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PROCESSED SWEET POTATO: RESPONDING TO KENYA'S URBAN FOOD NEEDS

Njeri Gakonyo

Advisor: Thomas T. Poleman

Department of Agricultural Economics
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University, Ithaca, New York, 14853-7801

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CORNELL
UNIVERSITY

New York State College of
Agriculture and Life Sciences

Department of Agricultural Economics
Warren Hall
Ithaca, NY 14853-7801
USA

Phone: 607 255-4463
Facsimile: 607 255-9984

Thomas T. Poleman
Professor of International
Food Economics

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Fifty years ago *gari* was virtually unknown as a supplier of dietary energy in the cities of West Africa and cassava, the root from which it is derived, ranked near the bottom of the consumer's preference scale. The cities have since burgeoned in size--Kinshasa from 30,000 people to 3.5 million, Lagos from 200,000 to almost 8 million--and *gari* has become the staple food. Cassava remains unloved, but its ability to yield heavily even under adverse climatic and soil conditions has proved an irresistible attraction, especially when processed into *gari*, a meal that is both storable and transportable. In most cities it is the cheapest source of calories.

Some form of processed sweet potato is a logical candidate to play a similar role in western Kenya and this is the subject of Njeri Gakonyo's paper. The region is densely populated and the farms small; it is also well-watered, rugged, and high in elevation--in short, sweet potato country par excellence. Yet its obvious appeal to producers does not carry over to its potential market. Once harvested the roots spoil in a few days and transporting such a low unit value commodity any distance is usually prohibitively expensive. It is little eaten in the towns.

Ms. Gakonyo's analysis of whether this can be changed divides into two parts. The first examines the acceptability to consumers in Kisumu and Nakuru of various forms of processed sweet potato and concludes that flour to be used as a component of *ugali* has the greatest potential. Ms. Gakonyo then evaluates whether on-farm production of such flour could be an economically viable activity. Her conclusions are positive. Since simple and cheap technologies exist for flour preparation, the enterprise could generate returns higher than those from selling fresh roots. Ms. Gakonyo also shows that sweet potato flour could be priced competitively compared to maizemeal, wheat flour, and the other staples currently consumed in Kenya's cities.

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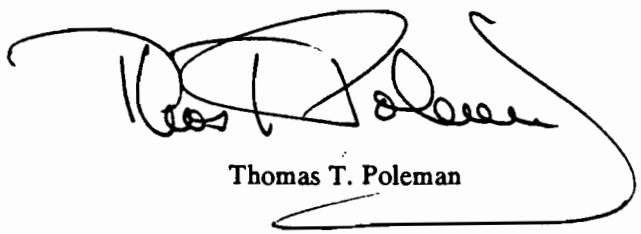
In Ithaca, Lillian Thomas prepared the final manuscript. Professor Ralph Christy shared with me the pleasure of working with Ms. Gakonyo.



Thomas T. Poleman

TELEX: WUI 6713054 E-Mail: MH6J@CORNELLA.CIT.CORNELL.EDU

PROCESSED SWEET POTATO:
RESPONDING TO KENYA'S URBAN FOOD NEEDS

CHAPTER 1
INTRODUCTION

This thesis examines the consumer acceptability and economic viability of producing processed forms of sweet potato in western Kenya. This area is characterized by high rainfall and altitude, rugged terrain and small farms--all of which make the sweet potato an appealing crop to producers. However, the root ranks low in the consumer's preference hierarchy and, because of the expense of marketing a perishable, low unit value commodity, is little consumed off the farm. Forms of processing which reduce bulk and add storability could help to expand sweet potato's role as a supplier of calories to urban populations. Given Kenya's high population growth rates and limited land resource base, it is imperative that high-yielding crops such as sweet potato be accorded greater consideration.

Chapter 2 discusses the growing problem of food availability for urban populations whose economic situation is grave. Exacerbating factors such as the high population densities on the only available arable land and over-reliance on maize as a starchy staple strengthen the case for sweet potato. The root's desirable characteristics and shortcomings are also presented.

Chapter 3 reviews the history of the root and the most important factors related to low acceptance of sweet potato worldwide. Solutions suggested in the literature are then examined.

Chapter 4 deals with the measurement of preferences for processed sweet potato products in two towns in western Kenya: Kisumu and Nakuru. The development of the measurement methods, and the features of the particular model used and the design of the taste test surveys are discussed.

The fifth chapter presents the findings of the preference surveys, the results of the analysis of socio-economic factors--termed filters--and the implications of these results. Of those products used in taste test surveys among residents of Kisumu and Nakuru, sweet potato flour appears the most promising. Although the operation of the filters is highly food-specific, ethnicity and income status are clearly the most important. The conclusions of the chapter form the basis for the next on production.

The economics of sweet potato flour production are detailed in Chapter 6. Assessments of time and investment requirements provide a profile of possible on-farm processing. If production and marketing costs could be kept low, processing could be a viable enterprise. Fortunately, simple and cheap technologies are available so that such an activity could be accessible to the average sweet potato farmer. The chapter concludes with a comparison of the returns from processing with paid employment as an economic alternative for the grower.

The final chapter discusses the implications of the thesis findings for promoters of sweet potato products and growers who may take on processing activities. A key conclusion is that the sweet potato flour could be competitively priced compared to similar commodities available in Kenya.

CHAPTER 2
SWEET POTATO--A POSSIBLE SOLUTION TO KENYA'S FOOD SUPPLY PROBLEM

Kenya's legendary population growth rates threaten to erode the gains in food production per capita achieved during the 1960s and 1970s. In particular, the rapidly growing numbers of the urban poor bear the brunt of the food supply problem because adequate nutrition depends on a marketed surplus from the rural areas. Consequently, there is a need to raise food output levels and improve distribution mechanisms to ensure that food is both available and affordable for all.

However, with arable land covering less than one-fifth of the total area--already heavily populated and farmed--the scope for increased production is severely limited. Problems associated with the cultivation of the hilly fertile areas include soil erosion and deforestation. Moreover, the country's heavy dependence on maize as a starchy staple presents the risk of severe shortages if the maize crop does poorly.

Given the situation, it has become necessary to explore crops which can maximize food production through more intensive use of available arable land. Sweet potato appears to have substantial potential in this respect: impressive yields, low input requirements and an extensive ground cover combine to make it an attractive crop for the farmer. Unfortunately, the root does not lend itself well to movement through the marketing system because of its bulk and perishability. In addition, its popularity among urban consumers is low. However, it may be possible to facilitate the increased use of the root through processing.

The Emerging Food/Population Dilemma

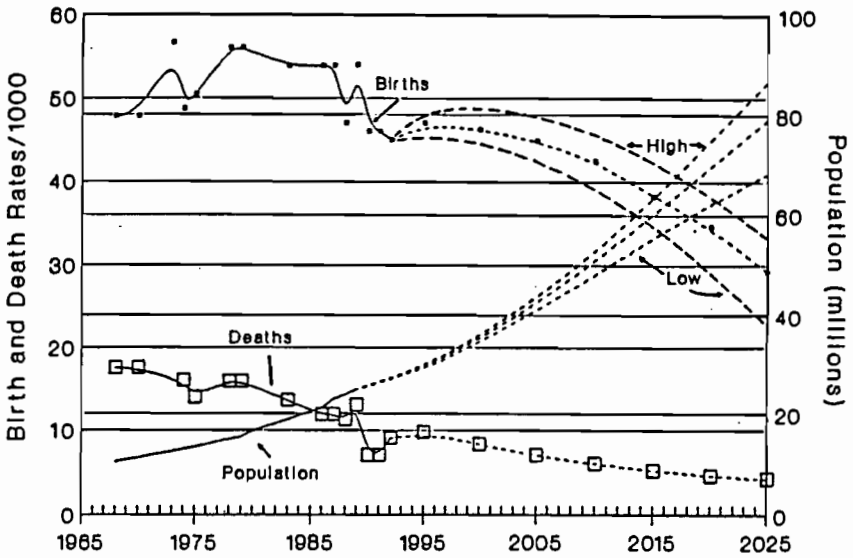
More Mouths to Feed

Kenya's population has increased from about 9 million in 1963 when the country achieved independence, to 25.8 million in 1992 (Food and Agriculture Organization 1993). This phenomenon is a result of mortality rates which have fallen faster than fertility rates (Figure 2.1). Major improvements in health and sanitation helped to reduce crude death rates to the 1992 level of 9 per thousand from about 17.5 in the late 1960s. Yet attitudes towards family size remained largely unchanged even though more children were surviving to maturity. In fact birth rates at first increased to almost 57 per thousand live births towards the end of the 1970s. As the 1980s drew to a close, the trend in birth rates began to fall as family planning programs extended throughout the country. This means that population growth rates, which reached a peak of 4.1% in the mid-1980s, are also tending downwards. However, even at the 1992 growth rate of 3.9% per annum, the doubling time for population is still low at 19 years. Most alarming are the United Nations' population projections whose estimates for the year 2025 range between 62 and 84 million depending on the speed at which birth rates fall (1991).

Furthermore, even were the country to immediately lower fertility rates to replacement level, the burden of feeding those already born is enormous. With half of the population under 15 years of age (Economist Intelligence Unit 1991, 6), their reproductive years yet to come, most of the projected increase in numbers is still ahead. In other words, whereas 17 million people were added to the population in the 30 years between 1962 and 1992, there will be another 37 million in the next 33 years. Clearly, the population situation will get worse before it improves.

The provision of adequate nutrition for all under conditions of high population growth is difficult. Yet, Kenya was able to make impressive strides in food production during the late 1960s and the 1970s such that per capita availabilities of food grew faster than the population. The importance of maize as a food source for the population--it provides about half the caloric intake--allows its use as a proxy for total food production (Figure 2.2). By this measure, output levels increased quite rapidly and had doubled by the mid-1970s. At the same

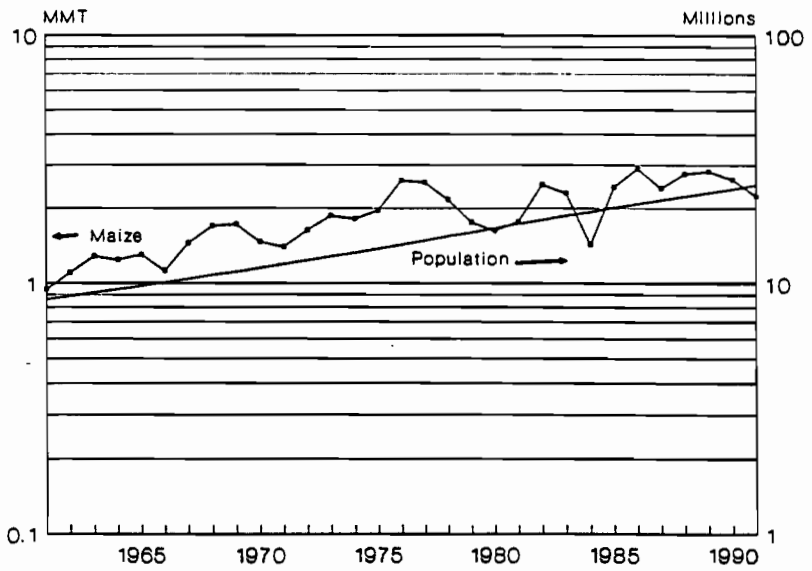
Figure 2.1: Kenya: Crude Birth and Death Rates, and Population Growth, 1965-1992, with Projections to 2025.



Notes: Broken lines indicate projections. Death rate projections are median projections.

Source: United Nations. 1990. *Demographic Yearbook*. New York; and Ibid. 1991. *World Population Prospects 1991*. New York.

Figure 2.2: Kenya: Maize Production and Population Growth, 1961-1991 (Logarithmic Vertical Scale).



Source: Food and Agriculture Organization. 1990. Agrostat PC Database. Rome.

time, population was rising steadily but not as fast as maize production. In effect, the country was able to satisfy its food needs. The gains of the early period were primarily achieved through increased acreage under cultivation, adoption of high-yielding hybrid maize varieties and greater use of fertilizers. These have often been characterized as "easy" achievements; subsequent increases in food output will require larger investments (Peterson 1986, 60). However, because most adopters of the new technologies were large scale farmers, there remains scope for improvement through widespread adoption by small scale farmers.

Over the decade of the 1980s, however, it appears that food production barely managed to keep up with the number of people to be fed. The Food and Agriculture Organization (FAO) of the United Nations goes as far as suggesting that indices of per capita production are falling (Figure 2.3). Even putting aside questions of data accuracy, all indications are that food production is not growing as rapidly as before. Perhaps more serious are the wide fluctuations in output evident for maize from the late 1970s onwards (see Figure 2.2). Since 1980, production of this grain has not matched the performance of the 1970s. These trends probably reflect the increasing cultivation of marginal land together with the effects of erratic rainfall patterns during the 1980s.

Limited Agricultural Resources

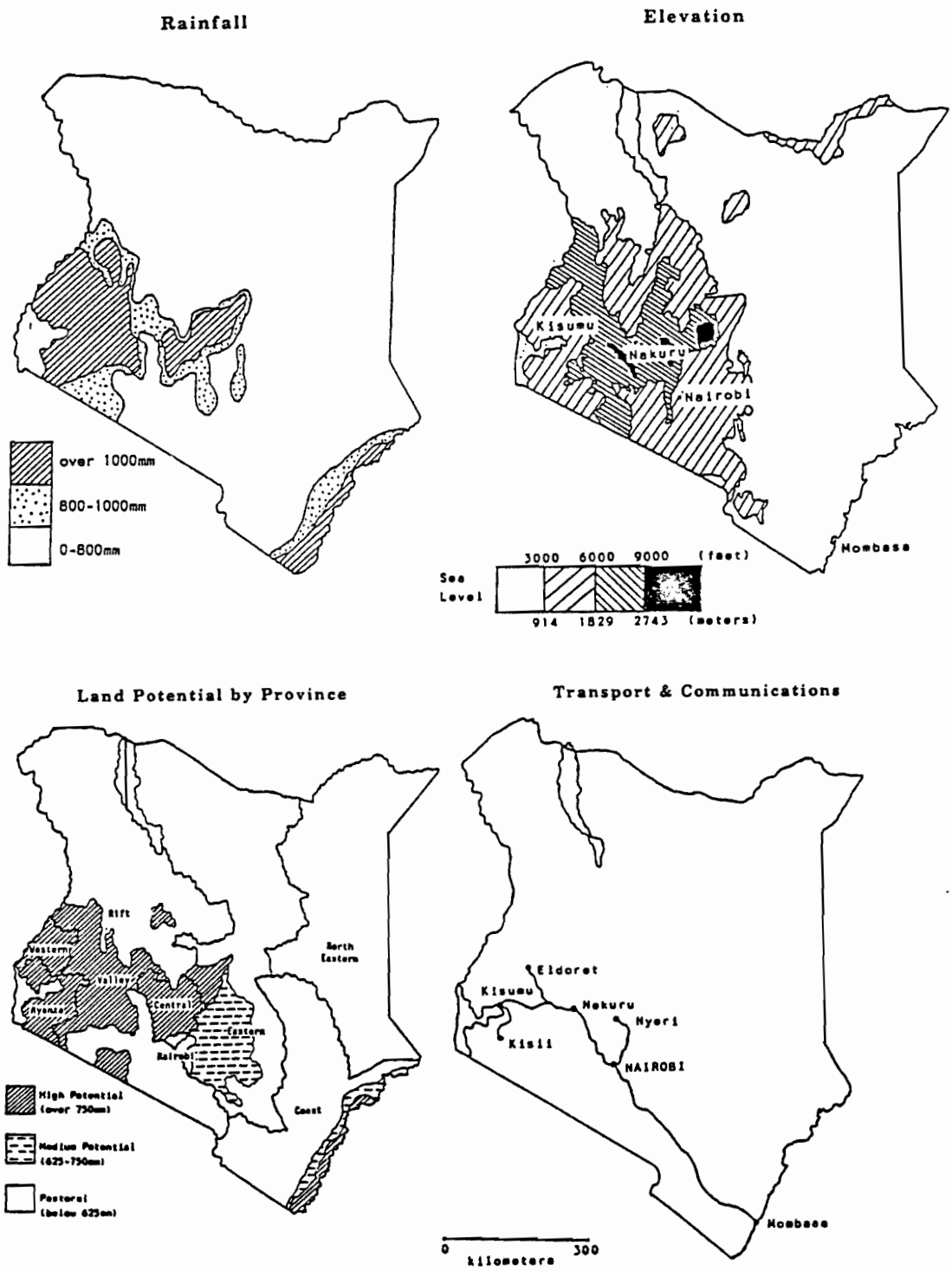
To compound matters, the country's meager agricultural resources preclude any great expansion of cultivation to bridge the gap between needs and availabilities. Using a 750-800 millimeters annual rainfall cutoff to delineate arable land, Kenya's geography reveals that only one fifth of the total area can be considered high to medium potential. Almost all of this lies in the central and western regions of the country (Map 2.1). The northern and eastern parts of the country are arid or semi-arid and only suitable for pastoral activities. Apart from the coastal strip, it is also safe to say that agricultural potential increases with elevation: towards the central and south-western regions. The regions which receive rainfall above 750 millimeters per annum are favored by moisture-bearing winds: from Lake Victoria for the western areas, and from the Indian Ocean monsoons for the coastal strip. Population density patterns closely follow the geographical distribution of fertile and well-watered areas (Map 2.2). Central, Nyanza and Western provinces, which are the leading agriculturally high potential areas, contain about half the population. As a result, per capita arable land availability in these regions is extremely low at about 1/4 hectare per person (in 1985) and will fall even further (Lele & Stone 1989, 54). Farmers in these areas have to make use of literally every square inch of land available in order to maximize agricultural production. Evidently, this shortage of land is serious and necessitates intensive agriculture.

Farm size has fallen as the population density has increased. The number of holdings below two hectares has increased dramatically since independence, suggesting that average farm size has dropped (Peterson 1986, 62). The situation is particularly acute for smallholders in view of the large fertile areas controlled by large-scale farmers. The latter's holdings are primarily in the heart of the Rift Valley which is both well-watered and fertile. Indeed this was the land that the settler colonialists chose for their agricultural pursuits: 7.5 million acres or about one quarter of the high potential land (Lofchie 1989, 149). During this time many Kenyans experienced "land hunger" in the face of wholesale appropriation of their land. After independence, a partial redistribution of land under the Million Acre Scheme helped to reduce landlessness as large settler farms were subdivided. However, because most of the large holdings in these "White Highlands" actually remained intact (only 1.25 million of the 7.5 million acres was resettled), substantial numbers were still left without farms of their own (Ibid, 151). Consequently, many of the landless in these regions have had to move into the more marginally productive areas in search of farm land.

There are dire consequences of high population densities such as those found in the high to medium potential areas of Kenya[1]. First of all, because the terrain in these regions tends to be hilly, heavy tillage has

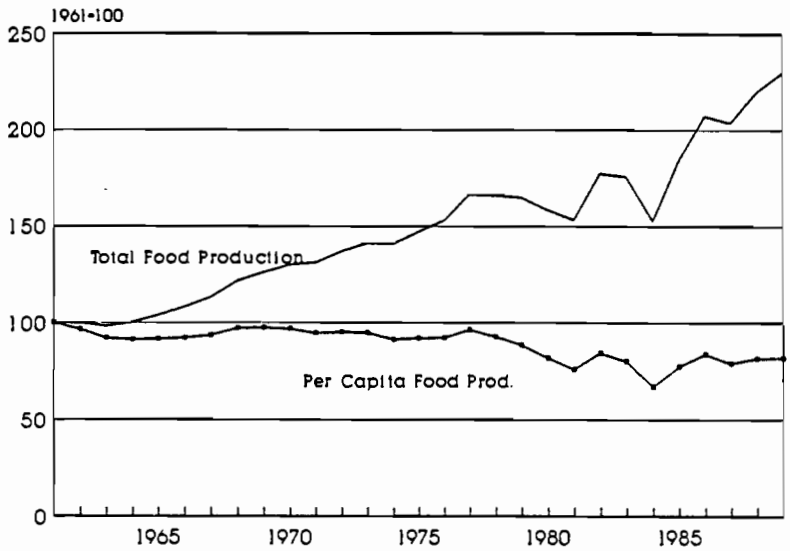
[1]However, population growth *per se* is not a negative force in development. Boserup even suggests that it induces greater agricultural intensification through technological innovation. Yet, she recognizes that if growth rates are too high, the negative effects outweigh the benefits (1965, 118).

Map 2.1: Kenya: Rainfall, Elevation, Land Potential by Province, and Transport and Communications.



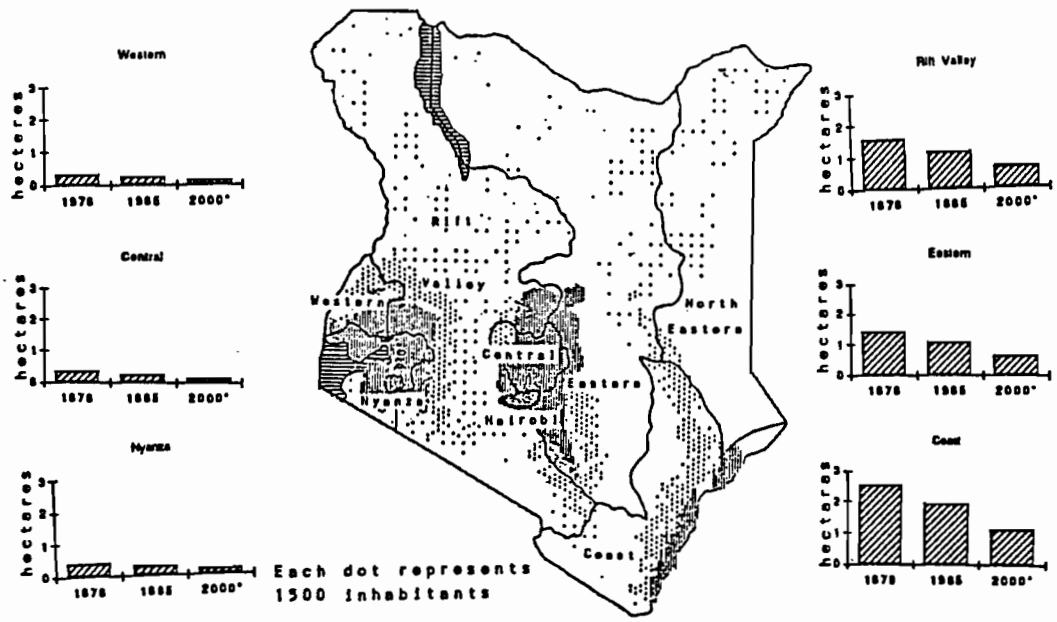
Sources: Rainfall: Cone, L. Winston and J. F. Lipscomb. 1972. *The History of Kenya Agriculture*. Nairobi: University Press of Africa. Elevation: Durr, G. and G. Lorenzl. 1980. *Potato Production and Utilization in Kenya*. Lima, Peru: International Potato Center. Land Potential: Jansen, A. A. J., H. T. Horelli, and V. J. Quinn. 1987. *Food and Nutrition in Kenya: A Historical Review*. Nairobi: University of Nairobi. Transport and Communications: Adapted from The Economist Intelligence Unit. 1990. *Kenya: Country Profile 1990-91. Annual Survey of Political and Economic Background*. London, England: Business International Limited.

Figure 2.3: Kenya: Total and Per Capita Food Production Indices According to the Food and Agriculture Organization (FAO), 1961-1990).



Source: As reported in: United States Department of Agriculture. 1991. World Agriculture Trends and Indices Database. Washington DC.

Map 2.2: Kenya: Population Distribution (1979) and Per Capita Arable Land (hectares) for Selected Provinces, 1979 and 1985, with Projections to 2000.



Sources: Population distribution map obtained from: Kabogo, Kimani. 1986. "Kenya: The Development of Secondary Cities." Master's Thesis, Cornell University. Ithaca, New York. Land availability figures from: Lele, Uma J. and Stevven W. Stone. 1989. "Population Pressure, the Environment and Agricultural Intensification: Variations on the Boserup Hypothesis." Washington, DC: World Bank.

resulted in severe soil erosion problems. Cultivation of crops which require substantial disturbance of the soil structure, has accelerated topsoil loss to alarming proportions. The predominance of maize in particular (it takes up about 40% of the total land under cultivation) greatly promotes erosion because it demands that the land be plowed and harrowed before planting (Lofchie 1989, 156). Naturally, with the soil goes much of the fertility which is difficult or impossible to replace. In effect, soil erosion reduces the agricultural potential of the land. Also, the deforestation which has accompanied population density increases may be the cause of the unreliable rainfall patterns experienced during the 1980s (Lele & Stone 1989, 7).

Overdependence on Maize

A final aspect of Kenya's precarious food supply situation is the country's heavy dependence on maize as a starchy staple. On average, the grain provides almost half the caloric intake of the population (Figure 2.4); the percentage may increase to 70% for some groups (de Wilde 1984, 15). About 90% of all smallholders cultivate maize mainly for home consumption but also for the market (Ibid, 17). With so much of the nation's nutrition relying on this grain, a poor or failed crop often means privation for many. Furthermore, maize is especially vulnerable to rainfall variations as shown by the wide production swings during the 1980s (see Figure 2.2). For instance, the 1984 drought resulted in a 40% drop in maize production which necessitated imports amounting to 565,000 metric tons (Lofchie 1989, 160). It is undesirable that the country remain vulnerable to food shortages in this manner.

The Plight of the Urban Poor

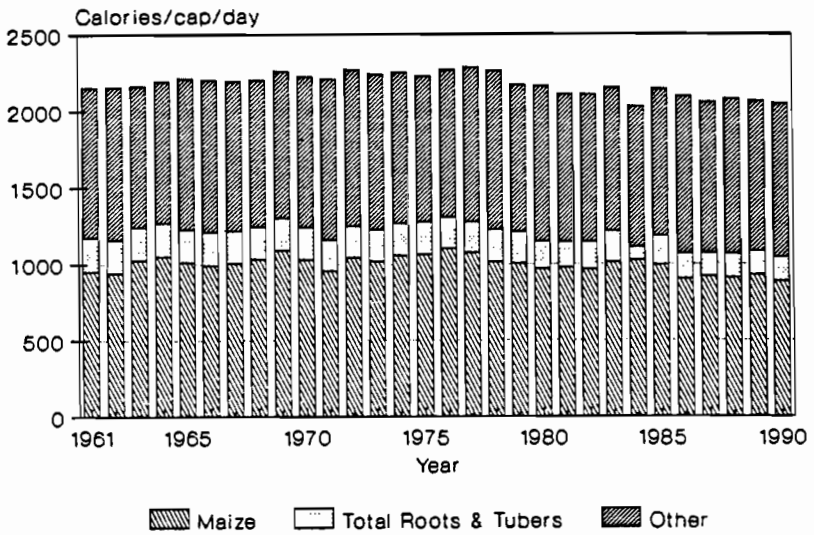
Of the total population the urban poor are particularly prone to suffer from food shortages and inadequate nutrition. At 7.9% per annum, urban population growth has been almost twice that of the overall population (World Bank 1992, 278) (Figure 2.5). According to the 1979 census, 16 towns had populations of over 20,000 as compared to only 4 in the 1969 census. In 1979, Nairobi, Mombasa and Kisumu each had populations above 100,000 while that of Nakuru was over 90,000 (Economist Intelligence Unit 1991, 6). By 1990, however, the population of Nairobi was almost certainly close to the 2 million mark while that of Mombasa approached 1 million. United Nations projections suggest that Kenya will continue to urbanize very rapidly. By 2025 it is expected that over 40 million Kenyans will reside in urban areas, representing more than half of the total population (1991, 450).

Farmers are being called upon to feed, not only their own families, but those of urban residents as well. The latter are highly vulnerable to food shortages if there is little or no agricultural surplus for sale. This was the case for some years in the 1980s and early 1990s due to unfavorable weather patterns or mismanagement of food stocks. The government then had to resort to maize and wheat imports to avert severe food availability problems in the towns.

The bleak employment situation in the towns also means that most people living in the urban areas are poor. "Formal" sector jobs (for example, in manufacturing) are few and, at about 3.4% per year, are increasing too slowly to absorb the increase in the labor force. Even at this seemingly strong rate of job creation, unemployment may well increase from about 13% in 1991 to above 20% by the year 2000. Moreover, just to maintain the 13% level of unemployment, the number of jobs available will have to double by the turn of the century. By that time the total labor force will have increased from 8.1 million in 1990 to 14 million (Economist Intelligence Unit 1991, 12).

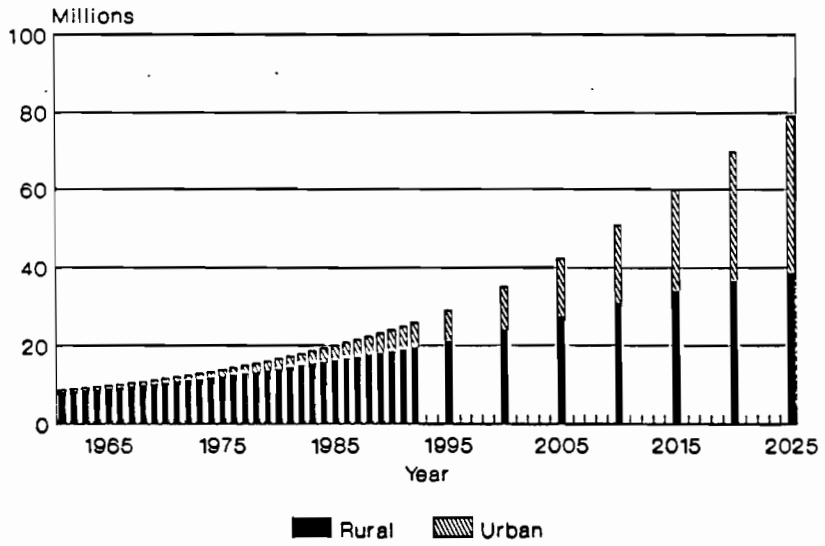
Consequently, most of the urban population has to resort to low-wage or part-time employment. Opportunities in the informal sector, while significant, are nevertheless insufficient to provide adequate incomes for all who need them. Yet, wage and price trends for the five years ending in 1989 suggest that real incomes stagnated for salaried workers while low income urban groups experienced a deterioration in their standard of living. In that same period, retail prices rose steadily by over 61% (Ibid 1991, 12-13). As a result, in order to obtain an adequate diet, food expenditures can command an appreciable proportion of the family's income. A

Figure 2.4: Per Capita Daily Contribution of Maize, Roots and Tubers, and Other Crops to Kenyan Diets, 1961-1990.



Source: United States Department of Agriculture. 1991. World Agriculture Trends and Indices Database. Washington DC.

Figure 2.5: Rural and Urban Population Growth in Kenya, 1961-1992, with Projections to 2025.



Source: United Nations. 1991. *World Urbanization Prospects 1990: Estimates and Projections of Urban and Rural Populations and of Urban Agglomerations.* New York.

survey conducted in the latter half of the 1970s reported an average food bill of over 40% of income in the towns (Central Bureau of Statistics 1981, 122-23). Although similar figures for the 1980s and early 1990s are difficult to obtain, it is almost certain that the situation has not improved for the average person in the urban areas.

The price of food continues to rise especially with government policy to eliminate consumer subsidies on food. Prior to the 1980s, urban consumers had benefitted substantially from these subsidies which aimed to keep the staple foods such as maizemeal, bread and milk affordable for the majority. By annually setting both producer and consumer prices for such commodities, the government hoped to simultaneously ensure satisfactory production levels and low enough food expenditures to allow adequate diets for the urban working class. Towards the end of the 1970s, the policy began to change. Subsequently, from a level of 56% of crop costs in 1982-83, subsidies fell to only 16% in 1988-89 (Shapouri et al. 1992, 29). The increased price of food associated with the policy has meant rising food bills. Evidently, the demand for food resulting from rapid urban population growth, is really demand for cheap food and is likely to be all the greater in the future.

Sweet Potato's Potential

The Agronomic Appeal of Sweet Potato

Sweet potato is an ideal candidate for cultivation under the conditions prevailing in the densely populated fertile areas of south-western Kenya. The root produces impressive yields when compared to maize and potatoes using maize equivalents[2] (Figure 2.6). The root's yields have been growing much more steadily than either maize or white potato. It is notable that these yields are achieved without the aid of fertilizers; output levels could rise much higher if such inputs were used.

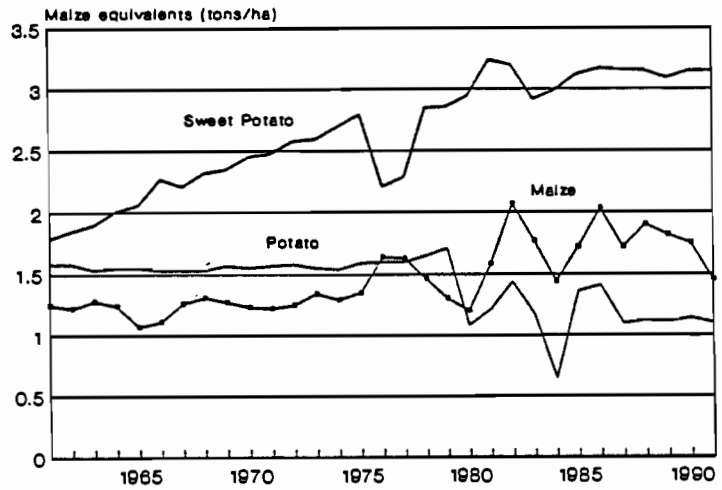
Sweet potato exhibits drought resistant qualities which enable cultivation when rainfall is less than ideal. Whereas the optimum rainfall requirements for the root are 750-1000 millimeters per year, it can tolerate long periods without moisture unlike many of the cereals and even some of the roots and tubers (Woolfe 1992, 29). In fact, dry weather is desirable during root development because it promotes the storage of starch and thus helps to increase yields (Kays 1985, 123). Accordingly, farmers in western Kenya always reserve space for sweet potato in the event of inadequate rainfall and for the "hungry" periods when other foods are in short supply (Gor 1989, 7). In warm and wet climates, sweet potato can be grown all year round and piecemeal harvesting allows a constant supply of food. Thus, the root plays a famine reserve role in case the more delicate maize crop does poorly. For resource-poor farmers, the crop is an attractive choice because propagation is vegetative. This means that seed storage or purchases are unnecessary. In contrast, if farmers plant crops like hybrid maize they have to purchase seed every year in order to maintain yield levels (Bouwkamp 1985, 5-6).

Even when the farmer forgoes the use of pest control chemicals, sweet potato is able to produce respectable yields. Because its roots penetrate deep into the soil, the crop can make use of residual fertilizer from previous crops. It also establishes a ground cover fast enough--within 4-6 weeks--to compete effectively with weeds. Usually, only one or two weedings are required. This same ground cover is an effective prevention against soil erosion. Problems with fungal and insect pests are few and superficial and do not result in yield losses (Woolfe 1992, 6) (moles and weevils are notable exceptions). This eliminates two more major cost items of farming. The extent of ground preparation may vary but at most this would involve making mounds or ridges of soil to ease development of the roots. Crops like maize require clearing of the land, ploughing, and harrowing which are all heavy time and labor demands. Only during the harvesting of sweet potato is much human power required.

Sweet potato is also a boon to rural consumers because it is a cheap source of food. Given the low--perhaps even zero--monetary costs of growing the root, consumers in local markets can obtain sweet potato at

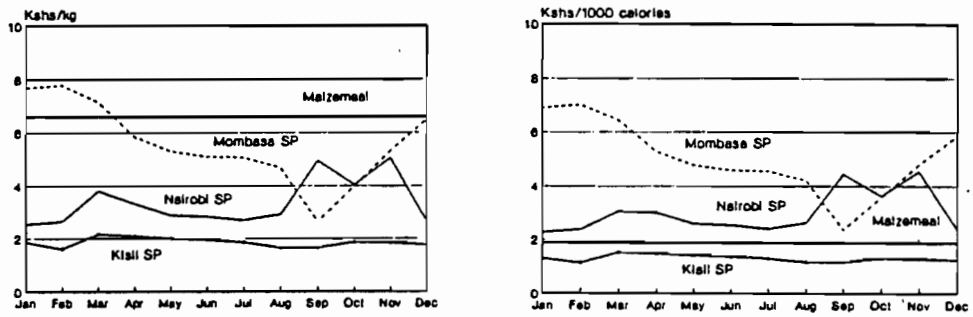
[2] Maize equivalents adjust for the calorie content of the food to allow a direct comparison of different crops.

Figure 2.6: Maize Equivalent Yields of Maize, Potato and Sweet Potato in Kenya, 1961-1991.



Source: Food and Agriculture Organization. 1990. Agrostat PC Database. Rome.

Figure 2.7: Sweet Potato and Maizemeal Prices in Kisii, Mombasa and Nairobi, 1991.



Source: Kenya, Ministry of Agriculture Marketing Intelligence Unit. 1992. Market Prices.

Table 2.1: Nutritive Value of Kenya's Major Starchy Staple Foods (per 100g edible portion)*

Food Item	Food Energy (calories)	Protein (grams)	Beta-Carotene (mg)	Ascorbic Acid (mg)	Thiamine (mg)	Calcium (mg)	Moisture (%)
Maizemeal							
-sifted	368	9.3	--	--	0.26	25	12.2
-unsifted	353	9.4	25	3	0.30	17	12.2
Wheat flour							
-imported	376	12.9	--	--	--	--	6.5
-90% extraction	254	8.0	--	--	0.22	20	36.0
Potato							
-raw	82	1.7	25	21	0.07	13	77.7
Rice, milled & polished	363	7.0	--	--	0.10-0.22	10-14	12.0
Sweet Potato							
-pale variety (raw)	121	1.6	75	37	0.09	33	68.8
-flour	334	12.5	--	--	--	--	11.7

Notes: -- data not available.

Source: Compiled from: United States Department of Health, Education and Welfare, and Food and Agriculture Organization. 1968. *Food Composition Table for Use in Africa*. Bethesda, Maryland.

much lower prices than people in towns far from the growing areas (Figure 2.7). Thus, for people living in Kisii town which lies in the heart of sweet potato country, prices in 1991 were less than one third of those in Mombasa which is several hundred kilometers from South Nyanza or Central Province. Interestingly, for both consumers in the growing areas and in the towns, sweet potato was even cheaper than maizemeal, whose price is subsidized by the government. On comparison with maizemeal in terms of price per 1000 calories, however, sweet potato is only cheaper than maizemeal in the Kisii markets.

In nutritional terms, the root is an excellent source of vitamin A, especially in the more orange varieties, while quantities of vitamin C are also substantial (Table 2.1). Depending on the variety, sweet potato can contain much dietary fibre (Collins 1988, 222). However, as with other roots and tubers, it is not a satisfactory source of protein[3] and must be supplemented with foods having higher amino acid content such as legumes. (The tops of the sweet potato plant are a much better source of protein than the roots). Nevertheless, sweet potato compares well with other roots and tubers in overall nutritional value.

Sweet Potato In Kenya

Cultivation Practices

Sweet potato is an important but secondary food crop in certain parts of Kenya. Cultivation of the root is concentrated in three parts of the country--western, central and coastal areas--which are also the most densely populated (Map 2.3). Over 80% is grown in Nyanza province and much of the remainder in Central and Western provinces. Yields are higher in the western and central areas which are also the most fertile. In Nyanza province, much of the production takes place in the lower altitudes (on the side closer to Lake Victoria) where rainfall is lower. Tea and coffee are grown in the more fertile highlands in the eastern part of the province. Cultivation of sweet potato is primarily limited to small scale farmers. Women form a large percentage of the grower population since the root is most commonly used for home consumption. Indeed, one survey revealed that well over half of the respondents indicated that sweet potato cultivation is done by the "wife alone" (Mutuura 1990, 36). If the crop is grown for the market it becomes the preserve of men.

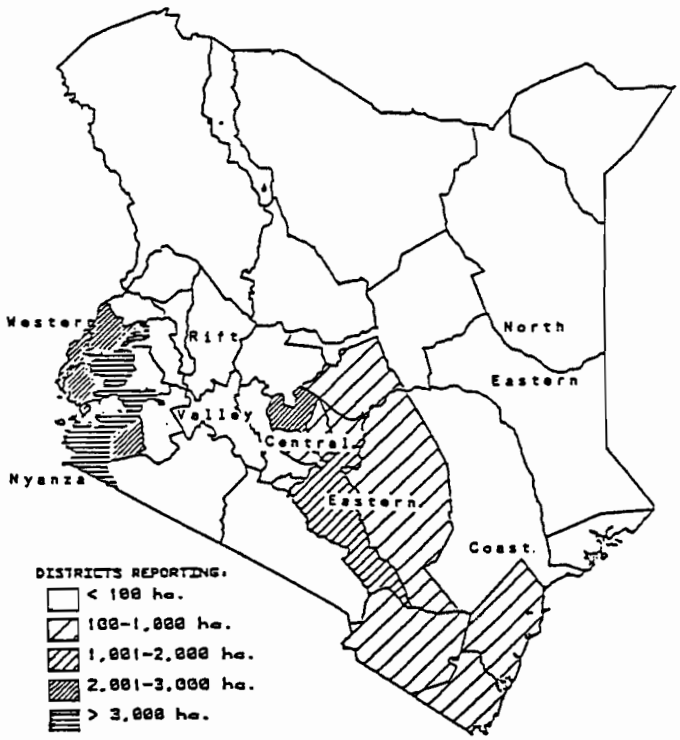
Planting is often calculated so that harvesting takes place during the periods when other crops are still immature or when granaries are empty. For instance, in the western provinces, farmers plant sweet potato between March and May and/or from August to December (Figure 2.8). Allowing roughly 4-5 months for the vines to mature and roots to develop, harvesting usually takes place from July to September and from December to March. In the former period the maize crop would still be growing while in the latter period much of the maize harvest would have been already consumed[4]. This is a clear illustration of sweet potato's famine reserve role. The pattern also suggests that sweet potato activities do not compete for labor with those of maize. In this way, farmers can increase their sweet potato output without threatening the maize crop which remains an important source of income for rural households.

Vine cuttings are the planting materials and are obtained for free from the previous season's harvest or from neighbors and friends. A survey of sweet potato growers in western Kenya found that 86% used their own planting material while another 10% received it from neighbors (Ewell et al. 1991). Ground preparation varies from farmer to farmer but is often minimal. The root is often planted on the least fertile portion of the farmer's fields and few inputs if any are used. (This partially reflects the generally low level of yield-enhancing input use for all crops by small scale farmers.) In fact, sweet potato is usually grown in between two plantings of other, more input-demanding crops since farmers believe that the root improves soil fertility. The rare use

[3]However, the quality of the protein in sweet potato is high (Collins 1988, 222).

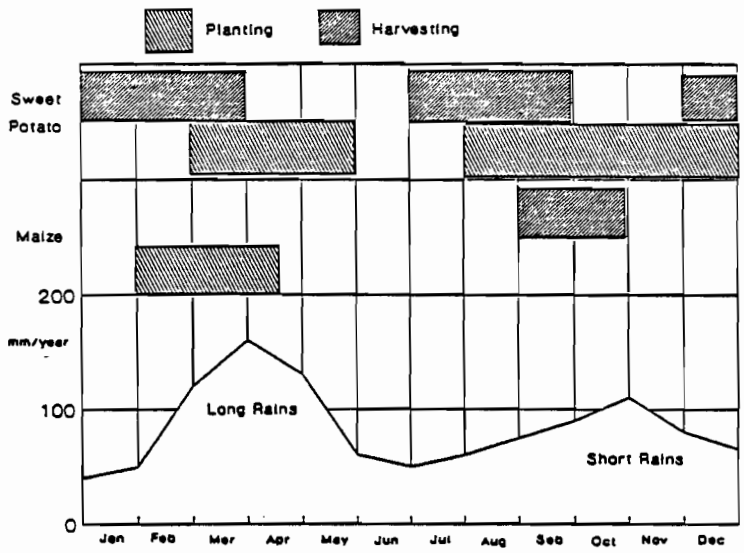
[4] Farmers usually sell much of the maize immediately after harvest in order to get cash for urgent needs and then purchase maizemeal later in the season when the home supply has dwindled (de Wilde 1986, 17).

Map 2.3: Sweet Potato Growing Areas in Kenya.



Source: Ewell, P. et al. 1992. Unpublished report.

Figure 2.8: Agricultural Calendar in Western Kenya.



Source: Rainfall figures obtained from: Sands, Michael W. 1983. "Role of Livestock on Smallholder Farms in Western Kenya: Prospects for a Dual Purpose Goat." Doctoral Dissertation, Cornell University. Ithaca, New York.

of fertilizers or manure is due to the farmers' contention that these inputs promote growth of the vines and leaves rather than the roots (Mutuura 1990, 37). This probably accounts for relatively low level of yields obtained in Kenya. Whereas yields of 18 tons/hectare are common in China, Kenyan growers rarely achieve levels above 9.5 tons/hectare (see Map 2.3) (Woolfe 1992, 6). Sweet Potato is treated as an annual crop even though it is actually perennial, and is rarely intercropped with other plants.

Uses of Sweet Potato in Kenya

Information on utilization in Kenya is scanty in general because research efforts have tended to concentrate on production. Very few farmers devote the whole sweet potato crop to the market; most is used for home consumption or as animal feed. Any surplus remaining after family needs are met is sold in nearby markets. (Mutuura found that only farmers who plant more than one acre of sweet potato will sell all the harvest (1990, 37)). Western Kenyans treat sweet potato as a supplementary staple and may consume it boiled whole or mashed with legumes. Other common accompaniments include leafy vegetables, meat, and fish. The root is also a popular alternative to bread for the morning meal. In Central Province sweet potato plays only a minor role as an alternative breakfast food or snack. Most preparation takes the form of boiling although some families do fry the root. In general, transformation of sweet potato into different forms is rare. However, there have been reports of farmers in western Kenya making dried chips and milling these into a flour. When mixed with millet or maizemeal, the sweet potato flour is incorporated into traditional foods such as *ugali* (a sort of stiff porridge).

Some Shortcomings

Despite the clear potential of sweet potato in helping to meet the country's food needs, there are important constraints which prevent its full exploitation. Because of its bulk and perishability, sweet potato is an expensive and difficult commodity to transport. Like other roots and tubers, the high moisture content of sweet potato (70%) is much greater than that of the cereal grains (Woolfe 1992, 42). This high water content contributes to perishability. Also, since the root is a living organ which respires, bruising or wounding results in faster deterioration.

For the farmer, these features of sweet potato are also a disadvantage because the root is of low unit value. This may help to explain why, even in Nyanza and Western provinces where production is highest, most farmers only plant sweet potato on a very small portion of their plots. In one survey, over 57% of the growers interviewed cultivated the root on 0.2 acres or less of their land; only 6.6% devoted more than 1 acre to sweet potato (Mutuura 1990, 36). The greater part of the farm is reserved for more lucrative crops such as tea, coffee and maize. Crops like maize are able to command a high price because they are much more amenable to movement over long distances and do not suffer from serious perishability problems.

Conversely, many risks are associated with the sale of sweet potatoes by the grower. He or she has to sell the sweet potatoes before they begin to spoil (this can begin within two or three days after removal from the ground). However, with unreliable transportation and insufficient market information (for example, in terms of prices in distant markets) it is extremely difficult for growers to be assured of a reasonable price for their produce. Farmers often try to circumvent these problems by only harvesting the roots as required so that storage is avoided. Unfortunately, this strategy also means that the opportunity cost in terms of land is high since in-ground crops preclude other activities. At the same time, losses of roots to moles and weevils can increase.

Marketers face similar problems. They have to ensure that the sweet potatoes arrive in destination markets fast enough to avoid huge losses to spoilt roots. Consumers in these markets will naturally demand discounts for produce which they perceive to be of poor quality, to the detriment of the sellers. In essence, marketers and retailers are vulnerable in much the same way as growers. Sweet potato's perishability also creates seasonality in the supply and prices of sweet potato (see Figure 2.8). Price fluctuation becomes more pronounced the further away markets get from the producing areas. For instance, Kisii prices of sweet potato

remain roughly constant throughout the year while those in Nairobi and Mombasa exhibit sharp swings. Prices also vary greatly geographically depending upon distance from producing areas. The higher prices represent the rapidly increasing cost of maintaining root freshness over time and distance, not to mention the generally high cost of transportation in Kenya (Gor 1989, 12).

At the other end of the marketing chain, sweet potato faces problems related to low consumer acceptability. Even though it compares favorably with other starchy staples in terms of nutritive value, it is still only used as a form of famine insurance and ranks low on the consumer's preference scale. Also, sweet potato is merely considered a snack--not as a food which could constitute the main part of a family's diet. This form of usage is a substantial barrier to increased consumption.

Consequently, consumption of sweet potato is very low in the urban areas--even in western Kenya where production of the root is highest. In most homes, sweet potato is an occasional tea-time snack or breakfast food. Often, urban families will only partake of the root after a visit to relatives in the rural areas who are growers. This situation is due, in part, to high prices in the towns and unavailability. In some cases consumption is associated only with specific events: during the Muslim fasting month of Ramadhan, sweet potato is an integral part of the evening fast-breaking meal (Ewell 1991, personal communication). These low consumption patterns are also partly responsible for sweet potato's failure to become a more important food crop in Kenya.

Processing as a Solution

In order to overcome some of the marketing problems, the root could be modified to achieve greater storability, higher unit value, and increased consumer acceptance. As Bouwkamp notes, "... many staple crops are rarely consumed directly in the form in which they are produced. The importance of corn, wheat and soybeans in the agricultural economics of temperate zone countries is related in part to the versatility in their utilization" (1985, 137). Processing sweet potato into forms such as chips, flakes or flour may serve the purpose. The transformation of the root could remove much of the moisture in order to extend its shelf life. For the grower, processing could allow greater sales and profits due to the higher value associated with the processed product. New forms of the root may also allow it to assume greater importance for consumers if the products designed are acceptable.

The processing strategy has often been used with foods whose traditional consumption form presents barriers to increased consumption. Processing is then used to find ways of enlarging markets for such foods. For instance, even though human consumption of corn (maize) in the grain and flour forms has fallen rapidly in the United States, the development of products such as cornflakes and corn-based sweeteners has allowed the crop to retain a role in the food systems of Americans. Similarly, if the stigma of the sweet potato is not passed on to the processed product then consumer acceptance may be enhanced. Jennifer Woolfe mentions that processing into high quality products could help to add prestige to sweet potato (1992, 11). Therefore, it may be possible for Kenya to achieve greater utilization of the root through processing.

CHAPTER 3
FACTORS AFFECTING GLOBAL CONSUMER DEMAND FOR SWEET POTATO

Not only in Kenya has sweet potato failed to receive the widespread acceptance that would be expected given its ease of production and nutritional value. In terms of total world production, crops like wheat, rice, maize and white potatoes are far more important than sweet potatoes. Only in the densely populated tropics of Asia and Africa, and in some Pacific islands, has the root achieved staple food status. Overall, the literature on consumer issues is scanty. Filling the information gap would greatly enhance sweet potato marketing. This chapter, then, reviews the most important problems affecting sweet potato's ascent along the food acceptance scale.

The Sweet Potato's History

Origins

There appears to have been some controversy regarding the original home of the sweet potato (*Ipomoea batatas*) (Yen 1974, 1). Africa, Asia and Latin America have all been suggested, at one time or another, as the primary source of the root. Others contend that sweet potato had multiple origins. The tripartite hypothesis which traces the root to the area between the Yucatan peninsula and the Orinoco River in South America (present-day parts of Peru, Colombia and Ecuador) (Yen 1982, 20) seems to have received widespread acceptance. From there, three main dispersion routes have been identified. The Portuguese are said to have been responsible for carrying the sweet potato to Africa, India and the East Indies (Yen 1982, 20). Edmond suggests that it was the Spanish who carried the root to their country and then to Africa during the 16th century[5]. Another type of sweet potato known as *kamote* was introduced into the Philippines from Mexico by Spanish explorers. A third variety--*kumara*--reached the Polynesian islands from South America although it is still unclear who the transporters were.

Dispersion

The dispersion of the root to different parts of the world was aided by its appealing agronomic characteristics which clearly showed its value as a famine insurance crop. Most notable were its drought resistant and high-yielding qualities. Even typhoon tolerance was mentioned in the case of China, Japan and the Philippines (Woolfe 1992, 487, 505, 521). In many areas, sweet potato achieved staple food or supplementary food status, especially when other foods were unavailable (either due to the failure or seasonality of other crops). Indeed, the importance of sweet potato is reflected in its presence in agricultural rituals in Hawaii, Easter Island and among the New Zealand Maori (Yen 1982, 26). The root's use as a vegetable or supplementary staple was particularly important in southeast Asia. In other countries such as the Philippines, the leaves became a permanent part of the diet (Woolfe 1992, 522).

Food Use of Sweet Potato is Falling

Sweet potato's use for human consumption as a whole, however, has decreased in recent decades as foods made from wheat, rice and maize have come to predominate (Figure 3.1)[6]. These three crops in

[5]Sweet potato was unsuccessful in northern Europe because low temperatures were inappropriate for its cultivation.

[6]At least two sources examined cautioned against overreliance on consumption statistics for sweet potato. The FAO (which is the primary source for such numbers) calculates food available for human consumption as a residual of production and utilization figures derived from official country data. This method almost certainly understates production and possibly overestimates utilization resulting in a residual that is probably far from

particular have displaced other cereals and the roots and tubers in world production. In industrialized nations, the root is now only an occasional or snack food, whereas its role in developing nations is increasingly only significant in rural areas. (Urban populations have a clear bias towards cereal-based diets). Because China produces over 80% of the world total, the decline in production in that country since the 1970s has affected global trends quite clearly. (Government policy during that time promoted cultivation of wheat and rice above that of sweet potato (Woolfe 1992, 488)). In many other parts of the developing and industrialized world, the trend has been similar. Only in Africa have overall production trends continued to rise over the 25 year period from 1960 to 1985 (Horton 1987, 22).

In most regions, the greater versatility and high status associated with the cereal grains have helped to displace sweet potato's place in the diet. Yang reports that sweet potatoes, rice and sugarcane used to be the three most important crops in Taiwan until the late 1950s. In the rural areas, sweet potato supplied about 44% of total caloric intake. Over time, however, imported wheat has overshadowed the root which is now mainly used as animal feed and industrial purposes (1982, 31). This seems to be the overall fate of roots and tubers with the notable exceptions of white potato, cassava in West Africa, and the aroids in the Pacific Islands.

By and large, the general move away from sweet potato seems to be associated with rising per capita incomes[7] suggesting that the root is an inferior good. Figure 3.2 shows trends in annual sweet potato consumption per capita for selected countries. The downward trend is best illustrated by the southeast Asian countries where the root's use for human consumption has fallen steadily while incomes have risen sharply. Countries where sweet potato consumption has either remained steady or actually increased are exemplified by Rwanda and Uganda. These are characterized by wet and warm climatic conditions, highland terrain and high population densities (for example, Rwanda's population density figures are on the order of 540 persons per square kilometer (Woolfe 1992, 550)). Evidently, great advantage is taken of sweet potato's high yielding capacity in order to maximize food output per unit of land.

In Papua New Guinea, sweet potato remains the most important food crop especially for the peoples residing in the highlands (see Figure 3.1). In those regions, the root provides between 60% and 90% of daily caloric intake. Sweet potato has increasingly displaced other root and tuber crops such as taro and yam which have great cultural significance. The rise in production of the root has been associated with increased population growth and the greater value of sweet potato versus other roots and tubers as a cash crop (Bourke 1982, 45) (Woolfe 1992, 539).

Why Sweet Potato Consumption is Low

Unfortunately, strong barriers exist among consumers and in the market which prevent the root from achieving, what some have called, its "rightful place" in the diet. Problems range from negative perceptions of the food to difficulties with storage and transportation of the root. The discussion draws extensively from the work of Woolfe (1992) and Villareal et al. (1982) who give the most comprehensive analyses of these issues.

Sweet Potato's Poor "Public Image"

In most parts of the world, sweet potato is relegated to the status of a "poor man's food" (Villareal 1982, 12). As a famine reserve crop, it is the food people turn to when other, more preferred foods are unavailable (Woolfe 1992, 475). These perceptions have been documented in varied regions such as China, Uganda and even in Peru--the original home of the root (Woolfe 1992). Also, because its demands on land and labor are few, it is most often grown by the most resource-poor farmers. Once it enters the market this association with the poor remains, making it a second or third choice for many consumers.

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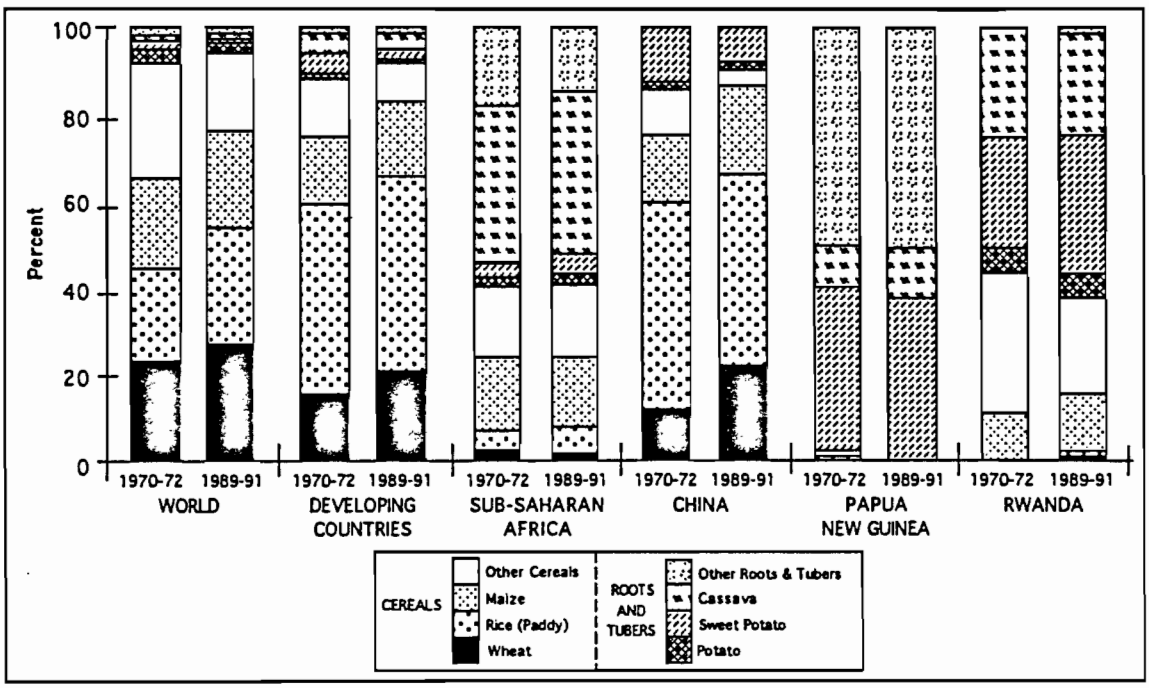
accurate (especially for developing countries). However, these are often the only figures available.

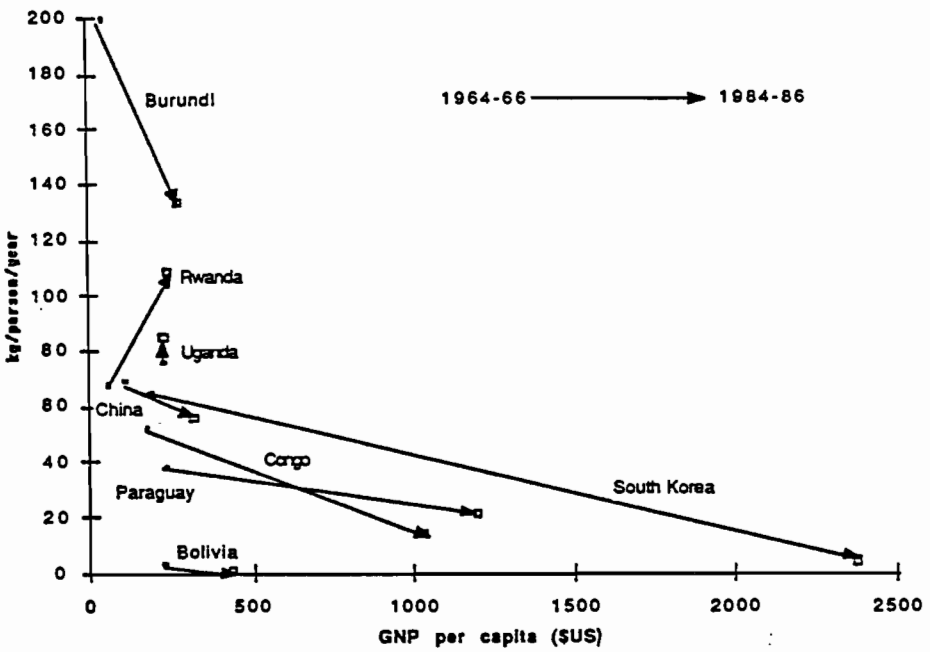
[7]Tsou and Villareal also note a negative correlation between per capita food availabilities and sweet potato consumption for all parts of the developing world (1982, 39-40).

Figure 3.1: Composition of Starchy Staple Production in the World, Developing Countries, Sub-Saharan Africa, China, Papua New Guinea and Rwanda, 1970-72 and 1989-91 (percent grain equivalents).



Source: Food and Agriculture Organization. 1990. Agrostat PC Database. Rome.

Figure 3.2: Sweet Potato Per Capita Consumption (kilograms/year) and Per Capita Income ($US) for Selected Countries (1964-66/1984-86).



Source: Food and Agriculture Organization. 1971. *Food Balance Sheets, 1964-66 Average.* Rome; and Ibid. *Food Balance Sheets, 1984-86 Average.* Rome.

Sometimes the negative perception may take a mild form whereby people do not object to eating sweet potato *per se* but still consider it only a minor food. The root has no permanent and important place in the family's diet. For instance, in the United States, apart from the period between Thanksgiving and Christmas, sweet potato only appears on the plates of southern, rural African Americans who are among the poorest populations in the country. At other times of the year, it is rarely consumed. Also, the root's use as animal feed has increased in some countries which may lower it in the eyes of consumers (Woolfe 1992, 592). In Southeast Asia, most production is devoted to feed while that for human consumption takes the form of snack foods.

In general, consumers seem to prioritize the foods in their diets and will only partake of those occurring lower on the scale under extraordinary circumstances. In this respect, specific events may sometimes contribute to the problem. Most cited is the case of Japan where sweet potato played a major role as an emergency food during World War II (Johnston 1953, 126). In 1943 the Allied countries subjected Japan to a blockade in an effort to make it surrender. Consequently, it could not receive regular supplies of rice--the overwhelmingly preferred staple--from Korea and parts of China which were then part of the Japanese empire. To prevent widespread starvation, the Japanese government emphasized cultivation and consumption of white and sweet potatoes. Unfortunately, this policy helped to create a stigma against sweet potato since it became associated with hardship (Woolfe 1992, 505). Thus, even though it was previously acceptable, once forced to eat it, people began to regard it in a negative light. Currently, sweet potato only retains a place in the country's food systems as a snack food, albeit an important one. A somewhat similar situation obtained in the Philippines and Taiwan (Tsou & Villareal 1982, 40).

Promotion Activities are Necessary

It would appear, then, that efforts to increase sweet potato consumption would be greatly facilitated by breaking down or redefining these negative images of the root. Promoters of sweet potato could undertake specific marketing strategies to present the root in a more favorable light and thus increase acceptance. Promotion activities could emphasize the food energy value of sweet potato and highlight nutrients such as vitamins A and C in which some varieties are rich (Villareal 1982, 11). This strategy was successful in the United States where the orange and white varieties were confined to specific markets: the orange kind were popular in the south while the white were preferred in the north. However, with intensive promotion of the orange varieties, highlighting the beta carotene content, this commodity eventually competed strongly with the white types in the north and are now found in both regions (Edmond 1971, 5).

In industrialized nations, marketers could capitalize on growing health concerns among consumers by bringing out the root's high fibre, high carbohydrate and low fat content (Woolfe 1992, 520). Accompanying preparation ideas may help to provide consumers with incentives to purchase the root[8].

Given that consumption of a product often hinges on its image among consumers, the role of promotion for sweet potato is crucial. The Japanese have been particularly successful in maintaining a role for sweet potato by pursuing such a strategy (Woolfe 1992, 504, 519). Even though widespread processing of the root into different forms has helped, publication of preparation ideas and nutritional content has contributed substantially to sweet potato's place in Japanese diets. It is even possible that many potential consumers merely forget about sweet potato. Therefore, marketers would do well to remind them of its existence and desirable characteristics as a food. An even more adventurous approach is to completely redefine the status of the root. In urban areas of Taiwan, sweet potatoes are now regarded as gourmet food and incorporated into exclusive restaurant menus (Woolfe 1992, 592).

Sweet Flavor is Inappropriate

Perhaps sweet potato would be more popular as a staple if it were not sweet. Compared to rice and wheat which contain less than 2% of sugar of their dry weight, sweet potato can have between 8% and 40%

[8]Some supermarkets in the United States already provide such services for food items which are unfamiliar.

depending on the variety (Villareal 1982, 7). For most consumers, it is difficult to visualize sweet foods as major parts of the diet because they tend to dominate the flavors of other foods. Starches often achieve their success in the diet by acting as flavor-carriers: they are usually bland or possess only a mild flavor and aroma. Because of its sweetness and distinct flavor, it is difficult for the root to play such a role. In a survey among urban Japanese consumers, people noted that sweet foods do not fit neatly into meals which are primarily savory (Woolfe 1992, 514).

For populations which were not historically sweet-toothed, the high sugar content constitutes an even greater problem. As in the case of Kenya, traditional diets consisted of few sugary foods which could form a base on which to ease the enhancement of sweet potato use. It has been suggested that the sweet flavor is the main reason why the root has failed to become a more important food crop in most parts of Africa (As-Saqui 1982, 59).

Tsou & Villareal suggest that researchers endeavor to breed sweet potato varieties with a lower sugar content in order to overcome the problem. These efforts have already been underway for a number of years (Villareal 1982, 7). In this manner, the root could behave in much the same way as other starchy foods. However, the present market for sweet roots would still exist and should not be overlooked. Sweet potatoes as breakfast food or as a snack would then represent a different market from newly developed less-sugary varieties. Indeed, in some places, consumers actually prefer sweeter sweet potatoes. In the United States, processing and preparation often involve the addition of sugar.

The "Unmentionable" Problem

A particularly interesting problem with sweet potato is found in reports of flatulence associated with consumption. Whereas few people actually mention the issue (perhaps for understandable reasons) it is significant enough to be included in the literature. In Kenya people also cite cases of choking while eating sweet potato. Naturally, this tends to create fear of consuming the root. It appears that the problem comes up more with the starchier varieties which are popular in Eastern Africa. This presents something of a dilemma for the marketer. Thus far, very little is known about the particular mechanisms which result in the flatulence and to what extent this leads to rejection of the root as a food (Woolfe 1992, 210). Overall, however, this is not the most serious problem facing promoters of sweet potato.

Getting Sweet Potatoes to Market

Unfortunately, solving these problems would not necessarily clear the way for sweet potato's role to blossom into that of a starchy staple, especially in developing countries. There remains the practical issue of the root's bulkiness and perishability (see Chapter 2). This problem translates into an unreliable supply of sweet potatoes and high prices during off-season periods, especially in urban areas. During the fieldwork surveys for this research (May-August 1992), most women mentioned either unavailability or expense as the most important reason for infrequent use. If sweet potato is considered food for the poor and yet is dearly priced, this implies somewhat of a mismatch in the market. In other words, some people do not buy sweet potato because they consider it fit for only poor people and yet this latter group cannot afford it. Consequently, consumption is low.

Moreover, because sweet potato is highly perishable, it is extremely difficult to get it to market in peak condition in order to be attractive to consumers. By the time the root has travelled several hundred kilometers on a bumpy road in the back of a lorry, it is likely to be bruised and well on its way to spoiling. Quantities sold in markets distant from the grower's field are thus small and expensive.

Processing has already been suggested as the solution to the problems of marketing sweet potatoes (see Chapter 2). The potential advantages of processing to the marketer and consumer are numerous. Perhaps most important is the reduced cost of marketing and the cheaper final product for the consumer. Also, the sweet potato marketer now has more products which may command larger or different markets from those of the root alone. Some products made from sweet potato could even compete with more preferred foods such as wheat and maize.

In transforming the root, researchers and marketers have to ensure that the resulting products have a fair chance of surviving in the market. This may mean experimenting with sweet potato in traditional foods to determine if they could supplement or even replace current ingredients. Kenya's National Potato Research Centre in Tigoni and the Katumani research station[9] have been at the forefront of such product development for sweet potato (both roots and leaves). Taste tests with in-house panelists have helped to narrow down the range of products to be considered for further evaluation. In China, sweet potato starch is used to make noodles of acceptable quality even though they were traditionally made from cereal grains. Entirely new products are also feasible including jams, beverages, pastes, and crisps. These require careful market research to determine whether the negative perceptions mentioned earlier remain with the new food or whether they could achieve acceptance as foods in their own right.

Several countries have been successful in using the processing strategy to increase or stabilize sweet potato consumption. Southeast Asian nations are notable because they have advanced the furthest in these endeavors. The range of products made is quite remarkable and innovative forms of packaging help to attract consumers. Other developing countries can learn from the experience of these nations in their attempts to find a more substantial role for sweet potato in their food systems.

Body of Knowledge is Incomplete

All in all, much is still unknown about consumer perceptions of sweet potato and the reasons why it does not command a greater market. Research into these issues is crucial as a complement to the work being done on increased production and yields. Woolfe rightly asserts that research on the production side has little meaning if it is not accompanied by greater consumption or utilization of the root (1992, 473-4). In particular, future work could focus more on potential markets for processed sweet potato products among various consumer populations, especially in developing countries. This research, then, seeks to address the need for this kind of information in Kenya.

[9]Both constituent centers of the Kenya Agricultural Research Institute.

CHAPTER 4
MEASURING THE ACCEPTABILITY OF PROCESSED SWEET POTATO

In order to estimate the potential of a new product, food marketers often elicit consumers' overall feeling or attitude towards the food. A key tool in determining this overall acceptability is the notion of food preference. Defined as the degree of like or dislike for a food, preferences play an instrumental role in the evolution of dietary patterns for the individual or the family. Evidently, unless extenuating circumstances exist people will not purchase and/or consume a food which they do not like. For the food industry, then, preferences become a crucial indicator of potential markets and possible sales trends for products over time. However, it is also important to recognize the effects of socio-economic factors on the individual's behavior towards a food. The chapter presents the background of food preference measurement, much of which is based on the work of Howard Moskowitz (1983, 1985 and 1988), and discusses the specific methodology used with respect to processed sweet potato for urban residents in western Kenya.

Measurement of Food Preferences

Conceptual Issues

Food scientists recognize a distinction between preference, acceptance and consumption. Preference is a purely attitudinal phenomenon concerning like and dislike for a food. Acceptance incorporates both attitude and behavior: an acceptable food is one that is consumed with pleasure. Finally, consumption represents behavior relating to the actual acquisition and ingestion of food. The relationship between the three concepts takes the form of a process from encounter with the food to ingestion (Figure 4.1). The particular model used in this research is D. Elizabeth Randall's conceptualization of the process (an extension of a previous model (Randall 1980, 50)) (Randall 1991, personal communication).

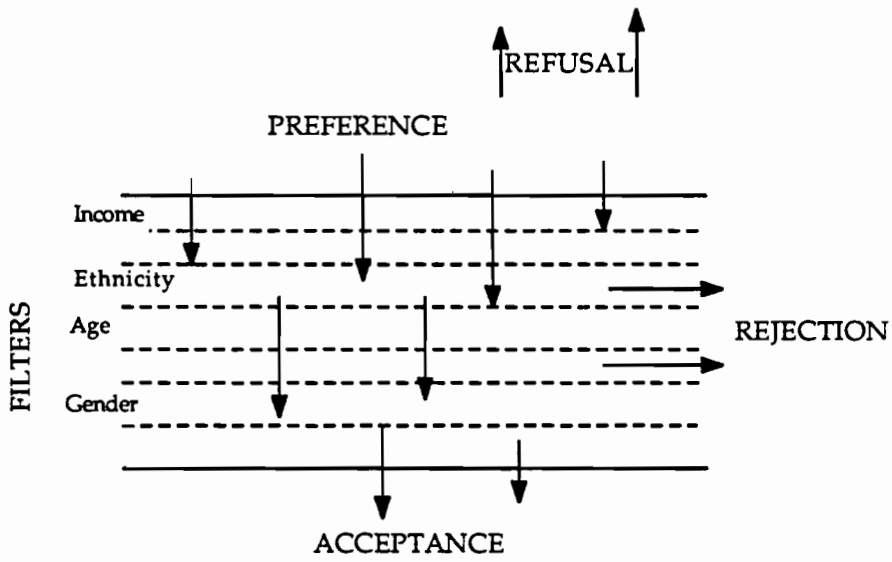
Randall envisions an initial purely sensory reaction which determines preference or refusal. According to the model, a refused food will not be consumed unless extenuating circumstances exist. For example, during a famine people have little option but to eat whatever form of nourishment is available. If preferred, the food is subjected to further evaluation according to the individual's socio-economic status, and attributes of the food and the environment known as filters. Factors such as ethnicity, income level, method of preparation and season of the year often shape the individual's diet. If the food fails to permeate this filtering process it is rejected. Otherwise the food goes on to become acceptable and will be consumed unless it is unavailable. Indeed, acceptability is considered a reliable predictor of consumption for measurement purposes. This model allows us to separate out the important factors which determine whether or not a product receives favorable response from consumers. The marketer can then target those populations which appear to have the greatest inclination to purchase and consume the product.

History of Food Preference Measurement

The measurement of food preferences and sensory analysis in general have their scientific origin in the branch of psychology known as psychophysics. Food preference measurement has become of great interest to the food industry because it provides the kind of "structure and quantitative methods needed to understand how people perceive and react to food" (Moskowitz 1983, 1).

In the period between the 1920s and the onset of World War II, scientists began to pay more attention to the psychological analysis of human sensory abilities and reactions to various stimuli. The United States Department of Agriculture (USDA) conducted studies using expert panels (people trained in taste techniques) to elicit reactions on different characteristics of the food. The growth of agricultural production had spurred the need for differentiation of produce. The purpose behind these exercises, then, was to develop better methods for agricultural commodity grading. Concurrently, university research stimulated the emergence of measurement for perceptions of food using scaling techniques (Ibid, 3).

Figure 4.1: Randall Food Acceptability Model.



Source: Randall, D. Elizabeth. 1991. Assistant Professor of Nutrition, State University of New York at Buffalo. Personal Communication.

Leon L. Thurstone, in particular, made substantial contributions to the marriage of sensory evaluation science with "real-world stimuli" (Ibid, 4). He posited the existence of an individual internal scale of like or dislike--a hedonic scale--which people use to evaluate preference for a stimulus. He developed the paired comparison procedure whereby a panelist in a taste test indicates preference for one of two foods. This technique has been widely used and respected for a long time; some researchers consider it to be the essence of hedonics.

The analysis of food using sensory techniques was first practiced in the Scandinavian countries around 1940 (Jellinek 1985, 17). Subsequently, the second World War played a major role in the development of food preference measurement. The United States Army Quartermaster Food and Container Institute began to recognize the importance of army ration acceptance among soldiers in order to reduce wastage. The Army's interest in these studies grew out of the need to develop better food storage methods and to improve on food quality: soldiers sometimes refused to eat their rations citing unpalatability (Moskowitz 1983, 5). The most notable studies were those carried out by F. Pilgrim, D. Peryam and H. Schutz's with the Quartermaster Corps (Stone & Sidel 1993, 6). They used a 9-point hedonic category scale which allowed the soldier panelists to indicate their preferences for a wide range of foods. This form of category hedonic scaling has become very popular. In the next decade, the works of Roland Harper, Carl Pfaffman and Rose Marie Pangborn were instrumental in furthering sensory analysis methodologies and their use for food analysis (Moskowitz 1983, 7-8). Also notable was the work of S. S. Stevens who developed the magnitude estimation technique (Moskowitz 1983, 6).

Further progress in the field of psychophysics during the 1960s enabled more developments in food preference measurement. This period also saw the movement of psychophysicists into the food industry. The use of sensory evaluation techniques in product development became popular among researchers in the food industry in the 1970s (Ibid, 11). With the increasingly wide variety and range of foods available, marketers began to recognize the value of ascertaining the reactions of potential consumers to their products. Currently these techniques are being used by research and development, marketers, food service & pharmaceutical industries, and cancer researchers. Over time, the superiority of actual taste tests over paper-and-pencil surveys (as with the US Army studies) has become evident. In general, sensory evaluation has enabled higher degrees of sophistication within the food processing industry.

Hedonic Scaling for Food Preference Measurement

This form of sensory analysis is important because it detects a person's instinctive response to a food. Researchers have found that when asked to evaluate a certain aspect of a food, people will often indicate whether they like that aspect or not, rather than evaluating it according to the given criteria, for example, hardness or softness regarding the texture of a food (Moskowitz 1983, 299). The term hedonic scaling refers to a group of procedures which measure different aspects of an individual's evaluation of a stimulus. The procedures include Thurstone's paired comparisons, category scaling and magnitude estimation. These techniques can also be used to evaluate different aspects of a food such as texture, smell and appearance.

The hedonic scale can vary in several ways depending on the particular application at hand. The number of categories presented to the panelist may be patterned to the desired degree of detail. The higher the number of points on the scale, the greater detail in preference rating is achieved. The researcher can also choose to have a middle category that represents neutrality or indecision. (Sometimes a researcher may want to force panelists to make a choice and thus omit the mid-point from his or her scale). Thus, even or odd numbered scales are possible. In addition, Moskowitz notes that bipolar scales which allow two directions of preference (like or dislike) are particularly useful since they allow the panelist to more accurately identify a response. Finally, the descriptors used for the scale could be numerical, verbal or even pictorial (visual). Numerical descriptors are used with trained panelists, verbal with untrained adult panelists and visual descriptors are particularly appropriate for children.

Category scaling has several advantages over the paired comparison technique. Scaling allows for evaluation of more food samples than paired comparisons. The latter method quickly becomes tedious as the

number of foods increases since each pair of food samples has to be tested. Moreover, with scaling it is possible to measure the strength or degree of liking for the food item. Paired comparisons, on the other hand, only show which food is preferred over another; they do not indicate whether the preferred food is liked overall. Also, the data provided by paired comparisons are not suitable for detailed statistical analysis. With category scaling it is possible to perform an analysis of variance (ANOVA) which can indicate real differences between liked and disliked foods.

Limitations of Category Scaling

Nevertheless there are still limitations to the category scaling procedure. Lack of a unit of preference or palatability across individuals means that it is not possible to make certain kinds of comparisons between individuals since responses are subjective (Moskowitz 1983, 302). Also in relation to subjectivity, the way in which panelists interpret scale measurement depends on the particular individual. Moreover, it is not clear that the "length" between categories really the same. Researchers also note that, despite the option of a full range of choices, people tend to avoid extreme values on the scale thus reducing the variability of responses. This has been named "the regression effect" (Moskowitz 1983, 286). Unfortunately, it is difficult to directly correlate the hedonic scale score with actual purchasing or consumption behavior. The classic example here is that of bread versus candy: candy is preferred to bread but people buy and consume a lot more bread than candy (Ibid, 300). Even if the scaling technique were accurate in measuring preferences there is still a problem in that these change with time--perhaps even from day to day. Thus, it may be difficult to conclude that the preferences will remain consistent. Repeated testing may sometimes be recommended. One final problem which applies to all sensory evaluation methods is that the testing situation presents the food in an artificial context: preferences may change in different contexts, for instance if the food is incorporated into a full meal.

Perhaps the best approach is to combine two or more of the techniques in order to ensure as much accuracy as possible. In this, one finds that category scales and paired comparisons are complementary. Using both of them supplies information on intensity of liking for the food and preferences between products. The latter aspect is particularly important when attempting to introduce a food which will compete against an existing market success.

In terms of actual experimental design two main sample size considerations for hedonic scaling are important. First of all, researchers should note the point in the product development cycle at which testing takes place. If testing occurs early in the cycle then the risk of making a wrong decision is low and a small size is not hazardous. A large sample size is recommended when much has already been invested in the product in order to increase the level of accuracy. Greater numbers of panelists often also imply that the group being surveyed is representative of the target population. Of course the availability of panel members is crucial since testing takes time and commitment.

Users of hedonic scaling techniques also endeavor to include the competing product (if any) as a benchmark to compare the acceptance of the experimental food. This helps to predict eventual sales of the new product as it competes with the old.

A word about extensions of hedonic scaling: there exists a Food Action (FACT) scale which deals with potential purchasing and consumption behavior (Stone & Sidel 1993, 244). Panelists may be requested to give information on fair pricing perceptions of the food in order to determine overall acceptability. This methodology is important because it helps to establish the correlation between attitude and behavior. The behavior is what ultimately determines sales volume.

Socio-Economic Filters

Filters are characteristics of the individual, the food or the environment which influence food preferences. For the individual, factors such as age, sex, ethnicity and health status contribute to the acceptability process. Cultural, religious and ideological factors, in particular, can play the most important part in the process. The attitudes that accompany these factors tend to be particularly strong. For instance, in Africa, ethnicity

remains central to the determination of acceptable foods. Thus, whereas an individual from the Luo ethnic group who reside around the shores of Lake Victoria in Kenya will readily eat fish, many Kikuyus (from central Kenya) regard any food obtained from water as suspect. Also, age and sex can play an important role because cultures may dictate some foods to be taboo to certain age groups or to one gender as a whole.

Factors surrounding the food itself also have a role to play. A food served in combination with other foods may receive greater acceptance than if consumed in isolation. The experience of mothers who have to disguise leafy vegetables in the meal rather extensively so that their children will not reject them is a testament to this phenomenon. Furthermore, the method of preparation matters greatly and, as in the case of many African countries, can even make acceptability family-specific. When cooking style varies between households, a food which is palatable in one home may be quite unacceptable in another.

Finally, environmental factors such as seasonal variation and geographical residence help to determine availability and appropriateness of the food. Thus, American families find cranberries particularly *à propos* at Thanksgiving. In Africa, the seasonal availability of food plays a disproportionately strong role due to the lack of adequate storage systems. This seasonality is one of the factors that has contributed to sweet potato's weak position in urban diets. Geography influences dietary patterns primarily because of variation in climate. This is why certain tropical fruits are a staple in many coastal regions while they are either unknown or a rarity in temperate climates.

Some filters have greater impact than others and can even override the effects of other factors. For instance, poor people may not be able to purchase an expensive traditional food even though their ethnic backgrounds may confer preference for that food. In this case the income effect overrides the ethnicity filter. Also, food preferences can, by and large, be learned and unlearned. Nevertheless, preferences developed in childhood tend to persist into adulthood even though the range of foods consumed may increase.

Survey Design for Processed Sweet Potato

Conceptual Issues

The purpose of performing hedonic scaling for the study is the belief that preference and acceptance are reliable predictors of consumption. In other words, if panelists indicated acceptance of the processed sweet potato forms, it was assumed that they would be prepared to purchase the foods if they were made available at affordable prices. The Randall model was chosen because it presents a clear relationship between preference and acceptability. The model's conceptual structure provides a means of interpreting the hedonic scaling data to determine acceptability. In addition, the paired comparison technique was used to determine preferences between food samples.

Practical Considerations

Sampling Procedure

The taste test surveys were carried out in Kisumu which lies on the shores of Lake Victoria, and in Nakuru which is in the Rift Valley (see Map 2.1). The panelist groups were drawn from the middle income section of the society. The assumption was that this group was more likely than either the poorest or the wealthiest groups to have an interest in processed forms of sweet potato. The people in this group are also likely to be trendsetters for the poorer groups. The choice of adult church-goers reflected the belief that they would be easily available for the study and that they would be committed panelists. However, it was recognized that they might not be strictly representative of the middle section of society as a whole. This choice of sampling group was not expected to be critical for the study.

Upper primary schoolchildren (between 10 and 12 years of age) were chosen because they are known to have preferences for sweet foods, their preferences can influence parents' purchasing decisions, and their responses may be used to test effect of age on preferences. As the managers of household diets adult women

were the most important group in the study. Not only are they in charge of family nutrition & purchasing decisions, they are also the most directly involved in food preparation. Moreover, it was believed that information on the nutritive value of sweet potato may influence purchasing behavior. Since adult male preferences play a strong role in determination of family dietary patterns (due to cultural norms) panelists were also drawn from this group. Furthermore, because they are often in control of family finances, men can influence purchasing patterns.

In each town, about 40 children, 30 men and 60 women were interviewed. This sample size was a reflection of the number of people who could be realistically interviewed given the time and management constraints. The availability of panel members played an important role. There was no great emphasis on randomization; any cooperation received was accepted. When church groups were unavailable, groups of teachers or office workers were interviewed instead. Nevertheless, despite the differences in occupation, the criterion of income status remained firm throughout the study.

Food Samples

The experimental food samples for the survey were forms of processed sweet potato with substantial promise in terms of production and distribution[10]. Previous studies by researchers at the National Potato Research Centre had identified these products for further evaluation (fieldnotes). Samples of sweet potato crisps, a mash made from dehydrated sweet potato flakes, and 15% sweet potato flour in both bread and *ugali* (a kind of stiff porridge widely consumed in Kenya) were presented to the panelists for tasting. For the latter two food samples, their conventional counterparts--all-wheat bread and all-maizemeal *ugali*--were used to compare acceptability. White and yellow varieties of fresh sweet potato roots were also included as controls.

For the roots, bread and *ugali*, panelists were asked to make paired comparisons: for instance, 100% wheat bread was juxtaposed with the bread containing 15% sweet potato flour and 85% wheat flour. If panelists were indifferent between the two foods, this was considered possible indication that processed forms sweet potato could find markets among these consumers.

Choice of Filters

The Randall model filters chosen for the study were income, ethnicity, age, education, consumption frequency of sweet potato roots and gender. Of the five, ethnicity and age were controlled for by the design of the study. The ethnicity filter was captured by the sampling of two towns while the obvious age difference between schoolchildren and adults accounted for the age filter. Information on the educational achievement of the panelists was solicited by direct interviewing. The last filter--income--was the most difficult to capture since people do not readily supply such information. Instead, proxies for income such as type of cooking fuel used, availability of piped water in the home, and occupation of the household heads were used. The information thus collected was sufficient to differentiate upper middle income and lower middle income groups. This classification was used in analysis of the income filter (see Chapter 5).

There were clear rationales in choosing these particular filters. Income has a direct relationship with household purchasing power and could influence actual preferences. It was also known that people aspire to eat the foods common to higher income groups. Ethnicity was chosen because culture is a very strong determinant of food habits (these influence preferences for new foods). Thus, whereas the Luo of Kisumu town are frequent consumers of sweet potato, the Kikuyu and Kalenjin populations in Nakuru often have little access to the roots. Information on education not only helped to infer income grouping, but also showed whether this filter influences

[10]The food samples were prepared in several places: the National Potato Research Center processed raw sweet potatoes into dried chips which were then ground at the University of Nairobi into flour which was used in the bread and the *ugali*; the Pilot Food Processing Plant at the University of Nairobi's Food Science and Technology Department made flakes for the mash; the sweet potatoes were purchased in local markets in Kisumu and Nakuru; and the mash and *ugali* were prepared immediately prior to the taste tests.

willingness to try new foods. Additionally, knowledge of nutrition information could enhance acceptance even if preference is not strong. Lastly, age and gender were included since preference patterns sometimes follow these two characteristics.

Actual Survey Procedure

Each group of panelists was assembled in one venue for the taste test and the following interview. In this respect, it was relatively easy to survey the schoolchildren since they were in a classroom, each seated at his or her own desk. For the adults, consultations with the local clergy and other contacts provided information as to the ideal time and place to carry out the survey. For instance, the interviews for the church group in Kisumu took place in one of the offices which had two desks to allow about 3 people at a time to go through the tasting. Each group would be seated at a table with a plate containing the various food samples, a spoon, a cup of water and the questionnaire to be filled out. Every attempt was made to minimize communication between the panelists since this could have influenced response to the foods. At the beginning of the test, the panelists would receive instruction regarding the procedures for tasting and filling out the questionnaire.

The panelists were asked to taste the food samples and give their preference rating on a 5-point category scale in the following manner: "Do you like the [name of the food sample]?

1	2	3	4	5
No, not at all	Not very much	I cannot decide	Yes, a little	Yes, very much

Visual descriptors were included to facilitate completion of the questionnaire (see Appendix 2). After tasting each food, panelists were requested to take a sip of water to try and eliminate the influence of one food sample on another. They were also asked to indicate the most liked and the least liked food sample.

Questions on filter information were included in the questionnaires. Fortunately, almost all those interviewed were literate. This greatly facilitated interviewing and also helped to minimize interviewer bias. Each panelist had to indicate occupation and educational attainment. After the Kisumu survey, it was decided to add questions regarding price of the sweet potato products for the Nakuru panelists. This alteration was done in recognition that the price of the food--especially as compared to that of conventional foods--could greatly influence purchasing behavior.

CHAPTER 5
FINDINGS ON ACCEPTABILITY OF PROCESSED FORMS

The results of the taste test surveys are encouraging in terms of the potential for processed sweet potato among urban consumers in western Kenya. The sweet potato root samples, designated as controls for the study, received among the highest mean hedonic scores for the whole survey. Of the processed products, the crisps were by far the most popular. The bread and ugali made from composite flours and the mash made from sweet potato flakes received mixed responses. The socio-economic variables which had the greatest influence on acceptance were ethnicity and income. Interestingly, gender was also an important filter for the adult group. If taste is the sole criterion, then crisps and sweet potato flour for ugali warrant further investigation as potential market successes. In this chapter, the general findings are presented and the effects of various filters discussed.

Survey Findings: The Preference Hierarchy

The broad findings are presented in Figure 5.1. Each chart shows the cumulative proportion of responses that fell in each category. Thus, for the white sweet potatoes, less than 10% of the panelists indicated categories 1, 2 and 3; about 20% chose number 4 and the rest awarded the roots the maximum score of 5.

One difficulty with a study of this kind was evident in the inability to guarantee similarity of samples from day to day. In other words, due to the overall research conditions, it was difficult to ensure that today's sweet potato *ugali*, for example, is exactly the same as yesterday's. The results of the study must be viewed in this respect. The expected effect is to slightly lower the mean scores of some products, notably, the bread and *ugali*. Interpretation of the results, then, takes into account the possibility that the true means are higher.

Sweet Potato Roots

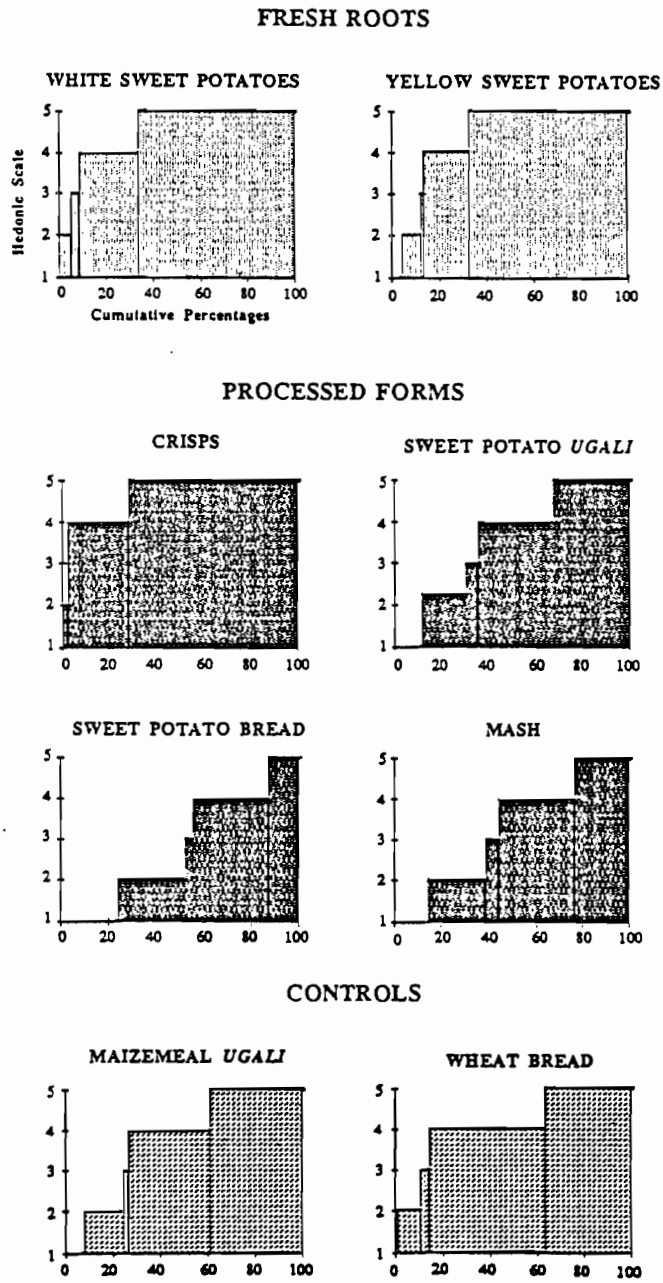
The fresh roots were among the most acceptable foods tasted as shown by the high percentages for the 4 and 5 response categories. The literature maintains that, in Eastern Africa, the white sweet potato is favored over the more yellow or orange kinds (Woolfe 1992, 553). However, in this particular study, the preferences expressed for both food samples were almost identical. This suggests that there may be a larger, untapped market for the yellow roots.

Processed Forms

Crisps

Among the processed forms, the crisps were far and above the most popular. The high scores observed were unsurprising since crisps are a fast food which are highly acceptable virtually everywhere. Slight variations in the crisp samples allowed a more specific observation of the attributes that consumers would prefer. For instance, it is clear that a thinner crisp is better. This may explain the slight but statistically significant difference in mean hedonic scores between Kisumu (4.69) and Nakuru (4.43) since the crisps tended to be rather thick in the latter town. The smaller width of the crisp makes for a crispier, less rubbery product, which probably accounts for the higher average score in Kisumu. Despite the variations in color of the crisps (all roots were white but some had purple parts inside), this seemed to have no effect on preference. Finally, a few panelists suggested the addition of condiments such as cayenne pepper and lemon juice. These are common accompaniments for savory snack foods and serve to enhance acceptability.

Figure 5.1: 1992 Preference Survey: Distribution of Hedonic Scores.



Source: Appendix Table A3.1.

Sweet Potato *Ugali*

For the sweet potato *ugali* (prepared using 15% sweet potato flour to 85% white maizemeal), acceptability in terms of hedonic scores was almost evenly divided between the like and dislike categories. Attributes of the food which may have affected acceptability include color and the detection of the sweet potato taste. In particular, Nakuru panelists seemed to find the slightly darker sweet potato *ugali* (as compared to the white all-maizemeal form) less acceptable[11]. However, this was not much of a problem in Kisumu. One International Potato Center (CIP) researcher suggested that the Kisumu result may be due to that population's greater familiarity with a wide color range of flours for *ugali* (fieldnotes). Furthermore, the sample had a slightly sweet taste (conferred by the sweet potato) which some panelists could detect and others could not. One Kisumu panelist mentioned that it would be better if the sweetness was suppressed. In comparison with the conventional *ugali* fewer panelists preferred the sweet potato form by a ratio of 58:42. This is still a respectable showing for the food sample and suggests some market potential.

Sweet Potato Bread

The scores for sweet potato bread must be viewed in light of the fact that the sample tended to lose freshness rather rapidly. Thus, it is expected that, in more optimum conditions, the average score would be higher. In terms of scores distribution, about half of the panelists liked this bread while the other half disliked it--much the same as with the sweet potato *ugali*. Very few panelists responded in the middle range. In the comparison with the all-wheat bread the experimental form was the clear loser with only 30% of the panelists preferring the latter bread.

Mash

The mash made from sweet potato flakes was most often mentioned as the least liked sample and also had the lowest mean score for the whole survey even though the frequency distribution shows the responses to be about evenly split between like and dislike. Given the almost complete lack of taste of this food, it was even surprising that some people responded that they liked it. Two negative attributes of the sample stand out. Perhaps the most serious point is that, even though the mash smelled of genuine sweet potato, it had no corresponding flavor. This characteristic tended to create expectations about the taste of the food which were not met. It appears that the flavor qualities of the sweet potato are lost during processing. Moreover, the mash was also more floury than would be expected from boiled and mashed roots. This aspect of the food sample was probably negative.

Survey Findings: Operation of Socio-Economic Filters

Analysis of variance methods were used to draw out the effects of the variables thought to have an influence on acceptance of the food samples. This statistical tool (analogous to regression) uses the hedonic scores to determine the contribution of each filter to the final score and whether this result is statistically significant or not. A 10% level of significance was chosen. This level was considered sufficient to bring out the filter effects that indicated a definite pattern, but not too stringent given the small sample size and the quality of the data. Both single (main effect) and multiple filter (interaction) approaches were used. One important result of this analysis is that the filters were highly food-specific. For instance, some samples showed several significant filter effects while others had few or none at all. Moreover, a filter whose effect was significant for one sample may have made no perceptible difference on another. A word of caution: analytical results that

[11]Even though questions on color were not included in the questionnaire, the attitude of the panelists towards the darker color was quite clear.

indicate statistical significance do not necessarily also imply logical significance. Thus, it was difficult to find clear reasoning behind some of the patterns observed.

Figure 5.2 shows the results of the analysis of variance by food sample. All the statistically significant results and other selected results are presented. Significance is indicated by the thickness of the box surrounding each chart. Thus, for the white sweet potatoes there were no statistically significant filter effects as shown by the thin boxes. Each bar in a box shows the mean hedonic score for the group named at the bottom of the bar. The bars are calibrated according to the category scale used in the survey and different shadings denote the panelist group.

Unfortunately, due to the difficulty in maintaining food sample similarity from day to day, the effect of date of survey on acceptance is also significant. However, the analysis and conclusions do take this result into account. The analysis also showed that there is an inverse relationship between income and consumption frequency of the roots and a direct relationship between income and education for the adults[12].

Sweet Potato Roots

Interestingly, none of the filters used had a significant effect on the high acceptability of the white roots. This result implies that the individual's socio-economic status has little discernible impact on preferences towards the white roots. Since the white roots are the most common form of sweet potato available on the market, the lack of significant filter effects is not remarkable.

Few filters--ethnicity, age and consumption frequency--were operative for the yellow sweet potatoes. Kikuyus liked this food sample more than Luos. Even though the yellow roots are almost exclusively found in the Nyanza area where Luos reside, the Kikuyu respondents gave a higher mean score to the yellow roots than the Luo. Apparently, Kikuyus think of the yellow roots as sweeter and better than the white ones--they are more prized among this ethnic group.

The age filter had a significant effect only in Kisumu. There, the children found this food sample less acceptable than the adults. However, if it is true that people find the yellow roots sweeter, then it would seem that age should operate in the opposite direction since children are more likely to take to sweet foods. Again for Kisumu only, those who consume sweet potatoes frequently preferred the yellow roots more than those for whom the root is a rarity. If Luos consumer sweet potatoes more frequently than even other ethnic groups in Kisumu, this result contradicts the ethnicity filter main effect where the Kikuyus would be analogous to the non-Luos in Kisumu.

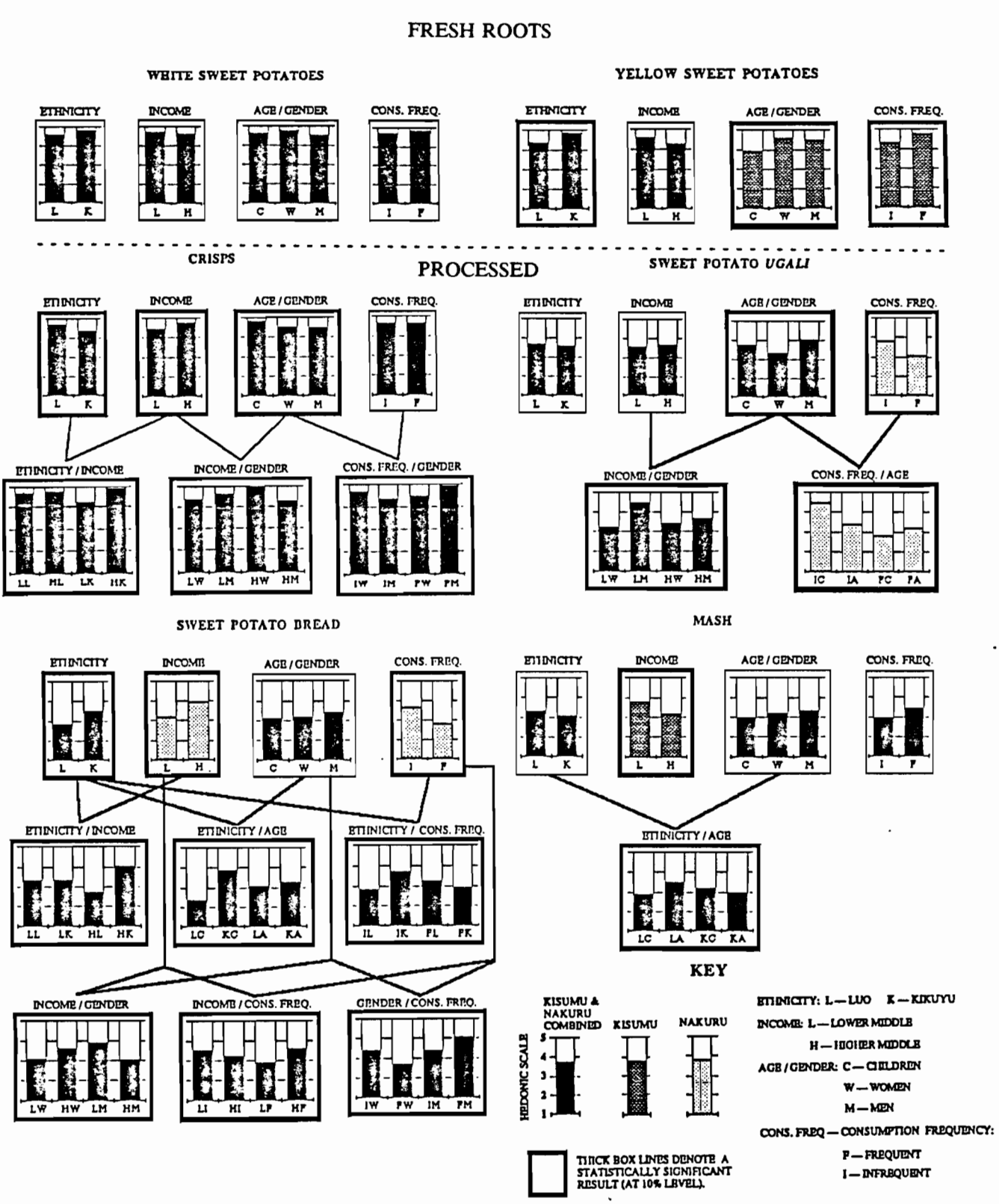
Processed Forms

Crisps

For the crisps, only consumption frequency was insignificant at the main effects level. The significant result for the ethnicity filter probably reflects the overall difference between Kisumu and Nakuru due to the variations in crisp width mentioned earlier. The greater familiarity of upper middle income groups with fast foods may help to explain the higher mean score for these panelists. However, it is puzzling that there is no positive novelty effect for the lower middle income panelists. For the age filter, it should come as no surprise that children's preference for the crisps is greater than that of adults. Children tend to like fatty snack foods more than adults and crisps fit the description.

[12]There was no significant effect of education on preferences.

FIGURE 5.2. 1992 PREFERENCE SURVEY: IMPACT OF SOCIO-ECONOMIC FILTERS



Source: Appendix Tables A4.1-A4.7.

The interaction effects for crisps are mainly between ethnicity, income and the adults. The pattern for income versus gender, and consumption frequency versus gender, reflect and confirm the relationship between income and consumption frequency. (Note: a negative correlation exists between income and consumption frequency. This result is consistent with the earlier observation that sweet potato is an inferior good.)

Sweet Potato *Ugali*

Children and men liked the sweet potato *ugali* more than the women. In Nakuru, infrequent consumers of sweet potato liked the *ugali* more than those who eat the root more often. The main filter effect for income is insignificant. Lower middle income men had a much higher mean score than the wealthier men and both income categories for women. It is not clear why this one group would differ from the rest in this manner. In Nakuru, the children who indicated infrequent consumption of roots gave the sweet potato *ugali* a very high mean score compared to the other groups in the interaction between age and consumption frequency. Again, there is no clear reason why this should be the case.

Sweet Potato Bread

The most outstanding feature of the results for the sweet potato bread is the great number of significant interaction effects between filters. The lower acceptability for the Luos compared to the Kikuyus is most likely a direct result of the fast deterioration of the bread in Kisumu. It was likely to be slightly stale for most of the panelists in this town. Hence, this difference between the two sets of panelists may be discounted.

One interesting filter influence is between ethnicity and income where the lower middle income Luos and the upper middle income Kikuyus had a stronger preference for the bread than high income Luos and low income Kikuyus. It is not clear why the effect would be switched around in this manner. Mean hedonic scores for both Luo age groups were lower than those for the Kikuyu. This result probably reflects the pattern for ethnicity alone.

The interaction between ethnicity and consumption frequency shows the same results as those for income and consumption frequency. This finding suggests that consumption frequency has the overriding influence. A similar comparison holds for the interactions between income, gender and consumption frequency. Lastly, the effect of income and consumption frequency together shows what happens for those panelists who fall outside of the expected pattern for these two filters. In other words, high income, high consumption frequency panelists are rare and their tastes are opposite to what we expect from high income respondents.

Mash

An unsurprising filter effect for the mash is that between lower and upper middle income groups in Kisumu: the latter group found the mash less acceptable than the former. Wealthier people are used to tasty foods since they can afford greater variety and spices. Since the mash was distinctly without flavor, it is reasonable that it was less liked by this group. For the interaction between ethnicity and age, Luo adults show the greatest acceptance for the mash compared to all other categories. It is unclear why this should be the case.

Implications for Production

Two samples warrant further consideration: the crisps and the sweet potato flour used in preparing *ugali*. As the most acceptable processed sample, the crisps could be evaluated further to determine their full market potential. However, production of the crisps is unsuitable for an on-farm procedure. Specifically, crisps are best when produced as close to the consumer as possible since freshness is crucial. Moreover, crisps may not be the most effective vehicle for increasing the role of sweet potato in the diet. As merely a snack food, they would

retain the same place in the diet that sweet potato roots currently hold, rather than helping the root become more of a staple. For these reasons, production and cost analyses for the crisps are excluded.

Sweet potato flour appears to be a viable product given the favorable response to the composite flour *ugali*, even when compared with the all-maizemeal type. Fortunately, the color of the flour does not make a significant difference for acceptability especially in Kisumu. This means that production costs and hence price can be reduced since the whitening inputs are not crucial. For the Nakuru consumers who appeared to be somewhat suspicious of the darker color, it may be better to make the flour as white as possible. Marketers could emphasize that this flour can be used much in the same manner as wheat flour--in the making of food such as *chapatis* (a type of flat bread), *mandazis* (a sort of doughnut), and porridge (*uji*). In this respect, preparation ideas such as recipes would help to extend use of the flour.

Hopefully, the sweetness conferred by the flour would not be a great hindrance to sales. However, given the recent severe shortages of maizemeal there is an obvious need for greater availability of alternatives such as sweet potato flour. Since the *ugali* was especially popular with the children, the use of the flour as a complement to maizemeal in educational institutions represents another market. (There is a clear need for alternative foods for schools. During the survey period of May-August 1992, some schools had to close early due to lack of maizemeal). It is also encouraging that flours of sorghum and finger millet are becoming more widely used. These may pave the way for the acceptance of sweet potato flour in the future.

The sweet potato bread and the mash require improvement before further evaluation. The main problem with the sweet potato bread is that it loses freshness too rapidly. This is even a shortcoming for the producer. Perhaps the use of conventional preservatives (such as citric acid) would help to eliminate this problem. The bakeries approached during fieldwork were interested in the bread if it could be shown that the flour was cheaper, the bread was of acceptable quality to consumers, and perhaps some nutritional selling point could be used.

Unfortunately, the lack of flavor could be a prohibitive problem for the mash despite the fact that half the panelists scored it in the liking range. Marketing such a product would be difficult given its taste (or rather, lack thereof). However, since it is possible to make potato flakes which retain their potato flavor, it should be possible to do the same for sweet potatoes. This product could be promising since it is extremely easy to prepare and thus would seem ideal for urban families. However, it should also be noted that the technology required to produce the flakes is highly advanced and expensive. Thus, it may not be an appropriate candidate for production since costs and thus prices would most likely be high.

CHAPTER 6
THE ECONOMICS OF SWEET POTATO FLOUR PRODUCTION

Having established an acceptable form of processed sweet potato-- flour for *ugali*--we now determine the economics of production. Ideally, processing should be performed at the farm level so that the movement of a bulky product is avoided and the value added to the root accrues to the growers--primarily women. This chapter, then, examines the cost to producers of processing sweet potatoes into flour and ascertains whether the flour could be reasonably priced from the consumers' point of view. In this way, it is possible to determine whether the products are affordable for the consumers envisioned in the study, and the possible gain to the women growers of performing this operation.

The Processing Operation

Necessary Conditions for On-Farm Processing

If processing is to be performed at the farm level, several important points must be taken into consideration. First and foremost, the technology used should be both cheap and easy to use. The rationale for this is clear: if the women growers are to exploit this opportunity to the fullest, the investment and maintenance requirements must be within their reach. Fortunately, fieldwork revealed that the two most potentially prohibitive stages of the processing--drying and grinding--can be simplified greatly. Drying merely requires a clean surface and favorable climatic conditions, while grinding into flour can be done at existing *posho* mills (used to grind maize into maizemeal). These facilities, located throughout the countryside, are designed to meet the needs of farmers who wish to process the home supply of cereal grains into a flour or meal. In this respect, they would be ideal for sweet potato processors.

Moreover, the simpler the technology, the more likely that it will be produced by local *jua kali* (informal sector) artisans and will thus be cheap. Furthermore, it is preferable that the technology have multiple uses for the times that sweet potato processing is not being performed. (The procedure is assumed to be a seasonal activity. See Chapter 2). In Ghana, the simple equipment used to transform cassava into *gari* has enabled widespread exploitation by small-scale farmers and marketers who are mostly women. Kreamer reports that many small scale processors cited the ease of investment as one of the primary reasons for engaging in cassava processing (1986, 35).

Finally, the procedures must be flexible in their time demands because rural women's time is already crowded with activity. Flexibility implies that the women should be able to attend to pressing needs without endangering the processing operation and vice versa. Also, the more time it takes to process the roots, the less likely that women will decide to make the investment. This reflects the valuation of their own time in terms of opportunity cost. Similarly, Nigerian women cassava processors appreciate being able to perform an income-generating activity at home versus having to obtain employment which takes them away from the family (Ebun-Williams 1979, 341).

Quality Considerations

The quality of the products in terms of color, taste, texture, cooking quality and the like, should be acceptable to consumers. In this case, the processed foods should be comparable to that of the samples used in the taste tests. The sweet potato flour used in the *ugali* was made without the use of sodium metabisulphite solution which whitens the finished product. Since panelists (at least in Kisumu) apparently found the slightly browner flour acceptable, color considerations could be eliminated. Consequently, the costs of processing fall considerably. In addition, one hurdle for the processor is removed because the chemical is not easily obtained

in rural areas. The acceptability of a darker flour color also implies that leaving the peel on the root may still result in a marketable product (fieldnotes).

Perhaps the most important determinant of quality is the condition of the root itself. This is a problem as observed from the sweet potatoes available in Kenyan markets. Many have large discolored or rotted areas resulting from diseases and pests which attack the roots in the field or during transportation. Because these parts of the roots are unusable, their widespread occurrence can greatly reduce the quantities of flour produced. In this way they raise the costs of the operation for the processor. The availability of good quality sweet potatoes would also help to make the processing easier since finding and cutting out bad parts is a tedious job.

In due course, quality differentiations for sweet potato flour will emerge just as the *gari* made by small-scale processors in Ghana is subject to quality restrictions, expressed in terms of grades (Kreamer 1986, 39 and 83). The gradations are based on the whiteness of the finished product, its characteristic sharp taste and its reaction to water in the preparation of *gari* dishes. However, these differentiations are flexible enough to allow for production by a wide range of entrepreneurs. Some processors even specialize their activities to produce a certain grade of *gari* and thereby occupy a niche in the market. It appears that different grades of the *gari* cater to specific income classes or ethnic groups. Also, in times and regions of high demand, the processors tend to slacken on quality but this is acceptable under the circumstances. In some cases a better quality of *gari* can command a price premium. Similar differentiations of sweet potato flour would have to be made over time depending on the demands and discrimination of consumers.

The Procedure

If quality requirements are not too stringent, processing can be a simple exercise. The use of unsophisticated technology means that time and labor inputs are substantial. However, it is assumed that the procedure would be carried out during times of low demand for labor on the farm (see Chapter 2). Table 6.1 details the steps involved in transforming sweet potatoes into flour. In the following discussion, costs of the various tools and materials required for processing reflect the retail prices for the items or were inferred from Jackson Kabira's work on potato flour (1990). Dr. Kabira, a food scientist at the National Potato Research Centre, evaluated both the processing procedure and the economic feasibility of production for potato flour.

We can use the example of cassava processing in Ghana to estimate how long it would take to process given quantities of sweet potatoes. Kreamer's research brought out the different processing times for women in various situations. One woman who was primarily a cassava farmer, produced, on average, 180 kilograms of *gari* per week during the busy times of the year; when her labor was less in demand she could turn out about 360 kilograms per week. Her case is thus instructive for sweet potato processing by women growers in Kenya. Taking into account the more difficult and time-consuming process of *gari*-making, it would seem that sweet potato processors in Kenya could achieve at least such standards. However, the quantities of roots processed would also depend on the particular situation of each woman.

In estimating the daily load of roots for processing, it is important to recognize that time is as much a constraint for the women growers as money. Their days are already taken up with productive, child-rearing and housekeeping duties. Yet, it is also true that the demands on their labor vary over the year depending on farm activities. Since sweet potato processing would most probably take place during the slack times of the year, we can allocate one working day (about 8 hours) for harvesting through readiness for milling. During this time, a quantity of 40 kilograms of roots could be processed (into about 15 kilograms of flour), based on estimates of the time required for each step for 40 kilograms of roots (Table 6.2).

Table 6.1: On-Farm Processing Operations for Sweet Potato Flour Production.

Operation	Time	Materials	Layout	Equipment	Losses	Transport	Setup	Quality Control
Peeling (May be unnecessary).	Time-consuming. Timing also important.	Clean water (availability may be a problem).	Pile of tubers and a pot with water.	Kitchen knife. Pot (*sufuria*) or bucket.	Depends on peeling skill: can be minimised.	N/A	Put water in pot.	Depth of cut should be low. Cut out bad parts.
Slicing	Time consuming. Equipment used is important.	(If blanching, put slices straight into blanching water).	Perform this close to the blanching or drying site.	Kitchen knife or special slicer.	Minimal (maybe only extremities).	N/A	Clean the slicing surface.	Width of slices important for drying.
Blanching with sodium metabisulphite. (Not crucial).	Not time consuming.	Clean water.	Perform close to slicing site.	Pot or bucket.	Minimal.	N/A	Measure the proper amount of chemical.	Chemical helps to whiten the flour.
Drying	If solar then time consuming.		Greater surface area is better.	Plastic sheet	Should be minimal if well done.	To drying site.	Spread out chips. Turn over periodically	Length of time affects moisture content.
Grinding into flour	Not time consuming.	None.	Have the receiving bag next to machine.	Grinding machine at local mill.	Minimal if machine is efficient.	To grinding site.	None.	Texture; taste.
Flour Packaging	Relatively little required.	Gunny sacks or plastic bags.			Minimal.	N/A	Opening the bags for filling.	N/A

Table 6.2: Estimated Time Requirements for Processing 40 kilograms of Sweet Potato Roots.

Processing Step	Time (hours)	
	Low est.	High est.
Harvesting the roots & transporting to processing site	1.5	2.0
Washing the unpeeled roots	1.5	2.0
Slicing	3.5	4.0
Spreading out on plastic sheet	0.5	0.75
Turning over while drying & collecting at the end	0.5	0.75
TOTAL TIME	7.5	9.5

The average sweet potato plot in western Kenya is 0.2 acres and its yield is 1400 kilograms of roots[13]. The grower would need to harvest 1/35th of this land--a parcel measuring 4 x 6 meters--to obtain the 40 kilograms (Figure 6.1). Thus, if two crops are planted during the year, such a daily throughput suggests that 70 days each year would be given over to sweet potato processing, not an unreasonable total.

The subsequent cost calculations assume a conversion factor of 2.65:1 for unpeeled roots:flour[14]. In other words, 2.65 kilograms of roots yield 1 kilogram of flour, assuming 10% wastage rate during processing. This rate of conversion is used to allocate the costs of equipment or materials whose role in the procedure applies to the fresh roots or wet slices.

Peeling

This step may not be necessary. It appears that leaving the peel on the root makes little difference in the final product, especially since color is not a major consideration (fieldnotes)[15]. Compared to the cassava peel which is thick and fibrous, sweet potato's outer covering is thin and would not pose problems if left on the root during processing. Moreover, peeling would reduce the yield of sweet potato flour, thus increasing processing costs. For example, allowing for a wastage rate of 10% of root weight, 100 kilograms of peeled roots would yield 34 kilograms of flour while unpeeled roots would produce 38 kilograms.

Perhaps more importantly, the elimination of this step greatly cuts down on processing time since peeling is time-consuming (and tedious) work. The same holds for cassava: to ease the burden of peeling, cassava processors in Nigeria often enlist the help of friends and relatives (Ebun-Williams 1979, 342). However, if the roots are not peeled, they should be washed thoroughly before further processing to remove soil and other dirt. There may be a trade-off between peeling and washing, however: since peeling removes the dirt on the root, it may have to substitute for washing if clean water is not available.

Slicing

In slicing the roots into 2-3 millimeter chips, the general principle is: the thinner the chip, the better because this speeds up drying. This step is somewhat difficult (as experienced by the researcher) because the root contains some sap which makes smooth slicing a problem as compared to slicing potatoes or cassava. During slicing, the root was resistant and would stick to the slicing tool. Some cassava-crisp producers even cited difficult slicing as the reason for avoiding production of sweet potato crisps alongside cassava and potato crisps. Researchers at CIP in Nairobi suggested that varieties may exist which contain less of the sap and are thus easier to slice (fieldnotes). Indeed, the orange varieties of sweet potatoes found in the United States contain almost none of this substance.

The slicer for the sweet potatoes could be the same as that used by the producers of cassava crisps (Figure 6.2). The tool is about 6 inches long and 4 inches wide and is made of heavy iron with a sharp blade positioned at about two-thirds of the length and held in by metal bolts. It can be held in the hand and allows the chips to fall in the space between the slicer and the palm. This tool produces remarkably good chips of even

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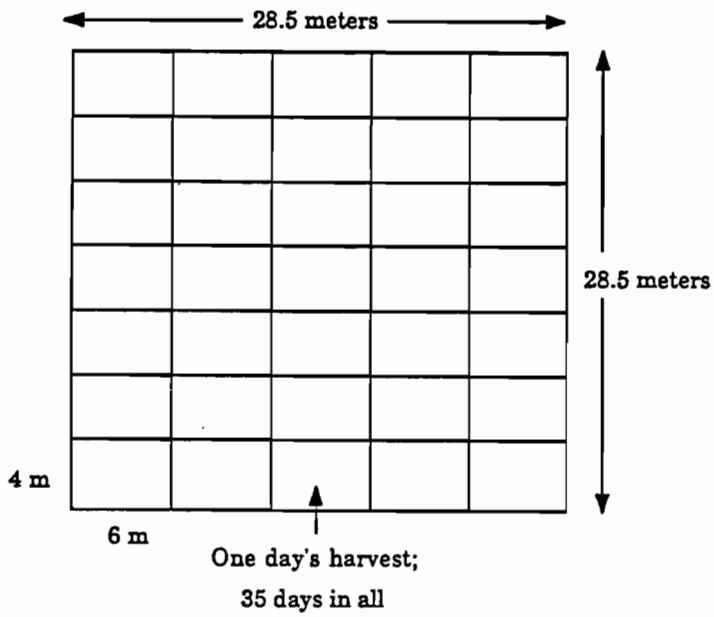
[13]This acreage is based on the plot size devoted to sweet potato which is most common among Kenyan smallholders as reported by Mutuura (1990, 37). Yields in the South Nyanza region average 7,000 kilograms per acre (Shakoor et. al. 1988, 149-150).

[14]The conversion factor is calculated from the known moisture content of the sweet potato root (70% of weight) and the desired moisture content of the flour (12%) and assumes a wastage rate of 10%.

[15]Kabira's study on production of potato flour also concluded that unpeeled tubers could yield a good quality flour whose whiteness was little affected by the peel (1987).

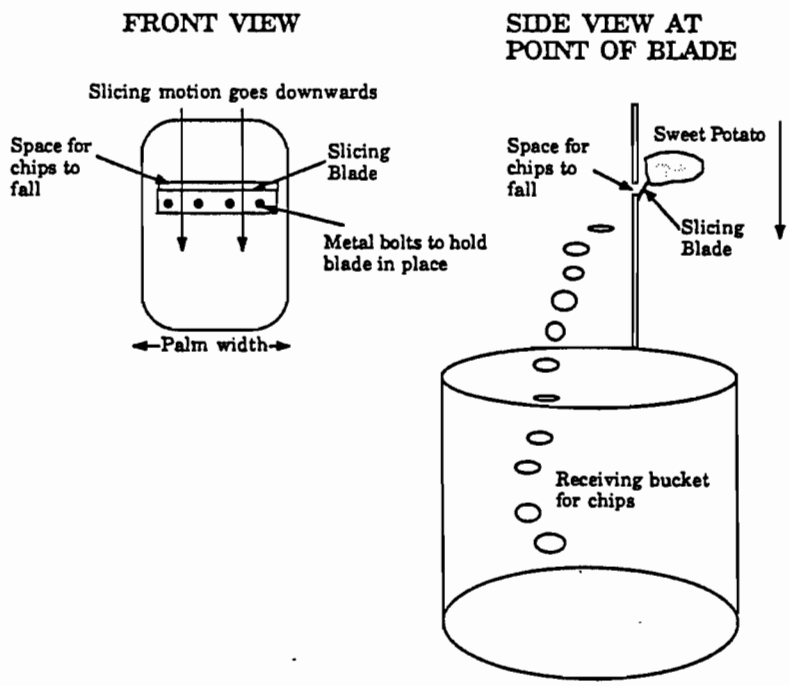
Figure 6.1: Daily and Overall Sweet Potato Plot Size for Processing



0.2 acres = approximately 810 square meters

Scale: 30 millimeters = 10 meters

Figure 6.2: Slicer for Sweet Potato Processing.



thickness with a minimum of fuss. It is a *jua kali* product which can last for at least two years under constant usage before the blade has to be replaced (the life of the tool is naturally greater if yearly use is reduced). In 1992 the cost of the slicer was estimated at Kshs 100 by the cassava crisp makers interviewed (fieldnotes). Also, a receptacle for the chips would be required. Therefore, the cost analysis includes a fixed cost item for a bucket estimated at Kshs 60 in 1992.

Blanching

This step could take the form of incomplete cooking by boiling or dipping for 5 minutes into a 0.5% solution of sodium metabisulphite which whitens the finished product. Both methods confer greater resistance to bacterial infection or spoilage. However, as with the peeling, this step is not crucial to the quality of the finished product and may be ignored. Similarly, Kabira's study on potato flour found that using raw chips gave higher yields of flour and did not reduce the overall quality of the flour (1990, 8). Leaving out this step also helps to reduce costs of processing to the grower.

Drying

Ideally, drying equipment would allow the maximum surface area for drying and would capture as much heat energy as possible to speed up the process. This would mean the use of a frame structure supporting several trays of a mesh material on which the sweet potato chips could be placed. Favorable climatic conditions such as warm dry days and windy nights would help to ensure fast drying with minimum loss to insect infestation or mildew.

For our purposes, however, the ideal equipment is simply inappropriate for a grower-processor, given the costs of construction. Kabira's work on potatoes reported equipment costs in 1990 at roughly Kshs 4,900 and 11,200 for dryers that would handle 50 kilograms and 200 kilograms of tubers per day, respectively. For a country whose annual income per capita was Kshs 11,100 in that year (World Bank 1992, 218), such outlays are largely out of reach for the rural population who may take on sweet potato processing.

Yet drying does not necessarily have to involve such great expense. In its simplest form, the drying equipment could consist of plastic sheeting which would be spread out on the ground to expose the chips to sunlight and wind[16]. Drying would then take one 24 hour period consisting of a sunny day and a windy night or slightly more time if overcast or humid conditions prevail (fieldnotes). One drawback of this method is that the plastic exposes only one surface of the chips to the drying elements. However, the sheet's strong points are that it is cheap, portable and can lend itself to other purposes in the household or farm. Furthermore, if rain begins during the drying period it is easy to fold up the sheet and keep the chips waterproof until better conditions return. Replacement of the sheet would only be necessary about once every three years as long as it is not under constant exposure to sunlight (Kabira 1990, 9).

Based on the study on potato flour, drying would require $1m^2$ of the plastic sheet for every 4 kilograms of slices (Kabira et al. 1990, 4). At a unit area price of Kshs 35, the plastic is the most expensive item in the processing operation and could determine the daily throughput for the processor. Therefore, an average daily load of 40 kilograms was estimated in order to keep investment outlays low. In order to dry this quantity of sliced roots, 10 square meters (1 X 10 meters) of the plastic is necessary at a total cost of Kshs 350. It is expected that this expense would be affordable for the growers without the need for heavy borrowing. This cost figure is used in further analysis.

[16]In fact, some Chinese dry their sweet potato chips directly on the ground (Woolfe 1992, p. 296).

Grinding

Fortunately, it is not necessary for the processor to buy a grinding machine. She only has to take the dried chips to the nearest hammer mill where maize and finger millet are also ground. Transporting 15 kilograms of chips to the mill is probably not an overbearing task since they are much lighter to carry than the original slices. Also, it is not necessary that all the chips be ground immediately since they are a highly storable form. Thus, the processor can transport the chips to the hammer mill on a need basis. The owner of the grinding machine will charge a fee: whereas in 1990 this was Kshs 0.30 per kilogram of flour produced, the cost in 1992 was estimated at Kshs 0.50 per kilogram for a total cost of Kshs 7.50 for the whole 15 kilograms.

Packaging

Gunny sacks or flour sacks made of synthetic material may be used. The price of a single bag was Kshs 20 in 1992. Both are widely available, cheap and can hold up to 100 kilograms of the product. Thus, if the grower produces 15 kilograms of flour per day, it would take about one week to fill up the sack. The most desirable packaging, however, would be airtight in order to avoid problems with moisturization of the flour which reduces its shelf-life. However, such packaging would also be much more expensive than the gunny sacks. The latter are widely used in Kenya for other flours and seem to provide adequate storage for the product.

The total investment costs for this operation are Kshs 950--probably not an unreasonable amount for a grower to raise, especially if the potential returns from the sale of the flour are high. If the farmer cannot come up with the total amount, a loan to make up the remainder could be repaid from the proceeds of the enterprise; the debt would not be an unduly heavy burden.

Cost Analysis

To fully evaluate the processing operation, it is necessary to perform two kinds of cost analyses: one incorporating only cash costs and the other allowing for opportunity costs. The cash cost analysis is based on the belief that the women growers are unlikely to explicitly account for several cost components. Yet the opportunity cost of performing the operation must demonstrate whether or not processing is in the interests of the grower vis-à-vis the economic alternatives. Also, in making these different accounting assumptions, it is possible to determine which cost options provide reasonable price estimates for the consumer while maintaining comfortable profit margins for the producer. Table 6.3 details the costing procedure and compares the cash costs with opportunity costs[17].

Cost of Roots

The cost of fresh roots used in the analysis--Kshs 3.71 per kilogram--is the average of sweet potato prices observed in rural markets in a 1992 CIP study. Since 2.65 kilograms of fresh roots are required to produce 1 kilogram of flour, the cost of one kilogram of the former is multiplied by 2.65 to arrive at Kshs 9.83 as the cost contribution of the raw material to each kilogram of flour.

This particular item is really an opportunity cost since the grower is using her own supply of sweet potatoes. In effect, the cost of roots represents the amount of money she forfeits by processing the sweet potatoes rather than selling them fresh. In recognition that the cost contribution of the roots may be viewed in different ways, the table also shows how the total cost figures vary under different assumptions for the cost of roots. Thus, in the first two columns, the cost of roots is discounted completely; subsequent columns increase the cost of the roots by 25% each time until the full cost of roots is included. The reasoning behind these

[17]The figures used in the analysis are not rounded up to the nearest 5 cents to avoid losses of accuracy.

Table 6.3: Production Costs for Sweet Potato Flour Assuming a Daily Throughput of 40 kg of Fresh Roots and Various Opportunity Cost Alternatives for Roots (figures in Kshs/kg of flour).

COST ITEMS	CASH COSTS	OPPORTUNITY COST ASSUMPTIONS FOR ROOTS[1]				
		0%	25%	50%	75%	100%
Cost of Roots (a)	0.00	0.00	2.46	4.92	7.37	9.83
Processing Costs: (b)	0.96	4.33	4.33	4.33	4.33	4.33
Fixed Costs:	0.26	0.26	0.26	0.26	0.26	0.26
Bucket	0.05	0.05	0.05	0.05	0.05	0.05
Slicer	0.09	0.09	0.09	0.09	0.09	0.09
Plastic Sheet	0.12	0.12	0.12	0.12	0.12	0.12
Variable Costs:	0.70	4.07	4.07	4.07	4.07	4.07
Labor	0.00	3.37	3.37	3.37	3.37	3.37
Milling	0.50	0.50	0.50	0.50	0.50	0.50
Gunny sacks	0.20	0.20	0.20	0.20	0.20	0.20
Total Cost (a+b)	0.96	4.33	6.79	9.25	11.71	14.16

Notes: This analysis assumes that 1,000 kilograms of flour are produced per year at the rate of 15 kilograms per day or 40 kilograms of roots per day (about 70 days' worth of processing activity).

[1]One kilogram of sweet potatoes cost Kshs 3.71 in 1992. At an allocation rate of 2.65 kilograms of fresh roots per kilogram of flour, the total unit contribution to costs of the roots is Kshs 9.83 per kilogram. The different assumptions reflect the fact that growers may discount the cost of the roots to the processing operation.

Table 6.4: Post Farmgate Costs for Sweet Potato Flour (in Kshs/kg) as a Function of Marketing Margins[1] and Sales Price.

	Sales Prices			
Marketing Margins	5.50[2]	8.25[3]	11.00[4]	13.00[5]
10%	0.55	0.83	1.10	1.30
20%	1.10	1.65	2.20	2.60
30%	1.65	2.48	3.30	3.90
40%	2.20	3.30	4.40	5.20
50%	2.75	4.40	3.30	6.50

Notes:
[1]Marketing margins are expressed as a percentage of the sales price.
[2]50% of the Kshs 11 price of maizemeal.
[3]75% of the Kshs 11 price of maizemeal.
[4]Actual price of maizemeal in the latter part of 1992.
[5]Free market sales price of maizemeal, assuming an 18% government subsidy on the consumer price (Shapouri et. al. 1992, 31).

assumptions is that the grower may reduce the value of the roots to the processing operation because she knows that she could not sell all the sweet potatoes fresh.

Processing Costs

Fixed Costs

An estimated asset life of 3 years for each piece of equipment is assumed based on the apparent durability of the item as observed during fieldwork. Then, using the straight-line depreciation method and assuming a zero salvage value, the contribution of each item to the unit cost of the flour is calculated:

$$\frac{\text{Cost of item}}{\text{Life of the Asset x Quantity produced/year}} = \text{Cost/kg of flour}$$

(Edwardson & MacCormac 1984, 24). The costs of all the equipment are then multiplied by the conversion factor (2.65) since their functions occur early on in the processing. Naturally, if daily processing load rises or costs of equipment fall, the unit contribution to the cost of flour declines. In reality, small scale operators are not likely to use such accounting methods in arriving at a price for their products. However, these costs are included to show total costs of processing were all costs counted.

Variable Costs

Costs of labor are estimated from agricultural wage rates from previous years to give a daily rate of Kshs 50.94 per day in 1992 (International Labor Organization 1992, 893). Using the assumption that 15 kilograms of flour can be made per day (from 40 kilograms of roots), this wage rate gives a cost of labor of Kshs 3.37 per kilogram of sweet potato flour. (This cost would fall were the daily amount of roots processed to rise). As with the roots, labor is an opportunity cost. It assumes that the processor could obtain employment at this wage rate but is giving up that opportunity to engage in processing. The cost of labor does not change across the table as does the cost of roots because the latter can vary substantially (between Kshs 0 and almost 10). Conversely, allowing for a range of labor costs affects the total costs only slightly. Milling and packaging costs are Kshs 0.50 cents and 0.20 per kilogram of flour respectively. These also remain constant for each assumption of the cost analysis.

Marketing Costs

These include all costs incurred after the flour leaves the processing site (in this case, the grower's homestead) until it reaches the consumer. These costs will vary depending on the distance to the final market, transportation conditions and the number of hands through which the flour must pass before the consumer purchases it. The actual costs cannot be anticipated. Therefore, in order to estimate the apparent profitability of processing, alternative assumptions are made about the percentage of the sales price which could be attributed to the post farmgate marketing process. Table 6.4 shows how these calculations are made.

The range of marketing margins posited (10%-50%) is drawn from the case of maizemeal in Kenya and *gari* in Ghana. For the former, Jones estimated margins amounting to 41.9% for Nairobi in 1966 (1972, 224). In Ghana, the difference between the costs of production and the producer price of *gari* was 23% of the sales price (Kreamer 1986, 65).

The marketing margin represents the difference between the farmgate price and the consumer price of the product and is expressed as a percentage of the latter figure (Kohls 1980, 212-213)[18]. The marketing costs in the middle of the table are the product of the margins and the sales prices. The resulting figures range from a low of Kshs 0.55 per kilogram of flour to Kshs 6.50.

The four sales price assumptions used to estimate post farmgate costs are based on various plausible scenarios for sweet potato flour. Since we know from the results of the taste test questionnaires that consumers would only purchase sweet potato products if their prices were equal to or less than, those of corresponding conventional foods, the maximum sales price of sweet potato flour was put at Kshs 11 per kilogram: the price of maizemeal. (Of course this is the best case scenario for the producer. The sweet potato flour would probably be unable to command such a price unless extenuating circumstances obtained, such as a severe shortage of maizemeal). Two other sales prices assume that the sweet potato flour could be sold at 75% and 50% of the maizemeal price. Finally, since the price of maizemeal is subsidized, we incorporated an estimate of the free market price in the analysis. In 1990, 18% of the maizemeal price was borne by the government rather than the consumer (Shapouri et. al. 1992, 31). Thus the market price in 1992 (assuming similar rates of subsidization) could have been Kshs 13 per kilogram instead of Kshs 11.

The Profitability of Processing

Figure 6.3 shows how returns on the sale of flour (on the vertical axis) change with total costs (on the horizontal axis; total costs are the sum of production and marketing costs), sales price and marketing margins. The cost assumptions from Table 6.3 are used to generate each line for a particular sales price. Thus, the point at the extreme left of each line represents the cost breakdown which excludes opportunity costs of both fresh roots and labor (from the first column of Table 6.3). Costs increase along the line as the opportunity costs for the fresh roots grow, until the last point on the right which assumes that 100% of the cost of roots contributes to the production of the flour. The Kshs 3.71 horizontal line denotes the point below which returns from processing are lower than those from selling fresh roots. In other words, the processor would want to operate at points above this line. Thus, the shaded area in each chart represents the cost and price combinations (for a given marketing margin) for which the processing will always outperform the sale of fresh roots, regardless of production cost or consumer price.

As the marketing margin increases from 10% to 50% (from one chart to the next), the shaded area diminishes. Obviously, returns to the processing operation are inversely related to the proportion of unit revenues that are taken up by post farmgate costs. Processors gain when factors such as transportation costs which make up the margin contribute little to the consumer price of the product.

The point at which each sales price line crosses the Kshs 3.71 return line marks the maximum total costs allowed if processing is to remain more profitable than selling fresh roots. Indeed, an absolute maximum for total costs may be posited: the difference between Kshs 11 and 3.71, since the price of sweet potato flour cannot rise above that of maizemeal. These conclusions can be extended for any cost, marketing margin, and price combinations.

The analysis does not presume any particular market structure. Instead, the use of a range of cost assumptions, marketing margins and sales prices allows flexibility regarding the possible situations likely to occur. The presentation used is merely for ease of understanding the variables and their interactions with each other. Thus, for any given sales price, the marketing margins and production costs can vary without the need to assume that choosing one price to observe implies a price-setting situation. In this way, it is possible to observe the impact on the producer of the flour as the marketing margins and production costs change.

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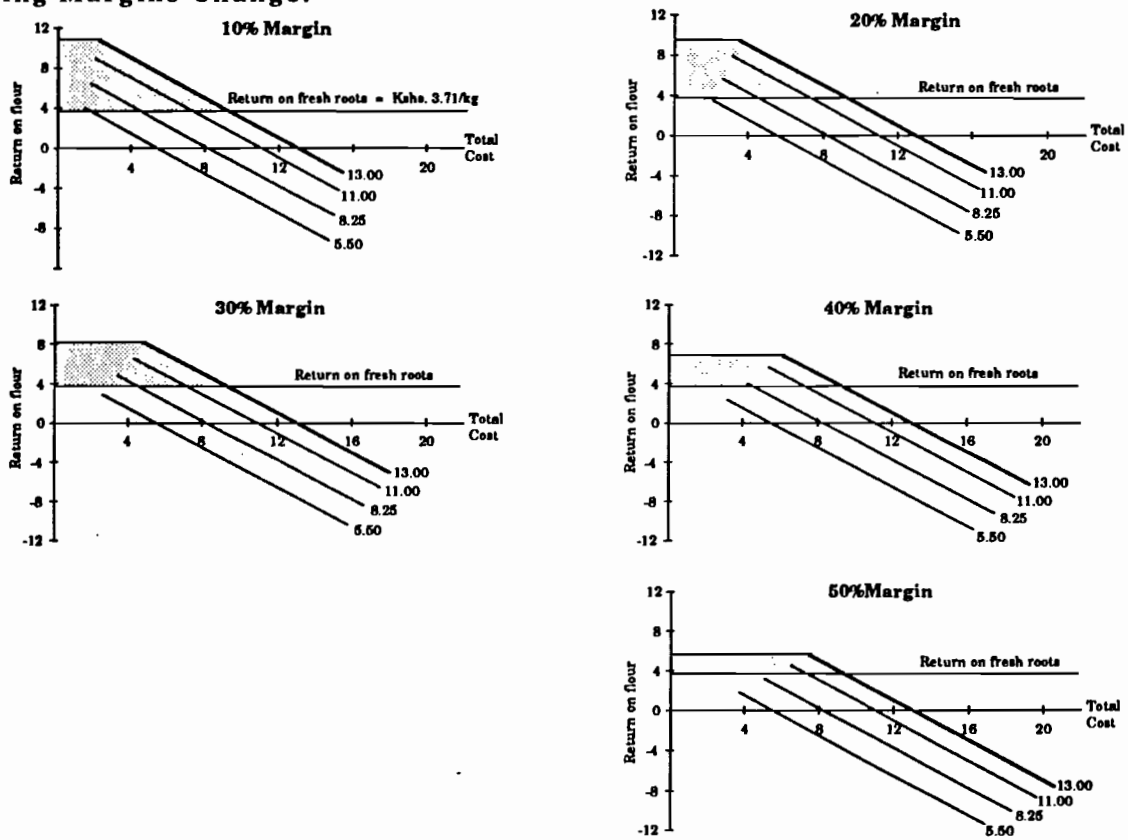
[18]It is common to represent post farmgate costs in this manner because it facilitates analysis of prices and consumer expenditures in the food industry.

Figure 6.3: Returns on Sales of Sweet Potato Flour (in Kshs./kg) as Total Costs, Sales Prices and Marketing Margins Change.



Source: Costs taken from Table 6.3. Sales prices and marketing margins as per assumptions in Table 6.4

We can focus on the 20% marketing margin case as the most likely outcome of sweet potato processing. This percentage reflects the experience with maizemeal in Kenya and *gari* in Ghana: from the 41.9% margin for maizemeal, we may subtract out the 23.7% that accrues to the Maize Marketing Board[19] leaving a marketing margin of 18.2%; the corresponding figure for *gari* is 23%. The 20% margin chart suggests that the processing enterprise would be worth the grower's attention only if the price of the flour is above 50% of the maizemeal price (or Kshs 5.50 per kilogram). However, if production costs are low, the price of the flour could fall to make it even more attractive from the consumer's point of view.

Moreover, even under the lowest marketing margin assumption, only the left-most part of the lines appear in the shaded area. These represent the lowest opportunity cost options for the fresh roots in Table 6.3. In the scenario where the price is Kshs 8.25 and the marketing margin is 20%, the contribution of the roots has been reduced by at least 80% in order to realize profits above those of selling the fresh roots.

Finally, the time and quantity of flour sold necessary to cover the Kshs 950 investment costs would be reasonable from the grower's point of view. Under the 20% margin and Kshs 8.25 sales price scenario, the processor would only have to sell 134 kilograms of the flour which is about 9 days' worth of processing activity. These figures are based on the cash cost accounting column from Table 6.3 as the most realistic assumption of the financial procedures the grower is likely to follow[20]. Clearly, even if processing is a part-time activity, it is lucrative enough to enable the grower to recover the start-up costs.

Processing Compared to Paid Employment

The returns for the likely scenario envisioned in the previous calculations (20% marketing margin and Kshs 8.25 sales price) is used to compare with the rural wage rate in Kenya. In 1990, average agricultural wages were estimated at Kshs 1,084.90 per month (International Labor Organization 1992, 893). Allowing for an increase in wages consistent with past average growth rates of 10% per annum, the 1992 estimate is Kshs 1,312.80 per month. For a woman grower to make more than that amount from her sweet potato processing activities, she would only have to sell 185 kilograms of the flour--about 12 days' worth of processing (assuming cash cost accounting; see Table 6.3).

However, the potential income from paid employment is artificially high because the probability that the women would obtain paid employment in the first place is extremely low. Taking into account that sweet potato processing would occur in times of low labor demand in agricultural activities (see Chapter 2), the feasibility of finding paid employment during that period falls even further. Therefore, the comparison almost certainly errs on the conservative side.

Moreover, the women typically have considerations over and above those of cash income. For instance, it is important that they are able to perform their income-generating activities as close to the homestead as possible in order to carry out child-rearing and home-keeping duties. Such considerations are not explicitly accounted for in an economic analysis. Their inclusion, however, would strengthen the case for sweet potato processing by the grower.

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[19]The Maize Marketing Board (now the National Cereals and Produce Board) is a government parastatal body with an official monopoly on maize marketing.

[20]The unit profit calculations are arrived at in the following manner: production costs are Kshs 0.96, marketing costs are Kshs 0.19 for a total cost of Kshs 1.15. Subtracting this cost from the sales price of Kshs 8.25 gives a profit of Kshs 7.10 per kilogram of flour sold.

CHAPTER 7
CONCLUSIONS

The production of sweet potato flour by growers in western Kenya for sale to consumers in urban areas appears to meet the conditions necessary for the role of sweet potato to grow: the flour is acceptable to consumers, can be easily produced by the women growers and, most important of all, can be affordably priced. This last point is crucial because, in a time when inflation in Kenya is high and real incomes are declining, people will try to ensure that they obtain the greatest value from food expenditures. Indeed, it is safe to say that substantial market share for the sweet potato flour depends on a cheap price since it will face stiff competition from more established flours. Given the cost analysis from Chapter 6, therefore, it is important to evaluate how sweet potato flour would fare compared to these other foods.

Sweet Potato Flour Versus Other Starchy Staples

Table 7.1 compares the price per kilogram and per 100 calories of energy value for sweet potato flour with Kenya's most common starchy flours. It is immediately apparent that the possible prices for the sweet potato flour ranging from Kshs 5.50 to 11.00 per kilogram appear very attractive for the consumer. Indeed, apart from maizemeal, the average urban resident cannot afford to make the other foods a regular feature of the diet. Wheat flour and rice at Kshs 22.50 and Kshs 80.00 per kilogram, in particular, are really luxury foods, accessible to only a few. With respect to food energy cost, only maizemeal at the subsidized price can even compare to the sweet potato flour.

The relationship between the food energy price of the flour versus that of the fresh roots shows the latter to be more expensive. Under all of the sales price assumptions in Table 7.1, the cost per 1000 calories of the flour is lower than the Kshs 3.34 figure for the roots. Thus, even though the flour appears more costly in terms of cash price, in reality it provides over three times the 1,110 calories available from the fresh roots. This relationship is similar to that between the fresh and processed forms of cassava in Ghana. Whereas the cost per 1000 calories of cassava was about 7.30 cedis per kilogram in 1985, an equivalent amount of food energy from *gari* cost only 5.70 cedis (Kreamer 1986, 37). These, then, are the benefits of reducing the bulk of such food crops before they enter the marketing chain.

In addition, in the case of cassava, the fresh form is preferred to the processed product but the latter is more practical and thus commands a larger market (Ibid, 33). It is hoped that the same would be true for sweet potato flour in Kenya.

Marketing Strategies

Overall, since urban consumers consider sweet potato merely a minor snack or breakfast food, perhaps the greatest task for promoters of processed products will be to change these perceptions to allow the root's importance to grow. Thus, whereas the positive response from the taste test panelists towards the processed forms was encouraging, actual long-term consumption cannot be guaranteed unless more work is put into making the sweet potato an attractive and viable alternative food. Government agencies concerned with product development could undertake promotion programs aimed at popularizing the foods. For instance, the aid of home economists could be enlisted to come up with recipes which are appealing to potential sweet potato consumers.

In general, promotion programs could emphasize the nutritionally superior aspects of these foods. The importance of this can be seen from the women panelists' responses regarding dietary decisions. Over 60% in both towns stated that the nutritive value of the food is the main concern in deciding the family's diet.

Table 7.1: Food Energy Costs to Consumers of Sweet Potato Flour Compared to Major Starchy Staple Flours in Kenya (1992).

	Sweet Potato Roots	Sweet Potato Flour			Maize-meal	Wheat Flour	Finger millet flour *(wimbi)*	Rice
Consumer price (Kshs/kilogram)	3.71	*5.50*	*8.25*	*11.00*	11.00	22.50	35.00	80.00
Food energy (calories/kilogram)	1110	3370			3540	3320	3360	3630
Cost/1000 calories (Kshs/kilogram)	3.34	*1.63*	*2.45*	*3.26*	3.10	6.78	10.42	22.04

Notes: Prices quoted are at the retail level in Nairobi.

Source: Food energy content of the different commodities obtained from:

U.S. Department of Health, Education and Welfare and Food and Agriculture Organization of the U.N. 1968. *Food Composition Table for Use in Africa.* Bethesda, Maryland.

and

Woolfe, Jennifer. 1992. *Sweet Potato: An Untapped Food Resource.* Cambridge: Cambridge University Press. p. 122.

Nevertheless, the picture is hopeful given the results of the study. Clearly, urban consumers in Kenya are willing to be flexible with their diets. However, marketers should recognize that ethnicity as a proxy for traditional diet still plays an important part in determining preferences.

Production Prospects for Sweet Potato Flour

The simulated flour production analysis can act as a guide for policymakers or others who may seek to promote sweet potato processing in Kenya. In reality, the production costs would probably be much lower than envisioned since people can be extremely innovative when resources are scarce. For example, the grower may make use of her own buckets or similar receptacles instead of buying one solely for the purpose of processing. Also, marketing margins may be higher or lower than assumed, depending on the distance between the grower and the retail market, the efficiency of the marketing system, and the length of the marketing chain.

More importantly, the grower is unlikely to follow accounting procedures such as those used in the analysis. Specifically, the way in which the grower values her supply of sweet potatoes and her labor will have important implications for the overall costs and profitability of the enterprise. Nevertheless, the analysis has shown that, even under conservative assumptions, the processing of sweet potatoes into flour can be an economically viable enterprise.

Research Extensions

The next logical step in the product development process is to actually experiment with the production of the flour through a pilot operation which could run for at least one year. In this way, documentation of the procedure over a substantial period of time would provide a more comprehensive profile of the processing enterprise. The operation could be situated in a sweet potato growing area which is also close to a town. The region surrounding Kisumu appears a natural choice in this respect since many farmers there grow the root and could then sell the flour to the nearby urban market.

The initiators of such a project could be government research bodies or non-governmental organizations with an interest in food issues. Several necessary steps are envisioned. First and foremost the researchers could identify sweet potato growers who would be willing to participate in the project. The researchers could then provide technical assistance in terms of the processing methodology. Once flour production is underway, an easily accessible "market"--most likely in the form of an educational institution--could provide a steady outlet for the flour[21]. In this way, both the processing and the flour could gain some popularity among growers, consumers, and later on, even marketers seeking to cash in on the new product. Such stimulated demand could provide an ideal launching pad for the sweet potato flour.

On the consumer research front, studies on behavior with respect to market prices for the sweet potato flour could be extended. The present study touched on such issues related to "willingness to pay" information. However, the main aim of the surveys was to solicit taste reactions from potential consumers of sweet potato products; the importance of prices only became evident during fieldwork and was not addressed in depth. Researchers could also make more extensive use of the preference methodology as an approach to market research. Currently, this research tool finds popularity only among product developers in academic and business environments. If the food industry is to achieve widespread growth, it would appear crucial for the academic or research institutions to undertake this kind of market research on behalf of those for who are unable to undertake such ventures.

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[21]The pilot project need not be large. To supply 1000 soldiers, students, or prisoners with 100 Kilocalories of sweet potato flour each day would require only 7 farmer processors, each selling 15 kilograms of flour twice a week.

APPENDIX 1

FIELDWORK METHODOLOGICAL NOTES

My collaborators in Kenya provided extremely valuable advice and assistance during the fieldwork. Yet, there are several features of the research which could have been improved. The organization of the taste tests was particularly difficult. Indeed, it was virtually impossible to conform to the methods described in the sensory evaluation textbooks. This, of course, is partly due to the fact that such manuals describe situations obtaining in industrialized nations. Rarely, if ever, is it possible to replicate the experiments in developing countries.

Even given these considerations, the fieldwork would have been facilitated by having a research assistant or two. For part of the time that I was in Nakuru, I had an assistant to help with the surveys. Her presence made a distinct difference since the logistics of administering the tests were quite involved. For example, her help in the preparation of the two types of *ugali*, in serving the food samples, pouring out and distributing cups of water, and in numerous other steps, was crucial in ensuring that the whole interview was as smooth as possible.

The availability of panelists was sometimes a problem since people were at work and even the church-goers had other activities to tend to. For this reason, it was fortunate that I did not stay in a hotel in either of the two towns but instead was hosted by local residents. They were instrumental in obtaining contacts with schools, churches, office workers and other groups who could be interviewed. Perhaps panelist availability would have been easier if the whole research had a more official tone about it. In other words, if I could have cited a government agency or other established group with a widely known name, I am almost certain that people would have been more cooperative. In fact, when I did mention that my work was in collaboration with the Kenya Agricultural Research Institute (KARI) and the University of Nairobi, interest levels would rise.

Standardization of the food samples from day to day turned out to be a problem. I would recommend that others who may endeavor to carry out such projects make every effort to gather as many panelists as possible at one time so that large quantities of the foods--all similar--could be used. In this way, inter-day variation could be reduced. This kind of centralization of the study would undoubtedly have eased the interviewing process and enhanced the quality of the experiments. Thus, the taste tests for the children were very easy to administer since they were all in class during the time of the survey.

For the sweet potato bread, the best arrangement would have been to obtain the assistance of local bakeries in the two towns. In this way, there would have been fewer problems with freshness. Also, such loaves would have approximated the conventional breads more closely making for a better comparison.

Yet, even with all these drawbacks, this kind of research is to be recommended for product development purposes. If carried out in the proper way, it can yield very useful information regarding consumer preferences which is often unavailable in developing countries.

APPENDIX 2

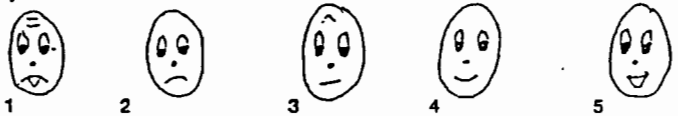
1992 PREFERENCE SURVEY: QUESTIONNAIRES

The taste test portion of all the questionnaires was exactly the same except that the children's questionnaire was in English while the adults' was in Kiswahili. Therefore, only the first portion from the children's survey is presented. The latter part of the women's questionnaire is also included. (The men's questionnaire was similar to the women's, but excluded questions 5-9).

QUESTIONNAIRE 1:CHILDREN'S TASTE TEST

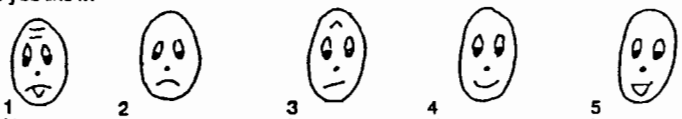
NAME:_____ DATE:_____

1. Taste the CRISPS.
Do you like them?



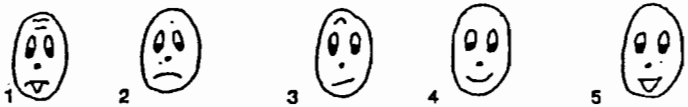
1 No, not at all | 2 Not very much | 3 I cannot decide | 4 Yes, a little | 5 Yes, very much

2. Taste the BREAD NUMBER 153
Do you like it?



1 No, not at all | 2 Not very much | 3 I cannot decide | 4 Yes, a little | 5 Yes, very much

3. Taste the BREAD NUMBER 264
Do you like it?



1 No, not at all | 2 Not very much | 3 I cannot decide | 4 Yes, a little | 5 Yes, very much

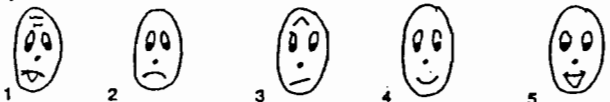
4. Between the two samples of bread, which do you like more?

NUMBER 153 NUMBER 264 I CANNOT DECIDE

5. Taste the MASH.
Do you like it?

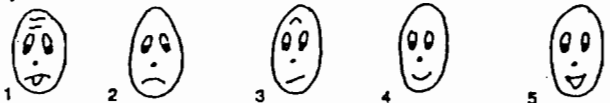
1 No, not at all | 2 Not very much | 3 I cannot decide | 4 Yes, a little | 5 Yes, very much

6. Taste the UGALI SAMPLE NUMBER 355.
Do you like it?



1 No, not at all | 2 Not very much | 3 I cannot decide | 4 Yes, a little | 5 Yes, very much

7. Taste the UGALI SAMPLE NUMBER 434.
Do you like it?

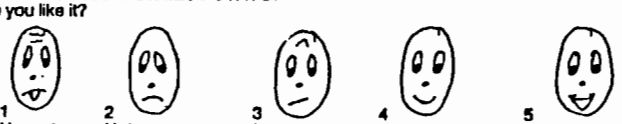


1 No, not at all | 2 Not very much | 3 I cannot decide | 4 Yes, a little | 5 Yes, very much

8. Between the two samples of ugali, which do you like more?

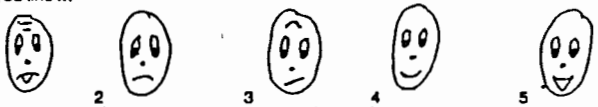
NUMBER 355 NUMBER 434 I CANNOT DECIDE

9. Taste the YELLOW SWEET POTATO.
Do you like it?



1 No, not at all | 2 Not very much | 3 I cannot decide | 4 Yes, a little | 5 Yes, very much

10. Taste the WHITE SWEET POTATO.
Do you like it?



1 No, not at all | 2 Not very much | 3 I cannot decide | 4 Yes, a little | 5 Yes, very much

11. Between the two kinds of sweet potatoes, which one do you like more?

YELLOW | WHITE | I CANNOT DECIDE

12. Of all the samples which one did you like the MOST?

13. Of all the samples which one did you like the LEAST?

12. Have you ever eaten sweet potatoes before?

YES NO

(If your answer is NO, go to question number 16. Do not answer questions 13. 14 and 15)

13. Did you like them?

YES NO

14. How often do you eat sweet potatoes at home?

A. More than once a week

B, Less than once a week but more than once a month

C. Less than once a month

15. What do you usually eat the sweet potatoes with?

TEA PEAS OR BEANS LEAFY VEGETABLES

SOMETHING ELSE _____

16. What jobs do your father and mother do?

FATHER _____

MOTHER _____

From the women's questionnaire

JINA:_____ TAREHE:_____

1. Je, umewahi kula viazi tamu? See children's question # 12.

   NDIO HAPANA

   (Kama umejibu HAPANA usijibu maswali nambari 2, 3 na 4. Endelea mpaka nambari 6).

2. Ulivipenda? See children's question #13.

   NDIO HAPANA

3. Ni mara ngapi nyingi mula viazi tamu nyumbani? See children's question #14.

   A. Zaidi ya mara moja kwa wiki.

   B. Si zaidi ya mara moja kwa wiki lakini zaidi ya mara moja kwa mwezi.

   C. Si zaidi ya mara moja kwa mwezi.

4. Mnakula viazi tamu pamoja na nini? See children's question #15.

   CHAI PINZI AU MAHARAGWE MBOGA ZA MAJANI KITU KINGINE

5. Unatengeneza viazi tamu kwa njia gani? How do you prepare sweet potatoes?

   KUCHEMSHA (Boiling) KUCHOMA (Roasting) KUPONDAPONDA (Mashed) NJIA NYINGINE (Other)

*6. Kama kwako nyumbani hamutumii viazi tamu (au mnavikula mara kwa mara tu) ni kwa sababu gani (sababu ile muhimu sana)?

   A. Jamii yangu haipendi viazi tamu. My family does not like them.

   B. Viazi tamu ni ghali sana. Sweet potatoes are very expensive.

   C. Si rahisi kupika viazi tamu. Sweet potatoes are difficult to cook.

   D. Kwa chakula yetu ya kitamaduni hatutumii viazi tamu. Not our traditional food.

   E. Ni gumu sana kupatikana. They are difficult to obtain.

   F. Viazi tamu vinaumiza tumbo. Sweet potatoes cause indigestion.

   G. Sababu nyingine. Other reason.

*7. Ni nini inafanya uchague vyakula vile mula kwako nyumbani (sababu ile muhimu sana)?

   A. Ni chakula ilé jamii yangu inapenda. Those are the foods my family likes.

   B. Ninajua ati chakula hicho ni kizuri na chakunjenga mwili. Nutritional reasons.

   C. Chakula ile bwana yangu anapenda. The food my husband likes.

   D. Ni chakula yetu ya kitamaduni. They are our traditional foods.

   E. Chakula hicho ni rahisi kuipata. Easy to obtain.

   F. Bei ya chakula hicho ni nzuri kwangu. The price is good.

   G. Ni rahisi kutengeneza (au kupika) chakula hicho. Easy to prepare.

   H. Sababu nyingine. Other reason.

8. Ukipika unatumia When cooking, do you use:

   NGUVU ZA UMEME (SITIMA) (Electricity) GAS (Gas) MAKAA (Charcoal) KUNI (Firewood)

*6. If you do not eat sweet potatoes often in your home, what is the main reason for this?

*7. What is the most imporentfactor that makes you choose the foods you eat in your home?

9. Kwako nyumbani una maji ya mfereji?
Do you have piped water in your home?

NDIO	HAPANA	SINA MAJI HAYO NYUMBANI KWANGU LAKINI YAKO KARIBU
Yes	No	Not in my home but nearby

10. Bwana yako anafanya kazi gani?
What work does your husband do?

11. Unafanya kazi gani?
What work do you do?

12. Umesoma mpaka darasa gani?
Until which level of education have you studied?

13. Kama hivi vyakula vya viazi tamu vinauzwa, unaweza kuvinunua? If these sweet potato products are sold in the market, would you buy them?

NDIO	HAPANA	NDIO KAMA*
Yes	No	-Jamii yangu inavipenda -Bei yao ni nzuri -Sababu nyingine _____

*Yes, if: -my family likes them
-the price is good
- other reason

14. Ni lazima bei ya vyakula hivyo iwe rahisi kuliko vyakula ya kawaida ndio uununue?
Must the price of these foods be lower than that of conventional foods in order for you to buy them?

NDIO	HAPANA
Yes	No

APPENDIX 3

1992 PREFERENCE SURVEY: TASTE TEST RESULTS

Table A3.1: Distribution of Hedonic Scores

	FRESH SWEET POTATO ROOTS				PROCESSED FORMS								CONTROL SAMPLES			
	WHITE		YELLOW		CRISPS		SWEET POTATO *UGALI*		SWEET POTATO BREAD		MASH		MAIZE *UGALI*		WHEAT BREAD	
Hedonic Score	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
1	0	0	7	3.0	2	0.9	26	11.2	38	16.4	43	18.5	12	5.2	0	0
2	9	3.9	13	5.6	9	3.9	45	19.4	66	28.4	59	25.4	31	13.4	21	9.1
3	2	0.9	2	0.9	0	0	7	3.0	3	1.3	9	3.9	3	1.3	6	2.6
4	37	15.9	46	19.8	65	28.0	74	31.9	54	23.3	59	25.4	63	27.2	102	44.0
5	138	59.5	158	68.1	155	66.8	74	31.9	62	26.7	56	24.1	117	50.4	99	42.7
Missing	46	19.8	6	2.6	1	0.4	6	2.6	9	3.9	6	2.6	6	2.6	4	1.7
TOTAL	232	100	232	100	232	100	232	100	232	100	232	100	232	100	232	100
Mean	4.63		4.48		4.57		3.55		3.16		3.12		4.07		4.22	
St.Dev	0.74		0.99		0.77		1.41		1.52		1.51		1.25		0.88	

Notes:
Hedonic Scores are in response to the question: "Do you like the [name of the food sample]?"

1 -- No, not at all
2 -- Not very much
3 -- I cannot decide
4 -- Yes, a little
5 -- Yes, very much

APPENDIX 4

1992 PREFERENCE SURVEY: FILTER DATA BY FOOD SAMPLE

The tables show the hedonic score group means for the charts presented in Figure 5.2.

Key:
Numbers in bold are those means for which the ANOVA analysis was statistically significant at the 10% level.
Numbers in italics indicate that those means are for only one of the towns. The letter following the number denotes which town: *K* for Kisumu and *N* for Nakuru.

Table A4.1: Fresh Sweet Potato Roots.

Filter	Category	Hedonic Score Group Means	
		White Roots	Yellow Roots
Ethnicity	Luo	4.53	4.31
	Kikuyu	4.77	4.84
Income	Lower Middle	4.68	4.56
	Higher Middle	4.57	4.20
Age/Gender	Children	4.59	*3.90 K*
	Women	4.71	*4.56 K*
	Men	4.49	*4.47 K*
Consumption Frequency	Infrequent	4.67	*4.26 K*
	Frequent	4.82	*4.74 K*

Table A4.2: Processed Forms: Main Effects Level.

Filter	Category	Hedonic Score Group Means			
		Crisps	Sweet Potato *Ugali*	Sweet Potato Bread	Mash
Ethnicity	Luo	4.66	3.61	2.82	3.28
	Kikuyu	4.35	3.53	3.47	3.02
Income	Lower Middle	4.40	3.49	*3.17 N*	*3.75 K*
	Higher Middle	4.75	3.63	*3.93 N*	*3.14 K*
Age/Gender	Children	4.77	3.71	3.09	2.95
	Women	4.47	3.27	3.12	3.19
	Men	4.44	4.00	3.37	3.25
Consumption Frequency	Infrequent	4.59	*3.76 N*	*3.64 N*	2.95
	Frequent	4.62	*3.03 N*	*2.77 N*	3.42

Table A4.3: Processed Forms Continued: Interaction Level for Crisps.

CRISPS		
Filter	Category	Hedonic Score Group Means
Ethnicity and Income	Luo/Lower Middle	4.64
	Luo/Higher Middle	4.71
	Kikuyu/Lower Middle	4.21
	Kikuyu/Higher Middle	4.85
Income and Gender	Lower Middle/Women	4.32
	Lower Middle/Men	4.58
	Higher Middle/Women	4.89
	Higher Middle/Men	4.25
Consumption Frequency and Gender	Infrequent/Women	4.59
	Infrequent/Men	4.31
	Frequent/Women	4.41
	Frequent/Men	4.88

Table A4.4: Processed Forms Continued: Interaction Level for Sweet Potato *Ugali*.

SWEET POTATO *UGALI*		
Filter	Category	Hedonic Score Group Mean
Income and Gender	Lower Middle/Women	3.22
	Lower Middle/Men	4.47
	Higher Middle/Women	3.40
	Higher Middle/Men	3.63
Consumption Frequency and Age	Infrequent/Children	*4.48 N*
	Infrequent/Adults	*3.33 N*
	Frequent/Children	*2.80 N*
	Frequent/Adults	*3.15 N*

Table A4.5: Processed Forms Continued: Interaction Level for Sweet Potato Bread.

SWEET POTATO BREAD		
Filter	Category	Hedonic Score Group Means
Ethnicity and Income	Luo/Lower Middle	3.29
	Kikuyu/Lower Middle	3.28
	Luo/Higher Middle	2.66
	Kikuyu/Higher Middle	4.00
Ethnicity and Age	Luo/Children	2.33
	Kikuyu/Children	3.83
	Luo/Adults	3.05
	Kikuyu/Adults	3.23
Ethnicity and Consumption Frequency	Luo/Infrequent	2.80
	Kikuyu/Infrequent	3.69
	Luo/Frequent	3.22
	Kikuyu/Frequent	2.86
Income and Gender	Lower Middle/Women	3.05
	Higher Middle/Women	3.59
	Lower Middle/Men	3.83
	Higher Middle/Men	3.00
Income and Consumption Frequency	Lower Middle/Infrequent	3.47
	Higher Middle/Infrequent	3.20
	Lower Middle/Frequent	2.86
	Higher Middle/Frequent	3.54
Gender and Consumption Frequency	Women/Infrequent	3.34
	Women/Frequent	2.66
	Men/Infrequent	3.33
	Men/Frequent	4.00

Table A4.6: Processed Forms Continued: Interaction Level for Mash.

MASH		
Filter	Category	Hedonic Score Group Means
Ethnicity and Age	Luo/Children	2.85
	Luo/Adults	3.47
	Kikuyu/Children	3.17
	Kikuyu/Adults	2.91

Table A4.7: Comparisons Between Experimental and Control Samples.

	UGALIS			BREADS		
Response	Sweet Potato *Ugali*	Maize *Ugali*	Missing	Sweet Potato Bread	Wheat Bread	Missing
# Responding	90	123	19	65	150	17
Percent of total	38.8	53.0	8.2	28.0	64.7	7.3
Valid Percent*	42.3	57.7	-	30.2	69.8	-

APPENDIX 5

1992 PREFERENCE SURVEY: RESPONSES TO QUESTIONS ON SWEET POTATO CONSUMPTION PATTERNS

Table A5.1: Have You Ever Eaten Sweet Potato Before?

PREVIOUS CONSUMPTION OF SWEET POTATO?			
Response	Yes	No	Missing
# Responding	215	3	14
Percent of total	92.7	1.3	6
Valid Percent	98.6	1.4	-

Table A5.2: How Often Do You Eat Sweet Potato?

CONSUMPTION FREQUENCY				
Response	<Once/Month	Once/month< <Once/week	>Once/week	Missing
# Responding	64	90	54	23
Percent of total	27.6	38.8	23.3	9.9
Valid Percent	30.6	43.1	25.8	-

Table A5.3: With What Do You Usually Eat Sweet Potato?

ACCOMPANIMENT*					
Response	Tea	Vegetables	Legumes	Other	Missing
Number Responding	154	42	18	47	24
Percent of total	66.4	18.1	7.8	20.3	10.3
Valid Percent	74.0	20.2	8.7	22.6	-

*totals and percentages do not add up to sample size or to 100 since panelists were allowed to mark more than one category.

(The Following Questions Were Addressed to Women Panelists Only)

Table A5.4: How Do You Prepare Sweet Potatoes?

FORMS OF PREPARATION FOR SWEET POTATO ROOTS					
Response	Boiled	Baked	Mashed	Other	Missing
# Responding	89	6	13	6	5
Percent of total	80.9	5.5	11.8	5.5	4.5
Valid Percent	84.5	5.7	12.4	5.7	-

Table A5.5: If You Do Not Often Eat Sweet Potatoes At Home, What is the Main Reason Why?

MAIN REASON FOR INFREQUENT CONSUMPTION OF SWEET POTATO								
Response	Dislike	Expensive	Difficult to prepare	Not our traditional food	Unavailable	Causes Indigestion	Other	Missing
# Responding	14	19	2	3	35	1	1	28
Percent of total	12.7	17.3	1.8	2.7	31.8	0.9	0.9	25.5
Valid percent	17.1	23.2	2.4	3.7	42.7	1.2	1.2	-

Table A5.6: What is the Most Important Factor That Determines Your Choices of Food Consumed in the Home?

HOUSEHOLD DIETARY DECISIONS ARE BASED MAINLY ON:									
Response	Family Preference	Nutrition	Husband's Preference	Traditional	Available	Good Price	Easy to prepare	Other	Missing
# Responding	24	62	4	1	8	4	1	2	4
Percent of total	21.8	56.3	3.6	0.9	7.3	3.6	0.9	1.8	3.6
Valid percent	22.6	58.5	3.8	0.9	7.5	3.8	0.9	1.9	-

APPENDIX 6

1992 PREFERENCE SURVEY: RESPONSES TO QUESTIONS REGARDING SOCIO-ECONOMIC STATUS

(Household cooking fuel and piped water questions addressed to women only.)

Table A6.1: Which Fuel Source Do You Use for Cooking?

HOUSEHOLD COOKING FUEL					
Response	Electricity	Gas	Charcoal	Wood	Missing
# Responding	10	18	54	26	2
Percent of total	9.1	16.4	49.1	23.6	1.8
Valid Percent	9.3	16.7	50	24.1	-

Table A6.2: Do You Have Piped Water in Your Home?

IS THERE PIPED WATER IN THE HOUSE?				
Response	Yes	No	Nearby	Missing
# Responding	77	11	13	9
Percent of total	70.0	10.0	11.8	8.2
Valid Percent	76.2	10.9	12.9	-

(Questions on educational level asked of both men and women.)

Table A6.3: Until Which Level of Education Have You Studied?

EDUCATIONAL LEVEL ATTAINED					
Response	Primary	Secondary	High	University	Missing
# Responding	104	91	15	10	12
Percent of total	44.8	39.2	6.5	4.3	5.2
Valid Percent	47.3	41.4	6.8	4.5	-

Note: Categorization of the income filter was performed on a case by case basis. However, there were some general guidelines used to determine whether a particular respondent fell into the lower middle or higher middle income category. For instance, it was possible that a high school graduate whose occupation was low-paying would fall into the lower middle income category.

General Characteristics of Lower Middle Income Households:
1. Use of charcoal or wood as cooking fuel.
2. No piped water in the homestead.
3. Education less than high school.
4. Occupation of household heads: for example, driver, carpenter, tailor, etc.

General Characteristics of Higher Middle Income Households:
1. Use of electricity or gas as cooking fuel.
2. Piped water available in the homestead.
3. Education at least at the high school level.
4. Occupation of household heads: for example, bank manager, headmistress, secretary.

APPENDIX 7

1992 PREFERENCE SURVEY: RESPONSES TO PRICE COMPARISONS

Price Comparison 1 -- Asked of Nakuru adults only.
Question: If sweet potato bread and sweet potato flour were available would you buy them?
A. Yes, even if their prices were higher than the corresponding conventional foods.
B. Yes, if the prices are equal to those of the corresponding conventional foods.
C. No, I would not purchase them.

Table A7.1: If Sweet Potato Bread and Sweet Potato Flour Were Available Would You Buy Them?

PRICE COMPARISON 1				
Response	A. Higher Price	B. Equal Price	C. No	Missing
# Responding	28	31	12	3
Percent of total	37.8	41.9	16.2	4.1
Valid Percent	39.4	43.7	16.9	-

Price Comparison 2 -- Asked of Nakuru adults only.

Table A7.2: Do the Prices of These Foods Have to be Lower Than Those of Conventional Foods in Order for you to Purchase Them?

PRICE COMPARISON 2			
Response	Yes	No	Missing
# Responding	17	52	5
Percent of total	23.0	70.3	6.8
Valid Percent	24.6	75.4	-

Asked of Kisumu women and all Nakuru adults.
Question: If these food products are made available on the market would you buy them?
A. Yes
B. No
C. Yes, if
  i) my family likes them
  ii) the price is reasonable
  iii) other reason

Table A7.3: If These Food Products Were Made Available on the Market Would You Buy Them?

POTENTIAL PURCHASER?					
Response	Yes	No	Like	Price	Missing
# Responding	76	3	20	13	8
Percent of total	63.3	2.5	16.6	10.8	6.7
Valid Percent	67.9	2.7	17.9	11.6	-

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