61% of the high potential trust land has been adjudicated, registered and transferred to private land.⁷

As for government land, there has been a policy to alienate the land and lease it for a term of years (in the majority of cases 999 years and in a few 99 years) with a reversion at the end of term to the government. Since 1960, alienation of government land for agricultural purposes has been for an initial development leasehold period followed by a grant in freehold, taking the farms concerned from government land category and placing them

Table 9: Estimates of Urban, Rural and Total Population in Areas with Potato Growing Potential 1976*

District	Population (000)			Population Density Persons/sq km	Population of Major Towns (000)	
	Urban	Rural	Total			
Bungoma	7	421	428	141		
Busia	2	247	245	146		
Kakamega	10	960	970	273	Kakamega	9
Kisii	9	828	837	378	Kisii	9
Kericho	23	573	596	120	Kericho	14
Nakuru	100	272	372	51	Nakuru	66
Trans Nzoia	16	140	156	63	Naivasha	10
Uasin Gishu	26	214	240	63	Kitale	16
Nandi	3	256	259	93	Eldoret	26
Murang'a	8	544	552	218		
Kiambu	34	560	594	230	Thika	26
Kirinyaga	4	265	269	181		
Nyandarua	13	207	221	67	Nyahururu	11
Nyeri	20	429	449	134	Nyeri	14
Embu	6	217	222	77		
Meru	6	733	739	78		
Sub-total Regions with Potato Grow- ing Potential	287	6,820	7,106	146		
Sub-total Other Regions	1,390	5,297	6,687	13	Nairobi	818
					Mombasa	348
					Malindi	15
					Kisumu	46
Total Kenya	1,677	12,117	13,793	24		

* Based on 1969 population census. Annual growth rates were assumed as 3.1% in rural areas, 7% in Nairobi and 5% in other towns.

Sources: Republic of Kenya, Statistics Division. Kenya Population. Census, Vol I. Nairobi 1970, pp. 2-68
Shah, M.H., Food Demand Projections Incorporating Urbanization and Income Distribution, Kenya (1975-2000). Laxenburg 1978, Tables 4.9, 4.18.

instead in private land category.⁸ Alienated government land -- often referred to as the "White Highlands" -- is located in the areas east of Nairobi (parts of Kiambu, Murang'a and Machakos Districts) in Nakuru, Laikipia, Nyandarua, Uasin Gishu and Trans Nzoia Districts and some parts of Kericho, Kisii and Nandi Districts.⁹ The overall area comprises some 3.7 million ha., of which about 1.1 million ha. are high potential land and provide suitable conditions for potato production.¹⁰

Alienated government land has formerly been allocated for European settlement only. Here, settlers established a number of large mixed farms for grains and livestock; monocultural plantations for tea, coffee or sisal and ranches.

Over the last 25 years, about 6% of this land has been earmarked for settlement of landless families where the government took charge of subdividing the land and allocated plots to individual families.¹¹ Farms not allocated for settlement and previously owned by Europeans were made available for transfer to African ownership through government negotiations. In the past these farms were bought by various groups: individuals, partnerships, companies and co-operative societies. Where multi-ownership is the case, the co-owners often claimed their share of land, settled on it and established small holdings. This sort of settlement is not legal, but up to now, has been tolerated by the government.

Out of the land tenure system, a dualistic farming pattern has evolved. Trust land areas with good agricultural potential are now referred to as the Small Farm Areas. This sector comprises some one million small farms and about 250,000 pastoral holdings. In addition, the small farm sector includes settlement schemes with about 35,000 farmsteads¹² and areas of illegal settlement on privately owned land, in forest areas or on other publicly owned land. The number of squatters, as these settlers are often referred to, was estimated to be 300,000 in 1969, with an annual growth rate of 15,000.¹³ Assuming an average family size of six, this population could now make up another 70,000 holdings. However, it can be assumed that at least part of these families have been absorbed by the large farm sector. In total, the small scale sector comprises some 1.5 million holdings.¹⁴

The large farm sector, which evolved on alienated government land, is made up by some 3,000 holdings, of which 1,540 are mixed farms with an average size of 600-700 ha., and the rest are ranches and plantations¹⁵

5. Farm Size

In the small farm sector, most farms have 2 ha. or less; few farms are of more than 5 ha. (Table 10).

The statistics drawn up in Table 10 exclude pastoral holdings in area with lower agricultural potential. There, farms have to be larger if they are to provide sufficient output to maintain a family.

**Table 10: Farm Size Distribution in the Small and Large Farm Sectors
1974/75**

Small Farm Sector 1974/75		Large Farm Sector 1975	
Farm Size Group (ha.)	Frequency (%)	Farm Size Group (ha.)	Frequency (%)
0 - 0.5	14	0 - 99	34
0.5 - 0.9	18	100 - 199	12
1.0 - 1.9	27	200 - 299	11
2.0 - 2.9	15	300 - 399	8
3.0 - 3.9	9	400 - 499	7
4.0 - 4.9	7	500 - 999	15
5.0 - 7.9	7	1,000 - 1,999	5
8.0 +	4	2,000 - 3,999	4
		4,000 +	4

Source: Republic of Kenya, Central Bureau of Statistics.
Statistical Abstract 1977, pp. 119 and 135.

In the large farm sector, farm sizes reach more than 20,000 ha. About half of the farms, however, are less than 200 ha. (Table 10).

Recently, through change of ownership, some of these large farms were subdivided into smaller units and are now managed as small-scale farms.

6. Land Use

Land use patterns in Kenya can be differentiated according to ecological potential, farm size and to some extent, ethnic particularities. In official statistics, the differentiating criteria are farm size (Large and Small Farm Sector) and administrative boundaries. Unfortunately, data on land use patterns does not allow a direct comparison of the two sectors either at the national level or in various agro-ecological zones. Table 11 gives a breakdown of the cropping pattern on large farms in various provinces.

In high potential areas, land use on large farms is characterized by mixed farming, with maize, wheat, barley, pyrethrum and livestock (for milk and beef) as the main enterprises. Industrial crops such as tea and coffee are planted in large estates in the higher regions. In warmer areas in the Lake Basin and along the coast, sugarcane estates have been established.

Table 11: Land Use on Large Farms by Province (000 ha.)

Type of Land Use	P r o v i n c e						Total
	Nyanza Valley	Rift Valley	Western	Central	Eastern	Coast	
Maize	-	66	-	1	1	-	68
Other Cereals	-	90	-	9	10	-	109
Total Cereals	-	156	-	10	11	-	177
Sugarcane	18	9	4	-	-	5	32
Pyrethrum	-	4	-	-	-	-	4
Other Temporary	-	5	-	-	-	-	5
Industrial Crops							
Sisal	-	20	-	7	15	30	74
Tea	1	22	-	4	-	-	26
Coffee	-	5	-	19	3	-	28
Other Permanent	-	13	-	-	-	2	16
Industrial Crops							
Total Industrial Crops	15	76	4	31	18	37	184
Root Crops and Vegetables	-	2	-	1	-	-	3
Other Temporary Crops	-	68	-	4	8	2	101
Fruits	-	-	-	5	-	1	6
Meadows and Fallow	1	110	-	15	22	18	167
Pastures and Others	<u>9</u>	<u>1,377</u>	<u>2</u>	<u>236</u>	<u>234</u>	<u>27</u>	<u>1,907</u>
Total land	26	1,789	6	322	295	84	2,547

Source: Republic of Kenya, Central Bureau of Statistics.
Statistical Abstract 1977, pp. 126, 127.

Large estates for sisal or beef production are located in medium potential areas. Where water and capital were available, irrigation has been established to produce horticultural produce (e.g., pineapples and flowers for export).

Farming patterns in Small Farm Areas stress the predominant role of foodcrops, maize being the most important one (Tables 12 and 14). The area under maize is as large as the area in all other major foodcrops together, and the volume of production is twice as much (Table 12). Maize and sorghum play a certain role as commercial crops, whereas beans and potatoes are grown primarily for home consumption (Table 13). One particular aspect

in Small Farm production is the high share of mixed cropping, where two or more crops are grown simultaneously on the same plot. The prevalence of mixed cropping may be attributed to the small size of the average holding, which tends to deter producers from employing crop rotations.

Table 12: Acreage and Production of Selected Foodcrops on Small Farms 1974/75

Crop	A c r e a g e (000 ha.)			Production (000 tons)
	Pure	Mixed	Total	
Local Maize	225	970	1,194	954
Hybrid Maize	258	243	501	550
Finger Millet	30	47	78	128
Sorghum	17	190	206	219
Beans	50	714	764	147
Potatoes	49	212	261	333

Source: Republic of Kenya, Marketing Development Project
Smallholder Marketing in Kenya 1974-75, mimeo., p.1.

Table 13: Disposal of Selected Foodcrops on Small Farms 1974/75
(% of Total Production)

Crop	Marketed	Consumed	Other
Local Maize	33	52	15
Hybrid Maize	28	62	11
Sorghum	39	41	20
Beans	26	72	2
Potatoes	16	70	13

Source: Republic of Kenya, FAO Marketing Development Project
Smallholder Marketing in Kenya 1974/75, mimeo., p. 2.

Farming in Small Farm areas is highly diversified, with sharp differences in production patterns between regions. This is largely determined by ecological factors, but also by historical processes¹⁶ (Tables 15 and 16). In high potential areas foodcrops like maize, beans and potatoes are frequently found as well as improved livestock. Maize is generally the most important crop. Commercial crops include tea, coffee, pyrethrum and in warmer regions, sugarcane.

In medium potential areas, farmers produce maize, sorghum and millet, beans and other drought resistant pulses and cassava for food; cotton is grown

as a commercial crop. Livestock, primarily Zebu cattle, sheep and goats are maintained for milk and meat. Due to shortage and uncertainty of rain, production intensity is rather low. Furthermore, improved production methods are not as readily available for these difficult conditions as they are for high potential areas. In other areas with medium potential, crop production is limited and land is mainly used through grazing. This differentiation in land use is due to ethnic differences in population.

Table 14: Production of Selected Crops on Small Farms in Various Provinces 1974/75 (000 holdings)

Item	P r o v i n c e						Total
	Nyanza	Rift Valley	Western	Central	Eastern	Coast	
Local Maize	311	53	188	312	348	66	1,278
Hybrid Maize	138	82	186	220	106	13	745
Finger Millet	129	46	116	-	66	-	357
Sorghum	291	1	94	3	55	1	445
Beans	152	19	202	324	305	19	1,021
Potatoes	4	7	1	283	184	2	480
Coffee	80	4	12	149	154	1	400
Tea	28	13	11	58	63	-	172
Pyrethrum	71	14	-	26	23	-	134
Cotton	<u>65</u>	<u>4</u>	<u>52</u>	<u>-</u>	<u>6</u>	<u>4</u>	<u>130</u>
Total	386	90	255	330	353	70	1,483

Source: Republic of Kenya, Central Bureau of Statistics, Integrated Rural Survey 1974/75, Nairobi 1977, pp. 80-83.

There is a limited degree of specialization in agricultural production in similar ecological zones. Historical developments and legislation have led to some regional differentiation in crop production. Maize, beans, and potatoes are major foodcrops in Tea and Coffee Zones east of Rift; whereas in the comparable zones west of Rift, maize (particularly hybrid maize), finger millet and sorghum are major items. As for industrial crops, coffee is grown primarily east of Rift, whereas pyrethrum constitutes a major item in areas west of Rift. In the lower western areas, cotton is a major commercial crop (Table 16).

Table 15: Land Use on Small Farms by Provinces 1974/75 (000 ha.)

Type of Land Use	P r o v i n c e						Total
	Nyanza	Rift Valley	Western	Central	Eastern	Coast	
<u>Cereals</u>							
Maize	342	125	254	359	495	120	1,695
Finger Millet	23	14	26	-	14	-	78
Sorghum	176	-	20	-	11	-	206
Other Cereals	-	-	10	9	92	-	112
(All Cereals)	(541)	(140)	(310)	(368)	(612)	(121)	(2,092)
<u>Pulses and Nuts</u>							
Beans	74	7	148	232	285	18	763
Other Pulses	3	-	14	26	316	46	403
Groundnuts	12	-	6	-	-	-	18
Others	2	-	1	-	30	4	37
<u>Root Crops</u>							
Potatoes	-	2	-	120	139	-	261
Others	41	2	36	16	44	5	145
<u>Fruit, Vegetables and Oils</u>							
Bananas	10	-	14	59	45	2	130
Other Fruits	-	-	-	5	-	7	13
Vegetables	1	1	5	40	7	2	56
Oilseeds	-	-	19	-	2	3	24
<u>Temporary Industrial Crops</u>							
Sugarcane	42	-	7	3	9	1	63
Pyrethrum	10	3	-	13	1	-	27
Cotton	25	1	20	-	22	1	70
Other	-	-	-	1	3	1	6
<u>Permanent Crops</u>							
Coffee	14	-	1	36	60	-	111
Tea	6	4	2	43	11	-	65
Others	-	-	2	20	12	105	138

Source: Republic of Kenya, Central Bureau of Statistics.
Integrated Rural Survey 1974/75, Nairobi 1977, p. 79.

Table 16: Production of Selected Crops on Small Farms in Various Ecological Zones 1974/75 (% of holdings)

Crop	E c o l o g i c a l						Z o n e	
	Tea East of Rift	Coffee East of Rift	L.Cotton East of Rift	Tea West of Rift	Coffee West of Rift	U.Cotton West of Rift	Coast Rain	National Average
Local Maize	91	100	97	42	79	90	93	86
Hybrid Maize	67	49	12	98	65	30	8	50
Finger Millet	20	5	10	56	43	32	-	24
Sorghum	-	10	15	1	38	87	2	30
Beans	98	100	66	38	76	39	9	69
Potatoes	93	85	1	6	1	-	-	32
Pyrethrum	15	3	2	49	3	2	-	9
Cotton	-	-	4	1	-	36	6	9
Coffee	43	66	1	30	19	2	-	27
Tea	57	7	-	30	4	-	-	12

Source: Republic of Kenya, FAO Marketing Development Project. Smallholder Marketing in Kenya 1974/75, mimeo., p. 12.

7. Technology

Considering the various aspects of technology, ranging from improved seed/breeds/varieties, to use of fertilizer and chemicals and timeliness of operations, it has to be noted that use of improved genetic material is fairly widespread for cereals, dairy cattle and industrial crops. For foodcrops such as beans, root crops and vegetables, traditional planting material is still used. Nutritional standards for both crops (fertilizer application) and livestock (feeding concentrates) vary greatly and are often not satisfactory. Similar conditions are true for disease control in plants and animals. Mechanical cultivation practices are well established in the former large-scale farming areas, where production of cereals is entirely mechanized. In areas with predominantly small farms, usually only ploughing is done with machinery and all other operations are done manually.

8. Agricultural Marketing

A wide range of agricultural commodities produced in the country are marketed locally and abroad. Those which are most important in internal trade are maize, beef, dairy products, wheat, sugar, potatoes, poultry, eggs, fruits and vegetables. Sweet potatoes, cassava, yams, plantains, millets, sorghum and pulses are all traded locally in substantial amounts,

but they do not enter prominently into the national trading systems. Kenya's major exports are coffee, tea, pyrethrum, sisal, hides and skins, beef, fruits and vegetables, cotton and, occasionally, maize.¹⁷

In most areas, the centre of local trade is the village market, where, besides food items, household commodities, agricultural equipment and almost anything else may change hands. Surpluses from the village markets and export products with no local market move over large distances to wider markets in Kenya and overseas. This trade is undertaken through a number of different marketing systems. Markets for poultry, eggs, beans, peas, potatoes, bananas, vegetables and many other products are entirely private. Also export trade for commodities including hides and skins and fruits and vegetables is private. The majority of Kenya's exports and many of the most important domestically marketed products move through marketing boards and cooperatives as well as private trade. The marketing boards control operations for maize, beef, wheat, pyrethrum, tea, coffee and to some extent horticultural produce. The objectives of the boards' interference are to control prices at all channel levels and to provide marketing facilities for the agricultural sector.¹⁸ As regards co-operative marketing, there are two types of organizations. The old established co-operatives operate at the national level and perform specialized tasks such as marketing of milk, horticultural products and processing of coffee as well as the provision of farm inputs. Small farmers co-operatives on the other hand, usually operate in conjunction with large marketing organizations. These societies usually market a range of farm products. Their tasks include collecting, processing and transporting farm produce, and also the supplying of farm inputs and provision of seasonal credit.¹⁹

The scope of interregional domestic food markets is comparatively limited. The urban population is largely concentrated in four cities: Nairobi, Mombasa, Nakuru and Kisumu.²⁰ A very high proportion of trade centres on Nairobi and Mombasa, which account for approximately three-quarters of the total urban population (Table 9). Nairobi is situated at the periphery of the main food producing regions, while Mombasa lies somehow off the route. Consequently, much of Mombasa's food supply is traded in Nairobi's markets. Within the rural areas food tends to flow from surplus producing areas in the west of Nairobi, Nyanza, Western and Rift Valley Provinces to deficit areas in the East, Eastern Central and Coast Provinces.

Markets for agricultural produce reflect the duality of production, that is the Large and Small Farm Sectors. Both Sectors contribute about equal shares to the total marketed production.²¹ However, the number of potential suppliers is only around 3,000 in the Large Farm sector, but 1.5 million in the Small Farm Sector. Especially in respect to foodcrops, many small farmers market only surplus production. Table 18 shows that for two commodities, local maize and potatoes, 74% and 86% of all farmers, respectively, market less than 10% of the produce and the average value of the produce marketed per farm is almost negligible. Therefore, the local food marketing system has to master the enormous tasks of collecting very small quantities from very large numbers of suppliers and directing them to potential consumers.

Table 17: Marketed Production of Selected Crops from Small Farms in Various Ecological Zones 1974/75 (% of National Marketed Production by Small Farms)

Crop	Ecological Zone						
	Tea East of Rift	Coffee East of Rift	L. Cotton East of Rift	Tea West of Rift	Coffee West of Rift	U. Cotton West of Rift	Other
Local Maize	2	20	5	1	62	6	4
Hybrid Maize	1	-	-	29	53	12	4
Sorghum	-	-	2	-	49	50	-
Beans	3	30	40	1	22	2	3
Potatoes	44	53	-	2	-	-	1
Pyrethrum	3	2	-	78	-	-	10
Cotton	-	1	11	-	-	88	1
Coffee	12	72	-	10	6	-	-
Tea	84	1	-	14	1	-	-

Source: Republic of Kenya, FAO Marketing Development Project. Smallholder Marketing in Kenya 1974-75, mimeo., p. 12.

Table 18: Production and Marketing of Local Maize and Potatoes on Small Farms 1974/75

Percent of Production Marketed by Crop	Number of Holdings (000)	Value of Production Per Holding (K Shs)	Value Marketed Per Holding (K Shs)
<u>Local Maize</u>			
0 - 9	943	260	4
10 - 29	124	565	95
30 - 49	94	1,740	645
50 +	117	1,876	1,304
Total/Average	1,278	546	179
<u>Potatoes</u>			
0 - 9	411	392	3
10 - 29	21	1,037	203
30 - 49	15	1,359	532
50 +	33	1,310	803
Total/Average	480	508	84

Source: Republic of Kenya, FAO Marketing Development Project. Smallholder Marketing in Kenya 1974/75, mimeo., pp. 31, 35.

Marketing of farm supplies, such as seeds, fertilizer, chemicals and machinery, is done by a number of private firms as well as by the Kenya Farmers Association (KFA). In former large-scale farming areas these firms operate a well established distribution system with well-stocked stores in major towns. In trust land areas, distribution of the main inputs (seed maize and fertilizers) is handled by small shop-keepers who operate on their own or as agents for the KFA or other firms. In settlement areas, these inputs are usually marketed by the co-operative union, through local co-operative societies. Supplies of less established inputs, such as fungicides, cattle feeds and mechanical equipment, are obtained mainly in larger market centres or towns.

Footnotes

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18. Heyer, J., et al., op. cit., p. 317.
19. Heyer, J. et al., op. cit., p. 321.
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IV. POTATO PRODUCTION¹

A. Location and Volume of Production

Potatoes are fairly widespread in all areas with favourable ecological conditions except in Western and Nyanza Provinces. The most important regions are: (1) Molo/Mau Narok; in Nakuru District (2) the areas on the western parts of Aberdares, Ol Kalou and (3) Kinangop; in Nyandarua District (4) the ridges along the eastern slopes of Aberdare range in Kiambu, (5) Murang'a and Nyeri Districts; and on the northern slopes of Mt. Kenya (6) Meru District (Table 19, Figure 4). The numbers in brackets identify the six areas shown in Figure 4 and those referred to in Tables 20-26.²

In these areas almost every farmer grows potatoes. In the western parts of the highlands (Uasin Gishu, Trans Nzoia, Nandi and Kisii Districts as well as Western Province,) potatoes are grown only to a very limited extent, although climatic conditions are favourable. Reasons for the unpopularity of the crop might be eating habits of the local people and lack of market outlets. Estimates for the total area under potatoes vary greatly, from 31,500 to 261,200 ha.³ The volume of production is estimated to be 333,000 tons.⁴ The 1979-1983 Development Plan for Kenya states an area of 51,000 ha. for 1976 and a total production of 408,000 tons.⁵ The largest area seems to be located in the Central and Eastern Provinces; Meru shows the highest acreage.

There are some indications that estimates I-III in Table 19 are rather low; first, intercropping is not indicated, and second, it appears that the estimates do not consider the vast extent of squatting and settlement on large-scale farms in the former white highlands and in forests in the Central and Rift Valley Provinces. Personal experience indicates that large areas officially referred to as forests have been penetrated by settlers, cleared and brought under cultivation. Such areas are found on top of the Mau Range, Timborua Forest, along the Aberdare Mountains and on the slopes of Mt. Kenya. Since most of the places are at altitudes near 3,000 metres, where maize does not grow satisfactorily, potatoes are a major crop.

Additional areas of potato production are found in indigenous forests which are cleared to establish new plantations. Land is leased to croppers who have to clear the original forest vegetation and are then allowed to grow crops for five years. Out of these they grow potatoes for about two years, followed by maize. Reasonable estimates indicate there could be some 10,000-15,000 ha. of potatoes.

On the other hand, the total production areas quoted in estimate IV seem rather high. If it is linked with the total production figure in the same source, 333,000 tons, this leads to an average yield of 1.3 tons/ha,

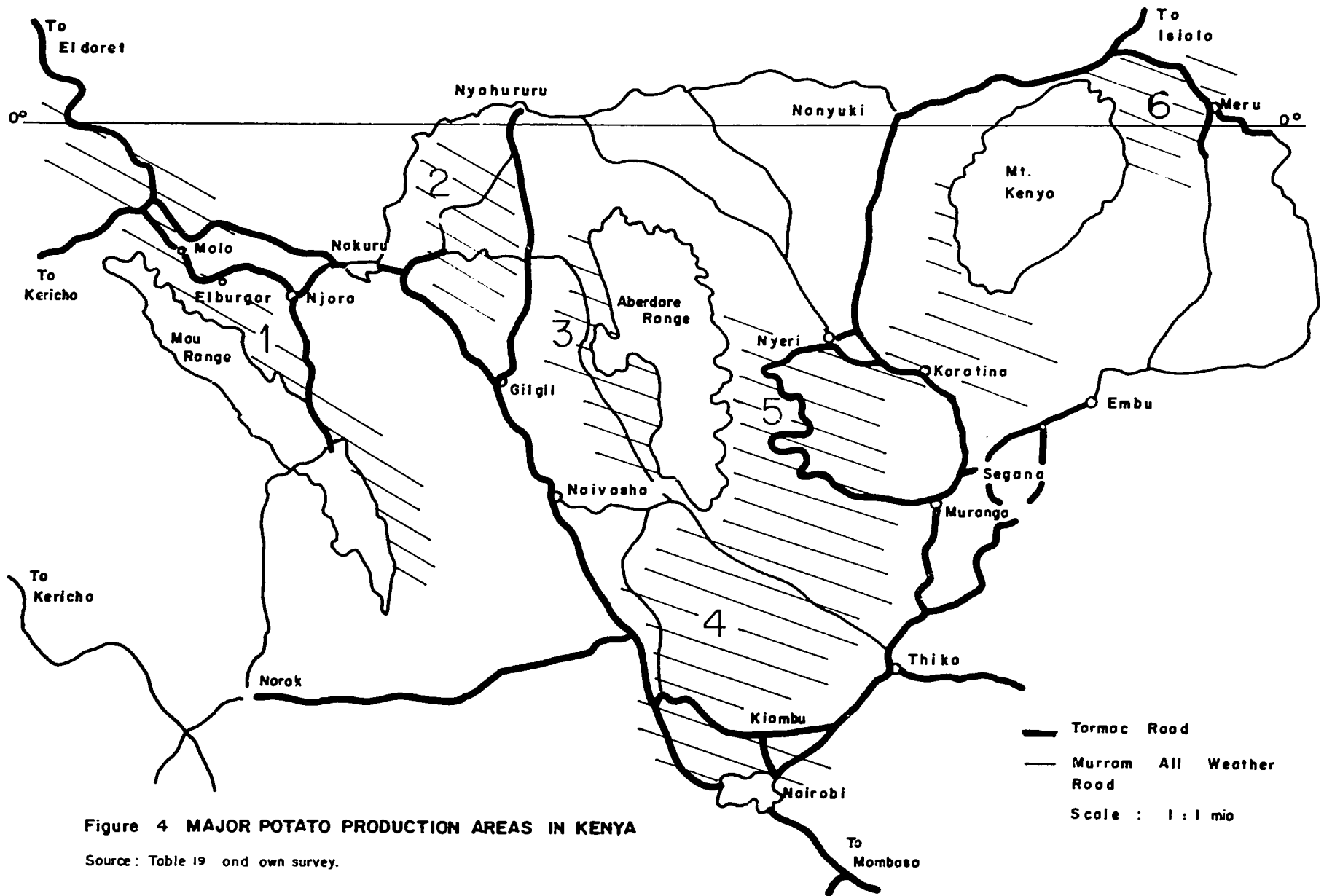


Figure 4 MAJOR POTATO PRODUCTION AREAS IN KENYA

Source: Table 19 and own survey.

Table 19: Published Estimates for the Area Under Potatoes 1975
(000 ha./year)

Districts and Provinces	Estimates of Potato Area				
	I	II	III	IV	
				Pure	Mixed
<u>Central Province</u>					
Nyandarua	9.0	13.9	7.2	-	-
Nyeri	2.0	1.9	2.3	-	-
Kiambu	1.8	2.9	6.2	-	-
Murang'a	0.7	1.1	3.3	-	-
Kirinyaga	1.0	0.8	0.2	-	-
(Sub-total)	(14.5)	(20.6)	(19.3)	(16.9)	(102.8)
<u>Eastern Province</u>					
Meru	10.0	13.4	13.2	-	-
Embu	2.0	0.2	0.6	-	-
Machakos	-	0.3	0.3	-	-
(Sub-total)	(13.0)	(13.9)	(14.1)	(31.0)	(108.4)
<u>Rift Valley Province</u>					
Nakuru	1.5	-	-	-	-
Narok	0.7	-	-	-	-
Uasin Gishu	0.3	-	0.4	-	-
Nandi	0.3	-	-	-	-
Kericho	0.7	1.1	3.0	-	-
Elgeyo/Marakwet	0.5	0.6	-	-	-
Laikipia	-	-	0.1	-	-
(Sub-total)	(4.0)	(1.7)	(3.4)	(0.9)	(0.9)
<u>Nyanza Province</u>					
Kisumu	-	0.2	-	-	-
South Nyanza	-	0.2	-	-	-
Kisii	-	0.4	0.2	-	-
(Sub-total)	-	(0.8)	(0.2)	(0.1)	(0.1)
<u>Coast Province</u>					
Taita	-	0.3	-	-	-
Kwale	-	0.4	-	-	-
(Sub-total)	-	(0.7)	-	-	-
Total	31.5	36.9	37.0	48.9	212.3

Sources: Estimate I : Ballestrem, C.G., Report on Activities and Experiences on Potato Crop in Kenya. Nairobi, July 1975, p. 5; Estimate II : Republic of Kenya, Central Bureau of Statistics. Statistical Abstract 1977, pp. 113-115; Estimate III : Republic of Kenya, Ministry of Agriculture. Annual District Agricultural Reports 1975. Various Districts; Estimate IV : Republic of Kenya, Central Bureau of Statistics. Integrated Rural Survey 1974-75, Nairobi 1977, p. 79.

which is far less than a personal estimate of 5 tons. It is extremely doubtful that potato production can be maintained at such a low yield level. If this acreage is accepted as well as the yield of 5 tons/ha, total production would amount to 1.3 million tons. Retaining around 25% for seed, about 1 million tons would be available for consumption, which amounts to an average national consumption of 64 kg per capita per year. Since, at most, only half of Kenya's population consumes ware potatoes regularly, their per capita consumption would be 130 kg/year. This consumption level seems unrealistically high.

A second aspect to be considered in estimate IV is the share of mixed cropping. 81% of the total potato area. In the survey, conducted for the present study, only about 20% of the potato stands were found to be mixed with other crops.

A third point of doubt is raised on the ratio of acreage for the Central and Eastern Provinces. A comparison of the total high potential areas in the two Provinces indicates that high potential land in Eastern Province amounts to only about 55% of the area in Central Province.⁶ Taking into account the great popularity of potatoes in Central Province it seems hardly possible that Eastern Province grows more of the crop. Hence, the ratios indicated in estimates I, II and III seem more reasonable than those in estimate IV.

On the basis of the diverse estimates for both acreage and volume of potato production it is difficult to arrive at the real magnitude of these variables. However, it seems clear that the potato crop is far more widespread than previously assumed, but that on most farms it is produced on a limited scale and mainly for home consumption. If the various estimates for area and production are compared, an estimate of 75,000-100,000 ha. pure stand and a production of 400,000-500,000 tons seems reasonable. This area allows for potatoes interplanted with other crops; the volume of production includes about 30% (1.5 tons/ha.) to be used for seed. This leaves 280,000-350,000 tons for domestic consumption and export. The total number of potato farmers could be some 400,000-500,000, and the area per farm 0.1 ha. (pure stand) per season, with two crops per year.

B. Seasonality of Production

Production periods for potatoes coincide largely with the rainfall patterns. since rainfall is bimodal in production areas two planting seasons are common (Table 20).

In Meru, seasonality is very distinct, with most potatoes planted in February and August/September. The main harvesting periods are January/February and June/July. In the other regions, seasonality is less marked and potatoes are planted year around. In areas east of Aberdare Range,

in Nyeri, Murang'a, and Kiambu Districts, major harvesting periods are June/July and December/January, in Nyandarua and Molo the majority of harvesting is done in July/August and December. The seasonal patterns of harvesting times ensure that there are fresh potatoes available year round, although quantities offered on the market fluctuate strongly.

Table 20: Frequency of Plantings in Six Areas 1976/77 (% of Total Plantings Per Year on Sample Farms)

	Molo	Ol Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru
January	9	1	7	3	2	1
February	10	1	14	17	4	37
March	22	16	5	25	25	12
April	8	34	18	7	14	-
May	1	2	3	1	3	-
June	3	1	9	1	1	-
July	5	3	4	4	3	-
August	18	11	17	17	11	27
September	15	15	10	17	15	22
October	6	11	6	7	19	1
November	2	4	3	-	3	-
December	1	-	3	1	-	-

Source: Own Survey.

C. Farming Systems

Farm sizes and land use patterns vary greatly in potato growing regions. Farms are smallest in the Districts east of Aberdare Range (Kiambu, Nyeri and Murang'a) which are former trust land areas and where farming has been practiced for a long time. They are larger in areas where settlements established recently (Kibirichia in Meru, Kinangop and Ol Kalou in Nyandarua District). In Molo area, a situation is found where former large-scale European farms have been taken over in a form of multi-ownership. In many cases, the co-owners have claimed their share of land to live on, and farm sizes are rather small (Tables 21 and 22).

Land use patterns differ between regions. The cultivated area varies less than the total farm area (Table 22). Main foodcrops grown in all areas are maize, beans, potatoes, and vegetables (e.g., cabbages, carrots and kale). An industrial crop, pyrethrum, is fairly widely grown, and especially common in Nyandarua and Molo.

Tea and coffee are grown only in Nyeri, Murang'a, Kiambu and Meru Districts. Wheat and barley, although generally considered large farm crops, are quite frequently found in Nyandarua and Meru Districts.

Table 21: Farm Size Distribution in Six Areas 1976/77 (% of All Sample Farms)

Farm Size Group (ha.)	Molo	O1 Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru
0 - 2	65	-	25	67	60	11
2.1 - 4	14	6	30	28	33	27
4.1 - 6	4	24	6	5	7	32
6.1 - 8	3	15	8	-	-	9
8.1 - 10	2	12	5	-	-	7
10.1 - 14	6	10	5	-	-	12
14.1 - 20	3	22	14	-	-	2
20 +	2	11	7	-	-	-

Source: Own Survey.

Table 22: Land Use Pattern in Six Areas 1976/77 (ha. per Average Sample Farm)

Land Use	Molo	O1 Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru
Potatoes	0.4	0.3	0.3	0.2	0.2	1.3
Maize	0.9	1.1	0.6	0.6	0.6	0.9
Other Foodcrops	0.1	0.3	0.5	0.2	0.2	0.3
Commercial Crops	0.4	0.2	1.1	0.2	0.3	0.7
Total Crop Land	1.7	2.3	2.5	1.3	1.4	3.3
Total Farm Size	3.5	12.3	8.0	1.7	2.1	5.9

Source: Own Survey.

Potatoes are grown by virtually every farmer. However, the acreage planted is relatively small, except in Meru, where potatoes occupy about 40% of the cropland and 22% of the total farmland. In other areas, the share of cropland ranges from 12-24%, and of total farmland from 2-11% (from Table 22).

Potato cultivation in forests under the auspices of the Forest Department is a peculiar production system. Natural forests, being cleared for improved silviculture are leased for cropping for four years before new trees are planted. The tenants clear and burn the forest and then plant potatoes for a year or two. Potatoes are then followed by maize. The clearing areas are being shifted continuously, and growers usually have several plots spread over a distant area, each being approximately one acre.

D. Cultural Practices

1. Rotations and Mixed Cropping

The potato crop is rather difficult to grow, and is quite demanding with respect to disease and pest control and soil fertility. A sound crop rotation can be an effective means of satisfying these demands, and it is recommended that potatoes be planted not more than once in four seasons. Table 23 indicates that in the areas on the eastern side of the Aberdares crop rotation is quite well established. These are the areas which have been intensively cropped for many years and where maintenance of soil fertility and control of diseases have become important and necessary features in cultural practices. In Molo, on the other side, crop rotations are not widely practiced and farmers tend to grow potatoes in mono culture. As to the intercropping of potatoes with other crops, Table 23 shows that only about 15-25% of the stands are mixed crops (mainly interplanted in maize); only in Molo is a higher share interplanted.

Table 23: Frequency of Potatoes in a Four Season Rotation and Interplanting of Potatoes in Six Areas 1976/77 (% of All Sample Farms)

	Molo	O1 Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru
<u>Potatoes Grown</u> <u>in 4 Seasons</u>						
Once	20	38	39	51	50	40
Twice	18	46	41	43	43	36
Three times	36	9	15	5	5	13
Four times	26	7	5	11	2	11
<u>Mixed Potato</u> <u>Stands</u>	37	13	15	15	25	11

Source: Own Survey.

2. Crop Husbandry

Potatoes are usually planted at the beginning of the rainy season. After preparing the land, furrows or planting holes are dug for tubers together with manure and/or fertilizer. Potatoes are generally planted in rows. The most common spacing is 60 cms. between rows and 30 cms. within the row (2 x 1 feet). After about four to six weeks, the crop is weeded two to three times at about two week intervals. At the same time, some earthing up is done. Harvest comes about four months after planting; tubers are often lifted prematurely. All harvesting is done by hand, with sticks, pangas or forkhoes. When lifted, tubers are graded roughly; normally small ones are kept aside for seed and damaged ones are kept for immediate home consumption or livestock feeds.

E. Input Structure

1. Mechanical Equipment

Mechanical equipment is used for land preparation by about 50% of potato farmers (Table 24), the majority of cases, engage tractor ploughs. The tractors are usually owned by bigger farmers who are able to raise capital to purchase the equipment. They carry out the operations on a contract basis for smaller farmers in the surrounding areas. Scale of operations is an important criterion for the viability of mechanized farm operations and size of farm and size of the potato plot determine to a large extent the use of tractors. Other limiting factors for tractor ploughing are topography and accessibility, which limit mechanization in parts of Kiambu, Murang'a, and Nyeri Districts and in forest areas in Molo. Keeping draught oxen is rarely found in potato growing areas; only in Meru where some cases of oxploughing was reported. Farmers generally consider it uneconomical to keep oxen.

2. Planting Material and Seed Rate

As for seed, farmers retain part of their crop to plant in the following season. They usually keep the small-sized tubers which are more difficult to sell and which are not too bulky to handle during storage and planting. Occasionally farmers fall short of planting material due to poor harvest or storage problems. In these cases seed potatoes are obtained from neighbouring farms, or (as reported mainly in Kiambu, Murang'a and Nyeri), potatoes from other areas (such as Meru) are bought on the market. Only a small fraction of potato growers (5-10%), have ever bought certified seed. Reasons for the unpopularity of improved planting material are its high cost, the lack of an established seed potato market and, in many cases, lack of know-how. Furthermore, it appears that the varieties offered by the seed production programmes are not particularly popular. One major argument against these varieties is their poor marketability and, in the case of Kenya Akiba, the long growth period.

Table 24: Input Structure for Potatoes in Six Areas 1976/77

Input Structure	Molo	Oi Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru
<u>Frequency of Application (%)</u>						
Mechanical Land Preparation	44	63	61	17	-	89
Certified Seed	9	1	-	1	5	-
Mineral Fertilizer	31	71	54	65	79	42
Livestock Manure	21	44	68	84	78	79
Chemical Disease Control	4	10	5	35	79	100
<u>Average Quantity Applied (kg/ha.)</u>						
Chemical for Blight Control	0.3	0.4	0.5	3.5	3.0	9.0
Seed Potatoes	1,320	1,390	1,300	1,600	1,410	2,000
Nitrogen from Mineral Fertilizer	2.8	19.8	3.5	10.1	11.2	9.0
Livestock Manure	900	800	1,900	4,900	3,900	5,800

Source: Own Survey.

The seed rate of 2 tons/ha. recommended by the extension service is reached only in Meru; in the other five regions the rates are considerably lower. The spacing of tubers at planting was reported as 60 x 30 cms. in all areas, which means that the number of tubers planted per ha. is similar. The difference in seed rates between areas is then due to the different size of tubers planted.

3. Varieties

Farmers surveyed in the six growing regions mentioned thirty-five varieties (Table 25).⁹

The most frequently mentioned variety is Kerr's Pink. Of the varieties propagated by the potato programme, only Roslin Eburu (B53) is commonly grown.

Farmers generally grow several varieties on their farms, except in Meru where Kerr's Pink is virtually the only variety grown. The varieties are all mixed in the fields, but farmers are very well able to identify a variety by the plant and tubers and also attach various attributes to each (e.g., length of growth period, blight resistance, yield potential, cooking quality and others to each type).

Table 25: Potato Varieties Named by Ware Potato Growers in Six Areas 1976/77 (Frequency of Responses in %)

Variety	Molo	Oi Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru
Kerr's Pink	11	59	81	85	57	100
Maritta	17	20	53	13	9	-
B 53	10	47	51	37	19	-
Kinongo	1	32	27	3	-	-
Ngabati	1	7	15	-	-	-
Ngorobu	2	3	14	4	3	-
K. 9	-	20	8	1	-	-
Annet	1	12	8	-	-	4
Thiba	-	-	6	3	-	-
B 59	-	-	6	-	-	-
Dutch Robjin	25	19	5	3	2	-
Desirée	-	-	4	-	-	-
Tako	-	-	2	-	-	-
Tanganyika	2	-	2	-	-	-
C 53	-	9	2	-	7	-
99	4	-	-	-	-	-
Pimpernel	-	3	-	-	-	-
Kenya Baraka	-	1	-	1	-	2
Kenya Akiba	-	1	-	-	-	-
Mkurino	-	1	-	-	-	-
N. v. Tana	-	-	-	-	-	2
K. 9	-	-	-	16	-	-
Susanna	-	-	-	11	-	-
Gaturn	-	-	-	1	-	-
Gatuwa	-	-	-	1	-	-
Arka	-	-	-	1	-	-
B 52	-	-	-	1	-	-
G.	-	-	-	-	14	-
C.	-	-	-	-	12	-
C. 52	-	-	-	-	9	-
Mwezi Mojs	-	-	-	-	5	-
Njai	-	-	-	-	5	-
Kenya 1	-	-	-	-	2	-
K	-	-	-	-	2	-
B	-	-	-	-	2	-
Red	21	-	-	-	-	-
White	47	-	-	-	-	-
Mixed	8	-	-	-	-	-

Source: Own Survey.

4. Maintaining Soil Fertility

Improvement of soil fertility through use of fertilizer and/or manure is generally recognized as necessary in potato production. The problematic aspect is, however, the type and quantity of nutrients to be provided. As for manure, little can be said about the extent to which it contributes to soil fertility, since nutrient content is much determined by treatment before application. However, it certainly contributes to an improved soil structure.

A wide range of mineral fertilizers is applied on potatoes, the majority of which are compounds. Only 25% of the farmers use compounds which provide the correct, or recommended, combination of nutrients, and only 1% meets the recommended standards in respect to both type of fertilizer and quantity. Many farmers are not aware of the different nutritional composition of various types of fertilizer and of differences in nutritional requirements of various crops. Also, they seem to neglect the high nutrient requirements of potatoes, since the rates of application are usually for below the recommended level. An additional problem in respect to fertilizer application is the availability of cash to purchase the item at the time of planting.

5. Pest and Disease Control

A wide variety of diseases and pests occur in potatoes. Hazards mentioned most frequently are blight and cutworms; bacterial wilt and tuber moth appear less often. What is termed "frost" appears to be identical to blight in most cases, although farmers are not aware of this.

The variation in pests and diseases identified in different areas (Table 26), has two explanations: first, the occurrence of various diseases differs between areas and, secondly, farmers' abilities to identify diseases differ. At least with respect to blight, the latter argument is supported, since most of the varieties grown are susceptible to blight and farmers in all areas are liable to face that problem.

In controlling pests and diseases, standards are even lower than with respect to fertilizer application. Blight can only be controlled through chemical application, and both the frequency of application and the rate per ha. appears to be linked with farmers' ability to identify the problem (Tables 24 and 26).

Bacterial wilt and nematodes are soil born diseases which occur most often in those regions where farms are small and/or where crop rotations are short. Both hazards can be controlled by adopting a strict rotation pattern of at least four seasons and by purchasing healthy planting material. Neither measure is taken up sufficiently, although the two areas with a high incidence of bacterial wilt (Kiambu and Nyeri) show a more distinct rotation pattern than the other areas (Table 23).

Table 26: Occurrence of Pests and Diseases in Six Areas 1976/77
(% Responses from Sample Farms)

Type of Pest or Disease	Molo	OI Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru	Total
No Record	33	5	39	11	5	-	17
Blight	21	57	46	71	64	98	57
Bacterial wilt	1	4	-	36	28	-	11
"Frost"	23	9	6	5	10	-	9
Nematodes	-	1	-	1	2	20	3
Tubermoth	8	31	1	12	2	-	10
Millipedes	-	24	3	-	7	13	8
Cutworms	39	51	14	23	71	57	41
Chafer grubs	-	20	-	-	9	-	5

Source: Own Survey.

6. Labour

Potato is a comparatively labour intensive crop; total labour input amounts to about 330 man-days per ha. (Table 27).

Table 27: Average Labour Input for Various Operations on Potato Farms in Six Areas 1976/77 (Man-days/ha.)

Operation	Molo	OI Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru	Average
Land Preparation	68	13	74	69	13	19	43
Planting	55	60	53	59	60	39	54
1st Weeding	58	72	55	62	72	49	61
2nd Weeding	33	68	45	40	68	43	50
3rd Weeding	5	22	17	4	22	25	16
Spraying	-	-	-	4	-	17	4
Harvesting	<u>85</u>	<u>123</u>	<u>97</u>	<u>92</u>	<u>123</u>	<u>100</u>	<u>103</u>
Total	304	358	341	330	358	292	331

Source: Own Survey.

It is noticed that labour input is roughly the same across areas, particularly for planting, first weeding and harvesting. (These operations are carried out by all potato farmers.) The input level is slightly lower in Molo and Meru. The former area includes forest cultivators, where labour requirements for weed control as well as planting are less than

under normal conditions. In Meru, farmers are specialized in potato production and might use labour more efficiently than in other areas.

With respect to source of labour, in all areas and for all operations a certain share of labour force is hired (Table 28). The contract is usually established on a daily basis, occasionally on piece rate basis.

Table 28: Share of Hired Labour in Various Operations on Potato Farms in Six Areas 1976/77 (% of Total Labour Input)

Operation	Molo	Ol Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru	Average
Land Preparation	17	20	22	19	26	29	22
Planting	24	35	22	19	28	30	26
1st Weeding	27	33	24	15	26	15	23
2nd Weeding	30	39	22	14	31	13	25
3rd Weeding	45	24	22	31	47	16	31
Spraying	-	-	-	33	12	9	9
Harvesting	27	40	24	22	26	37	29
All Operations	28	34	23	19	27	25	26

Source: Own Survey.

In Meru a number of farms produce potatoes entirely on a contract basis. Land preparation is done by tractor plough; planting and harvesting are paid for per bag; and weeding and spraying are contracted on a per acre basis.

The overall share of hired labour in potato production is around 25% fluctuating between areas at about one fifth in Kiambu and one third in Ol Kalou. Also, for the different operations it moves within a similar range. The subjective judgement of growers on labour scarcity shows greater variation (Table 29). Meru growers seem to experience a shortage of labour during harvesting time, whereas Nyeri/Murang'a growers report little difficulty in carrying out their operations.

Table 29: Records on Labour Shortage for Various Operations on Potato Farms in Six Areas 1976/77 (% of All Producers)

Operation, where Labour Shortage is Experienced	Molo	Ol Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru
Land Preparation	11	4	19	7	10	-
Planting	32	20	24	35	10	55
Weeding	49	36	19	12	17	57
Harvesting	23	32	25	28	17	72
No shortage	23	28	33	36	65	2

Source: Own Survey.

F. Yields and Utilisation of the Crop

1. Yields

Kenyan potato yields are generally low, around 5 tons/ha. All areas show similar performance except Meru, where yields are almost twice as high (Table 30). Within each region yields show wide variations, occasionally reaching over 20 tons/ha. On the other hand, 15-20% of the farmers harvest just about what they planted, 2 tons or less (Table 30).

Table 30: Distribution of Potato Yields and Average Yield in Six Areas 1976/77 (% of All Producers and Tons/ha.)

Yield Groups (Tons/ha.)	Molo	Ol Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru
<u>Distribution of Yields (%)</u>						
0 - 1.9	15	15	20	21	19	7
2 - 3.9	39	25	24	21	19	8
4 - 5.9	18	21	19	24	22	18
6 - 7.9	11	18	11	13	22	11
8 - 9.9	8	10	10	13	9	11
10 - 11.9	4	3	5	2	3	19
12 - 13.9	1	4	7	3	5	7
14 - 15.9	1	4	2	1	-	7
16 - 23.9	3	1	2	2	2	11
<u>Average Yield</u> (Tons/ha.)	4.5	5.2	5.2	4.8	5.4	9.4

Source: Own Survey.

Within the Meru area yields vary with altitude and, to a lesser extent, with planting season, (Table 30).¹⁰ The differences in yield levels are probably due to differences in rainfall. In the other five regions the yield distribution is strongly directed towards the lower groups, with the majority of farmers harvesting less than the average (Table 30).

2. Use of the Crop

Most farmers grow potatoes both for home consumption and sale, and retain part of the crop for seed. Emphasis on use of the crop differs by regions (Table 23). The share of produce sold is relatively low in Kiambu and Nyeri/Murang'a, where potatoes are produced mainly for home consumption. The total amount produced per farm and season is only about one ton (from Tables 22 and 30).

The situation looks different in Meru, where 61% of a total production of 12 tons per farm and season is sold and only 19% is retained for consumption. The primary objective of production, therefore, is to obtain cash income from potatoes. In the other three areas potatoes appear to serve a dual purpose, providing food and cash; because of the low volume of total production they appear to be grown primarily for food.

Further evidence of these conclusions can be drawn from Table 31, which shows the percentage of farmers who use their produce for the respective purposes. Virtually all farmers make use of potatoes for consumption and seed and interregional variations are minor. However, the use of potato as a commercial crop differs sharply between regions; the percentage of farmers selling potatoes varies with the average volume of production.

Table 31: Utilization of the Potato Crop and Purchase of Ware Potatoes in Six Areas 1976/77 (%)

Use	Molo	Ol Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru
<u>Percent of Production</u>						
Sale	39	32	27	14	18	61
Home Consumption	36	41	48	54	54	19
Own Seed	25	25	25	32	27	21
<u>Percent of Producers</u>						
<u>Who:</u>						
Sell Production	72	69	71	43	46	94
Consume Production	95	85	96	97	95	92
Save for Own Seed	81	93	99	93	86	98
Purchase Ware Potato	50	26	-	40	53	20

Source: Own Survey.

A further indication of the importance of potatoes as a foodcrop for growers is the fact that a considerable share of growers buy ware potatoes in addition to their own production. The data on purchases in Table 31 support (though not very strongly) the regional pattern of potato utilization.

3. Storage

Farmers store potatoes for various reasons: to provide seed for the next crop; to keep ware potatoes for home consumption; and possibly to retain potatoes destined for sale in expectation of better prices.

Farmers have several ways of storing potatoes, but many practices are not very suitable. As a rule they keep potatoes in the house or in a general farm store on the ground; occasionally they protect them against light. Some farmers store potatoes in the field by delaying harvest or in pits (Table 32).

Seed is generally stored separate from ware potatoes for the period between harvest and the next planting. This is usually about two months; an exceptional situation prevails in Meru, where the length of storage is only about three weeks. In Meru the main objective of seed storage is to break dormancy of the tubers. Farmers keep their tubers in a pit which is completely closed and where the potatoes heat up. After a few weeks, the tubers are ready for planting. In other areas pit storage is not common, since potatoes cannot be kept very long in them. A few farmers store their seed in shady, well airtight sheds, where they put the tuber in thin layers on trays. This type of store provides excellent conditions for seed potatoes, but is not widely used by growers.

Potatoes for consumption are stored for two to three months, which is usually not enough to bridge the period until the next harvest (Table 32). Therefore, in many instances, growers purchase potatoes to supplement their own supply of food (Table 31). The preferred storage place is the farmer's house. The average quantity stored for consumption is rather small (in the range of half a ton) with the exception of Meru. Such small quantities seem to justify giving much attention to storage practices.

Potatoes to be sold are kept in stores by about 50% of the growers who sell potatoes. The duration of this storage is five to nine weeks, which is less than the usual storage period for potatoes to be consumed. A larger share of farmers selling potatoes store them in farm stores rather than the house (Table 32).

Losses during storage are estimated at 6-19% over the entire storage period or about 3-10% per month. These values relate to a broad range of storage conditions, lengths of storage and qualities of tubers stored. More accurate information on storage losses has been obtained from trials, where local storage practices were compared with an improved small farm store in three locations. A fourth variable, use of sprout suppressants, was tested. Results of the trial are summarized in Table 33.

Table 32: Farm Storage of Seed and Ware Potatoes in Six Areas 1976/77

Type of Use	Molo	OI Kalou	Kinangop	Kiambu	Nyeri Murang'a	Meru
Seed Storage						
Average Length of Storage (weeks)	6	9	8	8	8	3
Storage System (%)						
House	53	58	46	45	47	-
Store	38	33	46	47	49	-
Pit/Field	5	9	8	8	-	100
Storage for Home Consumption						
Average Length of Storage (weeks)	8	13	8	11	11	13
Storage System (%)						
House	43	63	51	57	58	60
Store	53	33	33	42	42	38
Pit/Field	-	4	11	1	-	-
Storage for Sale						
Frequency of Storage for Sale (% of Growers)	44	27	14	7	36	68
Frequency of Storage for Sale (% of Sellers)	61	39	19	16	78	72
Average Length of Storage (weeks)	9	6	5	6	7	9
Storage System (%)						
House	45	50	46	-	44	46
Store	55	50	39	100	56	54
Pit/Field	-	-	15	-	-	-
Average Losses (%)	19	12	16	6	12	8
Average Length of Storage for All Uses (weeks)	7.4	9.1	6.9	8.2	8.5	8.4
Average Loss per Month (%)	10	5	9	3	6	4
Average Quantity of Potatoes Stored for Consumption (80 kg bags)	7	8	5	5	7	20

Source: Own Survey.

Table 33: Losses in Two Types of Ware Potato Stores in Three Areas
1976/77 (% of Initial Weight)

Length of Storage	Molo		Ngecha/Kiambu		Kiribichia/Meru	
	House	Improved Store	House	Improved Store	House	Improved Store
2 Months	2.8	4.8	6.0	6.8	7.3	4.6
3 Months	8.0*	5.3*	12.4*	10.9*	22.0	7.9
4 Months	15.7*	6.3*	18.9*	16.5*	18.0	5.6

* Sprout suppressants were applied.

Source: Republic of Kenya, Ministry of Agriculture. Feasibility of Ware Potato Storage in Kenya. By W.J. Zettelmeier, Nairobi, February 1978. mimeo., pp. 14, 16.

"House storage" represents the common practice of keeping potatoes on the floor in some corner of a house. The "Improved Store" is a wooden cylindrical construction with a raised floor which allows air to pass through the stack by natural convection. It can be easily constructed with locally available materials and techniques.

The improved store is superior to traditional house storage in the cooler areas (Molo and Kibirichia) and with storage periods longer than three months. The length of storage is particularly relevant for potatoes retained for consumption, since reduction of storage losses might enable farmers to consume potatoes over a longer period.

4. Farm Gate Potato Prices

Farm gate prices for potatoes vary between and within regions and between seasons. Table 34 presents the monthly and the annual averages for six areas. The average prices in the Table have to be interpreted with caution, since some are formed from few observations. Nevertheless, the data reveal clear price differences between regions. Prices are particularly high in Nyeri/Murang'a and Kiambu and low in Kinangop. The other three areas lie between the extremes and near the average of all areas.

Seasonal price movements show a depression in June to August in all areas. This period coincides with the main harvesting season, which indicates that prices react to the increased supply at that time.

Interregional and interseasonal price movements are overlaid by price differences between farms. Table 35 shows the highest and the lowest prices received by farmers for their potatoes in various months and areas. The data show that differences between these extreme prices

are in virtually all cases larger than the seasonal variations. This feature is particularly prominent in areas where price levels are rather low (Molo, Ol Kalou and Kinangop). This may indicate that the competitive position of producers on markets is rather poor, and that price information and market outlets are rather limited. Other possible explanations for the price differences are criteria of quality, variety and/or size of potatoes.

Table 34: Monthly and Annual Average Farm Gate Potato Prices in Six Areas 1976/77 (K Shs per bag)

	Molo	Ol Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru	Average of All Areas
January	43	-	18	63	68	30	50
February	55	-	-	58	72	37	47
March	91	-	-	-	69	36	57
April	30	-	27	-	-	-	27
May	43	-	22	55	-	-	38
June	22	-	27	54	49	-	37
July	25	31	27	54	64	34	39
August	28	23	17	56	55	38	33
September	31	31	30	-	62	41	36
October	46	31	23	70	65	48	37
November	46	51	29	-	77	27	46
December	-	60	28	54	50	-	41
Average	38	32	23	56	63	38	39

Source: Own Survey.

Even given the wide price variation within areas, price differentiation between areas is still maintained. For example, "high prices" in Kinangop are lower than "low prices" in Kiambu. This extreme difference is quite remarkable when one considers that these two areas are quite close together. Possible reasons for these wide price differences between such close areas are quality aspects, local market situations and/or, differences in market outlets.

5. Market Outlets

Producers' market outlets are differentiated according to the place of transaction and the farmers' trading partners. Table 36 indicates that, considering the aggregate of all areas, virtually all the produce is bought by traders.¹²

Table 35: Highest and Lowest Monthly Farm Gate Potato Prices in Six Areas 1976/77 (K Shs per bag)

	Molo	Ol Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru
January						
High	48	-	20	72	100	30
Low	36	-	13	55	25	20
February						
High	105	-	-	70	90	44
Low	15	-	-	50	60	18
March						
High	120	-	-	-	90	44
Low	35	-	-	-	58	28
April						
High	30	-	50	-	-	-
Low	30	-	17	-	-	-
May						
High	80	-	60	60	-	-
Low	17	-	14	45	-	-
June						
High	30	-	35	60	72	-
Low	15	-	18	48	35	-
July						
High	42	50	40	80	75	45
Low	12	18	12	45	60	27
August						
High	54	45	40	65	80	55
Low	12	15	8	40	30	18
September						
High	65	50	40	-	70	60
Low	18	12	15	-	55	27
October						
High	60	50	50	70	70	70
Low	20	18	12	70	60	30
November						
High	72	78	60	-	90	27
Low	30	30	15	-	65	27
December						
High	-	60	50	65	55	-
Low	-	60	14	30	45	-

Source: Own Survey.

**Table 36: Market Outlets for Ware Potato Growers in Six Areas
1976/77 (% of Total Quantity Sold)**

Place of Sale/ Trading Partner	Molo	Ol Kalou	Kinangop	Kiambu	Nyeri Murang'a	Meru	All Areas
Farm/Farmer	13	1	-	3	13	-	2
Farm/Trader	41	71	78	14	46	16	27
Farm/Consumer	7	3	-	11	3	-	2
Farm/Processor	-	-	18	-	-	-	1
Local Market/ Trader	30	18	-	28	22	85	65
Local Market/ Consumer	9	7	-	8	8	-	2
Nairobi/Trader	-	-	4	29	-	-	2
Nairobi/Consumer	-	-	-	5	3	-	-

Source: Own Survey.

The most important transaction place is the local market, where two-thirds of all potatoes are traded; the other third is sold on the farm. The picture looks different when the individual producer areas are examined. One remarkable feature is that in Kiambu, about one-third is sold by producers directly in Nairobi to traders (possibly retailers) and consumers. This market outlet is favoured by the proximity of the producers to the market and by its attractive prices. The vicinity of Kiambu to a major urban centre may also explain the fact that 24% of the produce sold goes directly to the consumer.

Farmers in Kinangop have direct access to processing facilities; a vegetable drying plant in Naivasha buys various types of vegetables such as peas, carrots or onions for processing. In 1976 prices for processed potatoes were exceptionally high on the export market and the firm included that commodity in its assortment. However, more recently, this outlet ceased to exist for farmers.

Trade between farmers is generally small and mainly carried out in Molo and Nyeri/Murang'a. It may well be that potatoes traded there are not only for consumption but seed.

One last aspect which draws attention is the high share of trade on the local market in Meru, whereas in other areas the farm is the dominant trading place. This is more remarkable when one considers that the average quantity sold per farm and per transaction is about three tons in Meru, whereas in other areas it is less than one-half ton. Under such conditions, one would expect that for larger quantities, the lorry traders would find it worthwhile to collect the produce directly on the farms, rather than have it handled twice.

G. Economics of Potato Production

1. Input Costs

Prices for inputs which are marketed through formal channels, such as fertilizers and chemicals, are fixed by marketing agents, and are similar all over the country. On the other hand, prices for locally offered inputs and services, such as manure, farmers' seed, contract ploughing and labour, vary between regions (Table 37).

Table 37: Costs for Locally Provided Farm Inputs in Six Areas 1976/77

	Molo	Ol Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru
Tractor Plough (K Shs/ha.)	215.00	214.00	220.00	338.00	--	200.00
Ox Plough (K Shs/ha.)	150.00	--	--	--	--	150.00
Local Seed (K Shs/t)	612.00	--	--	724.00	766.00	--
Manure (K Shs/t)	--	--	35.00	137.00	--	54.20
Farm Labour (K Shs/day)	5.85	5.45	6.00	7.65	6.95	6.25

Source: Own Survey.

In a number of areas certain inputs are not traded, and hence, there are no market prices for them. A generally high price level is found in Kiambu, where markets for almost all the inputs considered exist. Ol Kalou shows prices only for labour and tractor plough, and these are at a fairly low level.

The valuation of inputs which are provided by the farm (in most cases seed, manure and family labour) is somehow arbitrary. In cases where there is a market price, this could be used to value farm-provided inputs. With family labour, often only the amount which is used during periods of labour shortage is valued, with the argument that during slack periods the opportunity cost of labour is zero.

Where there is no market price, a value for "alternative use" could be attached. For example tubers kept for seed could have been sold as ware potatoes. If the input acts as a substitute for commercial inputs, a substitutional value can be calculated. This method can be applied for manure, which substitutes to some extent for mineral fertilizer. However the value attached to a farm-produced input must be determined according to the situation on each farm, and may vary from zero and the highest possible price.

2. Production Costs

The cost of potato production depends largely on the amount of inputs used and the values attached to farm produced items. The structure of production costs differs between regions. The major item in all areas is labour, followed by seed. The factors showing the highest interregional variation in costs are chemicals and, to a lesser extent, manure (Table 38).

Table 38: Average Costs for Inputs Employed in Potato Production in Six Areas 1976/77 (K Shs per ha.)

Cost Item	Molo	O1 Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru
Own Seed	507	551	379	810	578	849
Purchased Seed	185	-	-	313	518	-
Own Manure	45	40	65	409	195	253
Purchased Manure	-	-	-	262	-	61
Chemical Fertilizer	107	391	202	280	214	150
Chemicals	6	31	15	113	171	293
Own Machinery	10	-	-	-	-	-
Hired Machinery	81	230	289	81	-	255
Family Labour	1,323	1,409	1,555	2,035	1,383	967
Family Labour During Peak Periods	399	580	541	549	633	394
Hired Labour	455	545	452	479	511	858
Interest on Working Capital	76	93	81	147	109	116

Source: Own Survey.

Note: Costs for land are not considered since lease of land is not common. Interest is calculated on costs for seed, manure, fertilizer, chemicals, machinery and half the costs for labour at a rate of 10% per year for a period of five months.

The crucial variable in assessing the economic performance of the potato enterprise is the valuation of the farm produced inputs, as indicated by the large difference between total costs and cash expenses (Table 39). Since the assumptions made to value these inputs differ between individual farms and regions, no clear statement can be made on the actual magnitude of production costs for an average farm in an area, and one has to compromise within the range given in Table 39.

Table 39: Unit Costs for Potato Production in Six Areas 1976/77 (K Shs)

Cost Items Considered	Molo	O1 Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru
Total Costs:						
Per Ha.	2,795	3,290	3,038	4,929	3,679	3,802
Per Ton	621	633	584	1,027	681	404
Total Costs incl. Family Labour in Peak Periods Only:						
Per Ha.	1,871	2,461	2,024	3,443	2,929	3,229
Per Ton	416	473	389	717	542	344
Total Costs Excl. All Labour:						
Per Ha.	1,017	1,336	1,031	2,415	1,785	1,977
Per Ton	226	257	192	503	330	210
Cash Expenses:						
Per Ha.	834	1,197	958	1,528	1,414	1,617
Per Ton	185	230	184	318	262	172

Source: Own Survey.

3. Profitability

Performance of the potato enterprise within a farm can be assessed by its returns to factors of production. The compilation in Table 40 (derived from Table 38), takes various opportunity cost levels for family labour into consideration. The output includes all the produce harvested (seed, home consumption and volume sold) value at the average farm gate price in an area.

Again the Table indicates clear regional differences in the profitability of potato. The most profitable areas are Nyeri/Murang'a and Meru; somehow lower returns are achieved in Molo, and poor results are obtained in the other three areas. This pattern holds true for both the

factors land and family labour. The results in Table 40 should be taken with caution since they are based on estimates of yields, inputs, prices and opportunity costs for both inputs and the produce itself.

Table 40: Returns to Land and Family Labour on Average Potato Farms in Six Areas 1976/77

	Molo	Oi Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru
<u>Output</u> (K Shs/ha.)	2,160	2,061	1,515	3,330	4,054	4,218
<u>Returns to Land</u>						
<u>Considering:</u> (K Shs/ha.)						
All Family Labour	- 635	-1,229	-1,523	-1,599	375	416
Family Labour in Peak Periods	289	- 400	- 509	- 113	1,125	989
No Family Labour	1,143	725	484	915	2,269	2,241
<u>Returns to Family Labour</u> (K Shs/ha.)	5	3	2	3	9	10

Source: Own Survey.

H. General Assessment of Potato Production

1. Technical Performance

The wide variation of potato yields and the low average yield level indicate that husbandry practices applied by the majority of farmers are inadequate. The crucial factors to be looked at in this respect are seed, soil fertility and disease control.

The extension service recommends: purchase of certified seed at least once every three years, a seed rate 2-2.5 tons/ha, fertilizer application 500 kg/ha. Diammonium Phosphate (18-46-0), and blight control by planting resistant varieties. In none of the areas was this recommended package applied, not even by the better farmers.

A comparison of yields between areas shows that performance in Meru is better; the average yield is twice as high as in other areas, and the highest yields are over 20 tons/ha. Yield levels in the five other areas are all low and with similar patterns of yield variation. An analysis of input structure and crop husbandry shows a number of ways in which Meru differs from the other areas: (a) every farmer sprays his crop against blight at an adequate rate; (b) the seed rate is higher

than in other areas and in accordance with the recommendations (no difference against other areas is noted for fertilizer and use of certified seed), (c) varietal purity on a plot is maintained; (d) farmers have managed to keep the quality of their planting material by discarding poor crops and by exchanging seed with other farmers from the area.

Accordingly, the following factors can be identified as crucial for the better performance of the potato crop in Meru: (a) quality of the planting material and size of the seed tubers; (b) ability to identify diseases (in particular blight) and control them through correct application of chemicals (type, quantity, frequency and timing of application).

2. Economic Viability

In general, profitability of the potato enterprise is marginal and returns to all factors of production are not competitive. However, at two extreme ends performance looks better: Production in forest areas in Molo takes place without any purchased inputs, and at fairly low costs per ha. Although yields are rather poor, unit production costs are low enough to allow positive margins at prevailing prices. At the other end stands the relatively intensive potato husbandry in Meru, where fairly high yields are achieved. Though costs per hectare are high, unit production costs are low, and again positive margins are achieved. In the other areas, profits can only be achieved under exceptionally good market conditions, when the crop is sold during high price periods.

The profitable production system in forest areas is based on the high fertility and water holding capacity of the virgin land. It can therefore be maintained only until the natural fertility is depleted. Then nutrients have to be replaced through fertilizer, which after some time leads to the situation prevailing in low yield-low profit areas. Alternatively, producers have to shift to new forest areas.

Producers in the other areas have to move towards a stage Meru farmers have reached already, and further on. Through intensification of production they have to increase output without increasing unit production costs. Intensification means use of certified seed, mineral fertilizer and chemicals to control blight. The increase in input levels leads to higher productivity of land and labour but also to a much higher capital requirement. The need for cash strains the liquidity situation of producers. An intensification programme, therefore, requires credit facilities to finance the additional inputs and market outlets for the additional produce, to enable farmers to recover their cash outlays.

Economic viability needs to be looked at under a further aspect: the priority to secure sufficient food for the producer. The aim is to reduce unit production costs to a level which makes potato competitive with other foodcrops. In this respect, potato carries certain attributes which make it preferable to other food items: it grows fast, can be

planted twice a year, cooks fast, tastes good and is nutritious. The economic assessment of such a food item is then to be based on the price farmers would have to pay to obtain the good on the local market. It may well be that the relatively high level of farm gate prices in Nyeri and Murang'a Districts is the outcome of such an intraregional surplus-deficit situation.

3. Regional Differentiation

The production pattern is differentiated between regions according to resource allocation and disposal of produce. Three types of producers can be distinguished: One type of producer is characterized by the small size of holding, where most of the effort is directed toward securing food supply for the family. A typical feature on such farms is a high share of foodcrops in the cropping pattern. Commercial crops may include coffee, tea and pyrethrum. The standard of agricultural production is generally fairly high and commercial crops provide sufficient cash income to allow for additional basic requirements of the household.

Potato is primarily consumed at home and only a surplus may be marketed. Major constraints in production seem to be linked to the high intensity of foodcrops in the rotational pattern, which means deterioration of soil structure, incidence of soil-borne and other diseases. Areas where this type of subsistence farms are prevalent are Kiambu and Nyeri Districts.

A second type of producer manages relatively large farms with operations geared toward commercial production. Major enterprises are livestock, maize, barley or wheat. Perennial commercial crops, such as tea or coffee are absent. Agricultural production performance in general is rather poor. Major problems are shortage of capital and lack of secure market outlets. Potato is a relatively unimportant enterprise, produced for both subsistence and the market. The potato became more important in high altitude areas where maize becomes a marginal crop and market food supplies are expensive and insecure. Here the crop is valued for its short production cycle, which makes it a quick source of food and cash. This type of producer is prevalent in Kinangop, Ol Kalou and Molo.

A third type of producer has potato as a major commercial enterprise. Farms are relatively large, the share of potato in the rotation is high and most of the produce is marketed. The standard of farming is fairly good. The potato enterprise competes with tea, pyrethrum, maize, wheat or barley and livestock. Major constraints to potato production are rotational limitations and shortage of labour. Farmers appear to be open to programmes which improve the economic performance of the crop and are most likely more prepared to invest additional capital in the potato enterprise than more subsistence-oriented producers. The area where most of these commercial producers are found is Meru District.

Footnotes

1. Collection and analysis of data in the producer and trader surveys are described in the Appendix to this report. More details are found in Durr, G., Studies on the Potato Sector in Kenya. Interim Reports Nos. 1-6, Nairobi 1977, unpubl. papers. Chapters IV and V draw heavily on these papers.
2. The limits of the regions are impossible to define sharply due to the lack of statistics and land use maps. This map shows only rough limits.
3. See: Daily Nation from 21.10.1976. Potato Boom is Kenya's Aim, Ngagah Tells Researchers; and Table 19.
4. Republic of Kenya, Central Bureau of Statistics. Integrated Rural Survey 1974/75. Nairobi 1977, p. 82.
5. Republic of Kenya. Development Plan 1979-1983, Part I. Nairobi 1979, pp. 260, 262
6. Republic of Kenya, Central Bureau of Statistics. Statistical Abstract 1977, p. 104.
7. Sections V 2-8 draw heavily on Durr, G., Studies on the Potato Sector in Kenya, op. cit.
8. In these areas settlement commenced in the late 1950s.
9. Identical varieties may be named differently in different areas. However, in consultations with the extension staff in various regions, it was not possible to establish the real identity of the named varieties.
10. Durr, G., Studies on the Potato Sector in Kenya. Interim Report No. 1, Nairobi 1977, unpubl. paper, p. 8.
11. Republic of Kenya, Ministry of Agriculture. Feasibility of Ware Potato Storage in Kenya. By W.J. Zettelmeyer, Nairobi, February 1978, mimeo., pp. 14,16.
12. Only about 5% goes to farmers, processors, and consumers. The aggregate values for the six areas ("All Areas" in Table 36) are not equal to the sum of the respective values in the Table, but are calculated from the total volume marketed through the outlets. The discrepancy is because the total quantities sold in various areas differ considerably.

V. POTATO MARKETING AND UTILIZATION

A. Consumption and Processing of Potatoes

1. Nutrition and the National Food Basket

Kenyan nutritional standards at a national level were fairly adequate in the past. An FAO estimate for 1961-63 indicates that the country's caloric requirements were met (Table 41). In the more recent past, the nutritional situation has eroded; in the period 1972-74 an 8% calory deficit is shown. And the per capita protein supply decreased by 13% between 1961-63 and 1972-74.

Table 41: Average Daily Per Capita Supplies of Calory and Protein

	Calories (K cal)			Protein Supply (g)
	Supply	Requirement	Deficit	
1961-63	2,298	-	-	69.8
1972-74	2,137	2,320	8%	60.6

Source: FAO, The Fourth World Food Survey, Rome 1977, p. 79.

The decrease in caloric and protein supplies has paralleled a reduction of growth rates for agricultural production. For the period 1961-1965/70, FAO indicates positive, though small, rates of growth on a per capita basis (Table 42). For 1970-76 the values turned negative and were at a magnitude which is about equal to population growth. This means that production was more or less stagnant during the first half of this decade. Particularly the growth rate for cereals changed drastically.

Table 42: Average Annual Growth Rates of Per Capita Production of Food, All Agricultural Products and Cereals (%)

	Food	Agricultural Products	Cereals
1961-65/70	0.2	0.4	2.1
1970-1976	-3.1	-2.2	-4.0

Source: FAO, The Fourth World Food Survey. Rome 1977, p. 71.

The development of per capita production of food, especially cereals is to be seen against the development of demand as projected by FAO (Table 43). Per capita caloric intake, as well as consumption of cereals, was expected to increase during the seventies. The share of cereals in the caloric supply was estimated at 60% in 1965. Maize, the most important food item, accounted for three-quarters of calories supplied from cereals. In terms of protein supply, cereals (primarily maize) contributed a major share (52% of the daily consumption).

The second major source of calories, starchy roots, provide 13% of the daily calory intake, being closely followed by pulses (10%) and sugar (5%). Pulses supply 22% of the protein supply; meat supplies 12%. In the FAO estimates potatoes are included in the commodity item "Starchy Roots." The average per capita consumption of 111.9 kg of starchy roots in 1965 is made up from 11.4 kg potatoes, 41.7 kg cassava, 29.5 kg sweet potatoes and yams, 2.0 kg arrow roots and 27.3 kg plantains (including bananas).¹ Expressed in calories, potatoes' share is 8% of starchy roots and 1% of the total daily calory supply. For 1975, FAO gives a per capita consumption of 9.8 kg of potatoes, compared to 67.2 kg starchy roots and 93.5 kg maize flour. Shah estimates a per capita consumption of 19.9 kg of potatoes, 79.9 kg starchy roots and 111.3 kg maize flour for the same year.²

The data presented above give the impression that at the national level, potato is a rather unimportant food item and that its future role in nutrition will be limited. Data on production, however, indicate that at least in those areas where the crop is primarily grown, it has attained a certain popularity and serves as both a food and commercial crop (Tables 15, 16, 17, 22, 31). Further estimates presented in the following paragraphs indicate that consumption patterns are more differentiated than shown in the FAO estimates.

2. Potato Consumption in Rural and Urban Areas

The major areas of potato consumption are those producing the crop. These are mostly populated by Kikuyus and related ethnic groups. In contrast, little consumption is found in rural areas unsuitable for potato production. There are vast areas in western Kenya with suitable climate, but where potatoes are neither produced nor consumed.

Similar to information on area and volume of production, there are wide differences in consumption estimates. Shah gives a total volume of production for 1975 of 332,768 tons, of which 246,169 tons were consumed in rural areas and 24,029 tons were marketed to urban centres.³ These figures correspond with a per capita consumption of 21 kg/year for rural households and 15 kg/year for urban consumers (Table 44).

A 1975 survey of potato consumption in Nairobi obtained a per capita consumption of 44 kg/year. A retail survey for potatoes in Nairobi arrived at a per capita consumption of 60 kg/year for 1972/73

Table 43: Per Capita and Total Demand Projections for Food 1965-1980

Commodity Items	Per Capita Consumption 1965			Per Capita Demand Projections 1965-80 (kg/year)				Indexes of Projected Demand				Elasticity of Demand
	Quant. Kg/ Year	Calories Per Day	Protein Gm/Day	1965	1970	1975	1980	1970/ 1965	1975/ 1970	1980/ 1975	1980/ 1970	
Cereals	137.6	1,347	35.6	137.6	134.0	136.9	138.0	112.6	119.5	119.2	142.5	.40
Wheat	7.0	71	2.1	7.0	7.8	8.5	9.2	128.1	127.8	128.1	163.7	.80
Rice	1.3	13	.2	1.3	1.4	1.5	1.6	126.4	126.4	126.8	160.3	.70
Coarse Grains	129.3	1,263	33.3	129.3	124.8	126.8	127.2	111.6	118.9	118.5	141.0	.38
Maize	104.5	1,031	26.6	104.5	101.6	103.4	104.0	112.4	119.2	118.8	141.6	.40
Millet-sorghum	24.8	232	6.7	24.8	23.3	23.4	23.2	108.6	117.7	117.3	138.1	.30
Starchy-roots	111.9	281	3.5	111.9	114.4	113.8	111.2	118.2	116.4	115.6	134.5	.30
Sugar Products	12.1	128	-	12.1	13.6	15.5	17.6	130.1	134.0	134.0	179.0	1.00
Pulses-Nuts-Seed	28.3	237	14.6	28.3	29.8	31.1	32.3	121.8	122.1	122.7	149.9	.42
Vegetables	24.2	14	.9	24.2	25.8	27.1	28.3	123.0	123.1	123.5	152.1	.50
Fruits	4.6	5	-	4.6	4.9	5.1	5.4	123.0	123.1	123.5	152.1	.50
Meat	20.1	107	8.1	20.1	20.3	22.6	25.0	116.8	130.6	130.7	170.7	1.01
Eggs	.5	2	.2	.5	.6	.7	.8	140.0	130.7	130.7	170.8	1.00
Fish	3.0	6	1.1	3.0	3.3	3.7	4.1	128.1	131.0	131.4	172.1	.80
Whole Milk	34.6	67	3.6	34.6	34.7	37.5	40.0	116.0	126.4	126.2	159.5	.80
Skim Milk	2.5	2	.2	2.5	2.6	2.7	2.8	121.6	121.9	122.5	149.4	.40
Cheese	.1	1	.1	.1	.1	.1	.1	126.0	125.3	125.3	157.1	.70
Fats and Oils	2.3	55	-	2.3	2.7	3.1	3.4	133.2	132.2	132.2	174.8	1.11
Spices	.1	1	-	.1	.1	.1	.1	124.8	125.0	125.6	157.0	.60
Cocoa				.0	.0	.1	.1	119.0	127.8	128.1	163.7	.80
Total		2,253	67.9									
Calories				2,253	2,265	2,349	2,415	116.3	121.4	121.5	147.5	.44
Animal Calories				202	207	228	250	118.6	129.0	129.3	166.8	.92
Proteins				67.9	68.1	70.9	73.2	116.1	121.8	122.0	148.6	.47
Animal Proteins				13.3	13.6	14.9	16.4	118.0	128.9	129.4	166.9	.91

Source: FAO, Commodity Projections 1970-1980. Rome 1971, pp. 102, 195 and 324.

(Table 44). Assuming similar per capita consumption for 1978, these estimates lead to a total annual consumption of between 41,400 and 56,300 tons for Nairobi, which corresponds relatively closely to another estimate for Nairobi's consumption in 1978, amounting to 53,100 tons.⁴ Projecting these estimates for per capita consumption to the total urban population, urban consumption could be between 74,000 and 101,000 tons in 1976, or three to four times more than Shah's estimate (Table 9).

Table 44: Average Annual Per Capita Consumption of Potatoes 1975 (Kg)

Estimate and Regions	Income Group			Total
	Poor	Medium	Rich	
<u>Estimate I</u> :				
Rural Population	9.1	22.9	54.8	20.6
Urban Population	7.8	16.8	24.4	14.7
Nairobi	11.6	19.9	31.5	18.4
Mombasa	9.9	17.4	32.0	16.9
Nakuru	5.9	17.1	10.6	9.4
Kisumu	3.5	2.5	9.2	4.4
<u>Estimate II</u> : Nairobi	-	-	-	44.2
<u>Estimate III</u> : Nairobi	-	-	-	60.1
<u>Estimate IV</u> : Potato Producing Areas	-	-	-	116
<u>Estimate V</u> : Potato Producing Areas	-	-	-	70

Source: Estimate I: Shah, M.M., Food Demand Projections Incorporating Urbanization and Income Distribution, Kenya (1975-2000), Laxenburg 1978, Annex 1. Estimate II: Bottcher, D., Analysis of Demand for Potatoes. Berlin, August 1978, unpublished paper, p. 16. Estimate III: Heinrich, F., Consumption and Distribution of Fruit and Vegetables in Nairobi, Kenya. Berlin 1974, p. 7. Estimate IV: Own Survey. Estimate V: Republic of Kenya, Central Bureau of Statistics. Integrated Rural Survey 1974/75. Nairobi 1977, p.82.

As for rural consumption, results from my own survey in five producing areas indicate a per capita consumption of 116 kg/year in 1975/76 (Table 44). A survey carried out one year earlier gives an estimate of 70 kg/year. (Both figures refer to rural households which produce the crop themselves). If this latter estimate is applied to the total population in potato producing regions (3.3 million),⁵ one arrives near to Shah's estimate for rural consumption of 246,000 tons. This seems reasonable, since few or no potatoes flow into rural non-potato producing areas. Summarizing the estimates, total consumption seems to be in the range of 280,000-350,000 tons, of which 50,000-100,000 tons are marketed to urban centres and the rest is consumed within rural producing areas.

All these estimates on per capita and total potato consumption are higher than FAO published estimates. Since the original source and assumptions of the FAO figures is not known, no explanation can be given for the differing estimates.

With respect to consumption by institutions (e.g., hotels, hospitals, boarding schools and other training facilities), their requirements are not large compared to individual households. A survey in Nairobi revealed that large international hotels which provide 1,200-1,500 meals per day, only consume about 70 tons each per year; a large hospital with 3,000 meals daily consumes 100 tons per year; and a training institution with 1,200 students requires about 170 tons annually. A more interesting result of this survey is the amount of potatoes per meal, which in the case of the hospital is 90 gramms, in hotels 130-140 gramms and in the college 200 gramms per meal.

3. Potato's Share in the Household Budget

Although potatoes are consumed by a fairly large number of people in rural and urban areas, importance as a food item, expressed in terms of monetary value, is not very prominent. In rural areas where potatoes are produced, the value of food consumed (own production plus purchases) amounts to about 73% of the value of all commodities consumed in the households. The value of potato consumption (all assumed to be home produced) represents 15-20% of own produce and about 10% of the total food budget.⁶ The most important single consumption item is maize.

In urban centres, expenses for food amount to 40% of total household expenditure. Within the food group, the item on which most money is spent is cereals (that is maize), followed by meat and dairy products. Expenses for potatoes account for only about 3% of the total and are last in the group of ten major food items.⁸

4. Impact of Income on Demand

It is generally assumed that potato consumption shows little response to changes in income and price.⁷ The results of a consumer survey carried out by I. Meyer do not support the assumption concerning income. Her figures show an increase of consumption per capital from the lowest income area of Nairobi with 36 kg/year to the highest one with 53 kg/year (Table 45). This means that the high income households consume about 50% more potatoes than the lowest income ones.

Shah relates per capita consumption to rural and urban income. Three income classes are grouped as follows: incomes for the rural poor, range from 0 to 499 K Shs/capita/year; medium incomes from 500-1,499 and the rich earn 1,500 or more. The corresponding figures for the urban sector as well as the individual cities are 1-699 K Shs/household/month for the poor income class, 700-1,399 for the medium and 1,400 and more for the rich.

Table 45: Average Household Consumption of Potatoes in Various Sections of Nairobi 1975 (kg/week)

	Consumption Per Household	Consumption Per Capita
Mathare	4.1	0.7
Starche	3.8	0.8
Makongeni	4.4	0.8
Kariokor	6.5	0.9
Ngara	6.6	0.9
Nairobi West	5.5	0.9
Lavington	3.5	1.0
Total	5.0	0.8

Source: Bottcher, D., Studies on the Potato Sector in Kenya. Iterim Report No. 7, Analysis of Demand for Potatoes. Berlin 1978, unpubl. paper.

Table 44 shows that nearly all surveyed regions show a remarkable increase in potato consumption with higher income levels. The income elasticity calculated by Shah amounts to 0.6 for the rural sector as a whole and 0.7 for the urban sector. With respect to income classes, the income elasticity decreased from 0.91 (poor) to 0.56 (medium) and 0.33 (rich) in rural areas, and from 1.32 (poor) to 0.61 (medium) and 0.37 (rich) in the urban areas.¹⁰

The results indicate that potatoes consumed in urban areas by people with low incomes are primarily eaten as vegetables, whereas in high income groups potatoes become a staple food.

5. Impact of Price Changes on Demand

As mentioned above, it is generally assumed that potato consumption shows little response to changes in prices.

With respect to seasonal price fluctuations, the results of the Nairobi household consumption survey indicate that there are special periods during the year when potatoes are in greater demand -- during harvest times when they are cheap.¹¹ To estimate the price elasticity in detail, people are asked for their response to changing potato prices. If prices increased 50% higher than at the moment, about 40% of the respondents said they would buy fewer potatoes.

If the price were to decrease, about 65% of the respondents said they would consume more potatoes. Especially in low and middle income groups, the majority of people would expand their potato consumption, at the expense of ugali, vegetables, beans, maize and rice.¹²

From the results discussed above, it can be concluded that in periods of falling prices, the demand for potatoes will be elastic. Many people would like to buy more potatoes but cannot do so at current prices.

6. Consumer Preferences

Different Kenyan ethnic groups prefer different types of diets in which potatoes play diverse roles. The main potato consumers are the people living in the Central Highlands (i.e. Kikuyu, Embu and Meru). Here the basic food is a kind of stew, prepared from maize (whole grains), various types of beans, cooking bananas, potatoes, green vegetables and meat. The composition varies with the availability of the ingredients, but potato fits perfectly well into this sort of diet and its share can make up 30-40% of the volume. Thus, for one meal, a person may consume about 4-5 normal sized tubers. Potato is less important for people in other regions. It is an ingredient in meat or vegetable stew and is eaten together with ugali, rice or chapati. An average quantity per meal per person might be half or one potato. In urban centres, all types of foods are prepared, including European dishes with fried potatoes.

With regard to potato varieties strong consumer preferences exist. Nearly 70% of the consumers surveyed in Nairobi prefer red potatoes, whereas only 10% like the white ones. These results indicate that in the case of expanded potato production there would be a much stronger market for red potatoes than for white ones.¹³

In Nairobi all income groups consume potatoes together with meat, vegetables and/or beans. In the lowest income area investigated only one-third of the people could afford to eat potatoes together with meat, while in the highest income area nearly all people combine potatoes and meat (i.e. here potatoes are used as a staple food). Maize and rice are not mixed too often with potatoes.¹⁴

Consumer awareness and consciousness of potato quality in general and in relation to the growing area is not very great. About 65% of the respondents felt that there are differences in quality during the year, but the concrete reasons named reflect lack of information. Almost the same number of people in every region thought potatoes were better during the rainy season and during the dry season respectively. Only 35% of the respondents know from which area the potatoes they normally buy come.¹⁵

With respect to purchasing behaviour, the consumer survey indicates that most people buy their potatoes on the market. Other important places of purchase are shops and hawkers. The latter ones mainly serve the poorest income groups, while people with high income prefer to buy in shopping centres. People buying on the market said they look primarily at the price and quality, while those buying from shops and hawkers do so because of their short distance from home.¹⁶

7. Competitive Position of the Potato as a Staple Food

For urban consumers major food items are maize, rice, potatoes, beans, vegetables and meat. To compare these items and assess their role in the diet, caloric and protein contents are chosen as common elements (Table 46).

The data indicate that potato competes fairly well with vegetables but falls far below the other major foods. One kilogramme of potatoes provides only 20% of the calories supplied by the same quantity of maize, rice or beans. The protein content of potatoes amounts to only 7% of that of beans and roughly 16% of that of maize.

Table 46: Nutritional Conversion Factors for Selected Foodstuffs

	Calories K Cal/kg	Protein g/kg	Fats g/kg
Maize flour	3,530	93	38
Rice	3,630	70	5
Potatoes	710	15	1
Vegetables	220	14	2
Beans	3,410	221	17

Source: Shah, M.M., Food Demand Projections Incorporating Urbanization and Income Distribution, Kenya (1975-2000). Laxenburg 1978, Table 2.40.

A similar picture emerges when the caloric and protein supplies of the various foodstuffs are expressed in monetary terms. Table 47 shows a sharp increase in average retail prices for commodities in Nairobi since 1973. Over the entire period maize and potatoes were the cheapest among the major foods. Surprisingly, prices for the two goods were fairly similar in most years, even though the maize price is fixed by the government and potato prices are not.

The costs per caloric and kg protein provided by the various commodities have been calculated at 1976 prices (Table 58). Maize is the cheapest source of both calories and protein, followed by beans and rice. The costs of energy and protein from potatoes are much higher than those for maize and beans.

At price levels of other years the position of potatoes among the various foods is similar. It seems reasonable, therefore, that the basic diet of most consumers is made up of maize and beans. Potatoes are added to improve the taste and to some extent, the quality. As such, they play the role of a vegetable, although they are cheaper, for example, than cabbage.

Table 47: Average Retail Prices of Selected Foodstuffs in Nairobi
1969-70 (K Shs/kg)

	Maize Flour	Rice (Grade Two)	Potatoes	Cabbages	Beans
1969	0.55	1.75	0.50	0.70	1.14
1970	0.55	1.65	0.50	0.85	1.37
1971	0.55	1.65	0.63	1.15	1.61
1972	0.70	1.65	0.50	1.01	1.62
1973	0.70	1.65	0.85	1.26	1.60
1974	0.95	2.25	1.08	1.95	2.47
1975	1.19	3.00	1.26	1.92	3.10
1976	1.20	3.06	1.24	2.02	3.41

Source: Republic of Kenya, Central Bureau of Statistics.
Statistical Abstract 1977, p. 327

Table 48: Costs of Calories and Protein from Selected Foodstuffs in
Nairobi 1976 Retail Prices

	Calories (K Shs per 1000 K Cal)	Protein (K Shs per kg)	Relative Costs for Calories and Proteins. Maize as a basis = 1	
			Calories	Proteins
Maize Flour (unsifted)	0.34	12.9	1	1
Rice	0.84	43.7	2.5	3.4
Potatoes	1.75	82.7	5.1	6.4
Cabbages*	9.18	144.3	27.0	11.2
Beans	1.00	15.4	2.9	1.2

* In Table 46 vegetables are not specified. It is assumed, that the conversion factors describe sufficiently accurately the nutritive value of cabbages.

Source: Tables 46 and 47.

In rural potato producing areas major foods are maize, beans, potatoes and vegetables (such as peas and cabbage). Table 49 compares maize, beans and potatoes in terms of caloric and protein production per ha. and year, for three different yield levels.

The low yield level reflects the situation prevailing in Ol Kalou and Kinangop, and also in the higher areas of Molo, where maize takes up to twelve months to mature. For beans, climatic conditions are rather unsuitable, and peas are often grown instead. The medium yield level refers to conditions in Meru, where yields for maize and potatoes are

about twice as high as in the other areas. The third level is based on results from trials.¹⁷ The yield for potatoes has been extrapolated from small trial plots with 30 plants per plot. The yield was achieved with the following inputs per ha: Variety Anett, certified seed, seed rate 2.5 ton/ha, and 500 kg Diammonium Phosphate (equivalent to 90 kg nitrogen, 240 kg of phosphate). The trials were carried out on private farms. For maize and beans the circumstances under which the yields were achieved are not described. In the producer survey, the highest maize yield was 5.6 tons/ha, the highest potato yield was 24 tons/ha. per season. These yields were achieved under farm production conditions. It is therefore doubtful whether the yield levels given as trial results are really comparable.

Table 49: Calory and Protein Production per Year and Hectare from Three Foodcrops at Three Yield Levels 1973/76

Yield Level	Maize*	Potatoes*	Beans*
<u>Low Yield Level</u>			
Yield (tons/ha.)	1.3 ^a	10.0 ^a	- ^b
Calories ^c (million K Cal per ha.)	4.6	7.1	-
Protein ^c (kg/ha.)	121	150	-
Production Costs ^d (K Shs/1000 K Cal)	-	0.89	-
<u>Medium Yield Level</u>			
Yield (tons/ha.)	2.8 ^e	18.8 ^e	- ^b
Calories ^c (million K Cal per ha.)	9.9	14.2	-
Protein ^c (kg/ha.)	260	300	-
Production Costs ^f (K Shs/1000 K Cal)	-	0.54	-
<u>Potential Maximum Yield Level</u>			
Yield (tons/ha.)	5.7 ^g	80.0 ^g	4.6 ^g
Calories ^c (million K Cal per ha.)	20.0	56.0	15.6
Protein ^c (kg/ha.)	530	1,200	1,017
Production Costs ^h (K Shs/ha/year)	-	11,625	-
(K Shs/1000 K Cal)	-	0.21	-

* Maize is assumed to yield one crop per year, potatoes and beans are assumed to be planted twice.

Source: ^a Own Producer Survey in Ol Kalou, Kinangop, Molo. ^b Data on yields for beans in the survey area are not at hand. ^c Yields are converted with the factors from Table 46. ^d Calculation based on total costs per ha. for Ol Kalou and Kinangop, Table 40. ^e Own Producer Survey in Meru. ^f Calculation based on total costs per ha. for Meru, Table 40. ^g Republic of Kenya, National Horticultural Research Station Thika. Report on Potato Agronomy in Kenya 1972/73. By H.J. Holler, pp. 87, 88. ^h Republic of Kenya, op. cit., pp. 87, 88. Production costs were adjusted to 1976 prices in Meru area.

A comparison of caloric and protein production per ha. and year shows that at all three yield levels, potatoes are superior to maize. Under real farm-level production conditions (that is at the low and medium levels) they produce about 40-50% more energy and 15-25% more protein. At the high yield level, potatoes produce about 2.5 times more calories than maize and they show an even higher potential protein production than beans.

A comparison of production costs per unit of energy and protein for the three crops can only be made at the high yield level and 1973 production costs (Table 50).

Table 50: Costs of Energy and Protein Produced from Three Foodcrops at 1973 Prices

	Maize	Potatoes*	Beans*
Yield (Tons/ha.)	5.7	80.0	4.6
Energy (million K Cal per ha.)	20.0	56.0	15.6
Protein (kg/ha.)	530	1,200	1,017
Production Costs (K Shs/ha.)	1,460	7,010	2,360
Costs of Energy (K Shs/000 K Cal)	0.07	0.13	0.15
Costs of Protein (K Shs/kg)	2.75	5.84	2.32

* Two crops per year.

Source: Republic of Kenya, National Horticultural Research Station Thika, Report on Potato Agronomy in Kenya 1972/73. By H.J. Holler, pp. 87,88.

The competitive position does not prove favourable for potatoes, despite the high yields. Maize is cheaper in terms of both criteria and beans supply cheaper protein, at slightly higher costs for energy. A further feature to be mentioned is the depression of production costs for energy at higher yield levels (Table 49), which favours efforts to intensify potato production in order to supply cheaper food to producers.

Calculations at the consumer and producer levels indicate that, with present production and market conditions, the potato is a rather expensive food item. In order to determine its position in the range of food commodities more clearly, other differentiating criteria such as protein quality, taste, cooking time and others have to be employed.

8. Potato Processing

Potatoes are generally consumed fresh; processing is of very limited importance. The only produce made from potatoes are Potato Crisps: thinly sliced potatoes which are fried in oil and flavoured with various ingredients. There are a total of five plants producing Crisps in Kenya; the largest one processes about five tons of fresh potatoes per week, the

other four process another five tons all together. The produce is packed in packets of 20 and 125 gramms, which are sold primarily in schools, kiosks and retail shops.¹⁸

9. Projection of Future Demand

From the results outlined above, it is difficult to accurately project future demand for potatoes in Kenya. Although income elasticities are quite high, one has to bear in mind that most of the population in urban centres has low incomes, and most of their money is required to satisfy the most essential needs (basic foods, housing, clothing etc.). Therefore, expansion of future demand can be expected to come primarily from population increase. The projections made by Shah assume an overall annual growth rate of 4.9%, with the urban market growing at a rate of 8% and the rural market by only 4.5%.¹⁹ In absolute terms, the urban market might increase by some 5,000-7,000 tons per year (one or two percent of the total present production).

Consumption of the commodity in non-potato producing rural areas is constrained by the high cost of distributing the commodity in rural markets, and also by the lack of purchasing power of the rural population. Per capita consumption in potato producing areas is assumed to be saturated, at least on those farms where potatoes are grown. It is therefore doubtful that demand increases in those areas will go beyond the rate of net population growth.

B. Potato Prices

1. Trends and Seasonality

Price reporting for horticultural crops, including red and white-skinned potatoes, was introduced by the Horticultural Crops Development Authority (HCDA) in late 1972. Current weekly wholesale prices are now available for Wakulima Market, the major fruit and vegetable wholesale market in Nairobi. Figure 5 shows the movement of these weekly wholesale prices for red-skinned potatoes from 1973 to 1977.

The graph shows a clear seasonal cycle around an upward trend, with marked fluctuations within periods as short as one week. A likely cause for these fluctuations is that demand for potatoes in Nairobi is relatively stable, whereas supply fluctuates due to weather conditions, the bad state of roads in supply areas, perishability of the produce and lack of storage facilities.²⁰

Another remarkable feature is the tremendous price increase during 1977, when potato price tripled. The cause for this was an extremely poor harvest, due to heavy rains and rotting of the crop.

KSHS/BAG.

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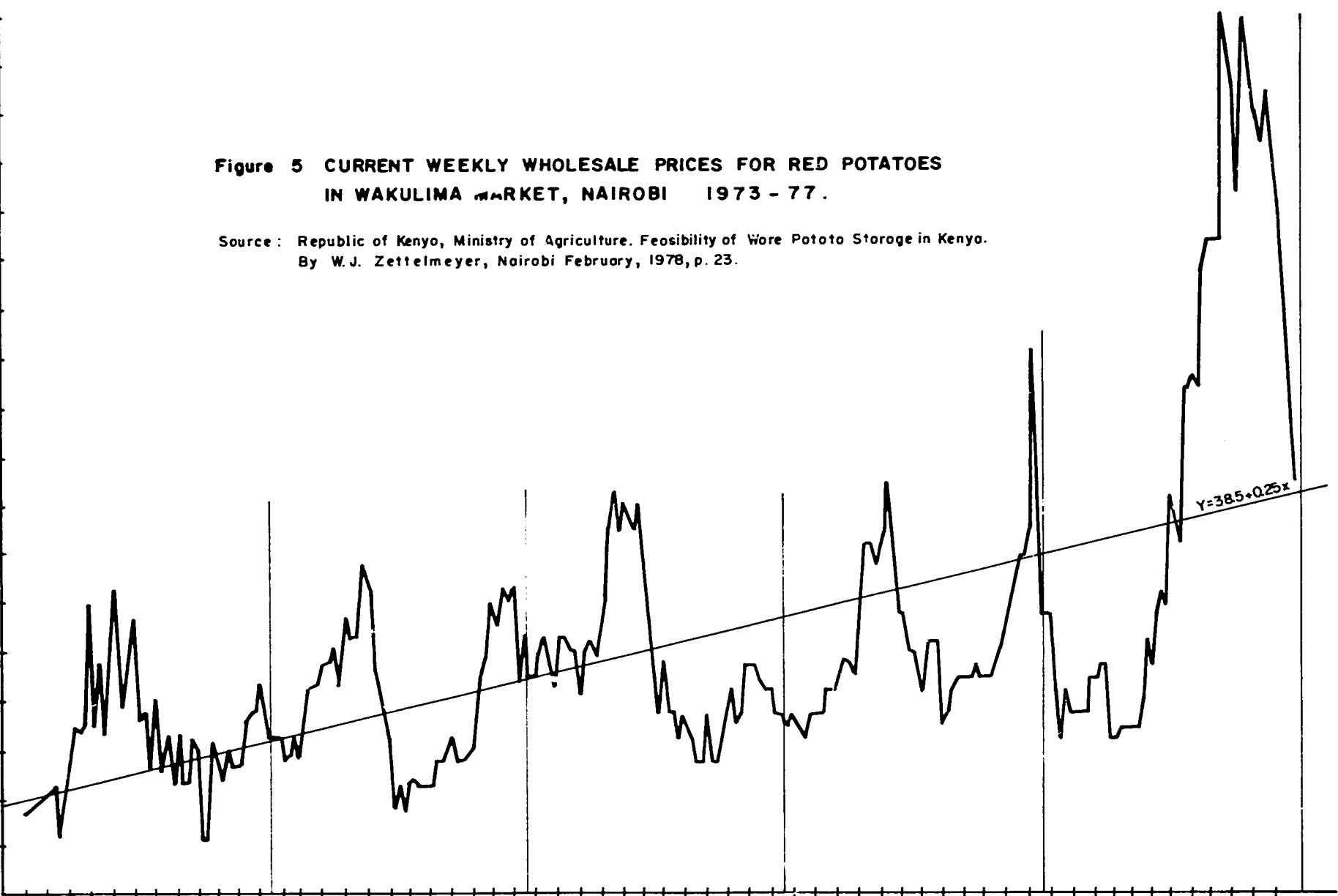
**Figure 5 CURRENT WEEKLY WHOLESALE PRICES FOR RED POTATOES
IN WAKULIMA MARKET, NAIROBI 1973 - 77.**

Source : Republic of Kenya, Ministry of Agriculture. Feasibility of Ware Pototo Storage in Kenya.
By W.J. Zettelmeier, Nairobi February, 1978, p. 23.

J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

1973 1974 1975 1976 1977

$Y=385+0.25x$



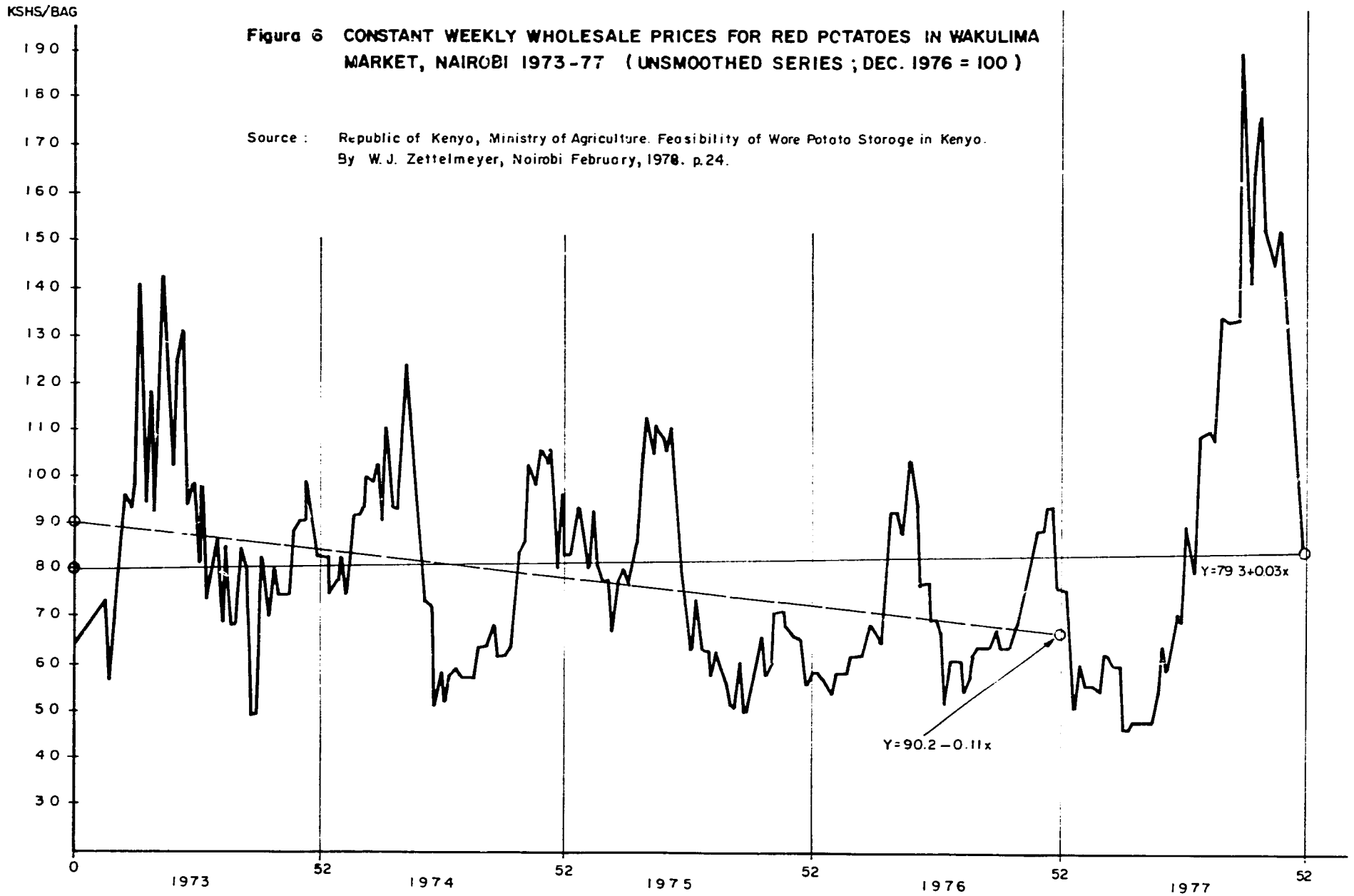
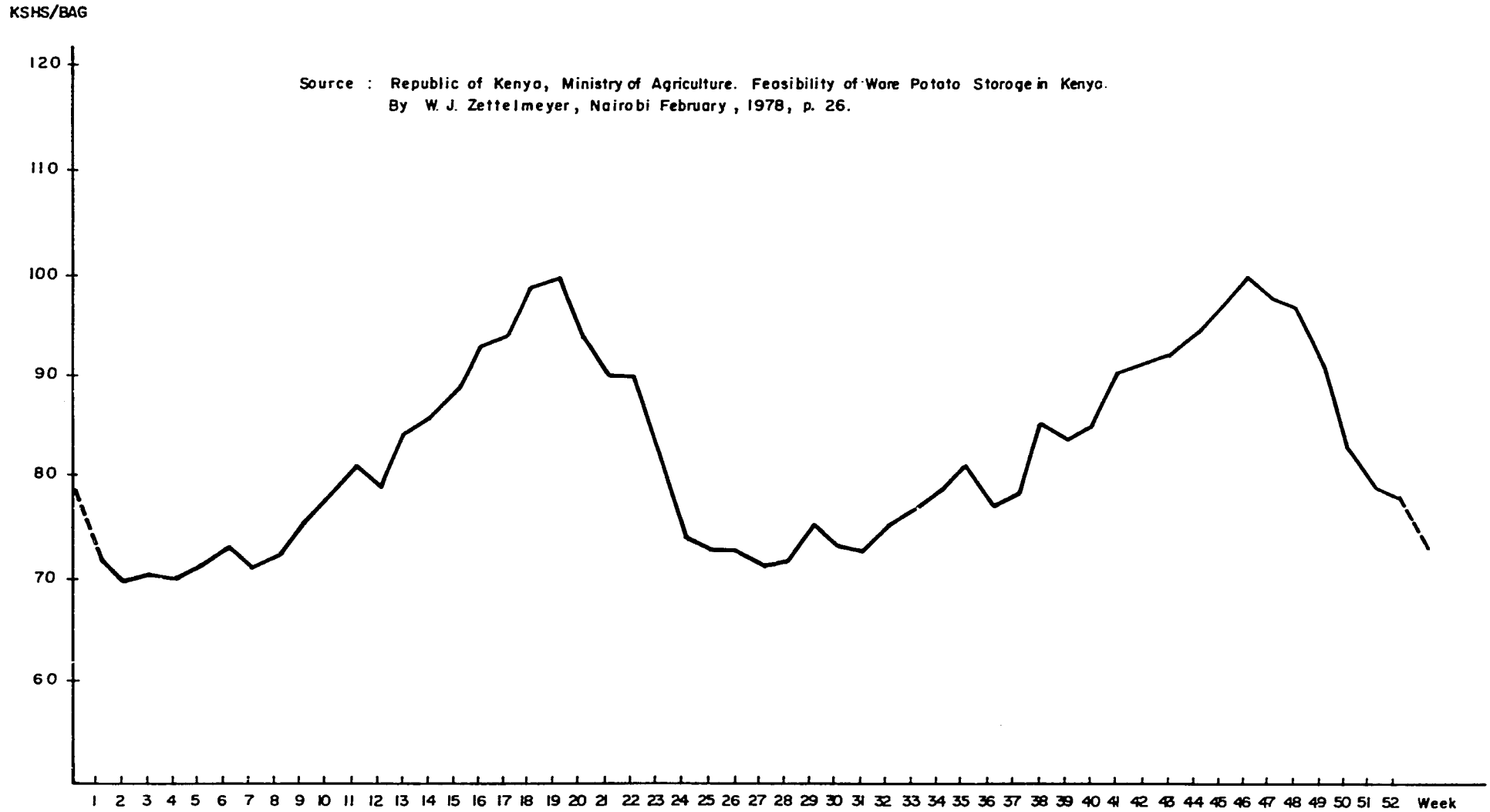


Figure 7 AVERAGE CONSTANT WEEKLY WHOLESALE PRICES FOR RED POTATOES IN WAKULINA MARKET, NAIROBI 1973 - 77 (two-week-moving-average)



In Figure 6, inflation was extracted from the series to indicate the real price trend. For the 1973-76 period, the trend is downward. Including the high-price period in 1977, potato prices remained almost stable over the five years.

To get some indication about the seasonal pattern of potato prices, constant prices for five years were smoothed with a 2-week moving average and averaged over the five years.²¹ Figure 7 clearly shows two low price periods, which coincide with the harvesting of potatoes in many parts of the country. The price peaks, which are about 40% above the low price level, are reached three to four months after harvest and are reduced to the initial level after another month. The magnitude of seasonal price fluctuations cannot be termed excessive, when one compares them with similar price series for other perishables like cabbage, tomatoes and cooking bananas. Potatoes had the most stable prices among these commodities.²²

2. Price Links Between Retail Markets

Since 1977, a Rural Market Survey provides retail prices for potatoes at two weekly intervals for 66 rural and urban markets. Price data are available for these markets as monthly averages for the period from January 1977 to June 1978.²³ In an attempt to analyze links in price formation between markets, monthly price changes were correlated for all the markets. The correlation coefficients are interpreted as an indicator of market transparency. The results show a general very low coefficient (in most cases less than 0.2), and also rather low levels of significance. However, in a group of about ten rural markets at the periphery of the major producing areas (in Central and Eastern Provinces, around Sangana, Karatina, Embu, in Figure 4), prices correlate very closely at a high level of significance. This gives an indication that prices are formed on the basis of competition in these areas. The markets are all within, or in the vicinity of, production areas, and they either serve as consumer markets for rural populations living near them or as assembly markets for large urban centres. Surprisingly, correlation coefficients between retail markets in Nairobi and Mombasa and the rural market prices were all very low, and it seems that price movements in these markets do not strongly influence each other.

3. Price Differentiation and Quality

The potato market differentiates prices according to quality of the produce, groups them into white and red-skinned types. Figure 8 shows the 5-year averages of monthly prices at Wakulima Wholesale Market for the two types of produce.²⁴ Average red potato prices are about 35% above white potato prices. The discrepancy varies over seasons, and is particularly relevant during periods with lower prices, the gap ranges from 114.00 K Shs/ton to 321.00 K Shs/ton. The price difference is so substantial that it appears worthwhile to identify the various aspects determining it. It seems to be due to reasons other than just skin colour. Other important aspects may be quality attributes of certain varieties which have red or white skins and qualitative features linked to production

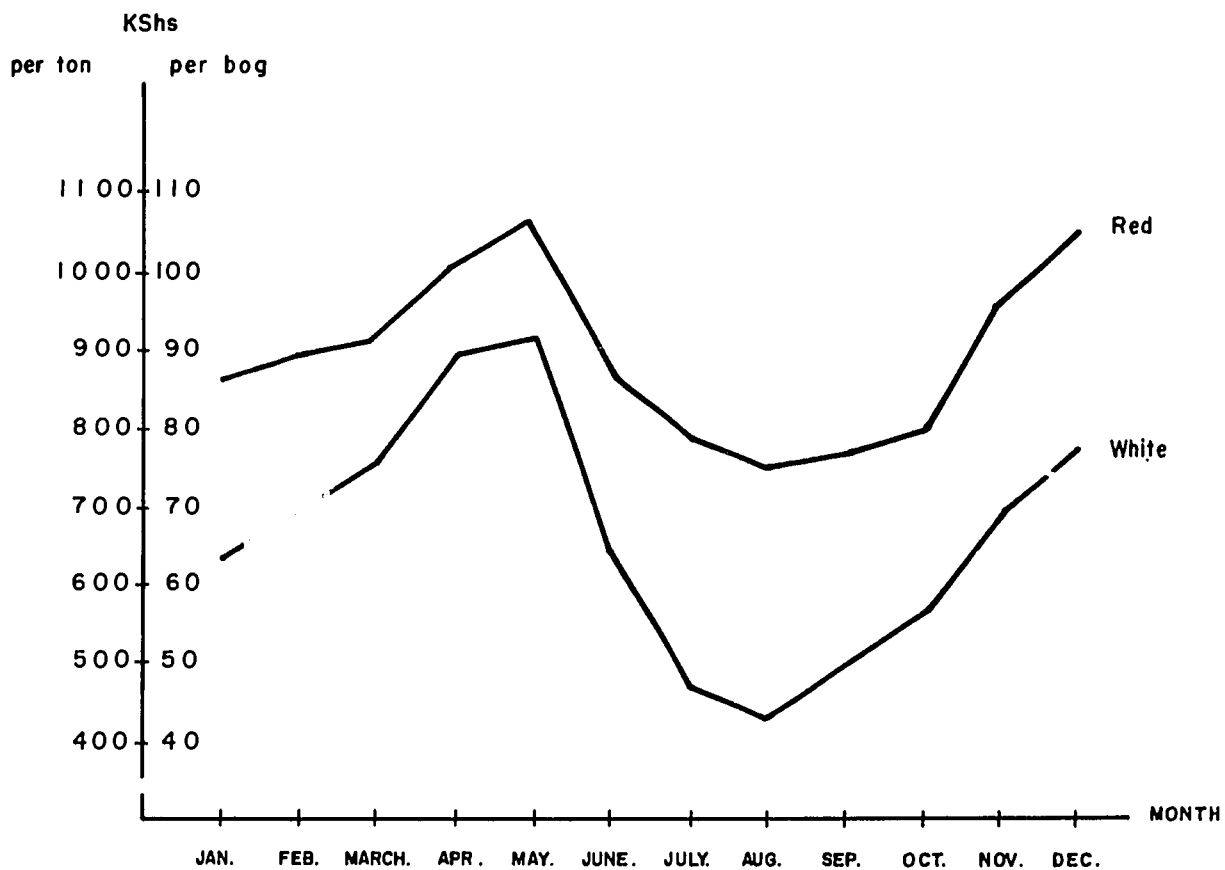


Figure 8 AVERAGE MONTHLY WHOLESALE PRICES FOR WHITE AND RED POTATOES AT WAKULIMA WHOLESALE MARKET, NAIROBI 1973 - 77.

Source : Republic of Kenya, Ministry of Agriculture. First Phase Report on the Horticultural Development Study, Vol. I. Main Report and Summary, Nairobi 1978, chapter 8, p.4.

conditions in certain areas (natural environment or potato husbandry) where mainly red or white-skinned varieties are grown.

C. Potato Marketing

1. Supply Pattern

Potatoes are grown in virtually every District where there is potential, except in Western Kenya and parts of Nyanza. However, a concentration of production can be located in six areas: Molo/Mau Narok in Nakuru District, Ol Kalou and Kinangop in Nyandarua District, Kiambu and Murang'a and Nyeri Districts, and Kibirichia in Meru District (Figure 4). Supply conditions vary in these regions in terms of total volume and seasonality of supply.

Since the estimates of total acreage and volume of production are based on dubious procedures, it is even more risky to estimate the regional distribution of supply.

An attempt is made in Table 51 to derive the total market supply on the basis of the total areas of production (own estimates the yields per ha. (from Table 30 and the marketed shares in each area (Table 32). The data differ somewhat from the general information on production and consumption discussed in previous parts of this report. The distortions are due to the relatively high yield level in Meru, combined with the area's relatively large production. It might well be that regarding the acreage yields are lower, although survey results are not conclusive in this respect.²⁵

Table 51: Production and Market Supply of Potatoes in Six Areas 1976/77

	Molo	Ol Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru	Total
Acreage (ha.)	6,000	4,000	5,600	8,000	8,000	11,000	42,600
Yield (t/ha.)	4.5	5.2	5.2	4.8	5.4	9.4	-
Total Production (tons)	27,000	20,800	29,120	38,400	43,200	103,400	261,920
Marketed Share (%)	39	32	27	14	18	61	-
Market Supply (tons)	10,530	6,656	7,862	5,376	7,776	63,074	101,274

Source: Own Survey.

Seasonality of supply coincides with the harvesting patterns in various areas. Table 52 gives a breakdown of sales over the year.

Table 52: Seasonal Pattern of Potato Sales in Five Areas 1976/77*
(% of Total Market Supply)

Month of Sale	Molo	Kinangop	Kiambu	Nyeri/ Murang'a	Meru
Jan./Feb.	15	1	11	25	39
Mar./Apr.	6	21	-	10	13
May/June	13	15	13	8	-
July/Aug.	49	25	62	32	40
Sep./Oct.	11	16	1	11	9
Nov./Dec.	<u>7</u>	<u>22</u>	<u>13</u>	<u>12</u>	<u>-</u>
Total	101	100	100	98	101

* In the sixth area, Ol Kalou, the survey was conducted at a time when the second crop was about to be harvested, and no data could be obtained on sales for that season. From the seasonality of general farm production, the pattern appears to be similar to the one in Kinangop.

Source: Own Survey.

There are two aspects to be noted: a) the relatively high percentage of potatoes sold in July/August, also the main harvesting period in all areas; and b) the regional differentiation of supply pattern. Meru and Nyeri show two marked peaks, Kiambu shows one and Kinangop and, to a lesser extent, Molo, sell potatoes throughout the year.

In Table 53 the regional differentiation of potato supply is combined with the seasonal pattern to obtain the seasonally and regionally differentiated pattern of potato supply. These figures indicate that the supply of potatoes shows a clear seasonal pattern with marked peaks in Jan./Feb. and July/Aug. These peaks are dominated by Meru supply; the regions with a more evenly spread production pattern (e.g. Kinangop) are not strong enough to balance these inequalities.

2. Potato Demand and Produce Flow

The areas where potato consumption is highest are the producing regions. Second to those are the urban centres, whereas consumption in non-producing rural areas appears to be negligible. With respect to marketing, potato consumption by the urban population is most relevant, and here the main focus is on Nairobi and Mombasa, which constitute approximately 70% of the total urban population (Table 49). Nairobi is located at the periphery of the main potato producing regions and gets supply from various areas, whereas Mombasa is situated far away from surplus areas, and much of its

food supply passes through Nairobi's markets. Consequently, the main trade flows have been established from the five or six main producing regions to Nairobi. Estimates for the total volume of urban trade differ greatly, but we conclude that they are in the range of 80,000-100,000 tons. Of these, Nairobi's share is about 50,000 tons, another 15,000 tons are taken to Mombasa and the rest is distributed to the other urban centres.

Table 53: Seasonal and Regional Pattern of Potato Supply in Six Areas 1976/77 (% of Total Market Supply)*

Month of Sale	Molo	Ol Kalou**	Kinangop	Kiambu	Nyeri/ Murang'a	Meru	Total
Jan./Feb.	1.6	0.1	0.1	0.6	1.9	24.3	28.6
Mar./Apr.	0.6	1.4	1.6	-	0.8	8.1	12.5
May/June	1.4	1.0	1.2	0.7	0.6	-	4.9
July/Aug.	5.1	1.6	1.9	3.3	2.5	24.9	39.3
Sep./Oct.	1.1	1.1	1.2	0.1	0.8	5.6	9.9
Nov./Dec.	<u>0.7</u>	<u>1.5</u>	<u>1.7</u>	<u>0.7</u>	<u>0.9</u>	-	<u>5.5</u>
Total	10.5	6.7	7.7	5.4	7.5	62.9	100.7

* One percent equals about 1,000 tons of potatoes.

** Seasonal pattern similar to the one in Kinangop was assumed.

Source: Table 51 and 52.

3. Marketing Channels

Potato trade is entirely in the hands of private traders. The produce on its way from the farm to the urban and rural consumers passes through a number of stages (Figure 9). The main link between the producer area and the urban consumption centre is the interregional trader (lorry trader). He purchases the produce directly from the farmer (on the farm or at a nearby market centre) or he buys through a local trader who takes charge of assembling smaller consignments. In the urban centre, part of the produce is channelled through the wholesale vegetable and fruit market; other parts are sold to wholesalers/retailers who operate their own premises; and a small part is sold to processors. A rather small share bypasses the various institutions and moves from the farm straight to urban traders or consumers.

A survey carried out during 1972/73 revealed that 39% of the potatoes channelled into Nairobi for retailing moved through the wholesale market, 31% were received by private traders residing in Nairobi, another 8% were traded by general retailers, and roughly 10% were obtained from producers directly.²⁶

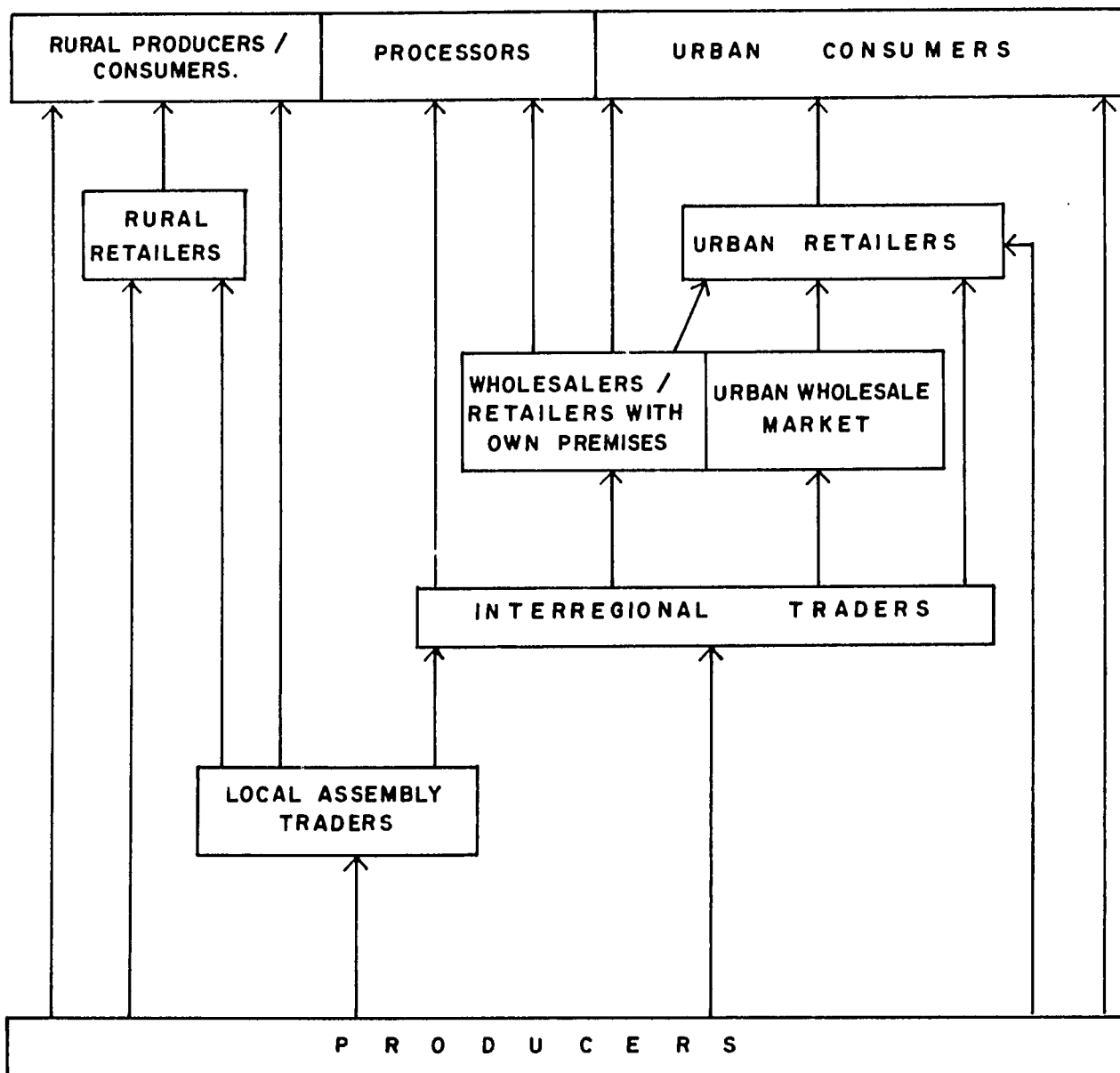


Figure 9 MARKETING CHANNELS FOR FRESH POTATOES.

Source : Own Trader Surveys August / September 1977, September 1978.
 Heinrich, F., Consumption and Distribution of Fruit and Vegetable
 in Nairobi, Kenya. Technical University Berlin.
 December 1974, p. 34.

In trade within rural areas, only few marketing agents are involved, such as rural assembly traders who sell to rural retailers or on rural markets to consumers. Interregional trade between rural areas takes place only on a very limited scale.

4. Types of Traders

Entry into potato trade is not restricted by institutional barriers, and therefore, all sorts of people are engaged in it. In interregional trade, three groups of traders can be distinguished, according to their place of residence and the degree of involvement in the business.

One type of potato trader resides in the major towns, and is usually involved in other trading activities such as wholesaling and retailing of other foodstuffs or general household commodities, sometimes in connection with transport businesses. Some of these traders establish contacts in the producer areas themselves and travel there regularly, while others engage employees or contractors to purchase the produce on their behalf.

Within the producer areas, a group of businessmen have established themselves as food traders, dealing with perishables like potatoes, cabbage, kale, peas and carrots. Often, they possess some other business or a farm. However, they consider trading as their main occupation.

Another group residing in producer areas, takes up potato trading as an occasional job when business prospects are bright. Often these part-time traders are farmers who try to earn additional income from trade. In other cases people without a regular source of income attempt to establish themselves in the business. Small-scale assemblers of produce in rural areas are often of this third group of traders.

At the urban wholesale level, trade takes place mainly in wholesale markets and on private premises. In both cases traders tend to be highly specialized in one commodity, especially in the case of perishables.

Urban retailing of potatoes is carried out on a fairly broad basis. There are various types of retailers, such as general grocers and green grocers (who sell only fruits and vegetables), retailers in city markets, and hawkers. With respect to numbers, hawkers are the largest group, followed by general and finally green grocers.²⁷

5. Modes of Operation in Interregional Trade

a. Assembling

Traders who purchase potatoes from farmers provide all the necessary facilities to handle the produce. The usual procedure is for traders (after having agreed to buy potatoes from a farmer,) to provide the gunny bags and send an employee to fill and tie the bag. When filling, the trader exercises some quality control. A bag filled and tied contains some 80 kg

of potatoes. However, the usual practice is to fill the bag up to the top, cover it with grass or leaves and weave some string network on top to hold the potatoes in. Such bags contain approximately 100 kg. The volume of the bag is the generally accepted measure in potato trade, except in Kibirichia in Meru, where the weight of a bag is fixed at 84 kg.

As for transport to assemble the commodity, all sorts of means are used, including headloads, bicycles, ox-carts and motor vehicles. Usually, the nearest collecting place (the road-side or market place) is within the range of 1 or 2 km; only in Meru, and to some extent in Molo/Mau Narok, does some sort of organized transport for assembling take place.

b. Transport

Traders who transport potatoes from producer areas to the main market centres use 7-10 ton capacity lorries. Traders from areas close to town, such as Kiambu, often use "matatus" (small 1-ton vehicles which maintain regular transport connections for passengers and goods). Also, traders who transport only a few bags often use buses, particularly over long distances. Rail transport is not commonly employed for potatoes because it is rather slow and this increases the risk of loss and ties up working capital.

Heavy transport is partly owned by potato traders, but there is also good service offered by general transporters who may lease their lorries at a fixed rate per day or per distance, or charge for transport on a per-bag basis. The latter means is used particularly by part-time traders who cannot afford to fill an entire truck.

c. Storage

Potato storage for speculative purposes is not known to take place. However, traders store potatoes to assemble large enough quantities to fill a lorry or occasionally to fulfill a large contract. This storage is done in ordinary concrete buildings at market places, where the produce is kept in bags for a few weeks.

d. Trading Practices

The turnover of potatoes within a given time varies greatly between traders. For part-time traders the factor limiting their capacity seems to be capital to buy the produce. Thus, depending on price and cash availability, their turnover may range from 0.5 to 3-4 tons for one buying activity. More established traders operate with greater working capital, and their constraints are handling at the assembly level (contacting sellers and having the bags filled, tied and loaded on the lorry). They usually try to fill one 7 ton-lorry for each buying tour.

A certain operational pattern has developed for trade between producing regions and Nairobi City. During the first day potatoes are bought from farmers. In the afternoon the bags are filled and tied and collected by a lorry. During the late evening the lorry travels to Nairobi where, during

the early morning hours, the potatoes are sold either at the wholesale market or to customers elsewhere. The second day is spent travelling back and forth establishing new business contacts. This two day pattern leads to a frequency of three business trips per week. At times of abundant supply this pattern is followed by most traders. When potatoes are scarce, it takes longer to assemble one lorry's capacity and therefore, only one or two trips are possible each week.

e. Terms of Payment

Terms of payment are generally cash at the time of transfer of the title. However, sometimes the sale is done on a "commission basis," which means payment is made after the produce has been resold. This practice has been found at both ends of the interregional trade channel.

6. Marketing Costs and Trade Margins in Interregional Trade

a. Marketing Costs

The structure of marketing costs in interregional trade is fairly well determined. Traders have to account for gunny bags; the string to tie the bag; labour for filling, tying, loading and unloading; transport and eventually market entry fees (Table 54). The gunny bags are provided to the seller and their cost is included in the selling price of the potatoes. Normally, the same gunnies are then offered at the urban markets at a price about one-half that for new bags.

Table 54: Average Marketing Costs in Interregional Trade Between various Producer Areas and Nairobi 1976/77

Items	K Shs/bag	%
Gunny bag	2.50	11
String	0.28	1
Labour		
Tying	1.00	5
Loading	1.00	5
Unloading	0.60	3
Transport	15.00	69
Legal Fees	<u>1.50</u>	<u>7</u>
Total	21.88	101

Source: Own Survey.

Labour for handling the produce in producer areas is employed on a contract basis, where payment may be made per bag or per day. For permanent workers payment is based on daily or monthly accounts. In the urban markets labour is usually contracted on a piece-rate basis. Legal fees levied by institutions operating in public markets usually have to be paid by the seller.

Transport costs incurred in interregional trade are difficult to determine. The expected dependence of transport charges on distance is not evident. For distances between 50 km and 450 km most transport costs are between K Shs 10.00 and 17.00 per bag; few values are above that range. Besides distance, transport charges depend on size of vehicle, volume transported, road conditions, location of the produce and the degree of competition among transporters. Looking at the data plotted in Figure 10, it seems that in interregional trade an average transport rate is taken irrespective of the distance to the market, until other differentiating criteria are employed

b. Trade Margins

Profit margins for traders vary according to supply conditions. During times of surplus, with farm gate prices of less than K Shs 30.00 in most areas, margins of K Shs 1.00-5.00 were reported, at times of scarcity margins were given as K Shs 10.00-15.00.²⁸ Though data were few, there is an indication that traders operate with certain fixed percentage margins. Support for this is given by survey results in rural retail markets which show that retail trade margins tend to stabilize in the range of 20-39% of the buying price; at lower prices margins are slightly on the higher side while excessive profits are less possible at high buying prices.²⁹

7. Price Determination and Competition

According to the information available, Wakulima Market, Nairobi's wholesale market for fruits and vegetables, is the price leading market for potatoes.³⁰ Virtually all interregional traders surveyed reported that they use Wakulima Market prices as a guiding mark to determine the prices they offer to producers. Price formation within Wakulima seems to operate on a basis of competition, according to supply and demand conditions.

Evidence for price links between Wakulima and rural markets is available in the case of Meru.³¹ but comparison of retail prices in other rural and urban markets does not show any common features in price movements.³² Further doubts on the wholesale market's price-leading role arise from the fact that less than 40% of potatoes coming to Nairobi pass through it, the rest being traded through other channels. Those traders by-passing the market are likely to follow well established business links where price formation is affected by factors such as reliability of supply or quality of the produce.

As for competition in interregional trade, it seems that a large share of the business is controlled by a fairly small group of traders,

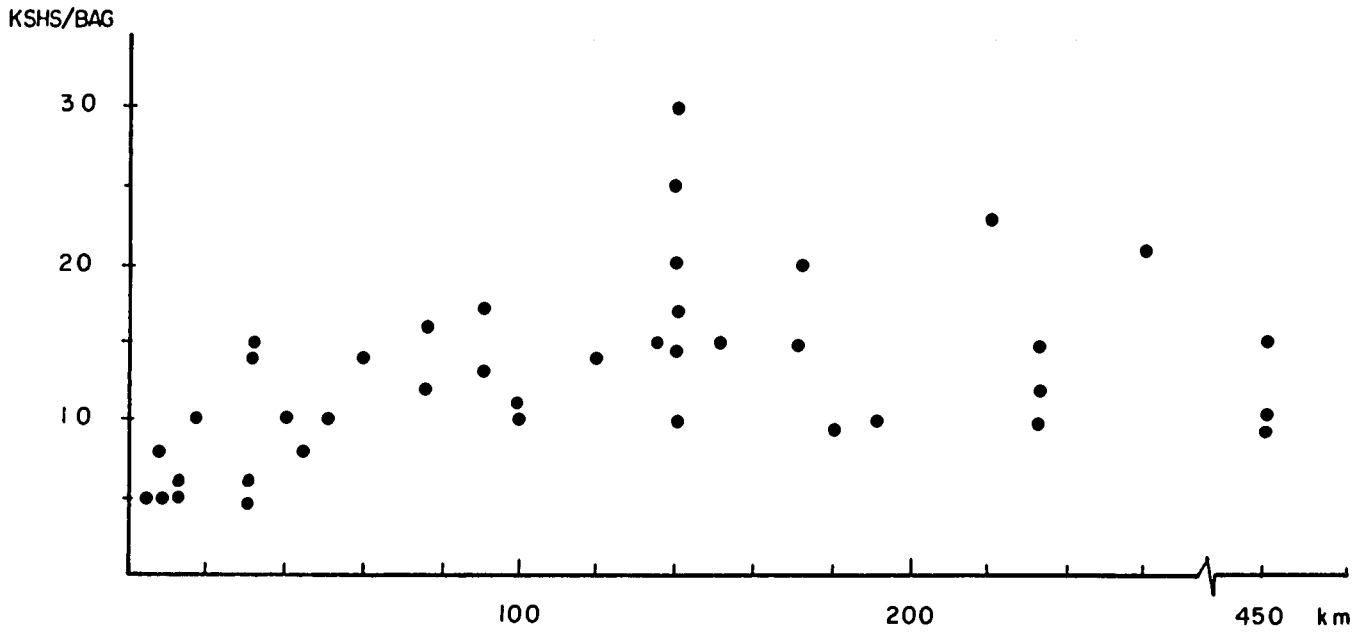


Figura 10 TRANSPORT CHARGES FOR POTATOES IN INTERREGIONAL TRADE 1976 / 77

Source : Own Producer Survey

while the remaining part of the trade is open to everybody. The wholesale market may form the outlet for the majority of those traders who do not manage to establish secure channels outside, and also for part-time traders. It might well be that the entire urban potato market is split into two parts. While the larger traders by-pass the wholesale market to enter the retail markets for middle and high income consumers and institutions, Wakulima may supply retailers in low-income areas.

8 Establishment of Rural Assembly Markets

The atomistic structure of potato supply requires an efficient marketing set-up to organize assembly of market surpluses at reasonable costs. One possibility may be to supply rural assembly markets where producers offer their commodities for sale. Such markets are particularly relevant in those areas where the amount of produce offered for sale is small and many consignments are needed to fill a trader's lorry.

It is symptomatic for the assembly trade that in all areas where farmers offer small quantities for sale spread over several months of the year the interregional trader buys and collects the produce on the farm. Occasionally, potatoes are taken to collecting places, but hardly any trade takes place at local market centres. Usually, traders contact farmers individually to negotiate the produce. Only in Meru a considerable share of the potatoes are sold on a local market and not on a farm. (Table 36). The difference between Meru and the other areas is that in Meru harvesting is concentrated in two short periods (two months each) and that the amount of potatoes offered for sale (per farmer and in total) is much larger than supply in other areas within a comparable length of time (Table 53). It appears that a certain minimum volume of trade is needed for a rural assembly market which cannot be reached in most areas during the year. The large amount of potatoes available in Meru at certain times attracts the bigger traders from urban centres who offer alternative outlets to producers in addition to those traders operating locally. In other areas it appears that the market supply at a given time is too small to attract traders from major consumption centres. This, on the other hand, does not give sufficient incentive to farmers to take their produce to the nearest market.

Footnotes

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VI. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

1. Aspects of Sectorial Development

The potato appears to be an unimportant commodity when it is assessed in such terms as value produced and marketed, exports, employment and share in consumption. However, between one-third and one-half of Kenya's population consumes potatoes and about one-third of Kenyan farmers grow the crop. This means that quite a number of individuals and households are affected by changes in the potato industry.

Subsistence Sector

The potato is a subsistence crop for a large part of the farming community. Characteristic production conditions include scarcity of land and capital, surplus labour, low-input production technology, low share of marketed production and low yields.

Commercial Sector

This sector provides mainly for the urban potato market; demand in rural non-potato producing areas is small. Commercial potato producers also provide for their own subsistence needs. Urban consumption is fairly stable and restrained by income. The potato market and the framework within which commercial producers enter this market is described under point 4 below.

The objectives of developing the potato industry need to be directed toward providing food to a large number of people in rural and urban areas at reasonable costs. But also, they need to aim at an efficient use of available resources. Consequently, development programmes need to stress intensification of potato production within the whole farm organization.

2. Potato as a Food in Producing Areas

Intensification of Production

As a foodcrop, the potato is characterized by high production of energy and protein per unit of land and a relatively short growing period (even at high altitudes). It cooks fast and needs little fuel. The characteristics mentioned in 2, are particularly important for three groups of farmers:

1. The small family farms in Kiambu, Murang'a and Nyeri Districts, in North Kinangop and in the former large scale farming areas in Molo Division. Here land has become a scarce resource and security and continuity of food supply is a major concern in farm operations

2. Farms at high altitudes, where the most common staple foodcrop, maize, takes up to twelve months to mature or cannot be grown any more at all. Here two or three potato crops are grown per year and they provide more or less continuously food for the farmer.
3. Squatters and cultivators in government forest areas with temporary (4-5 years) or permanent holdings on virgin forest land. The major resource in production is the farmers' own labour; usually little or no capital is available for investment. It is paramount for these cultivators to ensure a fast food supply, and potato is the most suitable crop for that purpose.

On all these farms yields are low and inputs are inadequately used. It is usually recommended that a package of improved seed and fertilizer be employed. However, such an improvement programme is likely to face a number of constraints, the major one being the need for cash to purchase these inputs. Often, cash is not available, which means that credit facilities would have to be provided. On the other hand, since the additional production is destined to improve food supply on the farm, cash outlays would not be recovered from sales, and this may make repayment of credit unlikely. A further aspect to be considered is the small quantity of inputs needed per farm. Procurement costs per unit of the input package will be high and might make the intensification programme unattractive to producers.

A strategy for improving potato production under these conditions should be directed towards better crop husbandry. A number of measures could be chosen which do not involve capital investment. For example (a) selection of larger tubers from healthy plants as planting material, (b) proper seed treatment, (c) effective weed control and (d) improved soil fertility and control of pests and diseases (e.g. nematodes and bacterial wilt) by adequate crop rotation. If such measures are not effective, capital is still scarce and farmers still produce potatoes mainly as a source of food, then capital intensive production methods could be introduced but only if the new inputs are subsidized and provided at low, or no cost.

Storage for Home Consumption

In most areas in Kenya, potatoes are produced in a bimodal seasonal pattern, with six months between harvests. The producer survey indicates that on many farms potato consumption is determined by the condition, or rather the deterioration, of the crop in store. The aim is to adjust consumption to minimize storage losses. Therefore, most farmers consume their own potatoes within a period of about three months, and after that they purchase potatoes for home consumption. Improved storage of ware potatoes could help ensure a continuous supply of potatoes throughout the year. This would be particularly important in high altitude areas where the range of foodcrops available is limited.

3. The Urban Potato Market

Problems of the urban potato market can be grouped under three headings: retail price level; price fluctuations; and consumer preferences.

Retail Price Level

Potatoes are a relatively expensive food item compared to the main staples: maize, beans and rice. The structure of urban retail prices for these commodities indicates that, in terms of energy and protein costs, the potato may become a competitive staple food only at prices which are about 20-30% of their present retail price level (Table 48). At present levels the price elasticity of demand is low, but at lower prices the price elasticity should increase substantially, and with it per capita demand, particularly among low income groups.

Retail prices can be reduced by lowering marketing costs and/or producer prices. Potato marketing appears to be done fairly efficiently, keeping in mind the difficulties encountered in assembling the produce from numerous small supplies, transporting it on poor roads over rather long distances and distributing it among numerous urban consumers. Marketing costs could be reduced by improving roads and by achieving economies of scale in assembly, transportation and distribution. Such improvements are expensive and involve a number of structural changes in production and trade and they could be achieved only over relatively long periods of time. Reduction of producer prices will be dealt with below.

Retail Price Fluctuations

Retail prices fluctuate over the year; during peak periods they are about 40% above their level in slack periods (Figure 7). Price movements are linked to seasonal supply fluctuations and, coincide in large part, with the production cycle of Meru, the main supplier for urban markets (Table 53). A smoothing of supplies and prices would be desirable to ease the pressure on food budgets of urban consumers and to remove some risks and uncertainties in urban food supplies.

Smoothing of supplies could be achieved by storing potatoes at harvest time in Meru for up to four or five months or by inducing production in Meru, or in other areas, to provide fresh supplies during high price periods (May and November; Figure 7). There, current supply during these periods (Tables 52 and 53) is inadequate in both quantity and quality. Possible restraining factors are the non-accessability of growing areas in certain periods (poor roads), rainfall or other climatic factors or organizational constraints within the farms (e.g., labour or capital shortages at critical times, crop rotations or pressing food needs for the farmers' households).

Consumer Preferences

Red varieties achieve retail prices which are about 35% above those for white varieties. The price differential is highest in low price periods. The difference is large enough to have an impact on producers' profits and incomes. Because of the present structure of the potato market, reasons for consumer preference for red-skinned potatoes cannot be easily identified. The preference can be attributed to certain qualities, the most common red-skinned variety being Kerr's Pink. Since most of the urban supply originates in Meru, where Kerr's Pink is the most common variety, consumer preference could also be linked to certain production conditions in Meru (e.g., soil conditions, climate or such husbandry methods as blight control).

4. Commercial Potato Production

The commercial potato sector plays two economic roles: it provides potatoes to urban consumers (Chapter VI-A 1) and it provides income to producers. The two parties (producers and consumers) are linked by the market price -- consumers want it low, producers want it high. However, depending on the importance of the crop for the various groups, the importance of the price differs. As a commercial enterprise, potato is particularly relevant for three groups of producers: squatters in forest lands, semi-commercial medium-sized farmers and fully market-oriented producers.

Production in Forests

Squatters and cultivators in forest areas who establish new holdings face an urgent need for a fast cash income to provide for their basic subsistence requirements. Again, potato serves a useful purpose, since the first cash returns can be obtained three or four months after planting. During the initial production periods, practically no inputs are applied except seed and labour, farmers are able to cultivate, harvest and market sufficient produce to create a meagre stock of capital. However, as the natural fertility of the soil depleats, capital inputs such as improved seed and fertilizer are required to maintain yields and provide food and a market surplus. For such an investment, cash surplus is usually not sufficient and a situation similar to the one described in the heading "Intensification of Production" evolves.

Semi-commercialized Production

On a large number of farms, mainly situated in Nyandarua District and Olengurone Settlement in Molo Division, potato plots are relatively small compared to other crop lands and to the total farm size. Major enterprises are cattle and grains. Labour and capital are scarce in relation to land and extensive farm organizations and technologies are found. Yields of potatoes and other enterprises are generally low. Cash income is usually derived from sales of surplus food, milk and livestock.

The potato is appreciated as a cash crop because of its short production cycle. Often, small quantities are sold to meet immediate cash requirements. The market price is taken as given -- if it is low, more produce is sold.¹

If such farms intensify operations to increase farm income, livestock and grains are likely to show better returns than potatoes. Furthermore, managerial requirements in producing and marketing potatoes are considered higher than for other commodities. Therefore extension efforts are likely to be more rewarding in those enterprises.

If potato production is to be intensified, credit facilities to finance additional capital and labour inputs would need to be provided. Furthermore, market outlets would have to be established to ensure marketing of additional production at reasonable costs. A practical approach to intensify production on the farms would be to provide inputs for a package of enterprises which fit into the present farm organization (Chapter II G. 1).

Market-oriented Production

A relatively small number of farmers in Kenya produce potatoes for the urban market. Most of these farms are located in Meru; a few are in the Districts of Central Province and in Molo. Decisions on varieties and quality of the produce are geared towards requirements. Yields on these farms are higher than on other farms. Production is fairly intensive and unit production costs are low. This type of producer is sensitive to changes in prices and market conditions, and it can be expected that production is adjusted accordingly. At present, major constraints in production are shortages of labour and, on many farms, problems with soil-born diseases. Improvement programmes should be directed towards overcoming these constraints. Additionally, improved seed which suits the requirements of the market should be provided to these farms. The managerial ability and capital to handle more sophisticated technologies seems to be available, but research has failed to come up with acceptable improvement programmes. For commercial producers in areas other than Meru, there are problems in marketing the produce, due to lack of market outlets. This is particularly serious in distant areas, such as North Kinangop and Olengurone, where roads are often not transitable and information about markets and prices are unreliable.

Impact of Production Intensification Programmes on the Potato Industry

The objective of intensifying potato production is to lower the urban potato price and, at the same time to maintain or increase producer incomes. Such a policy is expected to benefit urban consumers and commercial producers. It is detrimental to all those producers who do not have the resources to adopt improved production methods, which can compensate the lower prices by respective decreases in unit production costs. Farmers likely to be affected most adversely are the semi-commercialized producers and squatters in forest areas, who live near subsistence level and often depend on potato sales for their small cash income.

B. Recommendations

1. The Commercial Sector

Consumer Preferences

A research project could be useful to determine the criteria used by urban and rural consumers in appraising the quality of potatoes. These criteria and the respective quality attributes could then be considered in selecting varieties for seed multiplication schemes.

Seasonal Price Fluctuations

These are not felt to be very serious. Storage in Meru could overcome the problem. Research indicates that large, forced-air ventilated stores are economically superior to small, naturally ventilated farm stores. However, the large stores are technically more difficult to operate and require a rather complex organizational set-up. Alternatively, fluctuations could be overcome by shifting supplies over time. More research is needed on the entire farm system to determine whether planting or harvesting times could be spaced out over the year with different maturing varieties.

Intensification of Production

In Meru area the labour peaks could be reduced by selecting mechanizing of planting and harvesting. Sanitary conditions of the production environment could be improved by establishing crop rotations with forage production and livestock. Improved seed of marketable varieties (such as Kerr's Pink), should be provided. In other areas where the marketing risk for potatoes is high, the IADP approach with an input package for several enterprises on a loan basis could provide the needed impetus.

2. The Subsistence Sector

On-farm Storage

Simple improved storage techniques (for example false floor and use of sprout suppressants), in connection with training on how to handle and conserve potatoes, could be introduced to small farmers. Improved storage would improve food supply and give these farmers more options to enter the potato market.

Intensification of Production

Research needs to be established on agro-economic aspects of production. The presently propagated "green revolution package" of improved seed and high fertilizer rate is far too expensive to be accepted by most subsistence farmers. Farm-level research should be carried out on the impact of husbandry methods (e.g., time of planting, weed control, seed treatment and post-harvest technology) on yield and profitability. Furthermore, the economics of using purchased inputs, such as fertilizer, chemicals and certified seed, need to be investigated for a number of intermediate levels which can possibly be financed by the farmers themselves.

In the context of intensification of production, it should be kept in mind that a subsistence farmer will accept a proposal for improved production especially when it offers prospects for commercialization of the enterprise. Proposals merely directed towards better provision of food are not so attractive. It is therefore essential that the components of an improvement programme meet the quality requirements of the ware potato market.

Footnotes

1. Such behaviour leads to backward sloping supply function.

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APPENDIX

Objectives and Methodology of Producer and Trader Surveys

1. Objectives of the Surveys

Production of potatoes in Kenya is concentrated mainly in the Central Highlands along the slopes of Mt. Kenya, the Aberdare Range and Mau Range. Previous surveys on the crop in some of these areas revealed a differentiated pattern of production and utilization. Price recordings showed seasonal fluctuations at retail and wholesale levels in major towns as well as at the farm level.

Based on available information, a set of hypotheses was formulated which stressed the interseasonal/interregional patterns of potato production and use. The focal point linking all the different areas was thought to be the Nairobi Market.

The surveys concentrated on the following topics:

1. organization of potato producing farms, land use patterns, factor endowments, seasonal patterns of crop production, importance of the potato enterprise.
2. husbandry methods for potatoes, use of purchased and farm-supplied inputs, major production problems.
3. yields and utilization of the crop, storage of seed and ware potatoes, marketed share, market outlets for farmers and farm gate prices.
4. costs of purchased and farm-supplied inputs, production costs, profitability of potatoes and competitive position of the enterprise within the farm.
5. marketing channels in interregional trade, functions performed and institutions involved, organization of rural assembly markets, marketing costs and efficiency in interregional trade channels

2. Selection of the Survey Areas

The potato production and trade areas to be investigated were chosen according to the importance of the crop for producers in an area and in turn the assumed importance of the area for the urban market.

After a review of secondary data and consultations with Kenyan potato experts, it was decided to survey potato production in all five Districts on Central Province, in Meru District and in Eastern Province and Nakuru District in Rift Valley Province. Districts are administrative units and

are subdivided in Divisions, Locations and sub-Locations. Most Districts cover large areas and extend over several ecological zones. Therefore, in discussions with the Agricultural Officers in the District Headquarters, the areas where potatoes are actually produced and where the survey was to be conducted were specified further, on the basis of administrative sub-units.

Finally, the survey areas were defined:

1. Molo Division in Nakuru District, including the area under the auspices of the Forest Department.
2. Five Settlement Schemes: Ngorika, Sambugo, Matindiri, Melangine and Upper Gilgil in Ol Kalou Division in Nyandarua District.
3. Kippipiri Division and South Kinangop Division in Nyandarua District.
4. Kikuyu, Limuru, Githunguri and Kiambaa Divisions in Kiambu District.
5. Tetu, Othaya, Mukurweini and Mathira Divisions in Nyeri District and Kangema, Kigumo, Kiharu and Kandara Divisions in Murang'a District.
6. Kibirichia Location, South Imenti Division, Meru District.

3. Organization of the Producer Survey

Data on potato production were obtained through a farm survey based on a random sample of farms in the six areas surveyed. In all areas except Molo a complete register of farms was available from which a random sample could be drawn.

In Kiambu, Murang'a, Nyeri and Meru Districts all plots were registered and the owners were issued title deeds. A plot is identified by the name of the Sub-Location and plot number; in addition the owner's name is recorded. A sub-Location is made up by some 300-500 farms or occasionally more.

In Nyandarua District, Settlement Schemes were established by subdividing the former European-owned large farms into smaller holdings. Plots were identified by the Scheme's name and the plot number, and again the owner's name was recorded.

The complete record of all farms in an area would allow selection of a representative randomized sample. However, such a sample was not taken for three main reasons.

1. In Kiambu, Murang'a and Nyeri Districts it turned out that it was difficult to establish the exact number of holdings in the basic population. The unit recorded in the Land Register is the plot. Some farmers owned several plots, managing them as separate farm

units and residing on one of them. Other farms were subdivided into separate plots with different owners (usually family members), but were run as one farm. Finally, some farms were registered as one unit, but run as several holdings, often by the family members of the registered owner. In the other areas, Ol Kalou, Kinangop and Meru, such problems did not crop up, and the size of the total number of holdings given in Table A1 is felt to be fairly accurate.

2. The problems to be investigated were related more to individual farms than to the whole area. The aim was to cover the variability of various factors and describe the problems at farm level. The sample size was, therefore, oriented towards that aim and not toward representing the whole region.
3. The organizational set-up and time constraints did not allow large sample surveys. The survey had to be carried out during the dry period; during the rainy season transport problems are severe. This gave a total length of time of about five months, or about two weeks per area plus some time for preparing the surveys.

In each area three enumerators were employed to assist in conducting interviews. The capacity of the four enumerators, including the author, was estimated at eight farms per day (two each), which allowed for a total of about 100 farms per area in twelve days. On the other hand, a sample size of about fifty potato growers was thought large enough to achieve the objectives of the survey.

Based on this rather pragmatic set of arguments, a sample of around 90 farms was drawn in five of the areas. In Meru only 60 farms were selected because the total population was rather small and fairly detailed information covering a number of problems was available already.

In each of the areas, the Extension Officer in the Ministry of Agriculture was supplied with a list of the sample farms and extension workers in the Sub-Locations assisted in locating the farms. In some cases this procedure failed (Table A1). In other cases, the farm selected was not cultivated, or planted with a perennial crop, such as tea or wattle trees. Usually, the farm owner resided elsewhere, (mostly in towns). In a few other cases, the farmer was not capable or willing to accept the interview. The sample of potato growers was reduced further because a few farmers did not grow potatoes.

In Molo Division Nakuru District there was no complete register of farmsteads from which a sample could be drawn. The area to be covered in the survey was divided into three sections: the former large-scale farming area, the Olenguruone Settlement Scheme and the area controlled by the Forest Department. In the former large-scale farming area a sample of nine (large) farms was drawn from a register of same. All these farms were owned by groups of people (multi-ownership) and were subdivided in various degrees into smaller holdings. On each farm four residing members were selected for interviews, giving a total of 36 farmers.

Table A1: Size of Samples, Number of Interviews Conducted and Total Number of Holdings in Six Areas Surveyed in 1976/77

	Molo	Ol Kalou	Kinangop	Kiambu	Nyeri/ Murang'a	Meru	Total
Sample Size	93	97	92	95	87	60	524
Untraceable	-	-	-	9	4	1	14
Absentee Farmer	-	7	6	8	13	-	34
Uncapable/Un- willing to answer	-	3	5	1	4	1	14
Number of Inter- views conducted	93	87	81	77	66	58	462
Number of Non- potato Farmers	2	6	2	2	8	1	21
Number of Potato Farmers	91	81	79	75	58	57	441
Estimate for Total Number of Farms in Survey Area (000)	-	3.5	10	30	50	1	-

Source: Own Survey.

In Olenguruone Settlement Scheme, farms in various parts of the Scheme were chosen arbitrarily and their three adjacent neighbours were interviewed. With this procedure a total of 28 farmers were selected.

The Forest Department has allocated nine areas for clearing and cultivation of which three were selected arbitrarily for the survey. All farmers found on their potato plots during the day the area was visited were requested an interview. A total of 29 farmers were contacted in forest areas.

4. Organization of the Trader Survey

In accordance with the objectives of the study, the target groups for the trader survey were rural assemblers and interregional traders. Unfortunately, there is no record available which gives the number or identity of these traders. Since their number was believed to be small, it was originally decided to trace them in the various production areas, after obtaining information from producers on their market outlets.

Unfortunately, the producer survey was conducted at a time when there were hardly any potatoes available for sale, except in Meru. Furthermore, potato harvests were generally poor in 1977 and the market supply was limited. Hence, traders were equally scarce. Finally, a total of 52 traders were contacted and interviewed² during 1977 and early 1978. The majority of these were resident wholesalers in Nairobi; a few were found in South Kinangop. Lumuru Division in Kiambu and in Kibirichia in Meru.

5. Analysis of the Data

Data from the producer survey was tabulated on code sheets and then punched on IBM cards. A preliminary analysis was done by hand immediately after completion of the survey in the various areas. Results were compiled and circulated as interim reports to a limited number of people concerned with the project.³

Quantitative data are represented as arithmetic (unweighted) averages based on the total number of potato producers in a sample. Qualitative data are expressed as frequencies, again related to the sample size, rather than the number of respondents.

Footnotes

1. A record of all large farm units in Molo Division including information on the degree of subdivision was kindly made available by Mr. A.J. Blanker, c/o Consultant on Large Farms, Ward Ashcroft and Parkman P.O. Box 41425, Nairobi Kenya.
2. The trader survey was carried out in close collaboration with Dr. W. Zettelmeyer, Marketing Section, Planning Division, Ministry of Agriculture, Nairobi.
3. Durr, G., Studies on the Potato Sector in Kenya. Interim Reports Nos. 1-6. Nairobi 1977, unpubl. papers.

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