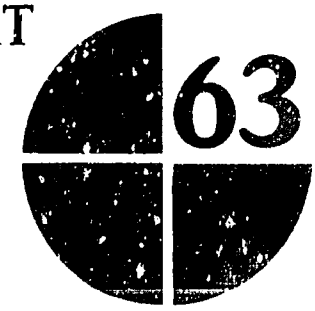
RESEARCH REPORT



INCOME AND NUTRITIONAL EFFECTS OF THE COMMERCIALIZATION OF AGRICULTURE IN SOUTHWESTERN KENYA

Eileen T. Kennedy
Bruce Cogill

November 1987

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FOREWORD

The commercialization of agriculture is the cornerstone of economic development in most developing countries. Yet relatively little is known about the income and nutritional effects of increasing commercial agriculture. The present study by Eileen Kennedy and Bruce Cogill is the first in a series of studies conducted by IFPRI in Africa, Asia, and Central America to assess the effects of the commercialization of agriculture on production, consumption, and nutritional status.

In 1983 IFPRI was invited by the government of Kenya to undertake a study of the production and consumption effects of a smallholder sugarcane contracting scheme in Southwestern Kenya. The resulting study is unusual because it uses a random sample of farmers at various stages of sugarcane farming and collected data over two maize-growing seasons. Detailed data are presented on the trade-offs between the major food crop, maize, and the contracted sugarcane crop. Furthermore, it traces the links between income from sugarcane and the associated effects on food intake, morbidity, and nutritional status of women and children.

Incomes of the farmers are increasing significantly as a result of participation in the sugarcane outgrowers' scheme. However, this increased income does not translate into improvements in child health and nutritional status, at least in the short run. The health/sanitation environment is a key determinant of a child's morbidity and growth. The agricultural/health linkages need to be considered in anticipating the impact of agricultural development strategies on preschoolers.

The report identifies positive effects of commercial agriculture and ways to enhance these and thus allows policymakers to use these data to fine-tune future schemes of this type.

John W. Mellor

Washington, D.C.
November 1987

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1

SUMMARY

Commercialization of agriculture is a controversial issue. While a number of studies have indicated that the effects of cash cropping on nutrition have been disastrous, others have found a positive or at least a neutral effect.

This research, which was initiated at the request of the government of Kenya and conducted jointly with the National Council for Science and Technology of Kenya and Kenyatta University, aims to evaluate the effects of a shift from maize to sugarcane on agricultural production, income, expenditures, consumption, and health and nutritional status.

The research was conducted in South Nyanza district, the area of Kenya with the highest mortality rate from birth to two years of age—216 per 1,000—of any district of Kenya. By encouraging farmers to move into commercial agriculture, the government hoped to improve the general health and well-being of low-income farm households.

A random sample of smallholder farmers in various stages of sugarcane production was selected from those under contract to a sugar factory in South Nyanza, Kenya. Nonsugar farmers (those not growing sugar under contract) with similar characteristics were randomly chosen from a mapping of next-nearest neighbors to ensure geographical similarity. A random sample of merchants and the landless were included in order to assess the total effects of cash cropping on the community.

Agriculture in the area is dominated by smallholder agriculture with maize being the major crop. Farmers mostly use a low-input technology, relying heavily on household labor. For maize, 95 percent of labor is provided by household members. Only 16 percent of the sugar farmers and 6 percent of the nonsugar farmers use any inorganic fertilizer.

As sugarcane production expands, it mainly replaces maize area. Of the plots planted in sugarcane, 95 percent were formerly used for maize. In 1984, a drought year, returns to land were similar for maize and sugarcane. Under normal climatic conditions, however, maize usually produces a larger return to land than sugarcane. The picture is dramatically different when the returns per day of household labor are analyzed. The return to labor for sugar is three times the daily agricultural wage rate and significantly higher than the return to maize.

Incomes of the farmers participating in the sugarcane outgrowers' scheme are significantly higher than those of nonsugar farmers. Most of the difference in income comes from marketed agricultural surplus—36 percent of the income in sugar-producing households compared to 20 percent for nonsugar farmers. Fifteen percent of the sugar farmers' income is from participation in the outgrowers' program.

Much of the incremental income earned by sugar farmers is spent on nonfood expenditures. Merchants and sugar-producing households spend more on housing and education than other households in the sample. Although these expenditures presumably have a beneficial effect, they do not appear to produce a nutritional benefit for preschoolers—at least in the short run.

However, the increased income positively affects household calorie consumption, and the percentage of income derived from sugar has an additional positive effect above and beyond the pure income effect. For each 1 percent increase in sugarcane income, household energy intake increases by 24 calories. At the mean, sugar income contributes an additional 360 kilocalories per day to household energy intake. Some fine-tuning of commercial agricultural schemes could help maximize the potential impact of the increased income on house-

hold and preschooler nutritional status.

Illness is so prevalent in South Nyanza that 50-70 percent of the children and women are sick at any given time, on average, one out of every four days. Illness tends to be most prevalent in the preharvest, rainy season. Morbidity patterns are one of the major determinants of preschooler nutritional status. The more a child is ill or has diarrhea, the less improvement will be shown in nutritional status.

Children from households headed by females consistently have better nutritional status than preschoolers from other types of households. Girls do better than boys and older children do better than younger in many of the growth parameters. There is also some evidence that income controlled by women correlates with improved nutritional status, indicating that women are more likely to spend on food and health care.

The positive effect of the sugarcane scheme on income is apparent and should not be understated. However, the data suggest that one of the major pathways to improving nutritional status is improvement of health and the sanitation environment. The health care infrastructure must be taken into consideration when policymakers are trying to anticipate the effects of agricultural policies and programs. Low-cost, low-technology innovations with a preventive focus can have a high payoff in child health.

2

RESEARCH DESIGN AND SURVEY METHODS

The appropriate role of export crop or cash crop production in many developing countries is a politically volatile issue.[1] Many governments are encouraging the increased production of cash crops as a means of generating and saving foreign exchange earnings, on the one hand, while stressing the production of food crops for domestic consumption on the other hand. At times, these goals appear to be in conflict.

In Kenya, there has been some concern that in areas with increased cash cropping, particularly increased sugarcane production, preschooler nutritional status has deteriorated. This concern is reflected in a 1981 Kenyan National Food Policy Paper, which indicated that "particular attention be given to safeguarding the family diet of small farmers who switch from food crop to cash crop production."[2] Little is known, however, about the effects on nutrition of the process of commercialization of agriculture. This is somewhat surprising given the importance of export crops/cash crops in the economies of many developing countries. A recent review of the income and nutritional effects of cash crop production suggests mixed results.[3] While some studies show a negative effect of cash crop production on consumption and nutritional status, an equal number of studies show a positive or neutral effect. What then are the health and nutritional effects of commercialization of agriculture?

This study was conducted to evaluate the effects of cash crop production on agricultural production, income, and food consumption and to assess the impact of cash cropping on the health and nutritional status of women and preschoolers. In addition, the research concentrated on identifying the process leading to these outcomes.

Conceptual Approach and Survey Methods

Almost all previous research on the nutritional effects of cash crop production has concentrated on evaluating outcomes; few studies have attempted to elucidate the process through which commercial agriculture may affect household behavior. Thus the results of the studies—whether positive or negative—have limited usefulness in formulating policy.

The figure below presents a simplified conceptual model of pathways through which cash crop production can potentially influence health and nutritional status.[4] There are a complex set of issues and linkages that need to be understood in order to evaluate the effects of cash crop production. Past work has concentrated on a limited number of household-level effects—mainly household agricultural production. Noticeably absent from most studies is any research related to an assessment of the effects of cash cropping on intrahousehold dynamics.

As can be seen from the figure, cash cropping can potentially influence factors at the household level by affecting agricultural

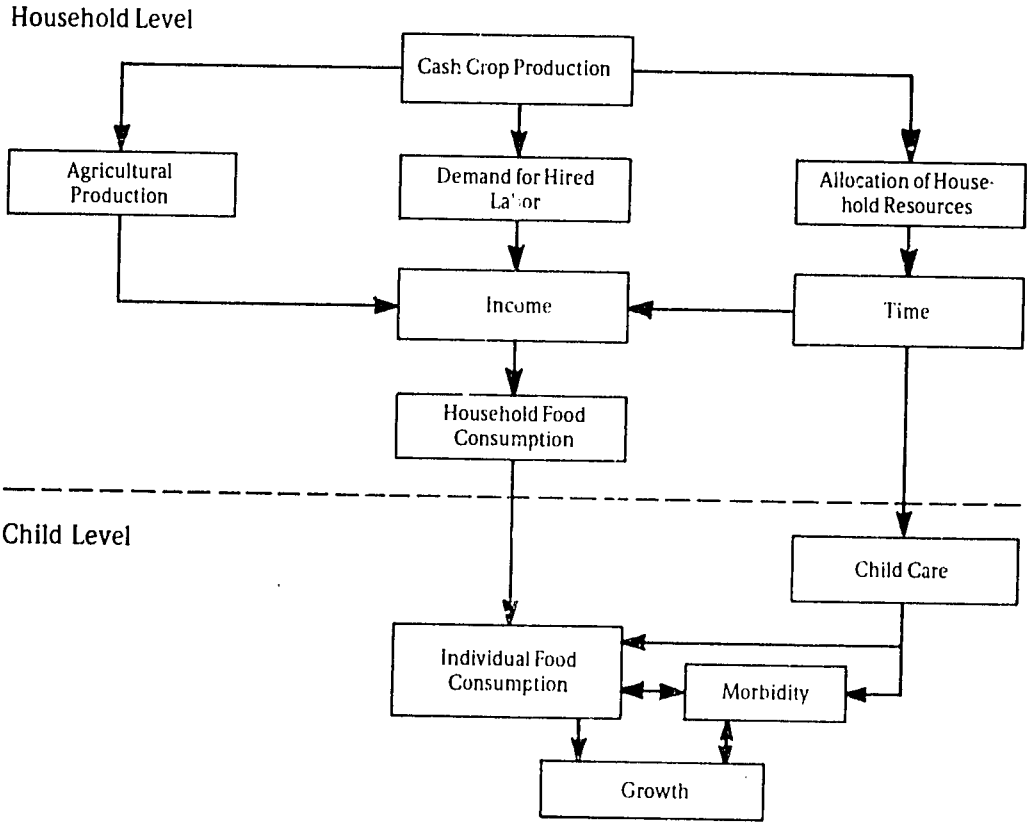
[1] The terms "export crops" and "cash crops" are often used interchangeably in the literature, and this creates some confusion. Export crops are those that are exported from the country; they can be food or nonfood crops. Cash crops are commodities that are sold, which can also be either food or nonfood crops.

[2] Republic of Kenya. *National Food Policy Paper*, Sessional Paper 4 (Nairobi: Government Printer, 1981).

[3] Joachim von Braun and Eileen Kennedy, *Commercialization of Subsistence Agriculture: Income and Nutritional Effects in Developing Countries*, Working Paper on Commercialization of Agriculture and Nutrition 1 (Washington, D.C.: International Food Policy Research Institute, 1986).

[4] A more detailed discussion of each of these pathways is contained in von Braun and Kennedy, *Commercialization of Subsistence Agriculture*.

Figure—Relationship between commercial agriculture and production, income, consumption, and health



production, the demand for hired labor, and allocation of resources within the family. A positive effect of commercial agriculture on one of these pathways could be offset by a negative effect on another. By influencing any of the three pathways at the household level, cash cropping can also affect the health and nutritional status of individual family members. Thus the figure serves as a basis for conceptualizing the study and design of the research protocol.

The process through which the commercialization of local agriculture may influence an individual's health and nutritional status is complex. As shown in the figure, an understanding of this process requires linking a series of household factors to individual characteristics and, therefore, involves collection of data from the community, household, and individual household members. Table 1 describes the variables included in the study and the method of data collection.

A variety of techniques including observation, recall, and direct measurement were used in the survey. Enumerators, recruited from the local area, visited the study households bimonthly over an eight-month period beginning in June 1984 and ending in February 1985.

Study Area

The research for this study was conducted in a project area located in Nyanza Province, South Nyanza District, in the southwest part of Kenya. Nyanza Province

Table 1—Data collected in the survey, June 1984 to February 1985

Variables	Round 1	2	3	4	Method	Frequency of Collection/ Period of Recall
Community-level variables						
Food prices	x	x	x	x	Observe	Every two weeks
Nonfood prices	x	x	x	x	Observe	Periodically during the survey
Population				x	Record retrieval	Population statistics collected for 1984
Services available	x	x	x	x	Observe	Periodically during the study
Household-level variables						
Socioeconomic information	x				Recall	Once, at initial visit
Income by source (agricultural, nonfarm, loans, other types)	x	x	x	x	Recall	Round 1 for prior six months; other rounds for the prior two months
Income by individual earner	x	x	x	x	Recall	Same as above
Food expenditures	x	x	x	x	Recall	Each round for prior seven days
Nonfood expenditures	x	x	x	x	Recall	Each round, flexible period of recall for each of the items
Energy consumption	x	x	x	x	Recall	Each round for prior 24 hours
Water (source, distance)	x				Recall	Once, differentiated by rainy and dry season
Sanitation (presence of latrine)	x				Observe	Once, at initial visit
Agricultural production (inputs by crop, production by crop)	x	x	x	x	Recall	Round 1 for prior growing season; other rounds for prior two months
Storage of crops and agricultural inputs	x	x	x	x	Recall	Each round, report on what is in storage at time of visit
Labor input by crop and task, by household (adult and child), and by hired workers	x	x	x	x	Recall	Same as for agricultural production
Women- and child-level variables						
Reproductive history	x	x	x	x	Recall	Once at initial visit, changes (births and deaths) recorded on subsequent rounds
Age	x	x	x	x	Recall	Once, at initial visit
Time allocation	x	x	x	x	Recall	Each round for prior day
Weight, length, and weight-for-length	x	x	x	x	Actual measurement	Each round
Preschooler energy intake	x	x	x	x	Recall by caretaker	Each round for prior 24 hours
Breastfeeding history and weaning practices	x				Recall by mother	Once, at initial visit, recall of birth to age of weaning
Morbidity patterns	x	x	x	x	Recall	Each round for prior two weeks
Mortality	x	x	x	x	Recall	Once, at initial visit, deaths of any children during survey were recorded

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.

has historically been a grain-producing area supplying basic staples for other parts of Kenya, but since the early 1970s, it has become part of the sugar belt of Kenya.

In 1977, a new sugar factory was established—the South Nyanza Sugar Factory (SONY). The SONY factory obtained approximately 2,500 hectares of land from local landowners to establish the factory and its nucleus estate. The majority of sugar, however, is produced by smallholders under contract to SONY. The outgrowers' program includes 6,000 contract farmers and approximately 6,000 hectares of land. A more detailed description of the sugar scheme is provided in Chapter 3.

Research Design and Sampling

The sampling frame was constructed to mirror the distribution of types of households found in the community as a whole. At the outset of the study, a list of all farmers ever in the outgrowers' scheme was obtained from SONY. From this list, a random sample of sugar farmers, weighted by sublo-

cation, was chosen.[5] Each of the randomly selected households had to meet the following criteria: first, each had to have at least one preschooler in the household; second, each had to have less than 20 hectares of land; and third, each farmer had to be a resident of the area. The presence of a preschooler in the household was important because the government of Kenya was specifically interested in evaluating the impact of the commercialization of agriculture on the nutritional status of preschoolers.

The sugar farmers represent outgrowers in various stages of the scheme. A contract with SONY normally lasts five years and includes a plant crop and two ratoon crops. The first sugar plantings in the area were done in 1978; farmers who planted in the early years of the outgrowers' program were already on their second contract when fieldwork for the current study began in June 1984.

Because the SONY factory is the newest sugarcane scheme in Kenya, the outgrowers' program is still expanding. Thus it provided the opportunity to identify a cohort of farmers prior to entry into the outgrowers' program or prior to their first sugar harvest and to collect baseline information on sociodemographic characteristics and health and nutritional status.

Of the 181 sugar farmers in the study sample, 77 percent had received at least one payment for a sugar crop. This group is called the sugar farmers. Twenty-three percent of the farmers had not yet had a first harvest and had therefore not received payment for any sugar harvest. This group is called new entrants.

The sample of sugar farmers is heterogeneous, permitting assessment of the short- and longer-term effects of the outgrowers' program by looking at farmers in various stages of the scheme. Once a sugar farmer was chosen for the sample, field staff identified the next nearest nonsugar farmers who met the same selection criteria.[6] This approach ensured geographic similarity of sugar and nonsugar farmers. For each sugar contractor, mapping was performed on comparable households of up to three neighbors of which one or two were randomly selected. The research was concerned with the effect of the sugar scheme on the entire area served by the factory. It was, therefore, important to have a representative sample of all types of households, including nonagricultural households.

In addition to a random sampling of farmers, this research is one of only a few studies that provides community assessment of the range of effects of commercial agriculture. On the premise that some of the most dramatic effects of cash cropping may be on households not directly involved in the scheme—the landless and the merchants—it was deemed important to include a sample of nonagricultural as well as agricultural households in the study.

This community-assessment approach has not typically been done in prior studies. Yet it may be the households not directly involved in cash crop production that are most affected. For example, if the new commercial crop is more labor-intensive than the crop it replaces, landless laborers may benefit the most by the transition from semisubsistence to commercial agriculture. If the opposite is true, landless laborers will be adversely affected. Therefore, landless households were randomly selected by doing a restricted area census of all families without land living in the eight small villages of the project area. Two groups emerged from the general category of "landless." First, there was a group of households who owned no land and who had no permanent source of income. These are the types of households who are generally thought of as landless and who for the purpose of this

[5] A sublocation is the smallest administrative unit in Kenya. The SONY factory serves 25 sublocations. Areas closer to the factory have a higher proportion of sugar farmers than areas further out from SONY. For more detailed information, see Bruce Cogill, "The Effects on Income, Health, and Nutritional Status of Increasing Agricultural Commercialization in South-West Kenya" (Ph.D. thesis, Cornell University, 1987).

[6] Nonsugar households also had to have a preschooler, have less than 20 hectares of land, and be resident owners.

study are called "landless." The second group of landless were those households who did not own land but who did have a regular source of income. It includes professionals as well as salaried workers. This group was reclassified as "wage earners."

Finally, a mapping was done of all businesses in the main township—Awendo—and the eight villages in the project area. From these lists, a random sample of local merchants was selected.[7] Many of the merchant households were also involved in agriculture; for the present study, however, a household was defined as "merchant" if the major source of household income was supplied by the business activity.

The composition of the study sample is shown in Table 2. Its distribution is similar to the distribution of types of households in the area as a whole. It is estimated that one-third of the approximately 22,000 households in the community are sugar farmers and 80 percent of all households are involved in agriculture.

The average household size for the sample as a whole—9.9 household members—is large because many households are polygamous. Table 3 shows that the nonagricultural households (merchants, wage earners, and landless) have smaller households, on average, than any of the agricultural groups. This is true even for the number of adult equivalents in the household.

As expected, landholdings in the agricultural households are larger than in the nonagricultural groups. The new entrants and both sugar and nonsugar farmer groups have a similar number of hectares per capita.

Table 2—Composition of the sample

Activity Group	Number in Sample	Share of Sample
		(percent)
Agricultural		
New entrants	42	8.3
Sugar farmers	139	27.6
Nonsugar farmers	231	45.8
Nonagricultural		
Merchants	30	6.0
Wage earners	18	3.6
Landless	44	8.7
Total	504	100.0

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.

Table 3—Characteristics of households in the study sample, 1984/85

Activity Group	Mean Household Size[a]	Number of Adult Equivalents[b]	Percent of Children in Household[c]	Size of Landholding[d]	
				(hectares)	(hectares/capita)
New entrants	9.4	6.2	50.5	5.0	0.59
Sugar farmers	11.1	7.4	52.9	5.6	0.56
Nonsugar farmers	10.2	7.0	52.3	3.7	0.41
Merchants	8.8	5.0	53.0	1.5	0.23
Wage earners	6.6	4.3	50.3	0.5	0.08[e]
Landless	6.6	4.1	52.3	0.4	0.07[e]
Sample mean	9.9	6.6	52.3	3.8	0.41

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: All variables are evaluated at the sample mean. Children are defined as those below 15 years of age.
[a] Sugar and nonsugar farmers have significantly larger households ($p < 0.05$) than landless, and sugar farmers have significantly larger households than wage earners ($p < 0.05$).
[b] Agricultural households are significantly larger at the 0.05 level than nonagricultural households.
[c] No two groups are significantly different.
[d] Farmers have significantly larger landholdings and more hectares per capita at the 0.05 level than nonagricultural households.
[e] Some of the landless have access to council-owned land.

[7] The merchant sample had to meet the same selection criteria as agricultural households.

3

COMPARATIVE ANALYSIS OF MAIZE AND SUGAR CROPPING PATTERNS IN SOUTH NYANZA

Farming Systems Profile

Farming in South Nyanza is dominated by smallholder agriculture with the household providing most of the agricultural labor.[8] Maize is the main staple grown in the project area. All crops are grown under rainfed conditions. There is a bimodal pattern of rainfall with a long rainy season from February to May and a short rainy season from October to December. In 1984 both rainy seasons were delayed by as much as two months.

From 1978 to 1983 rainfall in the project area ranged between 1,515 and 2,032 millimeters with an average for the period of 1,758 millimeters.[9] The research was conducted during 1984, which was a low rainfall period, averaging only 1,202 millimeters for the year. It is important to emphasize that although 1984 was a drought year throughout Kenya, the research area was not severely affected. Rainfall data provided by the Government of Kenya indicate that sufficient rain fell in most of Nyanza province; the total amount of rain was below normal (1,202 millimeters for 1984 versus 1,758 millimeters in a typical year) but still adequate for a good crop.[10] It was the late arrival of the long rain rather than an absolute deficit in rainfall that created a problem. Therefore, although the term *drought* is used throughout the report, in actuality, the situation was one of late arrival and slightly lower rainfall. The reduced rainfall in the area affected agricultural production but not to the extent expected in a drought.

Maize planting for the long-rains growing season is done in February or March, with harvesting in late July or August. Maize planting for the short rains begins in September with a harvest in February.

Table 4 presents a profile of cropping patterns for new entrants, sugar farmers, and nonsugar farmers in the long and short rainy seasons. Although nonsugar farmers often grow some sugar, they have not contracted to sell their sugar to SONY. From these data, nonsugar farmers emerge as having a different cropping pattern from that of sugar farmers. Most notable is the significantly smaller percentage of total farm area devoted to all crops by nonsugar farmers compared to sugar farmers in both seasons. A major part of the difference is due to the growing of sugar under contract, which uses 47.9 percent of total area cropped in the long-rain season.

The larger percentage of land devoted to all crops by sugar farmers is reversed when just food crops are compared. During the long rains, sugar farmers have a significantly smaller share—36 percent—of their land in food crops compared to 52 percent for nonsugar farmers. This pattern is repeated during the short rains. However, given that sugar farmers have larger total landholdings, the absolute amount of land devoted to food crops is almost identical for sugar and nonsugar farmers—2.0 hectares compared with 1.9 hectares.

New entrants, it should be noted, appear to be closer to nonsugar farmers with respect to area under all crops, but when food

[8] "Small farm" is defined as less than eight hectares.

[9] South Nyanza Sugar Company, Agronomy Section, Kenya, 1984.

[10] Coty Pinckney and J. K. Muthaka, "A Summary Report on the Food Situation in Kenya," Ministry of Agriculture, Kenya, July 1984 (mimeographed).

Table 4—Land allocated to specific crops by agricultural households, by season, 1984/85

Description	Long-Rain Season			Short-Rain Season		
	New Entrants	Sugar Farmers	Nonsugar Farmers	New Entrants	Sugar Farmers	Nonsugar Farmers
Farm size (hectares)	5.0	5.6	3.7	5.0	5.6	3.7
Mean number of crops	7.4	10.1	8.8	4.2	5.5	5.3
	(3.3)	(6.9)	(5.5)	(1.7)	(3.0)	(3.1)
Mean number of plots	5.8	7.5	6.6	3.8	4.8	4.6
	(2.3)	(4.6)	(3.8)	(1.6)	(2.5)	(2.6)
Land under all crops (percent)	51.7[a]	66.9[ab]	56.6[b]	54.1[a]	64.7[ab]	45.7[b]
	(28.2)	(28.3)	(29.0)	(31.2)	(28.4)	(27.9)
Land under food crops (percent)	36.4[c]	36.0[b]	52.1[bc]	32.9[c]	28.8[b]	45.0[bc]
	(24.8)	(23.6)	(28.8)	(24.2)	(19.7)	(27.7)
Percent of cropped area						
Local maize, pure stand	11.9	10.4	24.9	33.3	21.7	55.1
Local maize and beans	3.7	3.2	5.1	1.9	2.4	4.4
Local maize and peanuts	4.2	5.3	8.1	n.a.	n.a.	n.a.
Hybrid maize	11.4	6.1	7.7	9.4	8.7	12.9
Hybrid maize and beans	2.7	2.9	3.1	3.5	1.5	2.7
Hybrid maize and peanuts	2.7	2.9	3.3	n.a.	n.a.	n.a.
Sorghum or millet	10.0	8.4	16.6	0.8	3.3	8.5
Finger millet	0.7	1.0	0.5	1.1	0.0	0.0
Cassava	2.7	3.1	6.0	2.3	1.6	2.9
Tobacco	0.0	0.1	0.2	n.a.	n.a.	n.a.
SONY sugar	45.5	47.9	0.0	43.3	48.9	0.0
Other sugar	0.1	0.0	0.0	n.a.	n.a.	n.a.
Sample size	40	132	231	40	132	231

Source: International Food Policy Research Institute, "Survey 1984–85," South Nyanza, Kenya.

Notes: The long-rain season is from February to May; the short-rain season is from October to December. Numbers in parentheses are standard deviations. All variables are evaluated at the sample mean.

Estimates of crop area exclude fallow, pasture, and wooded areas. Multicropped plots are counted once. Only edible crops are included in food crops, although the yield may be sold for cash. Summation of individual crops will be greater than the mean percent of land under food crops because multicropped plots are counted more than once.

Tobacco is only planted during the long rains, and no new sugar plots are planted during the short rains.

[a] The t-test comparison of sugar farmers and new entrants indicates $p < 0.05$.

[b] The t-test comparison of sugar farmers and nonsugar farmers indicates $p < 0.05$.

[c] The t-test comparison of nonsugar farmers and new entrants indicates $p < 0.05$.

crops alone are considered, they have percentages similar to sugar farmers. From this result, it can be deduced that they are actively engaged in cash crop production, although they have not yet received payment for sugar.

When specific crops are examined (Table 4), the greater emphasis on food crops is apparent for nonsugar farmers. More than 50 percent of their cultivated land is under maize in both seasons compared to approximately 30 percent for sugar farmers. Furthermore, nonsugar farmers grow significantly more sorghum, millet, and cassava, crops associated with more traditional diets in the region. Another potentially important factor that may have affected the extent of planting of sorghum, millet, and cassava by more risk-averse nonsugar farmers in 1984 was the early reporting of the severe drought in eastern Africa, although, as already mentioned, the drought turned out to be less severe in South Nyanza.

Maize clearly dominates the cropping pattern for nonsugar farmers. Table 5 summarizes the pure-stand maize production for those households from which data were obtained. The total household farm area de-

Table 5—Production characteristics of local and hybrid maize and sugarcane by agricultural households, long-rain season, 1984/85

Crop Data	New Entrants	Sugar Farmers	Nonsugar Farmers
Local maize[a]			
Sample size	27	102	183
Total area (hectares)	0.4 (0.5)	0.7 (0.7)	0.8 (0.9)
Yield (kilograms per hectare)	962.7 (1,103.0)	864.2 (562.0)	845.2 (661.0)
Amount sold (kilograms per hectare)	101.1 (358.2)	74.1 (189.4)	85.9 (225.4)
Percent of production kept for own consumption[b]	89.5	91.4	89.8
Hybrid maize[a]			
Sample size	19	54	76
Total area (hectares)	0.4 (0.7)	0.4 (0.8)	0.3 (0.5)
Yield (kilograms per hectare)	876.2 (678.4)	990.8 (714.9)	987.5 (949.8)
Amount sold (kilograms per hectare)	124.1 (203.8)	117.4 (318.2)	127.8 (328.9)
Percent of production kept for own consumption[b]	85.8	88.2	87.1
Contracted sugarcane[a]			
Sample size	42	139	232
Total area (hectares)	0.9	1.7	...
Yield (tons per hectare)[c]	no harvest yet	106.0	...
Amount sold (kilograms per hectare)	...	...	...
Percent of production kept for own consumption	0.0	0.0	0.0

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Note: Maize is grown exclusively in these plots; no intercropped plots are included. The numbers in parentheses are standard deviations.
[a] Plots with single-stand crops tend to be larger than mixed-crop plots. Areas here will differ from those in Table 4.
[b] Some of the crops in storage may be sold at a later date.
[c] The sugarcane yield only includes the plant crop for 1984.

voted to single-stand local and hybrid maize tends to be small, ranging from 0.3 to 0.8 hectare. For sugar farmers, a larger parcel of land, on average, is allocated to the major cash crop, sugarcane. The average area of 1.7 hectares for sugarcane is about two-and-a-half to four times larger than the standard maize area.

What is striking from these data are the similarities in food-crop production among different types of households. Maize yields are lower than would be expected in a normal rainfall year. The shortfall in production can be partly explained by the reduced and badly timed rainfall. Yields are similar for both hybrid and local varieties suggesting little additional advantage in using the purchased hybrid varieties, although it is difficult to know what additional effect the adverse climatic conditions had on the performance of hybrid maize. Most of the maize, both local and hybrid, is kept for home consumption, suggesting that food security is a major household concern.

Adverse climatic conditions are but one reason for low yields. Overall use of inputs is low. Table 6 shows the average utilization of fertilizer per hectare for the major food

Table 6—Fertilizer use by crop, long-rain season, 1984/85

Crop	Total Area Under Production[a]	Area Fertilized		Total Fertilizer Use	Mean Fertilizer Use/Hectare of Total Crop Area	Mean Fertilizer Use/Area Fertilized
	(hectares)		(percent)	(kilograms)	(kilograms/hectare)	
Local maize	298	3	1.0	56	0.18	18.7
Hybrid maize	144	21	14.6	248	1.67	11.8
Sorghum	108	2	1.9	67	0.62	33.5
Peanuts	80	1	1.3	35	0.44	35.0
Tobacco	27	19	70.0	2,038	75.50	108.0
Sugar	251	226	90.0	38,602	154.80	170.8

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
[a] Area is based on estimates for sample households only.

crops and cash crops. The average amount of fertilizer used for local maize is only 0.18 kilogram per hectare; 84 percent of sugar farmers and 94 percent of nonsugar farmers use no inorganic fertilizer for local maize.

The average fertilizer use per hectare is misleading given the large number of farmers who use none at all. As shown in Table 6 for local maize, sorghum, and peanuts, only 1-2 percent of cultivated land receives any fertilizer. Where any fertilizer is used, the mean amount used per hectare of fertilized land is substantially different (12 to 35 kilograms, depending on the crop) from the average amount used on total cropped area (0.18 to 0.62 kilograms, depending on the crop). The percentage of cultivated area that is fertilized is dramatically larger for the two main cash crops: 90 percent of sugarcane and 70 percent of tobacco are fertilized.

Soil quality differences may also influence the yields of various crops. Data from this survey indicate that about 64 percent of plots growing sugarcane are ranked by farmers as good quality soil; this is in contrast to other crops where only 47 percent of the plots are ranked as good.

Labor is the major input used for most crops. As Table 7 shows, labor inputs differ between sugar- and nonsugar-growing

Table 7—Total household labor and hired labor for major crops, long-rain season, 1984/85

Crop	New Entrants		Sugar Farmers		Nonsugar Farmers	
	Household Labor	Hired Labor	Household Labor	Hired Labor	Household Labor	Hired Labor
			(man-days/hectare)			
Local maize	145	4	147	8	148	8
Hybrid maize	164	4	110	22	188	15
Sorghum	109	2	161	5	169	6
Peanuts	215	2	191	7	196	18
Beans	127	1	111	11	147	13
Tobacco	211	2	349	40	419	10
Sugar[a]	109	50	90	32	96	31
Total man-days per hectare (all crops)	1,080	65	1,159	125	1,363	101

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: One man-day equals eight hours. Child labor equals one-half adult labor.
[a] Sugar includes contract and noncontract sugar. It is not restricted to the long-rain period.

households. For local maize, sorghum, and peanuts, the amount of household and hired labor is similar. However, for hybrid maize and tobacco (crops commonly thought of as cash crops), the sugar households consistently use less household and total labor per hectare but about 25 percent more hired labor than nonsugar farmers.

Many of the functions required for sugarcane production are carried out by the factory at a cost to the farmer. The charges for each of these services are listed in Table 8. Weeding and harvesting of the plant crop accounted for 1,516 Kenyan shillings (KSh), most of which was the cost of factory-provided wage labor. At a 1980 wage rate of KSh 12 per day, this amounts to 126 days of hired labor per hectare generated as a result of sugarcane production. Thus the total demand for wage labor by sugar producers is 32 days of labor per hectare hired directly by the farmer and 126 days of occasional labor provided and charged for by the factory. The amount of factory-provided labor implies that wage-earning opportunities for the landless in the area served by the sugar scheme are substantial.

For each of the food crops, the allocation of household labor is much higher than that shown for sugarcane (Table 7). A 24-month plant crop cycle for sugarcane requires about 90 days of household labor. A similar 24-month cycle of four maize crops would require 510 days of household labor. The level of household labor in sugar farming is low due to the mechanized nature of the outgrowers' program. Because many tasks, such as land clearing, planting, and harvesting, are done by the factory, the need for household labor is substantially reduced. If these tasks were not mechanized or not done by the factory, household labor input would have to be about 50 percent higher than it currently is.[11]

Household labor in most cases is not fungible between the sugarcane crop and food crops; women are responsible for many of the tasks involved in producing food crops, whereas men have responsibility for the cash crops.[12] The amount of household, hired, and total labor going into the major food crops is virtually identical across the different agricultural households. Although the study does not have agricultural labor data disaggregated by gender, information was collected on time allocation patterns for women. As shown in Table 9, the amount of time spent in all farming tasks, excluding sugar, is similar for women from sugar and nonsugar-producing households. Moreover, women from sugar-producing households do not, on average, provide much labor for the sugarcane crop.

Sugarcane Production Costs, Yields, and Income

Kenya became self-sufficient in sugar for the first time in 1979. In 1980 and 1981, there was a small exportable surplus of sugar. However, by the mid-1980s, Kenya was again unable to meet the domestic demand for sugar. The current goal of the Kenyan government is to increase sugar production to at least cover domestic needs.

Smallholders are the primary source of sugarcane in Kenya. Small-farmer production of sugarcane increased from 30.2 percent of total supplies in 1976 to 44.4 percent in 1980. It is expected that the prominent role of the small farmer in sugarcane production will continue.

Most of the sugarcane production occurs in the Lake Victoria Basin area in Western and Nyanza provinces. The SONY factory, the newest sugar factory in Kenya, is located in the South Nyanza district of Nyanza Province, and has been in operation since 1978.

When the SONY factory was first built, 2,500 hectares were acquired from local farmers to provide factory-owned land for sugar production. These 2,500 hectares compose what is called the nucleus area of the sugar estate. In addition, the factory has developed an outgrowers' program where

[11] For estimates of average labor requirements for mechanized and nonmechanized sugarcane cultivation, see Republic of Kenya, *Soils of Kisii* (Nairobi: Government Printer, 1982).

[12] The one exception is land preparation for food crops, which is typically done by men in the household.

Table 8—Summary of the costs of factory inputs per hectare of sugarcane, by task

Task	Total Sample		Sample Excluding Those Who Had Zero Input Cost	
	Cost	Number of Plots	Cost	Number of Plots
	(Ksh)		(Ksh)	
Clearing land	848	189	1,020	157
Survey	48	188	50	180
Grading	10	184	240	8
Plowing	623	191	657	181
Harrowing	44	175	586	13
Furrowing	154	192	170	174
Intercultivation	50	184	329	28
Seed	1,571	188	1,604	184
Planting	19	184	354	10
Fertilizer				
Plant crop	1,058	177	1,232	152
Ratoon 1	745	87	887	73
Ratoon 2	411	42	785	22
Pesticide				
Plant crop	8	182	306	5
Ratoon 1	19	87	0	...
Ratoon 2	0	42	0	...
Weeding				
Plant crop	176	183	895	36
Ratoon 1	101	87	516	17
Ratoon 2	327	43	1,004	14
Harvesting				
Plant crop	1,340	174	1,371	170
Ratoon 1	779	85	860	77
Ratoon 2	702	42	757	39
Transportation				
Plant crop	3,942	174	4,132	166
Ratoon 1	2,300	85	2,539	77
Ratoon 2	2,324	42	2,440	40
Administration				
Plant crop	624	174	642	169
Ratoon 1	429	85	480	76
Ratoon 2	388	42	417	39
Interest				
Plant crop	1,110	174	1,143	169
Ratoon 1	282	85	311	77
Ratoon 2	151	43	202	32
Other				
Plant crop	361	178	613	105
Ratoon 1	359	86	630	49
Ratoon 2	112	42	364	13
Total cost of factory inputs per hectare				
Plant crop	12,031	174	...	...
Ratoon 1	5,030	85	...	...
Ratoon 2	4,400	42	...	...

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Note: 1980 is used as the base year.

Table 9—Time allocation of women

Women in Activity Group	Hours Away From Home[a]	Weeding[a]	Total Farming Excluding Sugar[a]	Child Care[b]	Sugar[c]
			(hours/day)		
New entrants N = 193	3.7	1.4	3.3	2.0	0.2
Sugar farmers N = 752	3.5	1.1	3.2	1.8	0.2
Nonsugar farmers N = 1,156	3.5	1.3	3.3	1.9	0.0
Merchants N = 106	1.1	0.1	0.7	1.2	0.0
Wage earners N = 62	2.2	0.8	2.1	1.5	0.1
Landless N = 160	2.5	0.5	1.8	1.4	0.2
Sample mean N = 2,429	3.3	1.1	3.0	1.8	0.1

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: Time allocation data are based on recall of time spent on the previous day's activities. Recall was reported a maximum of four times, and all four rounds were averaged. N equals number of observations.
[a] Women in agricultural households spent significantly more time on this activity at the 0.05 level than women in other types of households.
[b] New entrants and nonsugar farmers spent significantly more time on this activity at the 0.05 level than merchants.
[c] Sugar farmers spent significantly more time at the 0.05 level than nonsugar farmers.

farmers produce sugarcane and sell the commodity directly to the factory. Currently, 6,000 hectares are cultivated under the outgrowers' program.

The outgrowers' program at SONY is similar to outgrowers' programs in other sugar schemes throughout Kenya. Farmers are under contract to the factory, which agrees to purchase sugarcane from the outgrowers at the price prevailing at the time of harvest.

The normal cycle for sugarcane in the SONY area involves a plant crop and two ratoon crops. The time between planting and harvest is 22-24 months for the plant crop and 18-19 months for each ratoon.

For a fee, the factory provides a variety of services to the farmer. Typically, the factory will survey the farmland to identify the acreage most suitable for sugarcane production. In addition, the factory may also clear the brush, prepare the land, provide seed and fertilizer, plow, weed, cut the cane, and transport the final crop. The extent to which the factory provides these services varies depending on the individual needs of the farmer and the availability of inputs from the factory. Since 1983, the SONY factory has implemented the "self-development" scheme, which requires the farmer to provide a greater proportion of the crop inputs. For example, new farmers wishing to participate in the outgrowers' program now have to clear the land themselves or have a cleared plot of land available. So, while the factory has historically supplied most of the crop inputs, this pattern has been changing in recent years. The charge for each of the factory-provided services includes an interest charge applied to each service and an administrative levy, which is deducted from the final payment for the sugarcane crop. A description of the cost of factory inputs is provided in Table 8. The overwhelming portion of sugar crop inputs are supplied by the factory at a ratio of approximately 10:1.

Table 10 summarizes cost,[13] yields, and income per hectare for each of the three

[13] All cost information is in constant Kenyan shillings using 1980 as a base year.

Table 10—Summary of sugar yield, income, and inputs per hectare, by harvest, 1978-84

Yield/Income/Inputs	Plant Crop	Ratoon 1	Ratoon 2
Yield per hectare (metric tons)	103	63	54
Total cost of factory inputs per hectare (KSh)	12,031	5,030	4,400
Total cost of contract inputs per hectare (KSh)	1,097	519	469
Total number of days of family labor[a]	88	68	83
Total net income per hectare (KSh)	4,316	4,517	4,506
Total net income per hectare per month (KSh)	176	231	237
Ratio of factory inputs to gross returns per hectare	0.74	0.47	0.49
Total net income per hectare per day of family labor (KSh)	49	66	54
Total net income per hectare per estimated days of family labor[b] (KSh)	59	84	83
Sample size (number of plots)	175	86	42

Source: Records provided by the South Nyanza Sugar Company.
Notes: All cost data are in real terms in Kenyan shillings; 1980 is the base year.
[a] The average number of family days is imputed for households with missing labor data.
[b] Number of labor days is based on Government of Kenya labor estimates (see Kenya, *Soils of Kisii* [Nairobi: Government Printer, 1982]).

harvests. The total cost of factory inputs for the plant crop is approximately two-and-one-half times the input charges for the ratoon crops. Two factors account for this dramatic difference in input costs. First, many of the factory charges are on a one-time basis only, land clearing, surveying, grading, plowing, harrowing, furrowing, intercultivation, seed cane, and planting, for example. The cost of these inputs and services are recouped from the first harvest.[14] Second, yields generally decrease between the first, second, and third harvests; thus, the cost of any input that is based on tonnage—such as harvesting or transportation—decreases from the first to the third harvest.

This pattern of decreasing yields is consistent with data from the sugar factory management. For a well-maintained crop, the factory expects to see a 15 percent decrease in yield between plant crop and first ratoon and an additional 15 percent decrease between the first and the second ratoon. The data in Table 10, however, show a 40 percent decrease in yield between the plant crop and the first ratoon—higher than the yield decreases seen on the factory experimental plots. The low yields in the first ratoon crop may be due to a number of factors, including suboptimal use of fertilizer. Yields on the plant crop may not be affected by inadequate fertilizer use, but the yields on ratoons will be substantially less if fertilizer is not applied.[15]

It may seem surprising that farmers use less fertilizer than is optimal given that fertilizer is usually available from the factory. The choice to use it is left entirely up to the farmers, however. In addition, there were periods in late 1983 and 1984 when fertilizer was not readily available from the factory.

[14] In some cases, the factory splits the charge for land clearing between the plant crop and first ratoon.
[15] Based on data provided by SONY Factory, Agronomy Section, Kenya, 1985.

The net income per hectare is fairly stable across the three harvests despite the large drop in yields. This is due primarily to the concurrent decrease in total costs of inputs per hectare. The ratio of factory inputs to gross income decreases from 0.74 for the plant crop to 0.47 and 0.49 for the ratoon crops.

The net income per hectare per month of production and the net income per hectare per day of family labor are positive for each of the three harvests. The daily agricultural wage rate in the area during the study period was approximately KSh 16, or KSh 12 in 1980 figures. Data in Table 10 show that the returns to household labor from sugarcane using 1980 shillings are four to five times higher than the daily agricultural wage rate. Similar, although higher, net returns to household labor are obtained if the government's estimate of average family labor for sugarcane production is used.

The data in Table 10 indicate that, on average, sugar farmers are earning a return to family labor that is substantially better than an equivalent time spent as an agricultural wage laborer. However, these aggregate data mask year-to-year variations in yields and income. Table 11 presents input, yield, and income information broken down by year of planting: late 1979 and 1980 were particularly bad periods for planting because of the limited rainfall in the area. These adverse climatic conditions affected yields, which in turn influenced income. The net returns per hectare per day of family labor for 1979 and 1980 were lower than normal but still twice the daily agricultural wage rate. The significant increase in net income between 1980 and 1981 plantings are due to an increase in yield, an increase in the cane price, and a decrease in cost of factory inputs.

The majority of farmers in the outgrowers' program are not experiencing losses; 91.8 percent of the sample received some positive income. However, the percentage of farmers with losses varies by year, with a high of 20 percent for the 1982 harvest and a low of 7 percent for the 1984 harvest. Most farmers in the sample—93.4 percent—remain in the outgrowers' program.[16] Even farmers who have one debit crop usually remain and go on to achieve a positive income from subsequent sugar crops.

There is no significant difference in either yield or income between smaller and larger farmers.[17] The results presented in Table 10 indicate that the net returns per hectare of land and the net returns per hectare per day of family labor are positive and stable across the three harvests. In addition, the net returns to family labor are significantly higher than the daily wage rate for agricultural labor. This may seem surprising given the volatility in the world price of sugar during the period 1979-84. However, the government of Kenya has adopted a protectionist policy with regard to prices paid for sugarcane. Since 1979, there has been a consistent increase in both the nominal and real price paid to smallholders for sugarcane. If the government had used the world price of sugar as a benchmark for establishing the producer cane price, the profitability of sugarcane production in Kenya would be very different. A reanalysis of the data from Table 10 using the average International Sugar Agreement price for 1979-84, shows that in three out of the five years, net returns to land and labor would have been negative. The current sugarcane pricing policy has worked to the advantage of the sugar producer. This is most likely a major reason why 93.4 percent of the study plots planted with sugarcane have remained in the outgrowers' program.

National data suggest that sugarcane is replacing maize on most of the plots that are now in the outgrowers' scheme.[18] Data from the present study support this conclusion; 95.2 percent of the plots now used

[16] The random sample of farmers was chosen from contract identification numbers given to farmers upon signing a contract. Some of these farmers dropped out of the scheme.

[17] See Eileen T. Kennedy and Bruce Cogill, "A Sugarcane Outgrowers' Scheme in Kenya: The Case of SONY," International Food Policy Research Institute, Washington, D.C., February 1987 (mimeographed).

[18] Republic of Kenya, *National Food Policy Paper.*

Table 11—Summary of yield and income from sugar, by harvest and by year of planting, 1978-82

Year of Planting	Yield/ Hectare	Number of Plots	Total Net Income/ Hectare	Total Net Income/ Hectare/Day of Family Labor
	(metric tons)		(1980 KSh)	
1978				
Harvest 1	112	33	4,005	46
Harvest 2	62	31	4,021	59
Harvest 3	56	26	4,354	52
1979				
Harvest 1	98	28	2,146	24
Harvest 2	67	24	4,724	69
Harvest 3	50	14	4,551	55
1980[a]				
Harvest 1	88	35	2,485	28
Harvest 2	60	29	4,783	70
Harvest 3	57	2	6,185	75
1981				
Harvest 1	109	22	6,376	72
Harvest 2	54	2	5,894	87
Harvest 3	n.a.	n.a.	n.a.	n.a.
1982				
Harvest 1	106	53	5,775	64
Harvest 2	n.a.	n.a.	n.a.	n.a.
Harvest 3	n.a.	n.a.	n.a.	n.a.

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: All income is in real terms, using 1980 as a base year. n.a. indicates not available.
[a] 1980 was a drought year.

for sugarcane were planted in maize immediately prior to the outgrowers' scheme. Moreover, 57.1 percent of the study farmers in the outgrowers' scheme indicated that they have decreased the amount of land devoted to food crop production since they joined the program. However, the absolute area planted in food crops is almost identical for sugar and nonsugar producers. While it appears that subsistence production of basic staples has not been affected by sugar production, the amount of marketed surplus, particularly of maize, has probably decreased. This apparent food crop-cash crop trade-off could potentially affect local and national food availability.

Comparative Analysis of Food Crops Versus Sugar

The data on sugarcane yields and returns suggest that sugar production is profitable for the small farmer. Here the net returns to land and labor for alternative crops are analyzed with specific focus on maize because this appears to be the crop competing most heavily with sugarcane.

In Table 12 net returns for maize and sugar are compared. Because the cost data on sugar reflect a multiyear period and were all converted to 1980 figures, all cost information in this section is also presented in 1980 shillings. The sugar crop planted in 1982 and harvested in 1984 is compared to the maize crop harvested in 1984. The total net returns per hectare of land are similar for sugar and maize. However, given the significantly lower household labor input into sugar, the net income per hectare per day of family labor is dramatically higher for sugarcane (KSh 64) than for maize (KSh 10). The returns per day of family labor from sugar are substantially above the daily agricultural wage rate of KSh 12 at the 1980 rate, but for the actual 1984 returns to labor from maize, the opposite is true. The average return per day of family labor is lower

Table 12—Net returns for sugar and local maize, 1984

Income/Labor	Sugar	Local Maize	
	1982 Planting/ 1984 Harvest	Based on 1984 Actual Yield	Based on a Hypothetical Medium Yield
		(KSh 1980)	
Total net income per hectare	5,775	4,988	9,920
Number of days of family labor per hectare for 24 months	90	510	510
Total net income per hectare per day of family labor	64.0	9.8	19.5
Total net income per hectare per month	241	208	413

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: 1980 is used as the base year for all cost calculations for sugar and maize. All cost data are in constant Kenyan shillings, rounded to the nearest shilling.
Income calculations are based on the assumption that there are four maize harvests in a two-year period. Labor days are an average of household labor inputs in the long- and short-rain seasons.
A medium yield is about 2,000 kilograms per hectare.

than the agricultural wage rate. If the returns to labor for a medium-yield harvest are compared, the average return per day of family labor for maize is above the average agricultural wage rate.

The net returns per hectare per month are similar for maize and sugar. This comparison is based on the assumption that during the 24-month period in which the sugarcane plant crop is in the ground, the farmer has the equivalent of four maize harvests.

Because the comparison in Table 12 is somewhat distorted in that a drought maize crop is compared to a nondrought sugar crop, the data are reanalyzed to compare a drought sugar crop (1980 planting year) to the current 1984 drought maize crop (Table 13).[19] The net income per hectare is now substantially less for sugarcane than for maize. However, even with the lower income per hectare for sugar, the returns per day of family labor are still higher for sugarcane than for maize. The returns to household labor for the sugar crop are still above the daily agricultural wage rate and the returns to household labor for sugar are still

Table 13—Net returns for a drought-year sugarcane crop, 1980, compared with a drought-year maize crop, 1984

Income/Labor	Sugar Based on 1980 Planting, 1982 Harvest	Local Maize Based on 1984 Actual Yield
	(KSh 1980)	
Total net income per hectare	2,485	4,988
Number of days of family labor per hectare for 24 months	90	510
Total net income per hectare per day of family labor	27.60	9.80
Total net income per hectare per month	103.50	208.00

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Note: Figures for sugarcane are based on the plant crop only, not on the ratoon crops.

[19] Drought will have the most disastrous effects on sugar in the early months after planting.

three times higher than for maize.

Because sugarcane production data are available for 1980-84, it is possible to capture the interyear variation in yields and incomes. In order to capture the same interyear variation in maize returns, maize is analyzed for the period 1980-84 (Table 14). Given the climatic conditions, it is assumed that yields per hectare were average (2,000 kilograms per hectare) for 1981-83 and low for 1980 and 1984.[20]

The analysis presented thus far has been based on the official producer prices of the government of Kenya. Much of the maize in the project area is traded in small quantities and sold for the prevailing market price. Table 14 also compares the official trading price to the high, low, and average trading prices in the local market. The local market price data were collected as a routine part of the survey every two weeks for the period June 1984 to March 1985 and deflated to 1980 prices. Not surprisingly, given that 1984 was a drought year, there is a fair degree of volatility in the average trading price in the local market (more than a twofold difference between high and low maize prices for 1984).

Table 14 also reexamines the gross margins using local market prices. In contrast to Table 12, if all the maize produced by the household were traded at the average market price, the net return per hectare for maize would be higher than for sugar. This finding is somewhat unusual. In many parts of the world, returns to land for sugar are substantially higher than for maize. Two factors account for the superior profitability of maize per hectare compared to sugarcane. First, the growing period for sugarcane is long, averaging 22-24 months for the plant crop and 18-19 months for the ratoon crops. Second, the bimodal pattern of distribution of rain makes it possible to have two maize harvests during a 12-month period. These two factors combine to make returns per hectare for maize quite attractive in the project area. However, the returns per household day of labor are still superior for sugar compared to maize for the multiyear period.

The analyses presented in Tables 12 to 14 are fairly robust. Regardless of whether sugarcane is compared to actual maize yields for 1984, a five-year average for 1980-84, or a drought year for maize, returns to household labor are in all cases substantially

Table 14--Comparison of returns to land and household labor for maize and sugarcane, 1980-84

Returns	Sugar 1980-84	Maize, 1980-84[a]			
		Official Price	Unofficial Price		
			Low	High	Average
Average net income per hectare (KSh)	4,648[b]	7,996	7,738	10,989	11,606
Number of days of family labor per hectare	90	510	510	510	510
Net income per hectare per day of household labor (KSh)	52	16	15	39	23
Total net income per month (KSh)	194	333	322	833	484

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: All income calculations are converted to 1980 shillings and rounded to the nearest shilling.
[a]Maize figures are based on average yields of 2,000 kilograms per hectare for 1981-83 and on low yields for 1980 and 1984.
[b]This is the weighted average of plant and ratoon crops for 1980-84.

[20] 1984 actual production data were used to reflect low yields per hectare. Average yield estimates for maize were based on government of Kenya data. These yield estimates may overstate actual maize yields in nondrought years.

higher than those for maize. Similarly, for maize, regardless of the method of analysis, returns to land are greater than or equal to returns to land for sugar.

At this time in South Nyanza, labor is more of a constraint to production than land. Presumably households will want to optimize returns per day of family labor. In this respect sugarcane production is quite attractive. In the longer term, with current rates of population growth and migration into the area, land may become more constrained. Returns to land for cropping alternatives will then be more important.

4

INCOME AND EXPENDITURE

Proponents of a strategy advocating the commercialization of agriculture have assumed that incomes of farmers would increase if they switched all or part of their land to cash crop production. Although higher income is only one of a series of household objectives, it is clearly an important one. This chapter examines the effects of sugarcane production on income and expenditure patterns.

Table 15 shows the distribution of income and total expenditures per capita among the study households. Keeping in mind that 1984 was a year with lower rainfall than normal, incomes of households in the community may also be lower. One would expect, however, that agricultural households—sugar- and nonsugar-producing—would have been affected equally by the poor climatic conditions. Moreover, the main interest in this study is the comparison of relative incomes across groups; lower-than-usual absolute incomes are not a major concern for the comparison.

Sugar farmers have significantly higher incomes per capita than either nonsugar farmers or the landless. Since the new entrants to the sugar scheme have yet to receive payment for a sugar crop, their incomes per capita are similar to those of nonsugar farmers.

A similar pattern emerges for most groups when total expenditures per capita are used as a proxy for income. Expenditures per capita are higher (although not significantly so) for sugar farmers compared with new entrants or the nonsugar-growing households. However, there is a marked difference—almost twofold—between income per capita and expenditure per capita for the merchant households. This implies a gross underreporting of incomes by the merchant group, which is not surprising given that merchants' nonagricultural income is likely to be taxed. There is, therefore, an incentive to underreport actual income. The same may be true for landless households with a high proportion of wage income.

Table 16 presents a breakdown of income per capita by source. There are several items to note: first, all of the agricultural households have significantly higher in-

Table 15—Total annual income and expenditures per capita, by activity group, 1984/85

Activity Group	Mean Income	Mean Total Expenditures	Sample Size
	(KSh)		
New entrants	1,956	2,454	42
Farmers with sugar income	2,591[a]	2,756	139
Nonsugar farmers	1,924	2,595	231
Merchant	2,209	4,177[b]	29
Wage earners	2,037	2,183	18
Landless	1,290	1,963	43
Total sample mean	2,077	2,648	502

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: Total income includes marketed agricultural income, agricultural production used for own consumption, and nonfarm income. Total expenditures include all expenditures on food (purchased and home produced) and on nonfood items. KSh 16 = U.S. $1.00.
[a] Farmers with sugar income have significantly higher income than nonsugar farmers and landless at the 0.05 level.
[b] Merchants have significantly higher expenditures than any other group at the 0.05 level.

Table 16—Mean annual income per capita per year, by source for activity groups, 1984/85

Activity Group	Agricultural Income Per Capita: Used for Own Consumption		Agricultural Income Per Capita: Marketed		Nonagricultural Income		Percent of Female-Controlled Income	Sample Size
	(KSh)	(percent)	(KSh)	(percent)	(KSh)	(percent)		
New entrants	728[a]	37	404	21	824	42	56.5[d]	42
Sugar farmers	748[a]	29	942[b]	36	901	35	50.5	139
Nonsugar farmers	822[a]	43	393	20	709	37	58.5[d]	231
Merchants	51	2	17	1	2,141[c]	97	12.8	29
Wage earners	171	8	45	2	1,821[c]	90	18.6	18
Landless	163	13	48	4	1,079	83	37.7	43
Total sample mean	669	32	482	23	926	45	50.4	502

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Note: KSh 16 = U.S. $1.00.
[a] All agricultural households have significantly higher income per capita from agricultural production used for own consumption than other household groups at the 0.05 level.
[b] Sugar farmers have significantly higher marketed agricultural income per capita than all other groups at the 0.05 level.
[c] Merchants and wage earners have significantly higher nonfarm income per capita than other groups at the 0.05 level.
[d] Nonsugar farmers have significantly more female-controlled income than all other groups except new entrants; all agricultural households have a greater percentage than nonagricultural households. Female-controlled income includes nonfarm income and all agricultural income controlled by women, including the estimated value of household food consumption from own production.

come from production used for own consumption than merchant, wage earner, or landless households. A long-standing criticism of commercial agriculture has been that the amount of food available for home consumption is drastically decreased when households become cash crop producers. The data in Table 16 suggest this is not true. The income per capita used for own consumption is remarkably similar among the different types of agricultural households.

Income from agricultural sales is significantly higher for sugar farmers than for either the nonsugar or the new entrant households. The agricultural sales income per capita for sugar farmers is two to two-and-a-half times higher than that of nonsugar farmers. Much of this difference is due to the income from sugar production; KSh 400 out of KSh 942, or approximately 42 percent, of marketed farm income is contributed by sugarcane.

To present this in another way, sugar farmers earn approximately KSh 550 per capita more from commercial agricultural income than nonsugar farmers; of this amount, 73 percent is contributed by sugar. Sugar income makes a substantial contribution to household income.

Income from marketed surplus is similar for the new entrants and nonsugar farmers. Nonsugar farmers have agricultural sales income per capita of 20 percent, and new entrants, 21 percent. In contrast, 36 percent of total income of sugar farmers comes from agricultural sales.

Data from Table 16 show that the percentage of income controlled by women is significantly less ($p < 0.05$) in sugar-producing than in nonsugar-producing households. However, given that total household income is higher for sugar producers, women from sugar-growing households control a higher absolute amount of income than women from nonsugar-producing households. All women in agricultural households—whether sugar- or nonsugar-producing—control a significantly ($p < 0.05$) higher percentage of income than women from nonagricultural households.

Table 17—Annual food and nonfood expenditures per capita, by activity group, 1984/85

Activity Group	Nonfood		Food	
	Expenditure[a]	Average Budget Share[b]	Purchased Plus Own Production[c]	Average Budget Share[b]
	(KSh/capita)	(percent)	(KSh/capita)	(percent)
New entrants	883	36	1,571	64
Sugar farmers	1,166	42	1,590	58
Nonsugar farmers	953	37	1,642	63
Merchants	2,824	68	1,353	32
Wage earners	925	42	1,258	58
Landless	736	37	1,227	63
Sample mean	1,094	41	1,556	59

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
[a] Merchants have significantly higher nonfood expenditures than all other groups at the 0.05 level.
[b] Average budget shares are a percentage of total expenditures.
[c] No two groups are significantly different.

Table 17 presents a breakdown of expenditures per capita and average budget shares devoted to food and nonfood. It shows no significant differences in the mean amounts per capita spent on food among the different groups. At 32 percent, the average budget share allocated to food is lowest for the merchants. Nonsugar farmers and new entrant households allocate approximately the same amount of their overall budget to food, and sugar farmers allocate a slightly smaller percentage (58 percent) to food than other agricultural households (about 63 percent).

In Table 18 food expenditures are disaggregated by food purchased versus food consumed from own production. Agricultural households, whether sugar- or nonsugar-producing, allocate approximately the same proportion to food purchases. The merchants, the wage earners, and the landless obviously allocate a greater proportion of their food budget to food purchases because they have less land (or, in some cases, no land) on which to grow food.

When per capita food expenditures are broken down into major food groups, mean expenditures per capita are similar among

Table 18—Annual expenditures on and shares of purchased versus own-produced food, by activity group, 1984/85

Activity Group	Food Purchased		Own Production of Food	
	Cost	Percent	Cost	Percent
	(KSh/capita/year)		(KSh/capita/year)	
New entrants	843	54	728	46
Sugar farmers	843	53	747	47
Nonsugar farmers	820	50	822	50
Merchants	1,302	96	51	4
Wage earners	1,087	86	171	14
Landless	1,065	87	162	13
Sample mean	887	57	669	43

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Note: Purchased and own-produced food expenditures are given as a percentage of total food expenditures.

Table 19—Total food expenditures per capita per year and average budget share, by major food group, 1984/85

Major Groups	New Entrants	Sugar Farmers	Nonsugar Farmers	Merchants	Wage Earners	Landless	Mean
			(KSh/capita/year)				
Cereals and grains							
Expenditures	505.0	478.0	502.0	418.0	459.0	459.0	485.0
Mean budget share	20.6	17.4	19.3	10.0	21.0	23.0	18.3
Roots and tubers							
Expenditures	111.0	133.0	142.0	30.0	66.0	56.0	120.0
Mean budget share	4.5	4.8	5.6	0.7	3.0	2.9	4.5
Pulses							
Expenditures	100.0	106.0	91.0	27.0	29.0	28.0	84.0
Mean budget share	4.1	3.9	3.5	0.7	1.3	1.4	3.2
Vegetables							
Expenditures	126.0	137.0	153.0	119.0	120.0	117.0	140.0
Mean budget share	5.1	5.0	5.9	2.9	5.5	5.9	5.3
Fruits							
Expenditures	106.0	73.0	75.0	24.0	37.0	56.0	71.0
Mean budget share	4.3	2.7	2.9	0.6	1.7	2.9	2.7
Fish							
Expenditures	91.0	97.0	97.0	85.0	91.0	97.0	96.0
Mean budget share	3.7	3.5	3.7	2.0	4.2	4.9	3.6
Meat							
Expenditures	128.0	126.0	124.0	172.0	118.0	111.0	126.0
Mean budget share	5.2	4.6	4.8	4.0	5.4	5.7	4.8
Milk/dairy							
Expenditures	108.0	109.0	103.0	159.0	86.0	103.0	108.0
Mean budget share	4.4	3.9	3.9	3.8	3.9	5.2	4.1
Fats and oils							
Expenditures	84.0	83.0	72.0	104.0	69.0	75.0	78.0
Mean budget share	3.4	3.0	2.8	2.5	3.2	3.8	2.9
Sugar							
Expenditures	115.0	107.0	104.0	101.0	117.0	101.0	105.0
Mean budget share	4.7	3.9	4.0	2.4	5.4	5.1	3.9

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: Not all food groups are included. Food expenditures per capita are rounded to the nearest shilling. Average budget shares are a percentage of total expenditures.

all types of households for most food groups (Table 19). There are exceptions, however. The landless spent a larger share of total food expenditures on cereals and grains than other households, and merchants a smaller share.

The distribution of nonfood expenditures per capita among major nonfood budget categories is shown in Table 20. As with food expenditures, the average budget share allocated to the different nonfood expenditure groups are similar for most items, but there are some exceptions. Merchants and sugar-producing households spent a greater absolute amount and a greater share of income on housing and education.

The expenditure data presented for sugar farmers in Table 20 are corroborated by other qualitative data on expenditures. Farmers who had completed a first contract were asked to identify the major expenditure categories for which sugar income was used. Farmers were most likely to spend income from both the first and second sugar harvests first on housing, then on school fees.

The discussion thus far has focused primarily on the differences in income and expenditures among different types of agricultural households. However, nonagricultural households may also be affected by the existence of the sugar scheme. The data

Table 20—Nonfood expenditures per capita per year for major categories, by activity group, 1984/85

Nonfood Budget Items	New Entrants	Sugar Farmers	Nonsugar Farmers	Merchants	Wage Earners	Landless
			(KSh/capita/year)			
Housing						
Expenditures	31.0	135.0	39.0	617.0	56.0	63.0
Mean budget share	1.3	4.9	1.5	14.8	2.6	3.2
Fuel and light						
Expenditures	80.0	90.0	98.0	202.0	161.0	164.0
Mean budget share	3.3	3.3	3.8	4.8	7.4	8.4
Clothes						
Expenditures	127.0	163.0	132.0	224.0	187.0	102.0
Mean budget share	5.2	5.9	5.1	5.4	8.6	5.2
Supplies and household goods						
Expenditures	76.0	94.0	73.0	70.0	69.0	76.0
Mean budget share	3.1	3.4	2.8	1.7	3.2	3.9
Health expenses						
Expenditures	49.0	56.0	137.0	97.0	24.0	37.0
Mean budget share	2.0	2.0	5.3	2.3	1.1	1.9
Public transport						
Expenditures	54.0	117.0	70.0	178.0	58.0	59.0
Mean budget share	2.2	4.3	2.7	4.3	2.7	3.0
Bicycles						
Expenditures	88.0	9.0	27.0	468.0	123.0	2.0
Mean budget share	3.6	0.3	1.0	11.2	5.6	< 0.1
Education						
Expenditures	71.0	93.0	70.0	145.0	67.0	43.0
Mean budget share	2.9	3.4	2.7	3.5	3.1	2.2
Family events						
Expenditures	26.0	35.0	38.0	66.0	13.0	36.0
Mean budget share	1.1	1.3	1.5	1.6	0.6	1.8
Land bought and rented						
Expenditures	7.0	5.0	4.0	1.0	0.0	0.0
Mean budget share	0.3	0.2	0.2	< 0.1	0.0	0.0
Livestock						
Expenditures	47.0	18.0	14.0	< 1.0	< 1.0	3.0
Mean budget share	1.9	0.7	0.5	0.0	0.0	0.2

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: Figures are rounded to the nearest shilling. Not all expenditure categories and savings are included. Average budget shares are a percentage of total expenditures.

presented indicate that sugar farmers have a higher propensity to spend on nonfood items than nonsugar households. This translates into a demand for a different mix of goods and services and has an effect on merchants. Although this cannot be quantified from data collected in this study, there is some indirect evidence that creation of the sugar estate has had a positive impact on the merchant group.

A survey of merchants indicates that 69 percent started their business after the sugar factory was built. Although this finding does not indicate causality, there is an association between the outgrowers' scheme and development of increased trading in the area. Two components of the sugar scheme contribute to the growth of the trading class. The first has already been mentioned—sugar farmers spent 42 percent of their total expenditures on nonfood items. Second, the establishment of the factory also created a more extensive rural infrastructure. Electricity became readily available in the local township and new roads were built. This allowed households within the catchment area that historically had been isolated to have access to goods and services.

It is interesting to note that 41.3 percent of the merchants were farmers or employees of other businesses before becoming traders. About 45 percent of merchants employ two or more employees, indicating that laborers may also benefit from the linkage effects of commercialization through increased employment generation. Moreover, a sense of optimism seems to prevail among this new merchant group; 92.9 percent responded that they anticipated expanding their businesses.

5

THE EFFECT OF COMMERCIAL AGRICULTURE ON ENERGY CONSUMPTION PATTERNS

Income is one of the major determinants of family food consumption. In general, as income increases at least a part of the incremental earnings are spent on food. Given the differences in expenditures and income noted in Chapter 4, one would expect that sugarcane production would have a positive effect on the energy intake of a family.

In Table 21, which shows the energy intake per capita for each of the activity groups by season, however, there is no significant difference among the groups for any of the seasons. The caloric intake per capita is almost identical for the pre- and postharvest seasons.[21] Ordinarily one would expect to see an increase in energy intake in the postharvest season, but because yields for maize and other food crops were below average for 1984, stored grain was reduced and home consumption and market supplies were affected.

Calculation of calories per capita is somewhat misleading because it does not take into account the sex and age composition of different types of households. A more appropriate indicator of energy intake is calories per adult equivalent, which incorporates the specific caloric requirements for each age and sex into the calculation.[22] When the energy intake per adult equivalent is calculated (Table 22), calories are approximately 35 percent higher than when expressed as calories per capita. Here again, there are no significant differences in energy intake among any of the different types of households.

Table 21—Household energy intake per capita, by activity group and season, 1984/85

Activity Group	Season: Pre-Harvest	Post-Harvest	Harvesting/ Post-Harvesting[a]	All-Season Average[b]
	(kilocalories/capita/day)			
New entrants	1,778	1,798	1,934	1,869
Sugar farmers	1,711	1,639	1,666	1,707
Nonsugar farmers	1,631	1,592	1,844	1,706
Merchants	1,448	1,539	1,627	1,488
Wage earners	1,800	1,984	1,794	1,961
Landless	1,481	1,665	1,643	1,567
Total sample mean	1,645	1,638	1,771	1,703

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Note: No two groups are significantly different at the 0.05 level.
[a] This round took place from December 1984 to February 1985 and thus spans both a harvesting and postharvesting period.
[b] To determine the all-season average, an average for each household is derived from one to three 24-hour household dietary recalls. The overall average for each household is used to compute a mean for the activity group.

[21] In this report, all references to calories or caloric intake refer to kilocalories.
[22] Adult equivalent calculations are based on the kilocalorie requirements of an adult male of 2,850.

Table 22—Household energy intake per adult equivalent unit, by activity group and season, 1984/85

Activity Group	Season: Pre-Harvest	Post-Harvest	Harvesting/ Post-Harvesting[a]	All-Season Average[b]
	(kilocalories/adult equivalent unit/day)			
New entrants	2,745	2,561	2,932	2,822
Sugar farmers	2,627	2,690	2,646	2,689
Nonsugar farmers	2,524	2,602	2,814	2,669
Merchants	2,241	2,394	2,548	2,281
Wage earners	2,791	2,645	2,835	2,898
Landless	2,338	2,672	2,359	2,506
Total sample mean	2,544	2,620	2,740	2,657

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: No two groups are significantly different at the 0.05 level. The adult equivalent unit is a method used to convert consumption by persons of different ages and sex to standard consumption units. The standard for an adult male equivalent is 2,850 kilocalories.
[a] This round took place from December 1984 to February 1985 and thus spans both a harvesting and postharvesting period.
[b] To determine the all-season average, an average for each household is derived from one to three 24-hour household dietary recalls. The overall average for each household is used to compute the mean for the activity group.

Table 23 shows the average energy intake as a percent of the requirements by season for each of the activity groups. The overall adequacy for calories per adult equivalent for the total sample increased slightly from 89 percent to 92 percent between the pre- and postharvest periods. The lack of a larger effect is due to the drought conditions in Kenya during this period. The increase between the preharvest period and the later harvesting/postharvest season is closer to what would ordinarily be expected: caloric adequacy changed from 89 to 96 percent. For the nonsugar farmers, caloric adequacy

Table 23—Percentage of energy adequacy per adult equivalent unit, by activity group and season, 1984/85

Activity Group	Season: Pre-Harvest	Post-Harvest	Harvesting/ Post-Harvesting[a]	All-Season Average[b]
	(percent)			
New entrants	96.3	89.9	102.8	99.0
Sugar farmers	92.2	94.4	92.8	94.4
Nonsugar farmers	88.5	91.3	98.7	93.6
Merchants	78.6	84.0	89.4	80.0
Wage earners	97.9	92.8	99.5	101.7
Landless	82.0	93.8	89.8	87.9
Total sample mean	89.3	91.9	96.1	93.2

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Note: An energy standard of 2,850 kilocalories per adult equivalent unit is used. The adult equivalent unit is a method used to convert the consumption of persons of different ages and sex to standard consumption units.
[a] This round took place from December 1984 to February 1985 and thus spans both a harvesting and postharvesting period.
[b] To determine the all-season average, an average for each household is derived from one to three 24-hour household dietary recalls. The overall average for each household is used to compute the mean for the activity group.

steadily improved from 89 percent to 99 percent over the three time periods. The all-season average for caloric adequacy is almost identical for sugar and nonsugar households.

The mean adequacy levels presented in Table 23 mask the level of energy deficits found within the groups. Table 24 shows the percentage of households within each of the activity groups that are below 80 percent of caloric adequacy per adult equivalent. On average, from 33 to 41 percent of the sample households in any given round are below 80 percent of energy requirements. Caloric deficits are most prevalent in the preharvest period. The percentage of nonsugar farmers below 80 percent of adequacy decreases over time, but the percentage of deficit sugar farmers increases from 34 to 39 percent.

It is curious that the merchant group, which has the highest expenditure per capita, has 62.5 percent of its households below 80 percent of caloric adequacy in the preharvest season. The landless and the wage earners have a smaller percentage of households below the standard, even though both their average incomes and expenditures are smaller than those in the merchant group. Although the low energy intakes of the merchant households may indicate a true caloric deficit, an alternative explanation is plausible. The activity patterns of merchant household members may be dramatically different from those of agricultural households. There is some indication from the time allocation data presented in Chapter 3 that women from merchant households are less physically active; for example, merchant women spend significantly less time in energy-intensive tasks like weeding and other farm activities (see Table 9). Although time allocation data were not collected for all family members, it is reasonable to speculate that merchants have more sedentary lifestyles and thus reduced energy needs. The lower energy-intake levels reflected in Tables 23 and 24 may not signify a true caloric deficiency.

Protein intake in the population on average is above requirements (Table 25). Calories appear to be more limiting than protein.

The energy intake of preschoolers is also assessed, but analyses are complicated by two factors. First, many children, particularly those in the 6- to 12-month age category, obtain a substantial amount of their energy intake from breast milk. Because it was not possible to quantify the caloric contribution of breast milk, children who were receiving any breast milk were eliminated from the dietary analyses.

Second, it is usual for preschoolers to be fed from a common family dish. In these cases, the mothers or caretakers were un-

Table 24—Percentage of energy-deficient households, by activity group and season, 1984/85

Activity Group	Households Below 80 Percent of Energy Requirements		
	Pre-Harvest	Post-Harvest	Harvesting/ Post-Harvesting[a]
		(percent)	
New entrants	43.8	42.9	25.8
Sugar farmers	33.6	35.6	38.5
Nonsugar farmers	43.3	40.1	32.1
Merchants	62.5	52.9	40.0
Wage earners	27.3	33.3	20.0
Landless	44.1	42.3	33.3
Total sample mean	41.5	39.7	33.5

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Note: An energy standard of 2,850 kilocalories per adult equivalent unit is used.
[a] This round took place from December 1984 to February 1985 and thus spans both a harvesting and postharvesting period.

Table 25—Protein intake per adult equivalent unit, by activity group and season, 1984/85

Activity Group	Protein/Adult Equivalent Unit			All-Season Average[b]
	Pre-Harvest	Post-Harvest	Harvesting/ Post-Harvesting[a]	
	(grams)			
New entrants	98.6	93.4	104.3	100.6
Sugar farmers	99.8	99.1	106.3	101.0
Nonsugar farmers	89.8	94.8	102.9	95.8
Merchants	77.5	100.5	83.0	78.9
Wage earners	142.5	83.5	95.4	115.0
Landless	93.2	87.7	112.4	99.2
Total sample mean	94.6	95.4	102.9	97.5

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: The adult equivalent unit is a method used to convert consumption by persons of different ages and sex to standard consumption units.
[a] This round took place from December 1984 to February 1985 and thus spans a harvesting and postharvesting period.
[b] To determine the all-season average, an average for each household is derived from one to three 24-hour household dietary recalls. The overall average for each household is used to compute the mean for the activity group.

able to quantify the amount of food eaten by the child at a particular meal. Because dietary data for this group of children were "incomplete," energy consumption is probably underestimated. Although the problem of missing dietary data was equally distributed among preschoolers from various types of households, data for preschoolers' energy intake are presented separately for children with complete data and those who ate from the family pot and therefore have missing data (Table 26).

Table 26 presents data on average energy intakes and the percentage of the requirements consumed by preschoolers. For children with complete data, the highest energy intake, as well as the highest caloric adequacy, is for preschoolers from sugar-producing households. During the survey, the average caloric intake of these preschoolers was significantly higher than that of children from nonsugar farmer or landless households. The same pattern is seen for the larger sample, but these differences are not significant. The findings on children's energy patterns are in contrast to those seen for households. Household energy intake was similar across groups, but data indicate that preschoolers from sugar-producing households do better, and in some cases significantly better, than children from other types of households.

Determinants of Household Food Consumption

The analysis of energy consumption thus far has been a static comparison across groups. This descriptive analysis does not allow identification of the determinants of household caloric consumption.

The following model is used to predict household energy intake:

$$Cal_j = f(\text{Income, Adult Equivalent, Women's Income, Sugar Income, Mother's Schooling, HOH Schooling, Maize Price, Round 2, Round 3, Round 4}),$$

where

Cal_j	calorie intake of household j as measured by 24-hour recall,
Income	total household annual income in KSh,
Adult Equivalent	number of adult equivalent units,
Women's Income	women's income as a percentage of total income,
Sugar Income	income from the sugarcane scheme as a percentage of total income,

Table 26—Energy intake of preschoolers and percentage of requirements met, by activity group, 1984

Activity Group	Preschoolers with Complete Data			Preschoolers with Meals from Family Pot[a]		
	All Rounds	All Rounds	Percent of Requirements Met	All Rounds	All Rounds	Percent of Requirements Met
	(kilocalories)	(kilocalories/ kilogram of body weight)		(kilocalories)	(kilocalories/ kilogram of body weight)	
New entrants	791 (445)	63 (33)	64 (34)	628 (380)	53 (29)	55 (29)
Sugar farmers	837[b] (398)	67[c] (37)	69[d] (37)	676[e] (393)	54[c] (35)	56[d] (36)
Nonsugar farmers	716 (358)	58 (32)	58 (30)	631[e] (371)	52 (34)	52 (34)
Merchants	598 (295)	46 (23)	47 (23)	471 (281)	39 (26)	39 (26)
Wage earners	586 (307)	50 (23)	49 (24)	469 (294)	42 (26)	42 (26)
Landless	542 (501)	43 (36)	46 (36)	465 (295)	39 (25)	39 (25)
Sample mean	735 (340)	59 (34)	60 (33)	620 (373)	51 (33)	52 (33)
Sample size	655			1,027		

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: Numbers in parentheses are standard deviations.
[a] Because these children ate from a family pot, the number of kilocalories consumed is probably an underestimate.
[b] Preschoolers from sugar-growing households had higher energy intakes at the 0.05 level of significance than those from landless or nonsugar-growing households.
[c] Preschoolers from sugar-growing households had higher energy intake per kilogram consumed at the 0.05 level of significance than those from landless households.
[d] The percentage of preschoolers from sugar-growing households who met nutritional requirements was higher at the 0.05 level of significance than those of landless or merchant households.
[e] Preschoolers from both sugar- and nonsugar-growing farm households had higher energy intakes at the 0.05 level of significance than those from landless households.

Mother's Schooling	education of all women in the household averaged in years,
HOH Schooling	education of the head of household (in years),
Maize Price	maize price (in KSh) at time of 24-hour recall,
Round 2	round dummy, 1 for round 2, 0 for other rounds,
Round 3	round dummy, 1 for round 3, 0 for all other rounds, and
Round 4	round dummy, 1 for round 4, 0 for all other rounds.

This household consumption function was run for the total sample and for agricultural households alone. The results are presented in Table 27.

As expected, the number of adult equivalents is positively and significantly associated with household energy intake. Income also has a positive and significant—but small—effect on energy intake. The marginal propensity to consume calories is quite low. For the total sample, for each KSh 100 increase in income, household energy intake increases by only 3 calories; for the agricultural households, the effect is even smaller with a 2 calorie increase per KSh 100 increase in income.

Table 27—Regression of daily intake of household kilocalories for the total sample and for agricultural households alone

Variable	Total Sample	Agricultural Households Only
	(β)	
Income	0.03 (3.54)	0.02 (2.60)
Sugar income (percent)	23.80 (2.60)	15.50 (1.60)
Women's income (percent)	8.40 (1.60)	−1.60 (−0.24)
Adult equivalent units	1,543.00 (36.80)	1,508.00 (32.70)
Maize price	161.50 (0.55)	365.80 (1.10)
HOH's schooling	143.60 (3.10)	134.70 (2.60)
Mother's schooling	49.40 (0.90)	106.70 (1.70)
Round 2	135.40 (0.28)	53.30 (0.098)
Round 3	887.00 (2.00)	957.90 (1.90)
Round 4	1,676.50 (3.40)	1,944.70 (3.50)
Constant	2,819 (2.79)	3,512 (2.99)
R^2	0.534	0.510
DF	1,434	1,190
F	164.3	125.9

Notes: The numbers in parentheses are t-statistics. When the regression was respecified using income and income squared, the results were similar. HOH is the head of household.

Data in Table 15 showed that total household income in the sugar-producing households that have received payment was approximately KSh 670 per capita per year higher than incomes in households not producing sugar. This incremental income could account for an increase in household energy intake of approximately 200 calories per day or 27 calories per adult equivalent.

Some of the other income-related variables also appear to be important in influencing energy intake. Women's income has a marginally significant ($p < 0.10$) effect on household energy intake. For each 1 percent increase in women's income, household consumption would increase by 8 calories—a very small net effect.

The percentage of income earned from sugar production is also significantly associated with household energy intake. This effect is above and beyond what is mediated by total household income. A 1 percent increase in sugar income increases household calorie consumption by 24 calories a day. For sugar farmers in the sample who have received payment, the sugar crop contributed an average of 15 percent to total household income. This 15 percent could add

about 360 calories per day to household calorie consumption or approximately 33 calories per person in the household.

There is a seasonal effect, as indicated by variances between survey rounds. Household caloric consumption was significantly higher in rounds 3 and 4, the postharvest seasons, compared with round 1, the preharvest season.

The head of household's schooling also has a positive effect on household energy intake. For each additional year of education, household consumption is increased by 143 calories.

6

MORBIDITY PATTERNS OF WOMEN AND CHILDREN

The sugarcane scheme is one form of development assistance that was targeted to South Nyanza District with the expectation that the economic growth generated as a result of the outgrowers program would result in improved health and well-being for small-farm households. Results from Chapters 4 and 5 indicate that incomes and food consumption have improved as a result of participation in the outgrowers program. This chapter examines the effects of the increased income and improved household caloric consumption on the morbidity patterns of women and children.

Descriptive Analysis

The majority of children and women included in the study were ill in each round. For both women and children, morbidity tends to be highest in round 1, which is the preharvest, rainy period typically associated with more illness. Malaria is most prevalent during this period.

Table 28 presents data on morbidity patterns combined for all rounds. There is no significant difference among groups in the total percentage of time ill in general or with diarrhea during the survey period. What is clear is that the total number of days lost to illness is very high—27 percent—for all groups; the average woman and child is ill approximately one out of every four days.

Next, the morbidity data for preschoolers and women are analyzed by per capita income quartile (Table 29). For preschoolers, there is no significant difference across income quartiles for either the total time ill or the amount of time ill with diarrhea. For women, there is no difference in the total percentage of time ill across income quartiles, but, curiously, women in the two lowest income quartiles have a significantly smaller percentage of time ill with diarrhea than women in the upper quartile.

Prevalence of illness in preschoolers is also stratified by age (Table 30) and by nutritional status (Table 31). Illness tended to be most prevalent in the 7- to 24-month category and, to a lesser extent, the 25- to 36-month age group. The 7- to 24-month period corresponds with weaning for most children in the project area and is typically a time when morbidity escalates. Data in Table 30 suggest that as children get older and survive the weaning stage, overall morbidity tends to decrease.

Children classified as better nourished based on weight-for-age or weight-for-length were sick less frequently (Table 31), irrespective of the differences in income. The only indicator in which there was no difference between morbidity levels above and below the cutoff for adequate nutrition was stunting (Table 31). This reflects the fact that length-for-age, as a longer-term nutritional status indicator, is not a good discriminator for short-term illness.

Determinants of Morbidity for Preschoolers

The static comparisons presented in Tables 28 to 31 are supplemented by multivariate analyses of the determinants of illness for women and preschoolers, using the following functional form:

$$Morb_{ij} = f(\text{Age, Sex, Household Size, Percent Children, Mother's Schooling, Father's Schooling, Income, Water Time, Latrine, Childcare, Health Expenditures, Age Solids, Percent Women, Mother's Height, Round 2, Round 3, Round 4, Agricultural Dummy, SugarArea}),$$

Table 28—Percentage of time ill with any illness and with diarrhea, preschoolers and women, by activity group, 1984/85

Activity Group	Sample Size	Preschoolers: Total Illness	Preschoolers: Diarrhea	Sample Size	Women: Total Illness	Women: Diarrhea
		(percent)			(percent)	
Sugar farmers	425	27.4 (21.9)	4.9 (11.4)	245	27.3 (23.4)	1.5 (5.5)
Nonsugar farmers	646	27.3 (22.8)	6.1 (12.8)	367	28.2 (23.8)	2.9 (9.0)
New entrants	108	30.8 (21.6)	6.4 (12.0)	64	33.1 (22.9)	1.5 (6.7)
Landless	100	27.1 (18.9)	4.5 (9.2)	53	27.2 (17.6)	1.1 (5.2)
Wage earners	36	24.3 (14.7)	3.5 (7.7)	22	37.4 (26.5)	1.4 (5.3)
Merchants	72	24.4 (17.6)	5.4 (11.4)	37	23.8 (20.6)	0.7 (2.7)
All households	1,387	27.4 (21.8)	5.5 (11.9)	788	28.3 (23.2)	2.1 (7.4)

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: No group was significant at the 0.05 level. Sample size (N) is the number of preschoolers or women in each activity group who had morbidity data reported for any round. The numbers in parentheses are standard deviations.

Table 29—Percentage of time ill with any illness and with diarrhea, preschoolers and women, by per capita income quartile, 1984/85

Illness	Income Quartile 1	2	3	4
		(percent)		
Preschoolers				
Total illness[a]	27.5 (20.4)	26.0 (20.9)	29.5 (23.3)	26.5 (22.2)
Diarrhea[a]	4.9 (11.6)	6.4 (12.6)	6.2 (13.0)	4.6 (10.2)
Sample size	332	390	344	311
Women				
Total illness[a]	30.2 (21.6)	26.8 (22.9)	29.8 (25.2)	26.6 (22.6)
Diarrhea[b]	1.2 (4.9)	1.4 (5.3)	2.2 (6.7)	3.7 (11.0)
Sample size	177	212	206	189

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: The quartiles are based on total household annual income per capita for the total sample, with 1 the lowest income group. The numbers in parentheses are standard deviations. Sample size (N) is the total number of children or women surveyed during the four rounds.
[a] There was no significant difference across income quartiles.
[b] Women in quartiles 1 and 2 reported significantly shorter duration of diarrhea at the 0.05 level than women in quartile 4.

Table 30—Percentage of preschoolers' time ill with any illness, by age of child and activity group, 1984/85

Activity Group	Age in Months									
	0-6 Months	Sample Size	7-24 Months	Sample Size	25-36 Months	Sample Size	37-48 Months	Sample Size	49-72 Months	Sample Size
	(percent)		(percent)		(percent)		(percent)		(percent)	
Sugar farmers	24.7 (27.6)	67	33.7 (21.1)	119	28.5 (21.4)	75	22.6 (17.6)	65	23.5 (20.1)	96
Nonsugar farmers	18.3 (21.0)	80	34.0 (22.9)	196	27.0 (20.2)	119	29.4 (23.5)	83	23.4 (22.7)	165
New entrants	28.8 (22.9)	15	36.1 (24.9)	35	32.8 (18.6)	20	29.8 (18.5)	14	22.7 (17.8)	23
Landless	21.8 (19.8)	20	29.8 (17.2)	28	30.8 (11.1)	18	37.7 (27.5)	12	19.6 (16.9)	22
Wage earners	22.6 (12.5)	4	30.1 (18.6)	16	16.4 (6.9)	5	21.6 (10.0)	3	19.4 (7.5)	8
Merchants	34.9 (21.9)	10	23.8 (15.7)	23	29.7 (17.5)	13	17.9 (16.4)	15	18.7 (15.2)	11
All households	22.6 (23.6)	196	33.1 (21.8)	418	28.1 (19.6)	250	26.6 (21.3)	192	22.9 (20.8)	325

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: Time ill is determined by the duration of illness in the prior 14 days expressed as a percentage of total time. No group was significantly different at the 0.05 level. Sample size is the total number of children surveyed over a maximum of four rounds. The numbers in parentheses are standard deviations.

$Morb_{ij}$	percentage of total time ill for child i in household j,
Age	age of the child in months,
Sex	zero-one dummy (1 if a male),
Household Size	number of people in households,
Percent Children	percentage of children in households,
Mother's Schooling	years of schooling of mother,
Father's Schooling	years of schooling of father,
Income	total annual income (KSh),
Water Time	time to get water (in hours),
Latrine	zero-one dummy (1 if a latrine is present),
Childcare	zero-one dummy (1 if the child is cared for by an adult while the mother is away),
Health Expenditures	percentage of total expenditures on health,
Age Solids	age (in months) of introduction to solid foods,
Percent Women	percentage of women in the household,
Mother's Height	height of the mother, in centimeters,
Round 2	round dummy, 1 for round 2, 0 for other rounds,
Round 3	round dummy, 1 for round 3, 0 for all other rounds,
Round 4	round dummy, 1 for round 4, 0 for all other rounds,
Agricultural Dummy	zero-one dummy for type of household (1 if an agricultural household), and
SugarArea	total area of household land planted in sugar in hectares.

The same regression was specified, replacing the dependent variable "total time ill" with "percentage of total time ill with diarrhea."

The regression results for preschoolers in Table 32 show that there is a definite seasonal difference in the pattern of total illness for preschoolers. The total percentage of time ill decreases steadily from round 1 to round 4. The prevalence of illness is highest in the first round, which in this survey coincides with the lean preharvest season. However, this same pattern of sea-

Table 31—Percentage of time ill with any illness for preschoolers aged 6 to 72 months, by indicators of nutritional status and income quartile, 1984/85

Income Quartile	Weight-for Age				Weight-for-Length				Length-for-Age			
	Less Than 75 Percent	Sample Size	75 Percent or More	Sample Size	Less Than 90 Percent	Sample Size	90 Percent or More	Sample Size	Less Than 90 Percent	Sample Size	90 Percent or More	Sample Size
1	32.7 (24.3)	34	27.7 (19.6)	250	35.2[a] (22.6)	52	26.8[a] (19.4)	232	26.6 (20.4)	64	28.8 (20.2)	220
2	32.8[a] (20.3)	46	26.3[a] (20.9)	285	33.5[a] (20.8)	61	25.8[a] (20.7)	270	28.3 (18.9)	78	26.9 (21.5)	253
3	34.5 (21.8)	35	29.9 (23.0)	249	35.6[a] (23.6)	50	29.3[a] (22.6)	234	29.1 (22.2)	61	30.8 (23.0)	223
4	28.8 (27.7)	26	27.0 (20.6)	233	32.1 (26.9)	35	26.4 (20.4)	224	24.0 (22.4)	39	2[illegible] 7 (21.1)	220

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.

Notes: Nutritional status indicators are a percentage of the U.S. National Center for Health Statistics' median standards. Inadequate nutrition is less than 75 percent of standard weight-for-age and less than 90 percent of standard weight-for-length and length-for-age.

[a] Duration of illness below the cutoff is significantly longer than that above the cutoff ($p < 0.05$) within a quartile.

Table 32—Regression equations for total time ill and time ill with diarrhea for preschoolers

Independent Variable	Coefficient for Total Time Ill	Coefficient for Time Ill With Diarrhea
Income	-2.99 (-1.09)	4.22-06 (0.29)
Water time	-0.50 (-0.43)	-4.69-03 (-0.01)
Age for solids	-0.31 (-1.28)	-0.04 (-0.29)
Mother's height	-0.19 (-1.90)	-0.06 (-1.03)
Child care	0.99 (0.83)	-0.02 (-0.04)
Health expenditures	0.23[a] (2.30)	0.01 (0.22)
Latrine	-3.36[a] (-2.56)	-0.09 (-0.13)
Sex	-0.60 (-0.50)	-0.79 (-1.23)
Percent children	-0.06 (1.33)	0.01 (0.52)
HOH's schooling	-0.09 (-0.54)	-0.12 (-1.25)
Agricultural dummy	3.99 (1.95)[a]	2.50[a] (2.28)
Age	-0.18[a] (-5.29)	-0.17[a] (-9.22)
Sugar area	-0.03 (-0.92)	-0.04[a] (-2.62)
Household size	7.44-03 (0.06)	-0.04 (-0.63)
Percent women	-0.02 (-0.95)	-9.61-03 (-0.83)
Mother's schooling	0.11 (0.56)	-0.13 (-1.26)
Round 2 (dummy)	-5.80[a] (-3.50)	-0.64 (-0.73)
Round 3 (dummy)	-6.99[a] (-4.17)	-0.18 (-0.21)
Round 4 (dummy)	-7.63[a] (-4.50)	-0.67 (-0.74)
Constant	69.40 (4.26)	20.70 (2.36)
R^2	0.040	0.035
Degree of freedom	2,757	2,757
F	6.030	5.310

Note: The numbers in parentheses are t-values. HOH is head of household.
[a] This number is significant at the 0.05 level.

sonality is not present for diarrhea. Preschoolers are as likely to be sick with diarrhea in the postharvest as in the preharvest season, which reflects, in part, the generally poor sanitary conditions in the area throughout the year.

For children, age has a significant impact on both total illness and on prevalence of diarrhea (Table 32). Older children are less likely to be ill than their younger siblings. All else being equal, a four-year-old child will be sick 6 percent less than a one-year-old child. This corroborates the data presented in Table 30.

Not surprisingly, presence of a latrine in the household is associated with less total time ill. Preschoolers in a household with a latrine are sick 3 percent less than children from households without a latrine.

Health expenditures have a negative effect on total time ill because expenditures on health tend to be for therapeutic purposes. Households spend more on health care when children are sick.

Household income is not a significant determinant of total illness or diarrhea. Here again, this is consistent with the data in Tables 29 and 31. Area allocated to sugarcane production does, however, cause a significant decrease in the prevalence of diarrhea. One interpretation is that the expenditures associated with income from sugar result in health benefits to the child. It is quite plausible that expenditure on better housing from sugar income results in a home environment that leads to better health.

However, this modest benefit from sugar area is overwhelmed by the negative effect of the agricultural dummy on both total illness and diarrhea. All else being equal, children from agricultural households are, on average, ill for longer periods. Rural households are by definition farther from services, including health care. The agricultural dummy serves as a proxy for the general health and sanitation conditions within the community.

The model for preschooler health involves a complex interaction between household and child variables. The R^2 for both preschooler morbidity equations is low but typical of what is normally seen in multivariate analyses of this type.[23] No single variable in the model has a dramatic effect by itself. The results suggest that a number of factors, in combination, must be considered in order to have a substantial effect on child health.

Determinants of Morbidity for Women

The analysis of the determinants of morbidity in women follows a format similar to that for preschoolers. The following model was used:

Wmorb, f(Income, Water Time, Woman's Height, Health Expenditures, Percent Children, Husband's Schooling, Household Size, Percent Women, Latrine, Woman's Age, Agricultural Dummy, Woman's Schooling, SugarArea, Round 2, Round 3, Round 4),

where

Woman's Height	actual height of the woman in centimeters,
Husband's Schooling	years of schooling of the husband,
Woman's Age	age of the woman in years, and
Woman's Schooling	years of schooling of the woman.

Table 33 shows a strong seasonal pattern of illness for women, similar to that for preschoolers. Morbidity is most prevalent in the preharvest season.

A higher household income has a small beneficial effect on the prevalence of diarrhea but no effect on total time ill for women. Women from agricultural households have a higher prevalence of diarrhea.

[23] For example, Levinson found an R^2 of 0.037 for the diarrhea equations for children using an ordinary least squares approach. See F. J. Levinson, *Morinda: An Economic Analysis of Malnutrition Among Young Children in Rural India*, Cornell/MIT International Policy Series (Ithaca, N.Y.: Cornell University Press, 1974).

Table 33—Regression equations for total time ill and time ill with diarrhea for women

Independent Variable	Coefficient for Total Time Ill	Coefficient for Time Ill With Diarrhea
Income	7.71-06 (0.25)	5.82[a]-05 (5.03)
Water time	0.89 (0.67)	0.65 (1.32)
Woman's height	-0.11 (-1.02)	-0.02 (-0.52)
Health expenditures	0.23 (1.79)	-0.04 (-0.79)
Percent children	8.07-03 (0.17)	-0.02 (-1.07)
Husband's schooling	-0.09 (-0.45)	-0.05 (-0.61)
Household size	-0.28[b] (-2.09)	-0.06 (-1.26)
Percent women	-0.02 (-0.87)	-2.45-03 (-0.28)
Latrine	-0.95 (-0.65)	-0.06 (-0.10)
Age	0.02[a] (3.13)	1.73-03 (0.58)
Agricultural dummy	2.87 (1.29)	1.83[b] (2.19)
Woman's schooling	-0.51[b] (-2.31)	-0.05 (-0.61)
Sugar area	-0.10[a] (-3.29)	-0.04[a] (-3.28)
Round 2 (dummy)	-6.65[a] (-3.56)	0.58 (0.83)
Round 3 (dummy)	-9.40[a] (-4.98)	-0.36 (-0.51)
Round 4 (dummy)	-10.58[a] (-5.66)	0.75 (0.69)
Constant	49.80 (2.79)	4.62 (0.69)
R^2	0.035	0.018
Degree of freedom	2,574	2,574
F	5.890	3.010

Source: International Food Policy Institute, "Survey 1984/85," South Nyanza, Kenya.
Note: The numbers in parentheses are t-values.
[a] This figure is significant at the 0.01 level.
[b] This figure is significant at the 0.05 level

Women with more education and from larger households are less likely to be sick. This finding can be interpreted in two ways. The obvious explanation is that women with some education are better able to take advantage of information and services available within the community and thus to care for themselves. In addition, both of these factors presumably act as proxies for wealth. Older women are more likely to be sick than younger women. Finally, similar to what was seen for preschoolers, area of land allocated to sugarcane is associated with a decrease in the prevalence of diarrhea and in the total time ill for women.

There are some counterintuitive findings that emerge for both women and children. Total household annual income is not a significant determinant of total illness in either women or preschoolers. This is surprising given that conventional wisdom suggests that increases in a household's income will translate into improvements in the health and well-being of individuals within the household. Perhaps it is not simply absolute income but how the income is spent that has the major impact on health. This helps explain why a larger amount of farmland planted in sugar is associated with a significant decrease in the prevalence of diarrhea in women and preschoolers. Sugar area may be acting as a proxy for expenditure patterns, such as better housing and better sanitary conditions, that have a beneficial effect in alleviating diarrhea.

Whereas total illness for both women and children exhibits a seasonal pattern, diarrhea does not. This suggests that the poor health and sanitation conditions in the community are not cyclical, and thus conditions such as diarrhea are chronic and endemic to the area.

7

DETERMINANTS OF NUTRITIONAL STATUS OF WOMEN AND PRESCHOOLERS

The commercialization of semisubsistence agriculture is one type of income-generating strategy aimed at reaching the small-farm households in Kenya. The sugarcane outgrowers' program has many objectives, not least of which is the improvement in general health and well-being of the rural poor, including a reduction in preschooler malnutrition and a decrease in infant and child mortality. This chapter examines the effects on women and children of participation in the outgrowers' scheme.

Descriptive Analyses of Preschooler Growth

The Z-scores and percentage of standards for length-for-age, weight-for-age, and weight-for-length averaged for all four rounds are shown in Table 34.[24] There are no significant differences in any of the three indicators among the activity groups. This is a somewhat surprising finding given the differences in income across groups.

Most of the discussions thus far have assumed that the major effect of commercial agriculture on nutritional status is mediated through sugar production, hence the classification of farmers as either sugar or nonsugar farmers. However, other commercial crops are also produced in the area.

When agricultural households are reclassified into quartiles based on marketed agricultural income per capita, the average Z-scores and percentage of standards for each of the three anthropometric indicators in Table 35 are similar to those shown in Table 34. There are no significant differences in any of the indicators between high and low commercial agricultural groups. Commercial agricultural income per se does not have an effect on nutritional status.

Finally, the nutritional status indicators for children from the agricultural households are stratified by quartile of total income (Table 36). The data reflect the general conclusion that within most income quartiles, there are no differences in nutritional status indicators across groups. In the limited number of cases where significant differences occur (the second income quartile for weight-for-age and weight-for-length, for example), children of sugar households are better off than either nonsugar or new entrant groups.

There are no significant differences in the change in Z-scores between the first and last rounds in any of the groups.

Table 37 presents an analysis of the prevalence of wasting and stunting for all rounds combined. On average, 17.3 percent of the sample children are wasted (less than 90 percent of the standard weight-for-length) and 20.9 percent are stunted (less than 90 percent of the standard length-for-age); approximately one out of four children would be classified as moderately to severely malnourished based on weight-for-age. These data are consistent with national data from Kenya.[25]

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[24] The U.S. National Center for Health Statistics Standards (NCHS) are used in calculating Z-scores and percentage of standards:

Z-Scores (Actual Measurement 50 Percentile Standard)/Standard Deviation of 50 Percentile Standard

NCHS standards are the basis for growth standards used by the World Health Organization and are considered appropriate as international standards.

[25] Republic of Kenya, *Situation Analysis of Children and Women in Kenya*, vols. 1-4 (Nairobi: Central Bureau of Statistics and Ministry of Finance and Planning, 1984).

Table 34—Mean values of key anthropometric indicators expressed as a percentage of NCHS reference median and Z-scores for children aged 6 to 72 months, by activity group

Activity Group	Indicator of Nutritional Status					
	Length-for-Age		Weight-for-Age		Weight-for-Length	
	Percent	Z-Score	Percent	Z-Score	Percent	Z-Score
Sugar farmers N = 356	94.8 (5.4)	-1.34 (1.37)	89.3 (11.6)	-1.03 (1.04)	98.5 (8.8)	-0.22 (0.91)
Nonsugar farmers N = 556	94.1 (5.6)	-1.50 (1.42)	87.6 (13.1)	-1.17 (1.19)	97.6 (8.8)	-0.31 (0.93)
New entrants N = 90	94.3 (6.3)	-1.46 (1.62)	88.1 (12.8)	-1.13 (1.18)	98.0 (8.7)	-0.27 (0.92)
Landless N = 77	94.2 (5.5)	-1.45 (1.40)	88.6 (13.3)	-1.06 (1.22)	98.9 (10.3)	-0.18 (1.10)
Wage earner N = 30	93.5 (4.9)	-1.65 (1.23)	83.8 (10.4)	-1.49 (0.96)	94.8 (8.1)	-0.59 (0.85)
Merchant N = 62	96.1 (5.4)	-0.99 (1.38)	91.2 (11.6)	-0.86 (1.08)	97.9 (8.5)	-0.27 (0.92)
Total sample mean N = 1,171	94.4 (5.6)	-1.42 (1.41)	88.3 (12.5)	-1.11 (1.14)	97.9 (8.9)	-0.28 (0.93)

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: Standards of the U.S. National Center for Health Statistics are used as the reference median.
No group was significantly different. Sample size (N) is the number of children surveyed over a maximum of four rounds. The numbers in parentheses are standard deviations.

Determinants of Preschooler Nutritional Status

To identify the key determinants of preschooler growth, the following model was used for preschooler nutritional status:

NS_{ij} f(Age, Sex, Household Size, Female Household Head, Farm Area, Diarrhea, Mother's Height, Child's Calories, Round 2, Round 3, Round 4),

where

NS_{ij}	nutritional status of each child i 6 to 72 months of age in household j, as measured by Z-scores, weight-for-age, length-for-age, or weight-for-length,
Age	age of a child in months,
Sex	zero-one dummy (1 if a male),
Household Size	total number of people in the household,
Female Household Head	zero-one dummy (1 if a household is headed by a female),
Farm Area	total landholdings in hectares,
Diarrhea	percentage of time ill with diarrhea in the last two weeks,
Mother's Height	height of the mother in centimeters,
Child's Calories	total energy intake of the child in kilocalories for the previous day,
Round 2	round dummy, 1 for round 2, 0 for all other rounds,
Round 3	round dummy, 1 for round 3, 0 for all other rounds, and
Round 4	round dummy, 1 for round 4, 0 for all other rounds.

Table 38 presents the regressions for preschoolers' Z-scores. There are significant positive associations between preschoolers' caloric intake and Z-scores for length-for-age and weight-for-age and marginally significant associations for weight-for-length. However, the effect of diarrhea on weight-for-age and weight-for-length is much stronger than the child calorie variable.

Table 35—Average Z-scores and percentage of the standard length-for-age, weight-for-age, and weight-for-length for preschoolers, stratified by quartiles of annual marketed agricultural income

Quartiles of Marketed Agricultural Income	Length-for-Age			Weight-for-Age			Weight-for-Length		
	Z-Score	Sample Size	Percent of Standard	Z-Score	Sample Size	Percent of Standard	Z-Score	Sample Size	Percent of Standard
(KSh/capita)									
0.0-6.6	-1.27	281	95.0	-0.99	281	89.6	-0.26	280	98.2
6.7-21.8	-1.44	285	94.3	-1.03	286	89.2	-0.17	285	99.3
21.9-56.9	-1.29	299	94.9	-1.02	299	89.1	-0.27	299	97.9
57.0-293.4	-1.15	270	95.5	-1.08	270	91.1	-0.14	270	99.4
Total sample mean	-1.29	1,135	95.0	-0.97	1,136	89.7	0.21	1,134	98.7

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: Only agricultural households are included here. No two groups are significantly different at the 0.05 level. Standards of the U.S. National Center for Health Statistics are used as the reference median.

Unlike the total morbidity equations, seasonality has no consistent effect on Z-scores. Only the dummy for round 2 in the weight-for-length model is significant. This means that the level of wasting declined during the round following the lean period of round 1. Age significantly influences weight-for-age and weight-for-length Z-scores; older children are more likely to achieve growth closer to the standard.

Interestingly, male children do significantly worse than female preschoolers on all three measures of growth. This is contrary to what has been reported from some parts of Asia. The difference between the data from this study and the Asia data may be due to differences in child sex preference. Much of the literature from Asia suggests that boys are preferred over girls; female children are often disfavored in the allocation of food and health care.[26] In South Nyanza, there is no apparent preference for either boys or girls. When mothers were asked, "What do you want the sex of your next child to be?" the most common answer given (60.2 percent of the time) was "whatever God sends me."

Various explanations may account for the better nutritional status of female children. In Kenya, a bride price must be paid for female children upon marriage. Thus, the perceived economic value of female children may be greater in Africa than in Asia. Also, young girls, more than boys, may accompany their mother during the daily chores and may benefit from additional nurturing and feedings.

Children from female-headed households do significantly better on both of the longer-term measures of nutritional status (length-for-age and weight-for-age). This effect is mediated through something other than income because the income effect is reflected in morbidity and in child's calories, both of which are significant determinants of growth. One plausible explanation is that in female-headed households, women have more decisionmaking power, and this may result in more emphasis being put on nurturing activities that positively affect children. These findings on female-headed households are similar to those reported by Greer and Thorbecke for Kenya: the nutritional status of children from

[26] L. C. Chen; E. Huq; and S. d'Souza, "Sex Bias in the Family Allocation of Food and Health Care in Rural Bangladesh," *Population and Development Review* 7 (No. 1, 1981): 55.

Table 36—Indicators of nutritional status (expressed as Z-scores) for children aged 6 to 72 months for agricultural households, by income quartile

Measure/ Income Quartile	Sugar Farmers		Nonsugar Farmers		New Entrants	
	Mean Z-Score	Sample Size	Mean Z-Score	Sample Size	Mean Z-Score	Sample Size
Length-for-age						
1	-1.46 (1.48)	52	-1.55 (1.46)	171	-1.68 (1.38)	29
2	-1.14 (1.34)	70	-1.54 (1.40)	194	-1.24 (1.51)	27
3	-1.44 (1.39)	129	-1.50 (1.24)	90	-1.36 (2.09)	20
4	-1.30 (1.29)	107	-1.33 (1.53)	101	-1.58 (1.64)	14
Weight-for-age						
1	-1.06 (1.11)	52	-1.14 (1.25)	171	-1.28 (1.18)	29
2	-0.91[a,b] (0.99)	70	-1.22[a] (1.20)	194	-1.31[b] (0.99)	27
3	-1.08 (1.03)	129	-1.30 (1.11)	90	-0.76 (1.51)	20
4	-1.03 (1.08)	107	-1.02 (1.16)	101	-1.03 (0.96)	14
Weight-for-Length						
1	-0.18 (0.79)	52	-0.24 (0.96)	171	-0.28 (0.77)	29
2	-0.23[b] (0.77)	70	-0.35 (0.96)	194	-0.67[b] (0.68)	27
3	-0.20[a] (1.03)	129	-0.45[a] (0.90)	90	-0.13 (1.37)	20
4	-0.25 (0.91)	107	-0.24 (0.81)	101	-0.05 (0.49)	14

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.

Notes: Statistical t-tests are used to compare the means of the nutrition indicators within the quartile for sugar versus nonsugar farmers, sugar versus new entrant farmers, and nonsugar versus new entrants. Standards of the U.S. National Center for Health Statistics are used as the reference median.

Sample sizes are listed for the first indicator only and represent the total number of preschoolers within the quartile for the agricultural activity.

The numbers in parentheses are standard deviations.

[a] Sugar versus nonsugar farmers p· 0.05.

[b] Sugar farmers versus new entrants p· 0.05.

female-headed households was consistently better than children from other types of households.[27]

Household size and household landholdings are proxies for wealth. In the present models, neither of these variables have a significant impact on length-for-age, weight-for-age, or weight-for-length.

Tallness in the mother has a positive effect on a child's length-for-age, weight-for-age, and weight-for-length: this, in part, reflects the genetic endowment of the child

[27] Joel Greer and Erik Thorbecke, *Food, Poverty and Consumption Patterns in Kenya* (Geneva: International Labour Organisation, 1986).

Table 37—Percentage of children between the ages of 6 and 72 months below common cutoffs for nutritional status, by activity group, 1984/85

Activity Group	Sample Size	Length-for-Age	Weight-for-Age	Weight-for-Length
			(percent)	
Sugar farmers	356	17.7	20.8	12.9
Nonsugar farmers	556	23.0	29.3	19.6
New entrants	90	24.4	27.8	15.6
Landless	77	23.4	28.6	22.1
Wage earner	30	20.0	33.3	23.3
Merchant	62	12.9	17.7	16.1
Average or total	1,171	20.9	26.0	17.3

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
Notes: Standards of the U.S. National Center for Health Statistics are used as the reference median for nutritional status indicators. Prevalence rates are less than 80 percent for weight for age and less than 90 percent for length-for-age and weight-for-length.

and partly indicates a wealth effect. Women from upper-income households tend to be taller.

Determinants of Women's Nutritional Status

Very few studies have attempted to assess the impact of agricultural policies on adult women. Typically, studies have concentrated on assessing women's nutritional status only to the extent that it might influence infant or child growth.

In this research, women's nutritional status is evaluated using height and weight. Table 39 shows the mean weight for women in each of the activity groups. Merchant women are significantly heavier than most groups. With the exception of women from merchant households, the average weight of women in each activity group is similar. For women in all groups, weight is lowest in round 1, immediately preceding the long-rains harvest. Merchant women are also significantly taller than women from the other activity groups, which may indicate that merchant women were nutritionally better off initially than other groups (Table 39)

The actual weight changes between rounds 1 and 4 are also shown in Table 39. There are no significant differences in the average weight change among women in any of the groups.

In order to identify the influence of key determinants on women's nutritional status, the following model was specified:

WNS_{ij} f(Woman's Height, Female Household Head, Illness, Household Calories Predicted, Age, Farm Area, Household Size, Round 2, Round 3, Round 4),

where

WNS_{ij}	nutritional status of woman i in household j, as measured by weight in kilograms or weight-for-height squared,
Woman's Height	woman's height in centimeters,
Female Household Head	zero-one dummy (1 if household is headed by a female),
Illness	total percent of time ill in the past two weeks,
Household Calories Predicted	total household caloric intake for the full sample, predicted from the equation in Table 27,[28]

[28] Predicted household calories are used for each woman, including those with missing household consumption data.

Table 38—Z-score regressions for length-for-age, weight-for-age, and weight-for-length for preschoolers aged 6 to 72 months

Independent Variable	Z-Score		
	Length-for-Age	Weight-for-Age	Weight-for-Length
Diarrhea	−2.46−03 (−1.32)	−5.79−03 (−3.90)	−5.08−03 (−4.48)
Sex	−0.13 (−2.40)	−0.14 (−3.07)	−0.10 (−2.76)
Female household head	0.53 (3.03)	0.37 (2.70)	0.13 (1.10)
Mother's height	0.03 (5.90)	0.02 (5.50)	6.62−03 (2.10)
Child's calories	1.89−04 (3.43)	1.53−04 (3.49)	6.79−05 (1.82)
Household size	5.82−03 (1.06)	2.49 (0.57)	−3.99−04 (−0.11)
Age	−9.04−05 (−0.05)	2.62 (1.89)	3.29−03 (2.79)
Farm area	0.01 (1.57)	7.47−03 (1.40)	2.76−03 (0.61)
Round 2	0.03 (0.44)	0.09 (1.40)	0.11 (2.10)
Round 3	−0.05 (−0.69)	0.03 (0.51)	0.10 (1.80)
Round 4	0.07 (0.88)	0.06 (0.96)	0.04 (0.88)
Constant	−6.07 (−7.89)	−4.59 (−7.52)	−1.45 (−2.79)
R^2	0.026	0.031	0.020
Degree of freedom	2,781	2,781	2,781
F	6.64	8.17	5.13

Note: The numbers in parentheses are t-statistics.

Age	age of woman in years,
Farm Area	total landholdings in hectares,
Household Size	household size,
Round 2	round dummy, 1 for round 2, 0 for all other rounds,
Round 3	round dummy, 1 for round 3, 0 for all other rounds, and
Round 4	round dummy, 1 for round 4, 0 for all other rounds.

In the regressions of woman's weight and weight-for-height squared[29] in Table 40, landholdings and household size have a positive significant association with both nutritional status indicators. Women from female-headed households are significantly heavier and have a greater body mass index. Household caloric intake has a significant effect in both models, but the size of this effect is small. The total time ill does not

[29] Weight-for-height squared is an index of body mass.

Table 39—Weight by rounds, and height for adult women in each activity group

Activity Group	Mean Weight				Absolute Change in Weight	Mean Height[d]
	Round 1[a]	Round 2[b]	Round 3[c]	Round 4[a]		
	(kilograms)					(centimeters)
New entrants	57.25	57.40	57.55	58.21	-1.23	160.24
Sample size	57	56	55	54	50	55
Sugar farmers	56.91	57.94	57.86	57.72	-0.20	161.75
Sample size	224	205	198	208	187	217
Nonsugar farmers	55.69	56.41	56.39	56.67	-0.95	161.03
Sample size	316	303	291	307	280	320
Merchants	61.47	61.63	63.31	63.30	-1.25	164.34
Sample size	47	43	39	37	33	42
Wage earners	54.26	55.27	53.78	54.40	-0.43	161.14
Sample size	22	17	19	19	18	21
Landless	55.56	57.60	57.59	56.95	-1.56	158.47
Sample size	51	47	46	50	45	51

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.
[a] Merchant women are significantly heavier than all groups except new entrants at the 0.05 level.
[b] Merchant women are significantly heavier than women from nonsugar-growing households at the 0.05 level.
[c] Merchant women are significantly heavier than all groups except the landless at the 0.05 level.
[d] Women from sugar-growing and merchant households are significantly taller than women from other households at the 0.05 level.

exert a significant influence on either woman's weight or weight-for-height squared. The woman's height has a significant positive effect on weight. Similar to the nutritional status equations for children shown in Table 38, there is no apparent seasonal effect on either weight or weight-for-height squared.

Table 40—Regressions for women's weight and weight-for-height squared

Variable	Weight		Weight-for-Height Squared	
	β	t-Value	β	t-Value
	(kilograms)			
Mother's height	0.51	20.75[a]	-0.07	-7.79[a]
Female household head	4.64	5.64[a]	1.76	5.60[a]
Illness	-5.31E-03	-1.18	-2.32E-03	-1.36
Household calories predicted	1.69E-03	2.97[a]	6.44E-04	2.96[a]
Age	-2.35E-04	-0.14	1.13E-05	0.02[b]
Farm area	0.11	3.12[a]	0.04	3.19[a]
Household size	0.13	3.09	0.05	3.19[a]
Round 2	0.64	1.48	0.25	1.53
Round 3	0.64	1.48	0.25	1.49
Round 4	0.53	1.20	0.20	1.20
Constant	-32.23	-7.46	31.30	19.00
R^2		0.17		0.04
Regression		10		10
Residual		2,476		2,476
F		51.89		11.38

[a] This figure is significant at the 0.01 level.
[b] This figure is significant at the 0.05 level.

8

CONCLUSIONS

The commercialization of subsistence and semisubsistence agriculture is the cornerstone of economic development in many developing countries. Proponents of strategies advocating an emphasis on cash crops see this as a means of increasing the incomes of rural smallholders, providing employment for the landless, and stimulating growth linkages with other segments of the economy. An underlying assumption is that the economic gains will result in improvement in the welfare of the small farmers, including improvement in the health and well-being of household members.

Critics of commercialization argue that not only have the economic benefits not always materialized but in some cases the transition to commercial agriculture has had a negative influence on health and nutritional status.[30]

In Kenya, there has been some concern that in areas with increased cash cropping, particularly increased sugarcane production, deterioration of preschooler nutritional status has occurred. This study was initiated at the request of the government of Kenya and was conducted jointly with the National Council for Science and Technology and Kenyatta University.

Impact of Sugar Production on Agricultural Households

The results of this study suggest that commercial agriculture may have extremely positive effects on household income. The annual income of farmers in the sugarcane outgrowers' scheme is KSh 670 per capita higher than the income of nonsugar farmers in the same region. This is approximately 25 percent of income. Much of this income differential is due to agricultural sales—particularly of sugar: 73 percent of the difference in agricultural sales between sugar and nonsugar growers is attributed to sugar production.

Farmers are making a profit from sugar. The net returns to family labor for sugarcane are approximately three times higher than the daily agricultural wage rate.

Much of the sugar that is now grown in the project area is grown on plots of land that have historically been planted in maize; 95 percent of the land allocated to sugar was used for maize production.

Data from Table 4 show that the proportion of land under food crops—36 percent—is substantially less for sugar farmers than for nonsugar farmers (52.1 percent), but the decline in the percentage of land allocated to food crops by sugar farmers has not affected household food security. Food production has been maintained because of the larger amount of farmland held by sugar farmers, and quite possibly also because women control the basic staples.

In the drought year, 1984, the net returns to land were comparable for maize and sugar. In a nondrought year returns to land for maize should be superior to sugar. However, the amount of family labor devoted to sugar production is substantially less than that devoted to maize. Therefore, the net returns to family labor are superior for sugar.

The superior profitability of sugar compared to maize per day of household labor is due in large part to the pricing policy pursued by the Kenyan government. Since 1978, the producer price has increased both in real and nominal terms. If the government had used the world price of sugar, the situation would have been different. In

[30] See von Braun and Kennedy, *Commercialization of Subsistence Agriculture*, for the pros and cons of these arguments.

three of the five years included in this study, average net income would have been negative if the outgrowers' cane price had been based on world sugar prices. The pricing policy for sugar in Kenya has worked to the advantage of the small producer.

The sugarcane outgrowers' program, as it is implemented in Kenya, significantly adds to household income, which in turn positively affects household calorie consumption. However, this benefit at the household level does not appear to influence the preschoolers' nutritional status. There is a growing awareness that factors at the family level may be poor predictors of a child's nutritional status.

In the present context morbidity patterns and sanitation variables have the most dramatic effects on growth of children. The health infrastructure must be taken into consideration when policymakers are trying to anticipate the effects of agricultural policies and programs. The data suggest that preventive, rather than curative, strategies may have more positive effects on child health. Low-cost, low-technology health innovations with a preventive focus can have a high payoff. In the sample, only 61 percent of all households had latrines, yet the presence of a latrine is one measure that clearly had a positive effect on children's health. More emphasis needs to be placed on the health implications of agricultural policies and projects with particular attention to ways to improve the health infrastructure in a given community.

The positive effect of the sugarcane scheme on income is apparent and should not be trivialized. However, it appears that the incremental income from sugarcane is being spent on categories such as housing and school fees, which, though beneficial in themselves, will not improve nutrition in the short run.

Residence in a female-headed household is another factor that has been shown to have a positive effect on nutritional status. There are several plausible explanations. First, there is a large body of literature indicating that when women control household income, they are more likely than men to spend incremental income on food.[31] This also appears to be true for this project. Table 41 indicates that women are more likely to be responsible for food expenditures than men, and, in general, they are more likely to spend on nurturing activities that have an observable nutritional benefit.

Second, sugar income is not perceived as household income but as "men's income" (Table 41). Because the expenditure responsibilities and concerns of men and women differ, it is not surprising that the money earned from sugar production is spent on items like housing and school fees—categories of nonfood expenditure that fall under the responsibility of men.

Part of the difference in expenditures by men and women may also relate to the periodicity of income. Women's income from food crops and trading activities comes in smaller, more regular amounts. This may influence how the money is spent. Men's income from sugar comes only every 18 to 24 months and is paid in one lump sum. Lumpy sources of income tend to be spent differently than small, regular sources of income.

However, overall food insecurity is not a major problem in the area. Availability of food in the project area does not seem to have been affected by shifting land from maize to sugarcane. Although the percentage of land allocated to maize and some other crops has decreased, the absolute area planted in food crops has not. This pattern of land allocation may change as smaller farms enter the sugar scheme.

If policymakers are interested in maximizing the effects on nutrition of increased income, several steps might be taken. First, if it is culturally appropriate, the contract for the cash crop—in this case, sugarcane—should include the wife's or wives' names as well as that of the head of the household. This would help foster the concept of household income rather than simply male income.

[31] Ibid.

Table 41—Decisionmaking on food expenditures and sugarcane income

Decisionmaker	Percentage of Households
Food expenditures	
Husband	15.5
Wife or wives	76.3
Joint decision	5.9
Other household members	2.3
Sugar income	
Husband	79.0
Wife or wives	5.5
Don't know	0.5
Joint decision	12.8
Other household members	2.3

Source: International Food Policy Research Institute, "Survey 1984/85," South Nyanza, Kenya.

Second, payments for the sugar crop could be broken down into smaller, more frequent increments. Periodic payments—advances against anticipated production—might ensure that the marginal propensity to spend on food would be higher than it is with lumpy income.

Finally, there is an issue that has not been touched on directly in the study but warrants discussion. The community in which the outgrowers' scheme has been implemented is one where malnutrition is endemic. There may not be an awareness on the part of households that malnutrition is in fact a problem because their children look like all other children in the community. The outgrowers' program, which involves approximately 30 percent of the households in the community, would be an excellent and visible way to reach a significant portion of the community regarding the nutritional needs of the maternal and child population. Nutrition education integrated into a primary health care delivery system could have a significant effect on the health and sanitary environment of the child.

To date, most of the farmers who have joined the outgrowers scheme have remained. Given the way the program now operates, it is unlikely that there will be a mass exodus back to food crop production. As long as farmers are making a profit, they will probably stay in the scheme.

Cash cropping is a reality in developing countries and a definite part of most agricultural development strategies. Some fine tuning of the program, however, would help maximize the potential impact of the increased income on the nutritional status of households and preschoolers.

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Eileen T. Kennedy has been a research fellow at the International Food Policy Research Institute since January 1984. Bruce Cogill, formerly a research analyst, currently serves as a consultant to the Institute.

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