Determinants of Sweetpotato Commercialization in South Nyanza, Kenya

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Abstract

Sweetpotato serves as an important food security crop in many parts of Kenya, but rarely is a principal food staple or significant cash crop. A structured household survey conducted among 81 sweetpotato growers examines the factors influencing the extent to which farmers engage in commercial sweetpotato production in four distinct agro-ecologies in South Nyanza, the major sweetpotato growing area in Kenya. The sample is purposively stratified on agro-ecological conditions, road access, age of the sweetpotato grower, and gender of the household head. Marketing constraints emerge as the most limiting factor to expanding sweetpotato production and insufficient planting material and weevil infestation are also important constraints in drier agro-ecologies. Men typically cultivate sweetpotato only when the crop becomes commercially important. Differences in varietal characteristics preferred by commercial and non-commercial producers of sweetpotato are explored.

Introduction

Nyanza Province, consisting of the districts surrounding Lake Victoria to the east and to the north, is Kenya's principal sweetpotato growing area. According to the Ministry of Agriculture, in 1990-91 some 52% of all sweetpotatoes grown in the country hailed from South Nyanza district (Kenya Ministry of Agriculture, 1992). The district has since been split into four entities (Homa Bay, Migori, Kuria, and Suba) with Homa Bay District being the principal source of sweetpotatoes. Since most secondary data (e.g. National Census in 1989) are based on the previous boundaries, the South Nyanza terminology will be retained in this paper.

Previous work conducted by Mutuura, et. al. (1992) established that sweetpotato is an important food security crop in many parts of Kenya, particularly when maize yields are low and in months when other foods are scarce. Smit and Matengo (1995) documented farmers' cultural practices for sweetpotato in South Nyanza, noting the growing importance of sweetpotato as a cash crop in certain areas of the district.

This study builds upon this previous work by seeking to understand the determinants of commercialization in South Nyanza, emphasizing differing agro-climatic conditions, infrastructure, life-cycle, and gender considerations which may affect an individual's decision to sell sweetpotatoes. Specific objectives include:

(1) Describe the constraints faced by farmers located in distinct agro-ecological settings regarding sweetpotato production and marketing.
(2) Identify viable indicator variables which can be successfully used to distinguish commercialized versus non-commercialized sweetpotato growing households.
(3) Ascertain the most significant determinants of commercialized sweetpotato production.
(4) Investigate whether farmers selling sweetpotatoes have preferences in varietal characteristics that are distinctly different from farmers cultivating sweetpotato for home consumption only.

Methodology

Study Areas. Four distinct areas[1] were chosen in South Nyanza, three from Homa Bay District and one from Migori District (Rongo), each being distinct in annual rainfall patterns (Fig. 1), soil type, and the relative importance of sweetpotato to the household.

(1) In **Rongo** division, annual rainfall averages 1600, with monthly mean precipitation falling below 100 mm only in the month of July. Most of the location falls in the lower midland sugarcane zone (LM1) (Jaetzold and Schmidt, 1982), with altitudes ranging from 1300 to 1500 m and annual mean temperatures of 21.7^0-20.5^0 C. Sweetpotato is planted two times a year, May-early July during the long rains, and November through Mid-December during the short rains (Fig. 1). Soils are predominantly humic acrisols of low fertility, with the majority of farmers surveyed (81%) planting sweetpotatoes on sandy loams (*kuoyo* in Luo, the local language).

[1] Kenya's administrative categories are as follows: Province, District, Division, Location, Sub-Location, Village.

(2) **Kabondo** division is widely recognized for its commercial sweetpotato production. Located in the upper midland zones (UM1-3) with agro-climatic conditions favorable for coffee and maize production (Jaetzold and Schmidt, 1982), sweetpotato has emerged as a much more important cash crop than coffee in the area during the past 10 years. Altitudes range from 1450-1700 m, with annual mean temperatures from 21.1^0-19.3^0 C and annual precipitation levels similar to that of Rongo's (1598 mm). Sweetpotato is planted three times a year, Mid-March through June, July through August (the middle rains), and in October through November. Over 70% of growers reported June plantings, primarily aimed at harvesting during Ramadan, an important Muslim holiday for which sweetpotato is typically in high demand (Fig. 1). Soils are classified as chromo-luvic phaeozems of moderate to high fertility, with 70% of farmers planting their sweetpotato on clay loams (*lwala)*.

(3) The **Ndhiwa** area consists of two divisions, Ndhiwa and Nyarongi, which used to be both part of the same division. The area is noted for its heavy, difficult to manage black cotton soils (*anywang'*), which occasionally are mixed with sandy loams or clay loams. These two main soil types, pure vertisols (black cotton) and verto-luvic phaeozems, are considered to be of moderate and high fertility, respectively. Most of the division falls either under the cotton (LM3) or the lower midland marginal sugar cane zone (LM2), with conditions for growing maize ranging from fair to good (Jaetzold and Schmidt, 1982). However, no cotton was being grown in the area surveyed. Altitudes range from 1300-1500 m and average annual temperatures are 21.7^0-20.5^0C. Annual rainfall averages 1372 mm, with sweetpotato planting concentrated in the months of April through June, and in October through November. The past isolation of the area is being alleviated by the recent completion (September 1995) of a tarmac road through the center of the area.

(4) The **Kendu Bay** area for the study includes households from the East Karachuonyo division (previously part of the former Kendu Bay division). This dry agro-ecology typically only has one sweetpotato planting season for households without access to swamp land: from March through Mid-June during the main rains. Annual rainfall averages 1134 mm, but the short rains in some years are non-existent. The area is in the lower midland cotton zone (LM3), with altitudes ranging from 1140 along the shores of Lake Victoria to 1450 inland. Average annual mean temperatures are 22.7^0-20.8^0C. Two distinct soils are included in the study sites: low fertility orthic ferrasols on hillside sweetpotato plots (sandy loams or *kuoyo*) and moderately fertile vertisols in swampy locations (*anywang').*

These four areas constitute an agro-ecological gradient of descending mean annual precipitation as one moves inland from Rongo towards Kendu Bay, bordering Lake Victoria. In terms of yield potential for sweetpotato, Kabondo ranks highest, Ndhiwa second, Rongo third, and Kendu Bay last. Note that in all areas

the peak planting period for sweetpotato occurs a month after the onset of the main rains, as priority is given to planting maize and sorghum first.

Sampling Frame. A single visit, structured household survey was conducted among 81 *key* sweetpotato growers, with 20 growers selected from each of four areas during a 2 week period in 1995 (1 week during May and the second week in July). If more than one person was cultivating sweetpotato in the household, the grower with the largest amount of land under sweetpotato production was interviewed. First, within a given area, lists of sublocations having population densities of at least 150 persons per square kilometer, and known to produce sweetpotato were constructed with assistance from the resident Ministry of Agriculture staff. One village was randomly selected from sub-locations at least 7 kms from the main road, another among sub-locations within 2-3 kms of the main road. Ten households were subsequently chosen in both the near and distant village within the sub-location using the following guidelines: 5 key growers under 36 years of age and 5 key growers greater than 35 years of age. Among those growers, at least four should be widows. Within these categories, farmers were randomly selected from a list provided by the village elder. The final sample had 81 households, 21 in Rongo, 20 each in the remaining areas. The key sweetpotato growers interviewed comprised 43 growers over 35 years old, 38 growers under 36 years; 17 of the growers were widows, three of whom were less than 36 years old. This framework was chosen so that agro-ecological, infrastructure and life-cycle effects could be adequately examined. In addition, widows were selected as a representative sub-group for resource-limited households.

Results and Discussion

Importance of Sweetpotato As a Food Security and Cash Crop. Overall, sweetpotato's most important role in South Nyanza was as a supplementary food security crop, ranked 3rd in importance by 42% of farmers (Tab. 1). Maize was the most important food security crop in all areas, except Kendu Bay, where sorghum ranked first in 90% of the households.

Only 59% of growers reported that a woman in the household was engaged in sweetpotato selling. Thirty-two percent of the women ranked sweetpotato as their most important cash crop (Tab.1). Sweetpotato's importance as the principal cash crop varied considerably by area, with it being an extremely important source of cash for women in Kabondo and to some extent Ndhiwa and Rongo (Tab. 2). Groundnuts was a far superior

source of cash to sweetpotato for women in Rongo, and in Kendu Bay, groundnuts, cotton, and sorghum were the most significant sources of cash.

Only 59% of the households had the principal man selling agricultural produce raised on the farm independently of the woman. The most important cash crop for men differed in each agro-ecology: groundnuts being most significant in Rongo, sweetpotatoes in Kabondo, sugar cane in Ndhiwa, and cotton in Kendu Bay (Tab. 2). Not surprisingly, the average amount of cash obtained from sweetpotato sales during the year prior to the survey (the 1994/95 season) was highest in Kabondo (5766 Ksh)[2] and lowest in Kendu Bay (500 Ksh) (Tab. 3). However, high standard deviations are seen for all mean values, indicative of the dichotomy between sellers and non-sellers in each area.

At least 40% of growers in all areas increased the area planted to sweetpotatoes over the past 5 years (Tab. 2). Ndhiwa had the highest number of growers increasing the amount of land planted to sweetpotato (60%), whereas somewhat surprisingly, 26% of Kabondo growers were decreasing the amount planted to the crop. Almost half of all growers felt yields of their sweetpotato were increasing, compared to 19% citing declining yields, and 27% noting no major yield changes over the past 5 years. Declining sweetpotato yields appear to be a particular problem in Kendu Bay.

Increasing sweetpotato consumption is occurring in a significant number of households in Rongo, Kabondo, and Kendu Bay, while 70% of Ndhiwa farmers had levels of sweetpotato consumption similar to those 5 years prior to the survey (Tab. 2). In contrast, the majority of farmers in all areas noted the positive trend of the importance of sweetpotato as a cash crop. Sixty-two percent of the sample stated that their sales of sweetpotato had been increasing during the last five years.

The decline in sweetpotato sales reported by 28% of Kabondo growers is disturbing, given the established reputation of the area as a commercialized sweetpotato center. There are problems of market glut periodically occurring in the Kabondo region, as an increasing number of farmers are selling their sweetpotatoes and many tend to plant to target well-known selling periods, such as Ramadan. In addition, there may be increasing competition from other parts of western Kenya where sweetpotato production for sale is also increasing. Moreover, the tarmac road which has long served as the link to major markets in larger urban centers has deteriorated significantly, with several farmers noting a consequent decline in larger trucks willing to transport sweetpotatoes out of the area.

[2] The Kenyan Shilling (Ksh) to U.S. dollar exchange rate fluctuated considerably during the 1994/95 period. An average exchange rate of 45 Ksh/$1 U.S. can be used for comparative purposes.

Seasonality of Sweetpotato Consumption, Sales, and Purchases. The seasonal nature of sweetpotato consumption, sales, and purchases is evident in Figure 2. Peak periods of consumption center around the months of March through June (prior to the main maize harvest) in the well-rain fed areas, compared to August through October in drier Kendu Bay. There are clear gaps in the calendar, particularly November through March in Ndhiwa and Rongo, where sweetpotato could play more of an important role in the diet if made available as other food sources (particularly maize) are low in stock in many households. Farmers in the well-rain fed areas clearly rely on home grown sweetpotatoes for consumption. No Rongo farmer in the survey, for instance, ever purchased sweetpotato. Only Kendu Bay farmers purchase sweetpotatoes in large numbers at certain times of the year (e.g. March through July).

Selling of sweetpotatoes in Rongo occurs year-round on a small-scale basis. Very few Kendu Bay households are actively engaged in selling sweetpotatoes, and roots planted during the main rains are all harvested and disposed of by the end of October. In-ground storage is less of an option in Kendu Bay due to the massive weevil infestation which occurs if roots are left in the ground beyond September.

While over a quarter of Kabondo farmers are selling sweetpotatoes in all months, except July through October, Ndhiwa farmers concentrate their sales during the months of April through November. Periods of high sweetpotato prices in Kabondo and Ndhiwa are juxtaposed next to those of the lowest prices. Before maize is harvested in June and July, sweetpotato prices rise. As more sweetpotatoes mature from the middle and short rain planting periods, a glut of fresh roots appear on the market, coincident with the start of the maize harvest, and sweetpotato prices drop significantly.

Sweetpotato is predominantly sold fresh and consumed after boiling. Storage of fresh roots occurs in-ground, with the roots being highly perishable once removed. Techniques of curing and longer-term fresh storage are not known. However, 58% of farmers have prepared sweetpotato flour at some time in their life, although only 52% of those that know how to prepare flour do so regularly. Sweetpotato roots are typically dried by these households only when there is an excess production of sweetpotato roots.

Constraints. Farmers rated the severity of the problems the face in sweetpotato production, the results of which are shown by area in Figure 3. Earlier work (Mutuura et. al., 1992 and Smit and Matengo, 1995) indicated that moles are the greatest hazard to sweetpotato production in wet, higher elevations zones, while sweetpotato weevils and lack of planting material are the predominant problems in drier areas. These results are confirmed here, with one significant caveat. Sweetpotato weevil attack in roots was a severe problem for 30% and a moderate problem for 55% of farmers in the well-rainfed area of Kabondo. This may indicate that intensification

of sweetpotato production in this area has enhanced the spread of weevil among closely spaced sweetpotato plots. Since weevil infested roots are rejected by buyers, education of farmers on preventive cultural practices should be given high priority for this area. Apparently, Ndhiwa farmers suffer from significant mole infestations during the wet periods, while weevil attack is a major problem when their black cotton soils crack in the dry season.

Over 40% of farmers in all areas reported insufficient family labor to assist in sweetpotato production. Female labor is dominant in all sweetpotato activities except for field clearing whether or not sweetpotatoes are strictly for home consumption. The contribution of male labor only becomes significant when sales of the crop are important sources of household cash. While hired labor is readily available, its high cost was a also a major constraint, particularly in Rongo. Kendu Bay residents had the fewest problems with lack of buyers and transport, but this is no doubt due to the low level of sweetpotato commercialization in that area. Lack of transport was the most severe problem from the marketing standpoint in Ndhiwa, Rongo, and even Kabondo. Over a third of farmers complained of having problems finding a sufficient number of buyers as well. Clearly, expansion of sweetpotato production on a large-scale is dependent on the development of support infrastructure and the existence of sufficient market demand in relevant urban markets.

Determinants of Commercialization. Sweetpotato farmers are categorized on the basis of agro-ecology, distance from their home to the main road, the amount of sweetpotato production sold and the level of sweetpotato sales in 1994/95 in Table 4. Clearly, Kendu Bay farmers rely on sweetpotato for home consumption. Only farmers near to the main road sold at least half of their sweetpotato production in Rongo. In contrast, a significant proportion of farmers distant from the main road were able to overcome transport constraints in Kabondo and Ndhiwa and sell half or more of the sweetpotato they produced.

Another way to examine the extent of commercialization is to categorize farmers on the basis of the total amount of cash earned from sweetpotato during the previous year. Twenty-seven percent of growers earned 1000 Ksh or more in 1994/95, while 36% sold less than 1000 Ksh worth of sweetpotato, and 47% sold none whatsoever. While farmers near to the main road in Rongo and Kabondo had higher average sale levels than more distant farmers in those areas, the opposite held in Ndhiwa, where 50% of the more distant farmers earned 1000 Ksh or more, compared to 30% of farmers nearer to the main road. The randomly selected distant village in Ndhiwa was found to have many farmers utilizing sweetpotato to feed pigs, a phenomenon not seen in any of the other areas surveyed. Hence, there was a significant local market for sweetpotato roots in that location.

Ideally, one would like to have the actual percentage of total sweetpotato production sold as the variable indicating the degree of commercialization. However, such precision for a piecemeal harvested crop such as sweetpotato is difficult to achieve. Hence, two indicators were selected for use as limited dependent variables for a probit analysis examining the determinants of sweetpotato commercialization. The first is a binary variable for selling at least half of total amount of sweetpotato produced either in the short rains of 1994 or in the main rains of 1995 (23 cases). The second is a binary variable representing the sale of at least 1000 Ksh worth of sweetpotatoes during the same period (1994/95).

Independent variables consisted of variables reflecting agro-ecological zones (dummies for the study sites), ease of marketing (dummy for being within 2 kilometers of the main road), characteristics of the key sweetpotato grower (sex, age, education), labor availability in the household (additional adult men and women residing in the household besides the key sweetpotato grower), wage rates in alternative activities in which the farmer was engaged, wealth (remittances from outside the household, per capita landholding size, agricultural capital (tools plus livestock) and consumption (housing plus durable goods) indices, and resource control (percent of land managed by the key sweetpotato grower and whether the head of household is polygamous).

Results for the probit analysis (using the software LIMDEP) are shown in Table 5. The predictive power of the first model with the amount of sweetpotato sold as the dependent variable was greater than the second model where the levels of sweetpotato sales is the dependent variable. The percentage of outcomes being correctly predicted in first model was 78%, compared to 59% in the second.

Strongly significant positive determinants of commercialization in the first model were being within 2 kilometers of the main road, the availability of other adult women in the household, and regularly receiving remittances from outside the household. The negative sign on the remittance dummy implies recipients unearned income were less likely to sell significant amounts of their sweetpotato production. Moreover, the majority of the remittance receiving households were in Kendu Bay. Male outmigration from Kendu Bay to seek employment elsewhere is common and the best housing conditions were found in Kendu Bay in spite of the poor agro-ecological setting. Thus, the negative coefficient in part results from Kendu Bay farmers not being involved in commercial sweetpotato production. Interactions terms between the wealth indicators and the agro-ecological dummies were included in the original model specification, but failed to be significant and were dropped.

Both of the education variables, the dummy for having finished primary school and that for having some primary education, had negative signs and that for finishing primary school was weakly significant. The

implication is that more educated farmers were less likely to sell sweetpotatoes in significant quantities than their counterparts with little or no formal education.

In the model with level of sales of sweetpotatoes as the dependent variable, only the availability of adult men in the household was a strong positive determinant. In this model, the availability of additional adult women was weakly but still positively significant. In addition, proximity to the main road, the key grower being male, and land per capita were positive and weakly significant. Receiving remittances was also weakly significant, but with the same negative sign.

Characteristics Preferred By Commercial versus Non-commercial Growers.

A list of desirable characteristics for a hypothetical sweetpotato variety was obtained from a subsample of 41 farmers[3] to discern if differences exist in preferences based on whether or not the farmer sells sweetpotato. For several traits, all farmers are in agreement: the texture of the root must be dry, the vines should spread horizontally as opposed to having an erect stance, and any new variety must be acceptable to buyers. The majority also preferred little latex in the roots, although a few larger sellers noted latex is associated with starchiness by many consumers, for whom abundant latex is a desirable trait. Several women also reported that the gumminess associated with the latex makes the roots more difficult to slice and dry. There was also little difference between sellers and non-sellers regarding the length of time storage roots should be able to stay in the ground without rotting once mature. Overall, 49% desired storability for 3 to 4 additional months, 10% for 5 months, 20% for 6, with the remainder requiring longer periods of 8 to 12 months.

Some differences do exist, however, between characteristics desired by sellers and non-sellers. White-fleshed varieties are highly preferred by sellers, whereas home consumers were equally divided between white and yellow-fleshed sweetpotatoes. Sellers also desired red-skin color, while non-sellers liked both red and purplish-red skinned varieties. Only 17% of farmers preferred white-skinned sweetpotatoes. All home consumers wanted varieties which matured in 4 months or less, with 80% stipulating 3 months. In contrast, while 80% of sellers wanted varieties maturing in 4 months or less, the remainder favored maturity periods ranging from 5 to 9 months. Home consumers endorsed *very sugary* roots, whereas the top category of sellers was equally divided between somewhat sugary and very sugary. Only 7% of the growers fancied roots that were not sugary at all. The majority of home consumers want very large tubers (as one woman said, the larger

[3] Due to the length of the questionnaire, only half the farmers in the survey were queried on this topic. Of these, 9 were farmers having sweetpotato sales in 1994/95 of 1000 Ksh and above, 17 with sales below 1000 Ksh, and 15 not selling whatsoever. Sellers in this section refer to those having any sales of sweetpotato whatsoever.

the better to impress your husband) compared to sellers who prefer medium size tubers (e.g. 300 gms) for ease of packing into bags.

The desire for a variety that is weevil resistant was slightly more important to sellers than non-sellers, but the main variation in preferences was by agro-ecology. Weevil resistance was critically important for the majority of farmers in Rongo, Ndhiwa, and Kendu Bay, but not for those in Kabondo. Significant differences existed between older and younger growers for this factor. Thirty-six percent of key growers under 36 years of age thought weevil resistance was *not* an important criterion, compared to 15% of growers over 35 years of age.

Vine survival during the dry season was critically important characteristic for almost all farmers in Rongo, Ndhiwa, and Kendu Bay. In contrast, 36% of Kabondo farmers felt the ability of vines to survive the dry season was not important in a new variety. This probably reflects the ease with which planting material can be obtained from others in the Kabondo area.

When queried as to what desirable characteristics the varieties they now possess lack, three main major areas of concerned emerged: weevil resistance (44% of respondents), vine survival during the dry season (39%), and storability of the roots in ground once they have matured (27%). It is somewhat surprising that early maturity was not mentioned by Ndhiwa farmers, given the seasonal gaps in sweetpotato consumption previously noted.

Conclusion

This paper has described preliminary results from a structured household survey on sweetpotato commercialization in South Nyanza. Agro-ecological factors, distance to major roads, and adult labor availability within the household were found to be key determinants of sweetpotato commercialization. The binary variable of having sold at least one half of the total amount of sweetpotato produced either during the short or long rains during the year prior to the survey emerged as a good indicator for assessing the degree of sweetpotato commercialization. Farmers are particularly interested in new varieties which are weevil resistant, whose vines can survive the dry season and whose roots can remain in the ground for at least an additional 3-4 months once they have matured.

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Table 1. Ranking of Importance of Sweetpotato as a Food Security and as a Source of Cash (Percent of 81 Respondents)

Ranking:	1 Highest	2	3	4	5	6	NOT IMPORTANT
Food Security	0	5	42	21	14	6	12
Woman's Cash Crop	32	15	7	1	3	1	41
Man's Cash Crop	9	3	4	1	1	2	80

Table 2. Important Cash Crops and Trends in Sweetpotato Production and Consumption

	Percent of Respondents within Site				
Site: (Sample Size)	RONGO (21)	KABONDO (20)	NDHIWA (20)	KENDU BAY (20)	ALL SITES (20)
Most Important Cash Crop for Women:	Groundnuts	Sweetpotatoes	Sweetpotatoes Groundnuts	Groundnuts	
Maize			15		4
Sorghum				15	4
Sweetpotatoes	24	70	30	5	32
Cassava				10	3
Groundnuts	71	5	25	25	32
Sugar Cane		5	5	5	4
Vegetables		5	5	5	4
Cotton				20	5
Fruit (Bananas, Oranges)		10		5	4
Legumes (e.g. Cowpeas)	5		5	5	4
Coffee	5				1
Most Important Cash Crop for Men:	Groundnuts	Sweetpotatoes	Sugar Cane	Cotton	
Maize		5	5	1	4
Sorghum				10	3
Sweetpotatoes	5	25	5		9
Cassava	5				1
Groundnuts	33		10	5	12
Sugar Cane	19	10	15	5	12
Vegetables	5	15			5
Cotton				20	5
Fruit (Lemons)				5	1
Legumes (e.g. Beans)			10		2
Coffee		10			2
***During Past 5 Years*: Land Planted to SP:** Increasing	43	47	60	40	48
Decreasing	19	26	15	15	19
Same Amount	33	11	25	45	29
Yields of SP: Increasing	52	29	50	40	44
Decreasing	14	12	10	40	19
Same Amount	24	35	40	10	27
Home Consumption of SP: Increasing	48	37	15	45	36
Decreasing	14	5	15	15	12
Same Amount	33	58	70	40	50
Sales of SP: Increasing	61	56	65	67	62
Decreasing	11	28	0	8	12
Same Amount	28	0	35	25	22

Table 3. Amount of Cash Obtained From Sweetpotato Sales in the Past Year: 1994/95

SITES: (Sample Sizes)	RONGO (14)	KABONDO (19)	NDHIWA (16)	KENDU BAY (2)	ALL SITES (51)
Mean Cash (Ksh) Obtained From SP : 1994/95 (Std. Dev.)	702 (652)	5766 (8953)	2038 (2309)	500 (565)	3000 (5703)

Table 4. Characteristics of Sweetpotato Production and Sales by Agro-ecology and Distance to Main Road

A. Percent of Respondents in Each Category

Site and Distance to Main Road: (Sample Size)	RONGO-Near (11)	RONGO-FAR (10)	KABONDO Near (10)	KABONDO Far (10)	NDHIWA-Near (10)	NDHIWA-FAR (10)	KENDU BAY- Near (10)	KENDU BAY-Far (10)	ALL SITES (81)
Agro-Ecological Classification:	LM1	LM1 LM2	LM2 UM1	UM2 UM3	LM3	LM2	LM3	LM3	
Amount of SP Production Sold in MAIN RAINS 1995: Did Not Plant	18	30				30	30	40	18
None Sold	9	30	40	80	40	20	70	50	42
One-Quarter or Less	27	40	20		50	20		10	21
Half	36				10				6
More than Half	9		40	20		30			12
Amount of SP Production Sold in SHORT RAINS 1994: Did Not Plant	9	60		10		10	20	30	17
None Sold	9	20		10	30	20	70	70	28
One-Quarter or Less	36		10	30	30	10			12
Half	18					20			5
More than Half	27		70	40	10	20			21
Growers Earning: 1-999 Ksh on SP in 1994/95	64	40	20	60	40	40	10	10	36
1000 Ksh or More on SP in 1994/95	27	0	80	30	30	50	0	0	27

B. Averages (Standard Deviations in Parentheses)

Mean Household Size:	6.2 (1.3)	4.6 (2.8)	8.2 (2.0)	6.1 (3.2)	5.5 (1.6)	7.6 (3.0)	6.5 (2.0)	6.1 (2.7)	6.3 (2.4)
Average Education (Years): Key SP Grower	5.4 (4.0)	1.9 (2.7)	6.4 (2.3)	4.7 (3.3)	3.7 (4.2)	3.4 (3.3)	6.0 (3.8)	1.9 (2.6)	4.2 (3.3)
Mean No. SP Plots: Key SP Grower	1.5 (0.7)	1.3 (0.7)	1.8 (0.8)	1.3 (0.4)	1.5 (0.8)	1.2 (0.4)	0.9 (0.6)	1.0 (0)	1.3 (0.6)
Mean Size of Largest SP Plot (Acres): Key SP Grower	0.11 (0.11)	0.09 (0.08)	2.71 (4.34)	0.43 (0.61)	0.08 (0.05)	0.13 (0.05)	0.08 (0.14)	0.22 (0.57)	0.48 (1.71)
Mean No. Other Plots: Key SP Grower	3.5 (1.7)	3.8 (0.6)	4.2 (1.9)	4.0 (2.4)	4.5 (2.9)	3.1 (1.4)	3.9 (2.0)	2.9 (1.5)	3.7 (1.5)
Mean Agricultural Index: (Tools + Livestock)	21059 (18839)	19957 (29099)	56291 (50398)	5494 (4685)	26228 (28303)	118875 (169568)	41909 (43160)	29146 (20416)	39637 (71646)
Mean Consumption Index: (Housing + Goods)	17514 (23360)	13530 (21986)	49478 (54848)	11910 (9464)	9464 (11681)	35022 (55707)	62913 (58421)	13145 (7603)	26509 (40087)

Table 5. Probit Analysis For Selling at Least Half of Total Sweetpotato (SP) Produced (HALF OR MORE SOLD) or Selling at Least 1000 Kenyan Shillings (Nominal) Worth of Sweetpotatoes During the 1994/95 Agricultural Season (1000 Ksh OR MORE), 4 Sites in South Nyanza, Kenya
(1000 Ksh Approximately Equals $22 U.S.)

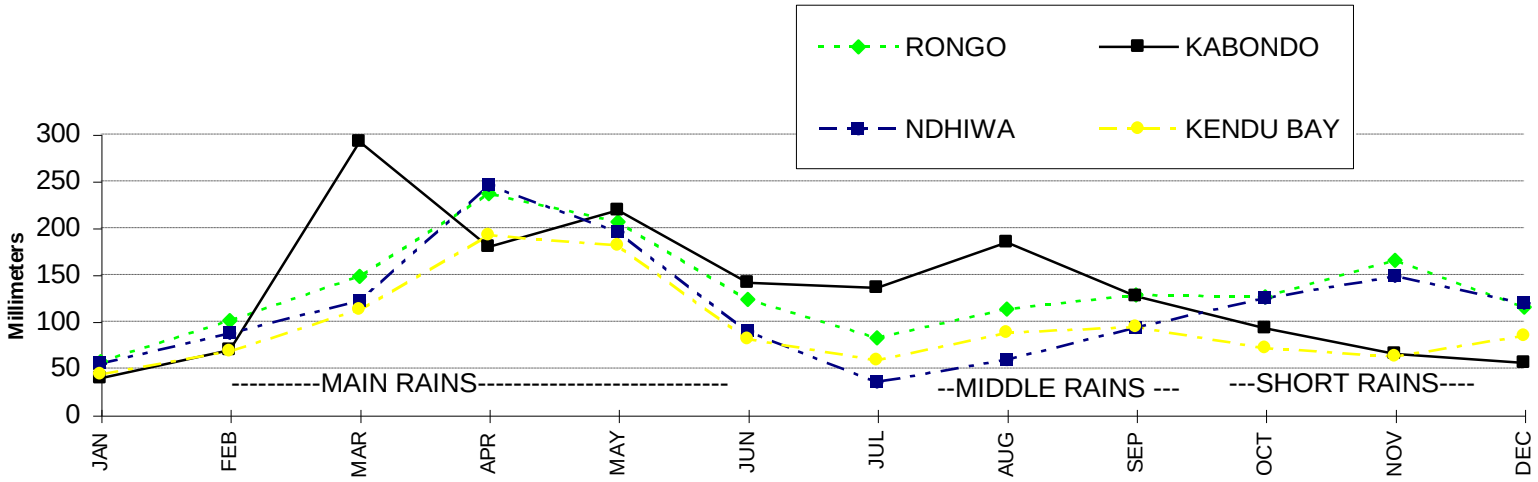
	HALF OR MORE SOLD		***1000 KSH OR MORE SOLD***		*SAMPLE*	
Variable	Coefficient	Asymptotic t-ratio	Coefficient	Asymptotic t-ratio	Mean	Standard Deviation
Constant	-10.289	-0.252	-3.288	-0.075		
Rongo Division	4.817	0.119	3.198	0.073	0.26	0.44
Kabondo Division	5.921	0.146	4.707	0.107	0.25	0.43
Ndhiwa Division	5.262	0.129	4.518	0.103	0.25	0.43
Within 2 Kms of tarmac road	1.172	2.020	0.860	1.583	0.51	0.50
Sex of Key SP Grower (0=Female, 1=Male)	0.235	0.161	1.440	1.418	0.09	0.28
Age of Key SP Grower (Years)	0.036	1.281	-0.005	-0.218	40.85	14.35
Some Primary School (Key SP Grower)	-0.632	-0.814	-0.075	-0.104	0.49	0.50
Finished Primary School (Key SP Grower)	-2.299	-1.551	-1.327	-1.106	0.20	0.40
Other Adult Men (>13 Years) in Household	-0.001	-0.005	0.476	2.193	1.70	1.22
Other Adult Women (>13 Years) in Household	0.731	2.010	0.258	1.093	1.07	1.11
Number Children under 6 Years in Household	0.422	1.420	0.122	0.530	0.91	1.05
Daily Wage Rate in Non-Farm Activity (Ksh/day)	0.00003	0.013	0.001	0.289	53.59	88.69
Receives Regular Remittances from Outside	-1.871	-2.322	-1.042	-1.424	0.30	0.46
Per Capita Land Holdings (Estimated Acres)	0.069	0.490	0.210	1.435	1.63	2.17
Percent of Land Managed by Key SP Grower	0.008	0.707	-0.004	-0.500	51.01	32.91
Agricultural Capital Index (Natural Logarithm)	0.308	1.215	-0.212	-1.117	9.59	1.58
Consumption Capital Index (Natural Logarithm)	-0.095	-0.365	-0.632	-0.262	9.33	1.34
Head of Household is Polygamous	-0.730	-1.158	-0.383	-0.690	0.23	0.42
Sample Size	81		81			
Maximum Likelihood Estimates:						
Log-Likelihood	-23.52		-27.09			
Restricted (Slopes=0) Log-L	-48.33		-43.37			
Chi Squared (18)	49.61		40.56			
Significance Level	0.00008		0.002			

Frequencies of Actual and Predicted Outcomes:

	Predicted 0	Predicted 1	TOTAL
Actual 0	54	4	58
Actual 1	5	**18**	23
TOTAL	59	22	

	Predicted 0	Predicted 1	TOTAL
Actual 0	53	6	59
Actual 1	9	**13**	22
TOTAL	62	19	

Figure 1. Mean Monthly Precipitation in Millimeters Near Research Sites and Percent of Farmers Planting Sweetpotato



ANNUAL RAINFALL	Months of the Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1600	RONGO: Monthly Rainfall	57	101	148	236	206	123	82	113	128	126	165	115
	Percent Planting												
1598	KABONDO: Monthly Rainfall	39	69	292	179	218	141	136	184	127	92	65	55
	Percent Planting												
1372	NDHIWA: Monthly Rainfall	55	87	122	245	195	89	35	59	93	125	148	119
	Percent Planting												
1134	KENDU BAY: Monthly Rainfall	43	68	112	192	181	81	58	88	94	71	62	84
	Percent Planting												
	LEGEND: Sample Size=55		NONE		1-19%		20-39%		40-69%		70% & Above		

Sources: For Kabondo, averages from three stations in Kabondo Division for 1994 (Oriang, Othoro, and Opanga), supplied by the local Ministry of Agriculture. No meteorological stations were operating in the remaining areas. For Rongo, Ndhiwa, and Kendu Bay, averages for at least 10 years up to 1976, as provided R. Jaetzold and H. Schmidt (1982), Farm Management Handbook, Vol. II, Part A, West Kenya, Russdorf, West Germany, p. 129.

Figure 2. Seasonal Distribution of Sweetpotato Consumption, Sales, Purchases and Prices
(Percent of Respondents Responding That Sweetpotato (SP) Activity Occurs in Given Month)

Sample Sizes: 13 for Rongo and Kendu Bay; 15 for Kabondo; 14 Ndhiwa; 55 Total

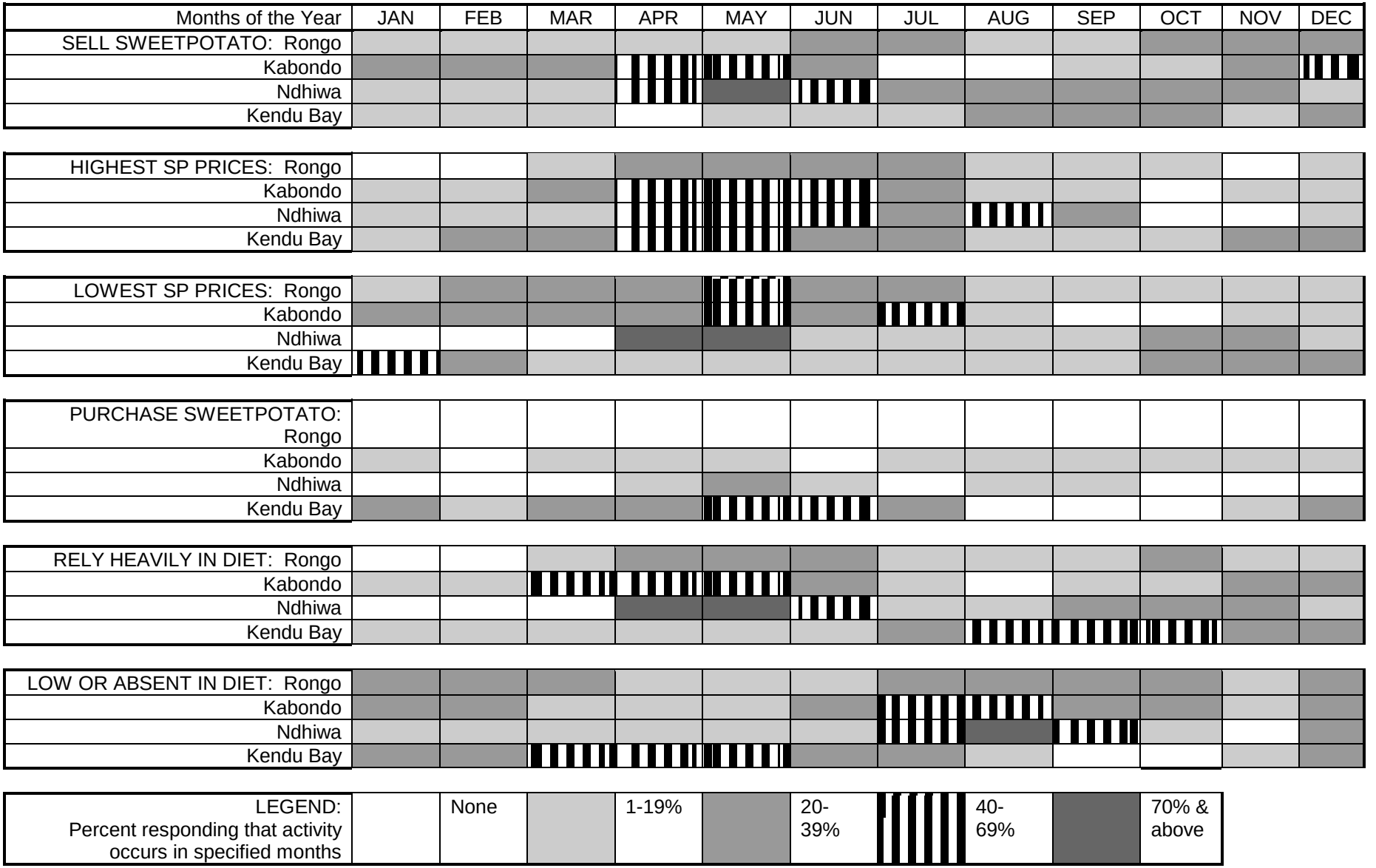


Figure 3. Problems Reported By Farmers in South Nyanza

Sample Sizes: 21 in Rongo (R), 20 in Kabondo (K), Ndhiwa (N) and Kendu Bay (B)