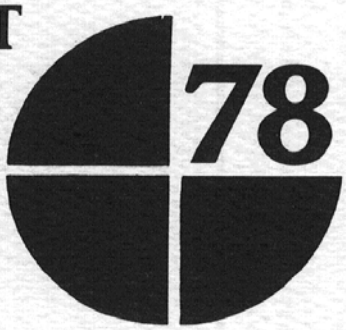
RESEARCH REPORT



THE EFFECTS OF SUGARCANE PRODUCTION ON FOOD SECURITY, HEALTH, AND NUTRITION IN KENYA: A LONGITUDINAL ANALYSIS

Eileen Kennedy

December 1989

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FOREWORD

This research report by Eileen T. Kennedy is part of a major IFPRI effort to assess the effects of the commercialization of agriculture on production, consumption, and nutritional status of rural people in African, Asian, and Central American countries. It reports on the continuation of survey work first undertaken at the request of the government of Kenya in 1983. The original survey work was analyzed in Research Report 63, *Income and Nutritional Effects of the Commercialization of Agriculture in Southwestern Kenya.*

The follow-up study described in this report presents a rare opportunity to examine longitudinal data on a group of farmers in three periods: before they entered a contract arrangement for growing a commercial crop—sugarcane; during the period before they harvested their first sugar crop; and after the harvest. Moreoever, the study includes landless, merchant, and nonsugar-growing farm households, as well as the contract sugarcane growers at various stages in the commercialization of agriculture.

This longer-term analysis confirms the findings of the earlier study that commercialization has positive benefits stemming from increased household incomes and has no negative effects on the nutritional status of children in sugarcane-growing households. It is also clear, however, that commercialization is not a cure-all for childhood illness and malnutrition. Increased incomes must be accompanied by improved health and sanitation facilities if they are to have a major effect in reducing such illness and malnutrition.

Other recently published research reports in the commercialization of agriculture series include *Cooperative Dairy Development in Karnataka, India: An Assessment,* Research Report 64; *Nontraditional Export Crops in Guatemala: Effects on Production, Income, and Nutrition,* Research Report 73; and *Irrigation Technology and Commercialization of Rice in The Gambia: Effects on Income and Nutrition,* Research Report 75.

John W. Mellor

Washington, D.C.
December 1989

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1

SUMMARY

The issue of the health and nutritional effects of the commercialization of agriculture—more commonly called cash cropping—continues to be contentious. Proponents of the commercialization process see it as a means of improving the overall welfare of small farm households and providing employment opportunities for the rural landless. However, critics of cash cropping argue that not only have most of the potential benefits not materialized, but in many cases cash cropping has caused a deterioration in the health and nutritional status of households. Until recently the evidence has been ambiguous.

There is a complex set of linkages between cash crop production and, ultimately, the health and nutritional status of individuals in more commercialized households. Much of the prior research on commercialization and its effects on food security and nutrition has focused on only a limited number of these potential linkages, and it has therefore been difficult to assess the net impact of cash crop production.

In 1983, IFPRI embarked on a series of studies to evaluate the full range of effects of commercialization of agriculture on household food security, health, and nutrition. A study conducted in conjunction with the government of Kenya in 1984/85 in an area of southwestern Kenya undergoing a transition from maize to sugarcane production was part of this series.

The present research report builds on this 1984/85 baseline study. The earlier study compared sugarcane farmers who had received at least one payment for a sugar crop with nonsugarcane producers. The incomes of the sugarcane farmers were significantly higher than those of the nonsugarcane farmers; a major portion of the differential in incomes between the two groups was due to sugarcane.

The 1984/85 study was cross-sectional. A possible criticism of this type of research design is that it might overestimate the positive effects of sugarcane production because the sugarcane farmers may have been more economically advantaged prior to entry into the sugar scheme. The follow-up study, conducted from 1985 to 1987 provided the opportunity to redress this criticism. The baseline study included a group of farmers about to enter the sugarcane scheme. This group of new entrants had an income per capita of 1,956 Kenyan shillings (KSh), virtually identical to that of nonsugarcane producers (KSh 1,924). The new entrants were similar to the nonsugarcane farmers on other key socioeconomic and food consumption parameters as well. The follow-up study allowed the new entrants group to be tracked up to and following the time of its first sugarcane harvest. The longitudinal nature of the two studies combined is methodologically much stronger than most cash-cropping studies, allowing strong inferences to be made about the actual effects of sugarcane production.

There were two other reasons that a follow-up study was deemed important. First, two important types of households were not included in the baseline survey: the group of households relocated as a result of the creation of the sugarcane factory and the households employed by and living on the sugar estate. The government was particularly interested in how the relocated households had fared because it was considering building sugarcane factories in other areas of the country. The follow-up study included a random sample of both relocated households and those employed by the South Nyanza Sugar Factory (Sony).

Second, the baseline study was conducted in a drought year—1984. It was unclear whether the positive income findings related to sugarcane production would be replicated in a "normal" agricultural season. The follow-up study provided the opportunity to compare the agricultural production and income effects of sugarcane cultivation in a drought year (1984) with a nondrought year (1986).

Although all household incomes increased between the drought and the nondrought year, the size of the income increases differed by type of household. The biggest increases in income between the two time periods were for the new entrants and the landless. However the reasons for these income increases differ.

The longitudinal analyses reinforce the income results from the earlier 1984/85 survey. In following up the cohort households (the same households that were in both studies), the average income per capita of the new entrants group was KSh 1,129 higher than that of the nonsugarcane farmers. Part of this increment in income is due to marketed agricultural income. The new entrants earned KSh 791 per capita from commercial agriculture, compared with KSh 365 per capita for the nonsugarcane producers. In the earlier survey the incomes per capita from commercial agriculture for the new entrants and the nonsugarcane producers were similar—KSh 404 and 393, respectively. The entry into sugarcane production increased incomes in the new entrants households.

However, other forms of income also contributed to differences in incomes per capita between the new entrants and the nonsugarcane farmers. The new entrants not only did well in commercial agriculture, but the amount of income per capita earned from production used for own consumption was significantly higher for new entrants (KSh 1,761) compared with KSh 1,302 for nonsugarcane producers.

Surprisingly, the landless group of households is the lowest income group in both studies, yet it had one of the biggest increases in real income between the two time periods. The coping strategy used by the agricultural households during the 1984 drought—putting more land into production to compensate for lower yields per hectare—was not possible for the landless. Therefore, the drought affected their incomes more than other groups in the community.

What is clear from the income data is how diversified the income sources are for each type of household. The prototype of either a purely subsistence household or a totally commercialized household does not exist. Even agricultural households depend on nonagricultural sources for 33-41 percent of their total household income.

The study corroborates that income is the major determinant of household food consumption. Although the increased income associated with sugarcane production translates into improved caloric intake for the household, the link between income and calories is significant but weak. The income elasticity of demand for calories is 0.15 at mean levels of caloric consumption.

Higher household income also benefits the preschoolers. As household caloric consumption increases, children's caloric intakes also improve. Here again, however, the link between household calories and child calories is significant but weak. A doubling of household income (unlikely in the short term) would be insufficient to cover the preschoolers' caloric deficit.

Moreover, the increases in income associated with participation in the sugarcane scheme did not reduce the prevalence of illness in children or in women, at least in the three years covered by these surveys. One needs to be cautious in interpreting these data. It may seem counterintuitive that strongly significant increases in income do not convey a health benefit. The survey shows, however, that increased income in

the sugarcane producing households is likely to be spent on items like education and housing, which while important, do not translate into less illness, at least in the short run.

These findings do not indicate that income is unimportant, but rather that increases in income must be combined with an improvement in the health and sanitation environment in order to bring about significant improvements in the nutritional status. The complementarities between increased income and an improved health situation should be stressed so that the potential effects of commercial agriculture for reducing malnutrition can be enhanced.

The 1984/85 study was conducted at a time when there was a popularly held belief that cash crop production caused malnutrition in children. There is no evidence from either the baseline survey or the more rigorous longitudinal analyses to suggest that sugarcane production is associated with an increase in malnutrition. The sugarcane scheme, as it has been implemented in the Sony area, has increased the incomes of smallholders in the program. This increased income has had a significant effect on household food security and a modest effect on children's caloric intake.

The data from the two Kenya studies suggest that increased household income based on the commercialization of agriculture can make a major contribution to the solution of the hunger problem, but it does not in itself provide a complete solution to the problem of preschooler malnutrition. Health and sanitation conditions should be improved in tandem with agricultural policies and programs in order to maximize the nutritional effects of income-generating policies.

2

RESEARCH DESIGN AND SURVEY METHODS

The health and nutrition effects of the commercialization of agriculture is a controversial issue. Whereas a number of studies have indicated that cash cropping has a negative effect on household food consumption and nutrition, other studies have reported positive or at least neutral effects.[1]

In 1984, at the request of the government of Kenya, IFPRI began a study to evaluate the income and nutritional effects of a shift from maize to sugarcane production. The government was concerned that in areas undergoing this transition to commercial agriculture, particularly the production of sugarcane, a deterioration in household-level food security and preschooler nutritional status was occurring.

This study was therefore initiated in South Nyanza, a sugar-growing area of Kenya, 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 preschoolers and women. In addition, the research concentrated on identifying the processes that lead to these outcomes.

Results from the 1984/85 baseline study[2] indicated that there was a significant increase in incomes of sugarcane producers compared with nonproducers; most of the difference in income—73 percent—was due to the production of sugarcane. Increased income in turn had a significant, positive, though modest effect on the households' caloric intakes.[3] Despite the significant increments in household income, however, there was little effect on preschoolers' health or nutritional status. These results suggest that an increase in income may be a necessary but not sufficient condition for bringing about a significant improvement in child health.

A follow-up study was initiated in the same project area in December 1985 (ending in March 1987) to build upon the information collected in the June 1984 to March 1985 portion of the research. There were three major reasons for placing high priority on an additional wave of data collection.

First, IFPRI had already collected baseline socioeconomic, food consumption, and health and nutritional status information on a cohort of households prior to their entry into the smallholder sugarcane outgrowers' scheme, but the 1984/85 baseline study was not able to follow these households up to the time of first payment for the sugarcane crop because the time between planting and harvest is 24 months in the study area; the field costs would have been prohibitive. However, this group of households, called the "new entrants" group, was ready for its first sugarcane harvest between March 1985, when the baseline study ended, and December 1985, when the follow-up study began. Thus the data from the earlier study was used as a baseline for the follow-up study.

Most prior research on the topic of commercialization of agriculture has involved ex-post research only. Households have been studied only after they have already

[1] For a review of much of the literature on the nutrition effects of the commercialization of agriculture, see von Braun and Kennedy (1986).

[2] For a detailed description of the survey design and research protocol, see Kennedy and Cogill (1987).

[3] In this report, all references to calories or caloric intake refer to kilocalories.

entered a cash cropping scheme, making it difficult to ascertain the health and nutritional status of households and individuals prior to making the transition to commercial agriculture. The follow-up study provided one of the few opportunities to follow farmers for whom baseline economic and health information was available up to and after payment for the sugarcane crop was received. Also, the new entrants to the sugarcane scheme were typical of the type of farmer that the government is trying to reach—the truly small, rural households.[4] In addition, data on income and consumption from the first study indicate that new entrants, prior to joining the outgrowers' program, were similar to nonsugar farmers on key socioeconomic and health variables.

A second reason for the follow-up study was that the baseline study was conducted in 1984, a drought year for Kenya. There was some concern that the income and agricultural production statistics that were collected during that year might not be representative of a normal agricultural year. The follow-up study presented the opportunity to examine some of the issues in a typical agricultural year.

Lastly, two groups were not represented in the baseline study. Specifically, those households that were relocated as a result of the creation of the sugar factory were not part of the earlier study. In addition, households employed by and living on the sugar estate also were not included in the earlier study. The follow-up study in 1985-87 allowed a representative sample of these households to be included.

This report presents the results of the longitudinal analysis for the period June 1984 to March 1987.

Conceptual Approach and Survey Methods

Figure 1 presents a simplified conceptual model of pathways through which cash crop production can potentially influence health and nutritional status.[5] 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 tended to concentrate 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 cash cropping on intrahousehold dynamics.

Cash cropping can potentially influence household-level factors by affecting agricultural production, the demand for hired labor, and/or allocation of resources within the family (see Figure 1). A positive effect of commercial agriculture on one of these pathways could be offset by a negative effect in another area. 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. Figure 1 serves as the basis for conceptualizing the present 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. To understand this process a series of household-level factors has to be linked to individual characteristics and, therefore, data have to be collected from the community, household, and individual household members. The types of variables included in both parts of the study and the method of data collection are described in Table 1.

[4] A small farmer, as defined by the government of Kenya, has less than 8 hectares of land.

[5] For a detailed discussion of each of these pathways, see von Braun and Kennedy (1986).

Figure 1—Some linkages between cash crop production and nutritional status at household and intrahousehold levels

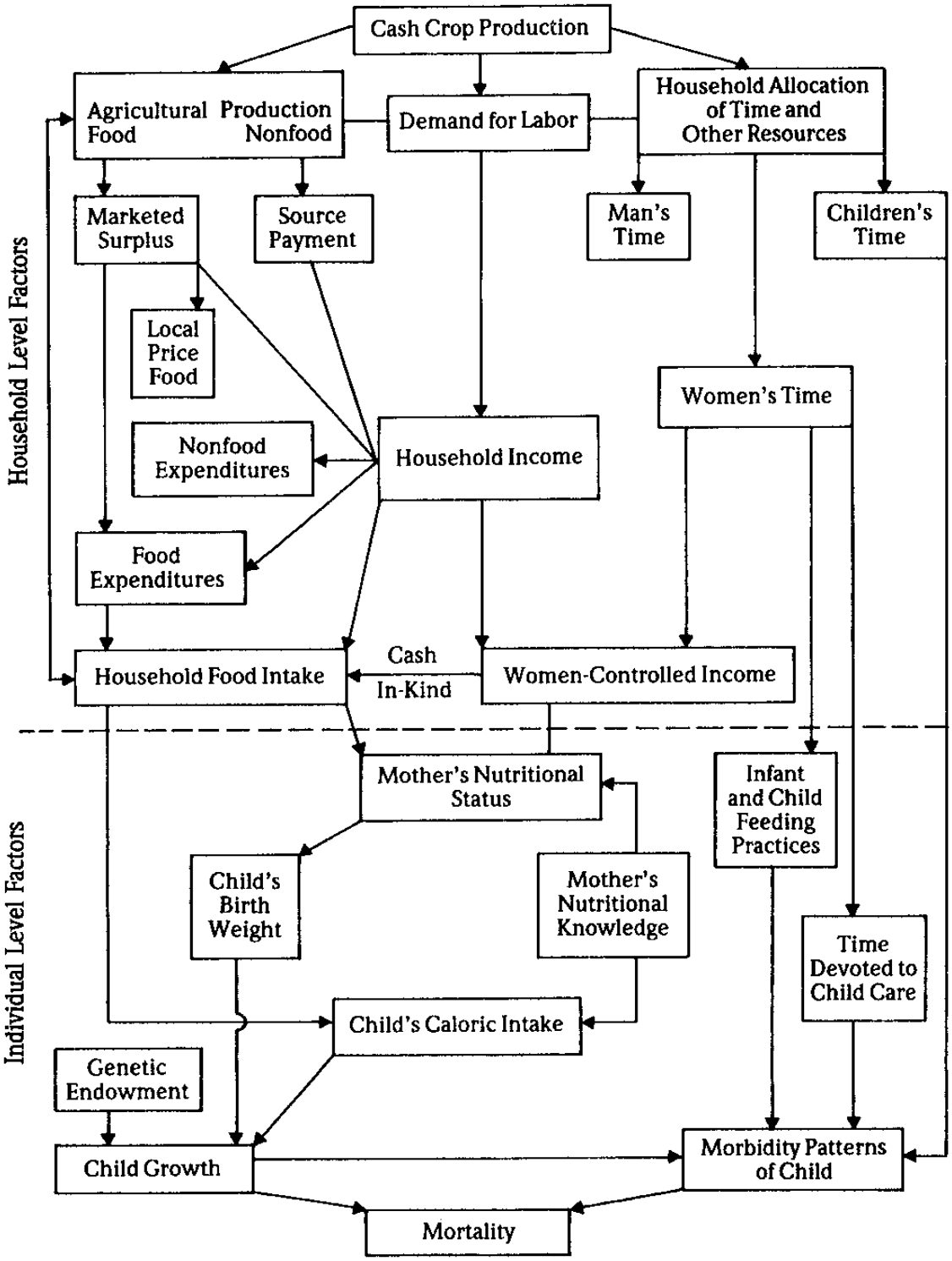


Table 1—Data collected in the survey, 1984-87

Variables	Round 1	2	3	4[a]	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 in each study
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, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
[a] There were four rounds in the baseline survey and four rounds in the follow-up survey for a total of eight rounds.

Study Area

The research for this study was conducted in a project area located in Nyanza Province, South Nyanza District, in the southwestern part of Kenya. Nyanza Province 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 area known as the sugar belt of Kenya.

In 1977, the newest of the sugar factories in Kenya 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 nucleus estate. The majority of sugar, however, is produced by smallholders under contract with the Sony Company.

The outgrowers' program includes 6,000 contract farmers and approximately 6,000 hectares of land. The outgrowers' program at Sony is similar to the outgrowers' programs

used in other sugar schemes throughout Kenya. Farmers are under contract with the factory; the factory agrees to purchase sugarcane from the outgrowers at the price prevailing at the time of harvest. The price paid to the sugar producer is set by the Office of the President, Government of Kenya.

The normal cycle for sugarcane in the Sony area involves a plant crop and two ratoon (offshoot) crops. The time between planting and harvest for the plant crop is 22-24 months. The ratoon crops are harvested 18-19 months apart thereafter.

The factory provides services for a fee to the farmers involved in the outgrowers' scheme. 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. In 1983, the Sony factory implemented a "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 their 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. There is a charge for each of the factory-provided services, including an interest charge applied to each service and an administrative levy, which is deducted from the final payment for the sugarcane crop. Most crop inputs are supplied by the factory; the ratio of factory to nonfactory inputs is approximately 10:1.

Research Design and Sampling

The baseline survey included a representative sample of 504 households. Sony provided a list of all farmers in the outgrowers' scheme. From this list, a random sample of sugar farmers, weighted by sublocation, was chosen.[6] Each of the randomly selected households had to meet the following criteria: it had to have (1) at least one preschooler; (2) less than 20 hectares of land; and (3) a resident farmer in the household.

The presence of a preschooler in the household was important because the government of Kenya was specifically interested in evaluating the effects of commercialization of agriculture on the nutritional status of preschool-age children.

The group of sugar farmers chosen represented outgrowers in various stages of the scheme. As already mentioned, a contract with Sony normally lasts five years and includes a plant crop and two ratoon crops. The first sugar was planted in the area in 1978; farmers who planted in the early years of the outgrowers' program were already into the second contract period when fieldwork for the baseline study began in June 1984.

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

Of the 181 sugar farmers in the baseline study sample, 77 percent had received at least one payment for a sugar crop. This group is called the "sugar farmers" in this

[6] A sublocation is the smallest administrative unit in Kenya.

report. Twenty-three percent of the farmers had not yet had a first harvest and therefore had not yet received payment for any sugar harvest. This group is called the "new entrants."

Once the sample of sugar farmers was chosen, field staff identified the next nearest nonsugar farmers who met the same selection criteria.[7] The nearest-neighbor method of sampling nonsugar farmers essentially enabled the use of the sugar farmer as a seed unit by mapping all neighbors who did not grow sugar. For each sugar contractor, mapping was performed on comparable households of up to three neighbors, up to two of which were randomly selected. This approach ensured geographic similarity of sugar and nonsugar farmers.

Because the research was concerned with the effect of the sugar scheme on the entire area served by the factory, it was important to have a representative sample of all types of households, including nonagricultural households. This community-assessment approach has typically not been done in prior studies. Yet the households not directly involved in cash-crop production may be affected the most. For example, if the new commercial crop is more labor-intensive than the crop it replaces, landless laborers may benefit most by the transition from semisubsistence to commercial agriculture because more hired labor may be required. If the opposite is true, landless laborers will be adversely affected. Therefore, landless households were randomly selected through a restricted area census of all families without land living in the eight small villages of the project area.

Finally, all businesses in the main township—Awendo—and the eight villages in the project area were mapped. From these lists, a random sample of local merchants was selected.[8] Many of the merchant households were also involved in agriculture; for the present study, a household was defined as a "merchant" if the major source of household income was supplied by the business activity.

Of the 504 households in the baseline study, 462 or 92 percent of these households remained in the follow-up study. The group of households that participated in both the baseline and follow-up studies is called the "cohort" sample. Because the present report relies heavily on a longitudinal analysis, the data presented will be based primarily on the cohort sample.

There are, however, two groups not part of the baseline study who were added to the follow-up study. Approximately 2,500 households were relocated when the Sony sugar factory was constructed. The government is particularly interested in how these relocated households have fared. Kenyan policymakers are currently discussing establishing new sugar factories, and they wish to use the information on the relocated households to guide future programs. The relocated households, randomly selected from a master list of households supplied by the Ministry of Agriculture, had to meet the same criteria as the farmers selected earlier.

Another group not part of the baseline study was those households employed by Sony and living on the Sony sugar estate. This group—the Sony employees—was included in the follow-up study. They were randomly selected from a housing list provided by the Sony management. The sample was weighted by type of housing. For example, most of the housing at Sony is for semiskilled workers. These manual workers, therefore, represent a greater proportion of the follow-up study sample than the admin-

[7] That is, to be selected, nonsugar farmers also had to have a preschooler, less than 20 hectares of land, and had to be resident farmers.

[8] The merchant households had to meet the same selection criteria as sugar and nonsugar farmers. Some merchants own land, but their primary source of income is from business.

istrative staff at Sony. Most of those in the Sony employee group are workers on the nucleus estate operated by the sugarcane company.

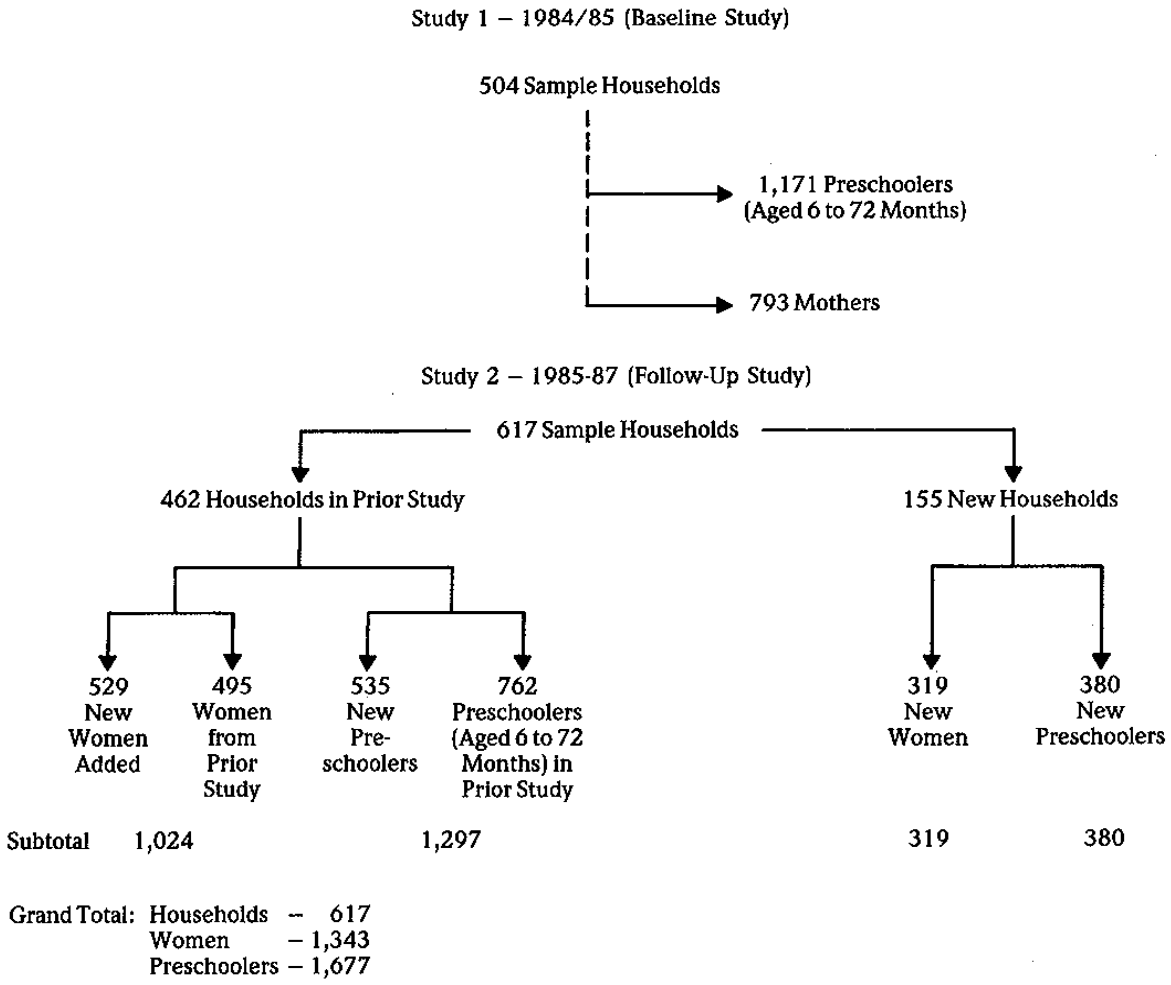
The cohort sample plus these two additional groups—the relocated households and the Sony employees—comprise the total sample. Results from the total sample will be presented only where they differ from the cohort sample.

In both studies, the proportion of agricultural households is approximately 80 percent. The study area remains a predominantly agricultural community.

Preschoolers and women were also traced from study 1 to study 2. Of the 1,171 preschoolers aged 6 to 72 months, 762 remained in the follow-up study. Children dropped out from the follow-up study primarily because they reached their sixth birthday. However, some were also lost to follow-up because of death or migration to another area. A total of 535 preschoolers were added to those in the baseline study due to births and in-migration of new children.

For women, the pattern is similar. Of the 793 mothers in the baseline study, 495 remained, but 529 new women were also added from households that were in the baseline study. The major reason for the addition of new women was a difference in the sampling approach used. In the baseline study, only mothers of preschoolers were included. In the follow-up study, all women in the study households were included. In the follow-up study, 319 women and 380 preschoolers were included from newly entered households. A schema for the samples in the baseline and follow-up studies is presented in Figure 2.

Figure 2—Composition of samples in 1984/85 and 1985-87 studies



Grand Total: Households – 617
Women – 1,343
Preschoolers – 1,677

3

CROPPING PATTERNS IN SOUTH NYANZA

In many parts of Kenya, 1984 was a drought year. In the study area, it was the late arrival of the long rains (delayed by almost two months), rather than an absolute deficit in rainfall that created problems for local agriculture in 1984. The follow-up study in 1985/86 provided the opportunity to assess agricultural production in a "normal" rainfall year and to contrast this with results from the earlier study.

Farming Systems in South Nyanza

Maize is the main staple crop grown in South Nyanza. All crops are grown under rainfed conditions. There is a bimodal pattern of rainfall with one long and one short rainy season. The long-rains period is the major season for production of staples.

Maize planting for the long-rains growing season is done in February or March with harvesting in late July or August, and that for the short rains begins in September with a harvest in February. Sugarcane planting and harvesting is carried out throughout most of the year.

Table 2 presents a profile of the cropping patterns for the new entrants, sugar farmers, and nonsugar farmers during the long rains of 1984 and 1986. From these data for two separate long-rains seasons, it can be seen that nonsugar farmers have a different cropping pattern from sugar farmers. A significantly smaller percentage of total farm area is devoted to all crops by nonsugar farmers, compared with sugar farmers. This is true for both time periods studied.

The larger percentage of land devoted to all crops by sugar farmers is reversed when just food or edible crops are compared (see Table 2). Sugar farmers have a significantly smaller percentage of their land in food crops compared with nonsugar farmers in each of the time periods presented.

Most of the difference between land allocated to all crops and land allocated to food crops alone is accounted for by contracted sugarcane. For the new entrants group, 94 percent of the difference in total cropped land versus food cropped area in 1986 is due to sugarcane; for the sugar producers, sugarcane accounts for 98 percent of the difference between total cropped and food crop area.

The sugarcane outgrowers' program has enabled farmers to put a greater proportion of land into production without much additional household labor, since the factory supplies most of the labor required for sugarcane cultivation. The charge for this factory-provided labor is recouped from the payment for the sugarcane crop. The factory has changed the credit environment in the community and by doing so has increased the availability of nonhousehold labor for sugarcane production.

The labor constraint at the household level is reflected in part by the area per capita put into food production. The agricultural households during the long rains of 1986 used only 44 to 58 percent of land for crop production. Clearly, if households could put more land into production, their incomes would increase. However, as already mentioned, household labor is limited and credit to pay for hired labor is also not easily accessible.

Although both the new entrants and sugar farmers are involved in sugarcane cultivation, the degree of involvement varies. In 1986, sugar farmers devoted 47.8 percent

Table 2—Characteristics of farming patterns of agricultural households, cohort sample, 1984 and 1986

Farm Data	1984 Long Rains			1986 Long Rains		
	New Entrants	Sugar Farmers	Nonsugar Farmers	New Entrants	Sugar Farmers	Nonsugar Farmers
Farm size (hectares)	5.0	5.6	3.7	5.0	5.1	3.4
Mean number of plots	5.8	7.5	6.6	7.0	7.0	5.9
Mean number of crops	7.4	10.1	8.8	8.4	8.6	7.2
Percentage of farm area devoted to all crops	51.7	66.9	56.6	55.6	58.2	44.4
Percentage of farm area devoted to food crops	36.4	36.0	52.1	31.4	29.6	40.3
Mean area devoted to food crops (hectare/capita)	0.19	0.18	0.19	0.17	0.14	0.14

Sources: International Food Policy Research Institute (IFPRI), "Survey, 1984/85," South Nyanza, Kenya; and IFPRI, "Follow-up Survey, 1985-87," South Nyanza, Kenya.

of their land to contracted sugarcane, compared with 40.6 percent for the new entrants group (Table 3). For the new entrants, the average plot size for contracted sugar was 0.91 hectares compared with 1.36 hectares for the sugar farmers. The new entrants group tended to have smaller plots because many of these households joined the outgrowers' scheme in late 1983/84 during the "self-development" program when farmers were required to provide their own labor to develop the plot or to put a cleared piece of land into production. Given that much more of the work in developing these

Table 3—Share of land allocated to specific crops, by agricultural household, long rains, 1984 and 1986

Crop or Crop Mix	1984 Long Rains			1986 Long Rains		
	New Entrants	Sugar Farmers	Nonsugar Farmers	New Entrants	Sugar Farmers	Nonsugar Farmers
	(percent)					
Local maize, single stand	11.9	10.4	24.9	18.0	14.5	28.5
Local maize and beans	3.7	3.2	5.1	2.5	2.7	6.6
Local maize and other crops[a]	4.2	5.3	8.1	6.1	4.7	10.6
Hybrid maize, single stand	11.4	6.1	7.7	8.6	12.1	15.9
Hybrid maize and other crops[a]	5.4	5.8	6.4	7.2	4.7	4.0
Other crop combinations	[b]	[b]	[b]	0.7	1.0	1.3
Sorghum and millet	10.0	8.4	16.6	1.1	0.7	2.0
Finger millet	0.7	1.0	0.5	. . .	. . .	0.7
Cassava	2.7	3.1	6.0	4.0	3.7	5.3
Tobacco	. . .	0.1	0.2	0.7	0.7	2.6
Sony sugar	45.5	47.9	. . .	40.6	47.8	. . .
Other sugar	0.08	0.03	0.03	2.2	0.7	6.6
Other crops	[b]	[b]	[b]	8.3	6.7	15.9

Sources: International Food Policy Research Institute (IFPRI), "Survey, 1984/85," South Nyanza, Kenya; and IFPRI, "Follow-up Survey, 1985-87," South Nyanza, Kenya.

Notes: Fallow, woodlands, and pasture are not included in estimates. The ellipses indicate a nil or negligible amount.

[a] For the 1984 long-rain season, peanuts were grown with local and hybrid maize.

[b] Data were not available for the 1984 harvest.

plots was done by household labor, not factory labor, it is not surprising that the plots of land devoted to sugarcane are often smaller.

When specific crops are examined (Table 3), it is apparent that nonsugar farmers placed greater emphasis on food or edible crops. More than 50 percent of their cultivated land is under maize crop production in both the baseline and the follow-up studies. In both a normal production year (1986) and a drought year (1984), nonsugar farmers grew more sorghum, millet, and cassava—crops that are associated with more traditional diets in the region. However, for each type of agricultural household, more land was used to produce drought-resistant crops like sorghum, millet, finger millet, and cassava in the 1984 drought year than in 1986. It appears that the use of these less preferred crops was one way to insure against potential losses of the maize crop in the drought year.

The proportion of land devoted to food crop production declined between 1984 and 1986 for each category of agricultural household. However, because of higher yields per hectare for both local and hybrid maize, household food security actually improved between the two time periods. Table 4 summarizes the single-stand maize production for the long rains in 1984 and 1986. The total household farm area devoted to local or hybrid maize tends to be small, ranging from 0.3 to 0.8 hectare in 1984 and 0.3 to 0.5 hectare in 1986.

Table 4—Production characteristics of local and hybrid maize, by agricultural households, long-rains season

Crop/Production Characteristic	1984 Long Rains			1986 Long Rains		
	New Entrants	Sugar Farmers	Nonsugar Farmers	New Entrants	Sugar Farmers	Nonsugar Farmers
Local maize						
Number of households growing crop	27	102	183	36	28	62
Total area (hectares)	0.4 (0.5)	0.7 (0.7)	0.8 (0.9)	0.4 (0.2)	0.4 (0.2)	0.3 (0.2)
Yield (kilogram/hectare)	962.7 (1,103.0)	864.2 (562.0)	845.2 (661.0)	1,321.0 (801.0)	1,455.0 (738.0)	1,345.0 (770.0)
Amount sold (kilograms/hectare)	101.1 (358.2)	74.1 (189.4)	85.9 (225.4)	104.0 (219.0)	74.0 (191.0)	219.0 (454.0)
Percentage of production kept for own consumption	89.5	91.4	89.8	92.1	94.9	83.8
Hybrid maize						
Number of households growing crop	19	54	76	18	16	25
Total area (hectares)	0.4 (0.7)	0.4 (0.8)	0.3 (0.5)	0.4 (0.4)	0.5 (0.3)	0.4 (0.3)
Yield (kilograms/hectare)	876.2 (678.4)	990.8 (714.9)	987.5 (949.8)	1,398.0 (883.0)	1,302.0 (624.0)	1,544.0 (926.0)
Amount sold (kilograms/hectare)	124.1 (203.8)	117.4 (318.2)	127.8 (328.9)	188.4 (303.0)	2.7 (11.0)	7.6 (27.0)
Percentage of production kept for own consumption	85.8	88.2	87.1	86.5	99.6	99.5

Sources: International Food Policy Research Institute (IFPRI), "Survey, 1984/85," South Nyanza, Kenya; and IFPRI, "Follow-up Survey, 1985-87," South Nyanza, Kenya.

Notes: All plots where maize is grown alone are counted here—not plots where maize is intercropped. The numbers in parentheses are standard deviations.

The similarities in production among the different types of households are striking for both years. Maize yields were lower than usual for everyone in 1984 due to the late arrival of the rains. In 1986, the yields for both local and hybrid maize were approximately 60 percent higher for all types of agricultural households.

Results indicate that household food production has not deteriorated as a result of the production of sugarcane. The area per capita devoted to food production is similar for sugarcane and noncane producers. The land devoted to sugarcane by both the new entrants and sugar farmers has primarily come from additional land being put into production. New entrants and sugar farmers have maintained maize production, despite entering the sugarcane scheme.

In 1984 maize yields were similar for both hybrid and local maize, which suggests that there is little advantage in using the purchased hybrid variety. In 1984, the poor performance of the hybrid variety was thought to be partially the result of the poor climatic conditions. In 1986, however, which was an average rainfall year, there was again no significant difference between the yields for local and hybrid maize. In fact, yields were lower than expected for both types of maize.[9]

Adverse climatic conditions are but one reason for lower-than-expected yields. Use of any type of fertilizer, particularly inorganic fertilizer, is extremely low for the food crops; 70 to 80 percent of the agricultural households use no fertilizer on any of the food crops. Even for the two major cash crops, sugarcane and tobacco, 33-40 percent of farmers use no inorganic fertilizer.

Soil quality also affects yields. In 1984, 63-64 percent of farmers ranked the soil in plots where sugarcane was grown as good quality. In contrast, only 46-47 percent of farmers ranked soil quality as good where other crops were grown.

The pattern for local maize was similar in 1986, only 48.2 percent of farmers ranked plots where local maize was grown in the long-rains season as good. Although the majority of farmers growing sugarcane during the 1986 long-rains season still ranked the soil in these plots as good quality, the proportion of "good" plots dropped from 64.8 to 51.0 percent. This may indicate that some marginal sugarcane plots were beginning to be put into production.

Labor is the major input used for most crops in the region, except sugarcane. Household labor for sugarcane averages only 45 person-days per hectare per year, much less than is used in food crop production.

Labor data for the major food crops—local maize, hybrid maize, and sorghum—are shown in Table 5. The total amount of labor for these crops was higher in 1984 than in 1986 for each type of agricultural household. The late arrival of the long rains in 1984 meant that fields that had been prepared in February had to be prepared again and planted two months later. This added, on average, an additional 30-40 days of labor per hectare for most of the major crops. For local maize and sorghum in both 1984 and 1986 the amount of household and hired labor was similar for sugar- and nonsugar-growing households.

In the baseline survey, household labor data were not disaggregated by gender. It was assumed, incorrectly, that most of the household labor devoted to food crop production was female labor. A breakdown of the amount of labor used by gender for the three types of agricultural households in the two studies is given in Table 6. Women provided the major portion of household labor for most of the food crops. Men provided

[9] Estimates of the government suggest yields of 2,000 kilograms per hectare for this region of the country (Kenya 1982).

Table 5—Household and hired labor for major crops, by agricultural households, long rains, 1984 and 1986

Study/Crop	New Entrants		Sugar Farmers		Nonsugar Farmers	
	Household Labor	Hired Labor	Household Labor	Hired Labor	Household Labor	Hired Labor
	(person-days/hectare)					
Study 1, long rains						
Local maize	145	4	147	8	148	8
Hybrid maize	164	4	110	22	188	15
Sorghum	109	2	161	5	169	6
Study 2, long rains						
Local maize	98	5	105	7	102	6
Hybrid maize	109	7	79	4	121	6
Sorghum	88	2	102	5	113	8

Sources: International Food Policy Research Institute (IFPRI), "Survey, 1984/85," South Nyanza, Kenya; and IFPRI, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Notes: In person-days per hectare, adult men and adult women are weighted equally and child labor equals one-half adult labor.

approximately 40 percent of the total labor for each of the three main food crops. For hybrid maize, the major portion of labor for new entrants and nonsugar farmers was provided by men within the household. In addition, for some specific tasks, men accounted for the major portion of the time spent on each food crop (Tables 7 and 8). For example, for tasks such as land preparation and hoeing and smoothing, men provided virtually all of the labor. Similarly, for functions like weeding, women within the households did the majority of the work. The small amount of child labor that was used was primarily during the short rains.

Household labor data for local maize are also analyzed to determine the share of plots controlled by women versus those controlled by men (Table 9). Here again, even when the primary person responsible for a particular plot is a woman, a significant amount of male labor is provided, especially for tasks such as land preparation, hoeing, and smoothing.[10] However, during both the long and short rains, men put in more labor on plots controlled by men than on plots controlled by women. Moreover, in both growing seasons, men used more child labor on the plots they controlled.

Table 6—Allocation of labor within households for major food crops, long rains, 1986

Crop	New Entrants' Household Labor			Sugar Farmers' Household Labor			Nonsugar Farmers' Household Labor		
	Men	Women	Children	Men	Women	Children	Men	Women	Children
	(person-days/hectare)								
Local maize	43	49	6	48	53	4	44	54	4
Hybrid maize	55	49	4	33	45	1	62	54	5
Sorghum	31	48	10	41	60	1	34	76	3

Source: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.

[10] This pattern holds true for other major food crops as well.

Table 7—Share of labor provided by men, women, and children, by task, in agricultural households for major crops, 1985-87

Task	Long Rains			Short Rains		
	Men	Women	Children	Men	Women	Children
	(percent)					
Land clearing	85	14	1	77	20	3
Hoeing and smoothing	80	16	4	78	18	4
Fertilizer application	33	66	1	31	52	17
Planting	39	58	3	36	59	5
Weeding	34	62	4	33	60	7
Harvesting	17	79	4	13	80	7
Processing	0	99	1	0	100	0
Marketing	3	95	2	2	97	1

Source: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Note: Crops include local maize, hybrid maize, sorghum, millet, and cassava.

For each of the food crops, the allocation of household labor is much higher than that used in sugarcane production. For a 24-month plant crop cycle, sugarcane requires approximately 90 days of household labor. A similar 24-month cycle in which four maize crops were raised in nondrought years would require 362 days of household labor. The low level of household labor devoted to sugarcane is due to mechanization in the outgrowers' program. Many tasks, such as land clearing, planting, and harvesting, are done by the factory.[11] This substantially reduces the need for household labor. If these tasks were not mechanized or done by the factory, household labor input would have to be approximately 50 percent higher than it currently is.

Weeding and harvesting the plant crop accounts for KSh 1,516 of charges,[12] most of which represent factory-provided wage labor. At a 1980 wage rate of KSh 12 per

Table 8—Days of labor provided by men, women, and children in agricultural households, by task, 1985-87

Task	Long Rains				Short Rains			
	Men	Women	Children	All	Men	Women	Children	All
	(person-days/hectare)							
Land clearing	7.6	1.5	0.2	9.3	7.9	3.2	0.5	11.6
Hoeing and smoothing	10.8	2.6	0.8	14.3	11.7	4.4	1.1	17.2
Fertilizer application	6.4	11.6	0.1	18.1	2.5	3.6	1.8	7.9
Planting	6.2	7.0	0.4	13.6	5.0	7.4	1.0	13.4
Weeding	18.3	26.7	2.3	47.3	14.9	33.7	3.4	52.0
Harvesting	3.6	15.1	0.8	19.5	2.4	10.0	1.1	13.5
Processing	0.0	6.3	0.1	6.4	0.0	3.6	0.0	3.6
Marketing	0.2	8.2	0.2	8.5	0.6	6.3	0.1	7.0
Total days	53.1	79.0	4.9	137.0	45.0	72.2	9.0	126.2
Percentage of total days	39.0	58.0	3.0	100.0	36.0	57.0	7.0	100.0

Source: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.

[11] This has always been true except for the self-developed plots.

[12] All cost data are converted to 1980 Kenyan shillings (KSh 16 = US$1.00).

Table 9—Share of labor provided by men, women, and children, by task, in agricultural households on women-controlled versus men-controlled plots of local maize, new entrants only

Task	Long Rains						Short Rains					
	Women-Controlled Plots			Men-Controlled Plots			Women-Controlled Plots			Men-Controlled Plots		
	Men	Women	Children	Men	Women	Children	Men	Women	Children	Men	Women	Children
	(percent)											
Land clearing	79	21	0	100	...	...	78	22	0	78	22	0
Hoeing and smoothing	77	19	4	74	20	6	82	17	1	80	16	4
Fertilizer application	...	100	...	...	100	...	32	63	5	43	32	25
Planting	42	55	3	44	49	7	45	52	3	48	48	4
Weeding	38	60	2	39	54	7	35	58	7	43	51	6
Harvesting	16	82	2	30	64	6	7	82	11	12	79	9
Processing	0	100	0	...	100	...	...	100	...	...	100	...
Marketing	0	100	0	...	100	...	...	100	...	...	100	...
Total labor	40.0	47.3	2.4	50.2	51.8	11.4	31.7	42.1	4.4	38.4	44.8	6.2

Sources: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Notes: This table is based on the new entrants sample only. Results are similar for sugar and nonsugar household groups. The ellipses indicate a nil or negligible amount.

day, the KSh 1,516 in charges amounts to 126 days of hired labor per hectare generated as a result of sugarcane production. The amount of factory-provided labor has substantial, positive implications for wage-earning opportunities for the landless in the area.

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. By the mid-1980s, however, Kenya was again faced with the situation of being 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 producers of sugarcane in Kenya: their production of sugarcane increased from 30.2 percent of total deliveries in 1976 to 44.4 percent of total supplies in 1980. It is expected that the prominent role of the small farmer in sugarcane production will continue.

Table 10 summarizes cost, yields, and income per hectare for each of the three harvests during the period 1978-86. The total cost of factory inputs for the plant crop was approximately two-and-one-half to three 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-only basis—land clearing, surveying, grading, plowing, harrowing, furrowing, intercultivation, and seed cane planting. The cost of these inputs and services are recouped from the first harvest.[13] Second, yields generally decrease between the first, second, and third harvests; therefore, the cost of any input that is based on tonnage—such as harvesting or transportation—also 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 the plant crop and first ratoon and an additional 15 percent decrease in yield between the first and the second ratoon. The data in Table 10 show a 40 percent decrease in yield between plant crop and first ratoon. This decrease in yield may be much larger than that seen on the factory experimental plots for a number of reasons, 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 reduced if fertilizer is not applied.

It may seem surprising that farmers use less fertilizer than is optimal given that fertilizer is available from the factory. The choice of whether to use it, however, is left entirely to the farmers. In addition, there were periods in late 1983 and 1984 when fertilizer supplies from the factory were in short supply.

The net income per hectare is fairly stable across the three harvests despite the large decline in yields, largely because of the concurrent decrease in total cost of inputs per hectare. The net income per hectare per month of production and the net income per day of family labor are positive for each of the three harvests. The daily agricultural wage rate in the area during the follow-up study period was in the range of KSh 16-20, or in 1980 values, approximately KSh 12. 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.

[13] The one exception is land clearing charges, which are sometimes recouped from the second as well as the first harvests.

Table 10—Summary of yields, income, and costs per hectare of sugarcane, by harvest, 1978-86

Yield/Income/Cost of Inputs	Plant Crop	Ratoon 1	Ratoon 2
		(KSh)	
Yields per hectare (metric tons)	102	57	51
Total cost of factory inputs per hectare	12,362	4,614	4,093
Total cost of contract inputs per hectare	779	197	188
Total net income per hectare[a]	3,390	3,027	3,520
Total net income per hectare per month[a]	141	168	196
Total net income per day of family labor[b]	49	68	77
Sample size (number of plots)	203	120	58

Sources: International Food Policy Research Institute (IFPRI), "Survey, 1984/85," South Nyanza, Kenya; and IFPRI, "Follow-up Survey, 1985-87," South Nyanza, Kenya. For labor days, Republic of Kenya, *Soils of Kisii* (Nairobi: Government Printer, 1982).

Notes: All cost data are in real terms in Kenyan shillings, with 1980 used as a base year.

[a] All charges for factors of production, including household labor, have been subtracted out of this calculation. Charges for hired labor have also been deducted.

[b] Labor days are based on Government of Kenya labor estimates.

Not all of the input, yield, and income information can be verified from factory records. However, the results for verified data are similar to data for the larger sample.

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 the year-to-year variations in yields and income. Table 11 breaks down input, yield, and income information by year of planting for 1978-84. 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 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 the 1980 and 1981 plantings was the result of 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 did not experience losses; 91.8 percent of the sample received some positive income. However, the percentage of farmers with losses varied from year to year, from a high of 20 percent in 1982 to a low of 7 percent in 1984. Most farmers in the sample—93.4 percent—remained in the outgrowers' program. Farmers who had one debit crop usually continued in the scheme and went on to achieve a positive income from sugar.

There was no significant difference in either yield or income between smaller and larger farmers. The results indicate that the net returns per hectare of land and the net returns per family day of labor were positive and stable across the three harvests (Table 10). In addition, the net returns to family labor were 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 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

Table 11—Yield and income of sugarcane production, South Nyanza, 1978-84

Yield/Income/ Harvest	Year of Planting[a]						
	1978	1979	1980[b]	1981	1982	1983	1984[b]
				(metric tons)			
Yield per hectare							
Harvest 1	118 (31)	98 (26)	87 (29)	118 (23)	108 (56)	84 (26)	90 (16)
Harvest 2	63 (26)	68 (21)	62 (23)	39 (13)	51 (33)	59 (3)	n.a.
Harvest 3	61 (23)	54 (18)	40 (14)	16 (2)	n.a.	n.a.	n.a.
				(1980 KSh)			
Total net income per hectare							
Harvest 1	2,903 (31)	847 (26)	1,453 (29)	5,422 (23)	4,291 (56)	4,116 (26)	4,483 (16)
Harvest 2	3,105 (26)	3,040 (21)	3,623 (23)	1,961 (13)	2,856 (33)	4,661 (3)	n.a.
Harvest 3	3,673 (23)	4,055 (18)	3,201 (14)	690 (2)	n.a.	n.a.	n.a.
Total net income per day of family labor[c]							
Harvest 1	44 (31)	21 (26)	28 (29)	72 (23)	60 (56)	58 (26)	62 (16)
Harvest 2	46 (26)	46 (21)	52 (23)	34 (13)	44 (33)	64 (3)	n.a.
Harvest 3	53 (23)	57 (18)	48 (14)	20 (2)	n.a.	n.a.	n.a.

Sources: International Food Policy Research Institute (IFPRI), "Survey, 1984/85," South Nyanza, Kenya; and IFPRI, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Notes: The number of plots is in parentheses. n.a. means data were not available.
[a] The harvest for the plant crop will be approximately 24 months later and each ratoon crop 18 months thereafter.
[b] 1980 and 1984 were drought years.
[c] This is computed as total net income per hectare divided by 90 labor days.

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 producers. Most likely this is a major reason why 93.4 percent of the study plots planted with sugarcane have remained in the outgrowers' program.

Comparative Analysis for Local Maize and Sugarcane

The returns to land and labor for local maize and sugarcane are compared in Table 12. Since the cost data on sugar in the previous section were converted into 1980 figures, all cost information in this section is also presented in 1980 Kenyan shillings. A weighted average of sugar plant and ratoon crops for 1980-86 is compared with the maize crops harvested in 1984 and 1986. The gross margins per hectare for sugarcane

Table 12—Returns to land and household labor for sugar and local maize

Income/Days	Sugar	Local Maize		
	1980-86[a]	Based on 1984 Actual Yield (Drought Year)	Based on 1986 Actual Yield (Nondrought Year)	1982-86[b]
Gross margins per hectare (KSh)	5,040[c]	4,988[d]	6,478[d]	6,040
Number of family days of labor per hectare for 24 months	90	510[d]	362[d]	362
Total net income per hectare per family days of labor (KSh)	56.0	9.8	17.9	16.7

Sources: International Food Policy Research Institute (IFPRI), "Survey, 1984/85," South Nyanza, Kenya; and IFPRI, "Follow-up Survey, 1985-87," South Nyanza, Kenya.

Notes: The Government of Kenya estimates that one out of every five years is a lower rainfall (drought) year in South Nyanza. 1980 is used as the base year for all cost calculations for sugar and maize. All cost data are in constant shillings rounded to the nearest shilling.

[a] Costs for factory-provided inputs and hired labor have already been deducted from income for this calculation.

[b] The 1982-86 average is based on low maize yields for 1984; 1986 actual yields are used for the other four years.

[c] This is the weighted average of plant and ratoon crops from 1980 to 1986.

[d] Based on the assumption that there are four maize harvests in a two-year period. Labor days are the average of household labor inputs in the long-rain and short-rain seasons.

are slightly higher than those for maize in drought years. However, in 1986, which is considered a normal production year, the returns per hectare of land for maize were higher than those for the sugarcane crop.

However, given that household labor input into sugarcane is significantly lower than that for maize, the net income per day of household labor (KSh 56.0) is dramatically higher for sugarcane. In drought years maize earns KSh 9.8 and in normal rainfall years, KSh 16.7. The returns per day of household labor from sugarcane are substantially above the daily agricultural wage rate of KSh 12.0, whereas returns for maize are slightly above the agricultural wage rate in a normal year but below in a drought year.

In order to capture interyear variation, maize returns are analyzed for the period 1982-86. The government estimates that one out of every five years is a low rainfall or drought year in the project area (Kenya 1982). It is assumed, therefore, that one of these years would be a low production year. Actual yields in 1984 for local maize are used to reflect the effects of adverse climatic conditions. The normal production patterns for the other four years are based on actual production statistics for 1986. Table 12, which also presents the analysis of the gross margins for land and household labor for local maize and sugarcane for the multiyear periods, shows that the returns to land for local maize are superior to those of sugarcane for the multiyear period. However, the returns per day of household labor are still superior for sugarcane, compared with maize, for the multiyear period. The analyses presented in Table 12 are fairly robust: regardless of whether the comparison is made in a normal production year or over a number of years, the returns to household labor for sugarcane are higher than those for local maize by a factor of three to five.

In the project area, labor is more of a constraint to production than land. Presumably, households want to optimize returns per day of household labor. In this respect, sugarcane production is quite attractive.

4

INCOME

Proponents of a strategy advocating the commercialization of agriculture assume that incomes of farmers will increase as they switch all or part of their land to cash crop production. While 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.

Since 1984 was a drought year in Kenya, one would expect that incomes of agricultural households would be lower than in a normal production year. Table 13 provides data on the income per capita for 1984 and 1986 for the cohort sample of households. What is apparent is that not all households were equally affected by the drought.

The comparisons of the baseline versus the follow-up study indicate that the income per capita of all types of households—agricultural and nonagricultural—have increased both in nominal and real terms. However, the magnitude of this increase varies dramatically. The nonsugarcane producers can be used as the reference for the difference in income between a "good" and a "bad" production year. Although yields for the major staple, maize, declined by about 60 percent in the drought year, incomes of the nonsugarcane farmers increased only 13 percent in real terms during the 1986/87 period. This is because the higher maize yields in the 1986 seasons were offset in part by the lower amount of total land put into production in the nondrought year by the nonsugarcane farmers.

With the exception of the merchant group, the biggest jumps in income between the two time periods were for the new entrants and the landless groups. The reasons for this vary.

The average annual income of the new entrants group (KSh 1,956 per capita) was virtually identical to that of the nonsugarcane producers (KSh 1,924 per capita) in the 1984/85 baseline study. In the follow-up study, the annual income per capita (both nominal and real) of the same new entrants group was significantly higher than that of the nonsugar group (Table 13). In the follow-up study, both the new entrants and sugar farmer groups had incomes per capita significantly higher than nonsugarcane producers.

Part of the difference in incomes between the cohort sample of new entrants and nonsugarcane producers is due to differences in marketed agricultural income (Table 14). The new entrants' income per capita of KSh 791 for marketed goods is significantly higher than the KSh 365 per capita for the nonproducers. However, other sources of income also contribute to the difference in incomes between the two types of households. Of the KSh 1,129 difference in nominal income per capita between the new entrants and nonsugar cohort groups in 1986, 41 percent can be attributed to commercial agricultural income, 38 percent to semisubsistence income, and the remaining 21 percent to higher nonfarm incomes in the new entrants group.

Unlike the baseline study, where sugarcane production contributed 73 percent of the difference in incomes between the sugar and nonsugar producers, the higher incomes of the new entrants came from more varied sources in the follow-up study.

Many sugar farmers in the cohort sample entered their second contract during the period between the baseline study and the follow-up study. Their sugarcane plots were

Table 13—Mean nominal and real income per capita, by activity, for the cohort group

Activity Group	Mean Nominal Income per Capita		Mean Real Income per Capita[a]
	1984/85	1985/86	
		(KSh)	
New entrants	1,956	3,837	3,070
	(42)	(38)[b]	(38)[b]
Sugar farmers	2,591[c]	3,390	2,712
	(139)	(135)[d]	(135)[d]
Nonsugar farmers	1,924	2,708	2,166
	(231)	(205)[b,d]	(205)[b,d]
Merchants	2,209	5,265	4,212
	(29)	(15)[e]	(15)[e]
Wage earners	2,037	3,222	2,578
	(18)	(14)	(14)
Landless	1,290	2,338	1,870
	(43)	(33)	(33)
Sample mean for cohort	2,077	3,091	2,473
	(502)	(440)	(440)
Relocated	n.a.	2,598	2,078
		(68)	(68)

Sources: International Food Policy Research Institute (IFPRI), "Survey, 1984/85," South Nyanza, Kenya; and IFPRI, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Note: n.a. is not applicable.
[a] 1985/86 incomes are adjusted to 1984 levels using a GDP deflator derived from World Bank, *World Development Reports, 1986, 1987* (Oxford University Press, 1986 and 1987).
[b] New entrants versus nonsugar farmers ($p < 0.05$).
[c] Sugar farmers have higher incomes than nonsugar and landless groups at the 0.05 level of significance.
[d] Sugar farmers versus nonsugar farmers ($p < 0.05$).
[e] Merchants have significantly higher incomes than all other groups, ($p < 0.05$).

plowed and reseeded, and thus they did not receive another payment for a sugar crop during the second study. This is the main reason for the percentage of income received from commercial agriculture being lower in the cohort sample of sugar farmers than in the baseline study.

Interestingly, the landless group of households was the lowest income group in both studies, yet it had one of the highest increases in real income between the two time periods. The major portion of the income increase for the landless group was from semisubsistence income—that is, production used for own consumption. This is counterintuitive because the term "landless" normally implies that a household has no land. In this case, however, although the landless households do in fact own no land, they have access to public land controlled by the local council. Not only did absolute income increase, but the relative increase in real income was accounted for primarily by the semisubsistence income. The landless were affected by the drought because their access to land was more limited—a half hectare for the entire household—than that of the agricultural households. As already shown in Table 2, the agricultural households, whether sugar or nonsugar producing, use only 44-58 percent of their land for production in a normal agricultural year, whereas the landless use all land possible to produce food. Despite using 100 percent of the land to which they had access for food production, the area per capita cultivated by the landless was 0.08

Table 14—Mean income per capita per year, by source and activity group, cohort sample, 1984/85 and 1985-87

Activity Group	Agricultural Income				Nonagricultural Income		
	Used for Own Consumption		Marketed				
	Mean	Percent	Mean	Percent	Mean	Percent	Sample Size
	(KSh)		(KSh)		(KSh)		
Baseline study							
New entrants	728	37	404	21	824	42	42
Sugar farmers	748	29	942[a]	36	901	35	139
Nonsugar farmers	822	43	393	20	709	37	231
Merchants	51	2	17	1	2,141	97	29
Wage earners	171	8	45	2	1,821	90	18
Landless	163	13	48	4	1,079	83	43
Total sample mean	669	32	482	23	926	45	502
Follow-up study							
New entrants	1,761[b,c]	46	791[b]	21	1,285	33	27
Sugar farmers	1,370[c]	40	625[d]	19	1,395[d]	41	146
Nonsugar farmers	1,302[b]	48	365[b,d]	14	1,041[d]	38	205
Merchants	571	11	49	<1	4,646[e]	88	15
Wage earners	972	39	233	7	2,017	63	14
Landless	841	36	162	7	1,336	57	33
Total sample mean	1,292	42	452	15	1,347	43	440

Sources: International Food Policy Research Institute (IFPRI), "Survey, 1984/85," South Nyanza, Kenya; and IFPRI, "Follow-up Survey, 1985-87," South Nyanza, Kenya.

[a] Sugar farmers have higher marketed agricultural income per capita than all other groups at the 0.05 level of significance.

[b] New entrants versus nonsugar farmers ($p < 0.05$).

[c] New entrants versus sugar farmers ($p < 0.05$).

[d] Sugar farmers versus nonsugar farmers ($p < 0.05$).

[e] Merchants have higher nonagricultural income than all other groups at the 0.05 level of significance.

hectare per person, compared with 0.14-0.17 hectare for the agricultural households. The coping strategy used by the agricultural households in the 1984 drought year—putting more land into production—was not possible for the landless. Because they could not put more land into production to compensate for the lower yields of basic staples per acre, the drought affected them more.

Each of the nonagricultural groups received the major portion of its income from nonfarm sources—57 to 88 percent for the cohort sample (Table 14). One group not in the cohort sample—the relocated—are included in the follow-up data in Table 13. The incomes of the households in the relocated group were similar to those of the nonsugarcane producers. The source of this income was, however, different for the two groups. The relocated households obtained a larger proportion of their incomes from nonfarm employment (55 percent) than did the nonsugarcane producers (36 percent). Conversely, the nonsugar producers obtained a greater share of their income (49 percent) from semisubsistence production; only 40 percent of the incomes of the relocated group came from production used for own consumption. Part of this difference in incomes was due to differences in landholdings.

As shown in Table 15, the amount of land owned, on average, by the households that were relocated as a result of the construction of the Sony sugar estate decreased substantially from 5.10 hectares to 1.17 hectares. It is not surprising, therefore, that the proportion of income provided by production used for own consumption was less for relocated households than for nonsugar farmers.

Table 15—Characteristics of relocated households

Item	Amount
Mean hectares owned prior to relocation	5.10
Mean hectares owned after relocation	1.17
Mean amount paid per acre sold (KSh)	894
Mean amount paid per acre bought (KSh)	1,019
Percentage of relocated households now growing sugar	13.3
Percentage of relocated households now landless	13.3

Sources: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.

If the relocated households had maintained the same amount of land owned prior to the creation of Sony—5.1 hectares—their average landholdings would have been larger than most of the other agricultural groups. Their household incomes probably would have been higher than they were.

Although for 71 percent of the relocated sample, land was the first item purchased with the money received for the sale of their old land, other items were also bought. Thus, the total amount of money received from the sale of their land was not reinvested in land. Moreover, even if 100 percent of the money received from the sale had been used to purchase new land, less land could have been bought because the price per hectare of land jumped by 20 percent in the community. This is undoubtedly one reason why 91 percent of the relocated sample believe that their life has been worse since the creation of the sugar scheme.[14]

What is clear from the data in Table 14 is how diversified income sources are for each category of household. Even agricultural households depend on nonagricultural sources for 33-41 percent of their total household income.

Expenditure patterns for the cohort sample are given in Tables 16-20. For all types of households, except merchants, the greatest share by far of total expenditures is allocated to food (Table 16). For merchants, expenditures are evenly split between food and nonfood items.

Within agricultural households, whether sugar- or nonsugar-producing, a higher share of food expenditures is accounted for by production used for own consumption (Table 17). Cereals and grains are the major category of food expenditure for each type of household (Table 18). There is little variation in the composition of the diet among different types of agricultural households. Within the cereals and grains category, maize and maize flour account for approximately 36 percent of the expenditures on staples (Table 19).

[14] Respondents were asked the question, "How has your life changed since the creation of the Sony factory?" Their open-ended responses were coded as better, worse, or about the same.

Table 16—Expenditures by activity group, cohort sample, 1985-87

Activity Group	Total Expenditures	Nonfood Expenditures	Food Expenditures	Food Budget Share
		(KSh/capita/week)		(percent)
New entrants	62.61	11.48	51.13	82
Sugar farmers	52.77	12.06	40.71	77
Nonsugar farmers	49.14	9.59	39.55	80
Merchants	77.21	37.50	39.71	51
Landless	51.99	12.38	39.61	76
Sample mean	52.71	11.74	40.97	78

Source: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.

Table 17—Share of food purchased versus food produced at home by activity group, cohort sample, 1985-87

Activity Group	Purchased	Own Produced
	(percent)	
New entrants	41.7	58.3
Sugar farmers	41.8	58.2
Nonsugar farmers	39.7	60.3
Merchants	75.0	25.0
Landless	57.5	42.5
Sample mean	43.1	56.9

Source: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Note: Purchased and own-produced food are given as percentages of total food expenditures.

Table 18—Distribution of food expenditures among food groups, by activity group, cohort sample, 1985-87

Activity Group	Cereals and Grains	Roots and Tubers	Meat, Eggs, and Fish	Pulses and Vegetables	Fruits, Snacks, Desserts, and Beverages	Cooking Ingredients and Others
				(percent)		
New entrants	41.3	8.2	16.9	10.4	19.1	4.1
Sugar farmers	44.0	7.5	15.5	10.7	17.7	4.5
Nonsugar farmers	45.2	7.3	16.1	10.3	16.9	4.2
Merchants	37.8	2.1	21.7	10.8	22.1	5.4
Landless	41.7	4.2	19.6	12.0	17.2	5.4
Sample mean	44.0	7.0	16.5	10.6	17.5	4.4

Source: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Note: Numbers may not add to 100 because of rounding.

Table 19—Food expenditures on staples as a percentage of total food expenditures, by activity groups, 1985-87

Staple	New Entrants	Sugar Farmers	Nonsugar Farmers	Merchants	Landless	Sample Mean
			(percent)			
Maize flour	27.1	31.4	32.6	19.5	25.6	30.8
Maize	6.8	5.3	5.5	6.5	5.9	5.6
Millet	0.2	0.1	0.2	0.0	0.1	0.1
Rice	0.9	0.7	0.8	1.7	1.0	0.8
Wheat products	0.6	0.2	0.2	1.1	0.1	0.3
Doughnuts	0.2	0.3	0.3	0.8	0.4	0.4
Bread	1.3	1.5	1.5	5.1	3.6	1.7
Finger millet	1.8	1.0	0.9	0.8	0.6	1.0
Sorghum	0.6	1.4	1.1	0.1	1.2	1.1
Grinder	1.8	2.1	2.1	2.0	2.9	2.1
Cake and biscuits	0.0	0.0	0.0	0.1	0.1	0.0
Others	0.0	0.0	0.0	0.1	0.0	0.0
English potatoes	0.1	0.2	0.1	0.6	0.3	0.2
Sweet potatoes	5.4	4.7	4.4	1.3	2.2	4.3
Cassava	1.1	1.0	1.0	0.2	1.3	1.0
Yams	0.0	0.0	0.0	0.0	0.0	0.0
Cassava flour	1.6	1.6	1.8	0.1	0.4	1.5
All staples as a share of total food expenditures	49.5	51.5	52.5	39.9	45.9	51.0

Source: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Notes: Staples include all cereals, grains, roots, and tubers. Numbers may not add to total due to rounding.

There are, however, differences in nonfood expenditures among the different types of agricultural households. New entrants spend significantly more on education than either sugar or nonsugar farmers (Table 20). In addition, new entrants spend substantially more on transportation than nonsugar farmers. The implications of changes in income and expenditures on food consumption and nutrition for the new entrants will be explored in Chapters 5, 6, and 7.

Table 20—Nonfood expenditures per capita by activity group, 1985-87

Item	New Entrants	Sugar Farmers	Nonsugar Farmers	Merchants	Landless	Sample Mean
			(KSh/capita/week)			
Health	0.17	0.19	0.20	0.55	0.19	0.20
Education	0.66	0.41	0.50	0.50	0.35	0.48
Housing	0.28	0.23	0.21	7.96	0.55	0.52
Clothing	0.79	0.77	0.84	0.55	0.51	0.78
Clothes	0.61	0.65	0.74	0.44	0.44	0.67
Footwear	0.18	0.12	0.10	0.11	0.07	0.11
Transportation	1.58	0.75	0.42	5.04	0.26	0.78
Public transport	1.57	0.72	0.41	5.02	0.26	0.77
Bicycles	0.01	0.03	0.01	0.02	0.00	0.01
Others	8.00	10.18	7.42	22.90	10.52	8.98
Fuel and light	0.36	0.48	0.53	3.13	1.06	0.63
Supplies/household goods	0.72	0.50	0.57	0.43	2.37	0.69
Family event	0.17	0.18	0.14	0.08	0.10	0.15
Land	0.21	0.09	0.02	0.00	0.09	0.07
Livestock	0.13	0.20	0.20	0.26	0.07	0.18
Personal care	1.19	2.17	1.47	6.01	1.14	1.95
Other personal care	0.02	0.03	0.02	0.44	0.03	0.04
Household services	0.32	0.31	0.33	3.90	0.30	0.44
Maintenance	0.11	0.24	0.51	3.10	0.00	0.44
Communications	0.03	0.04	0.01	0.32	0.01	0.03
Recreation and entertainment	0.17	0.08	0.05	0.30	0.06	0.07
Miscellaneous	0.71	1.26	0.62	1.92	1.70	0.96
Farm tools	0.09	0.03	0.04	0.01	0.02	0.04
Liquor	0.29	0.39	0.24	0.01	0.36	0.30
Tobacco and cigarettes	0.18	0.09	0.19	0.00	0.34	0.16
Other expenses	3.30	3.14	2.47	2.99	2.86	2.82

Sources: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.

5

CALORIC CONSUMPTION OF HOUSEHOLDS AND PRESCHOOLERS

A major objective of this research is to examine the implications of the levels and patterns of income on household food security. Given the differences in income noted in Chapter 4, one would expect sugarcane production to have a positive effect on the caloric intake of households. This chapter looks at the pattern of caloric intake of households and of preschoolers within households.

Table 21 presents the caloric intake per adult equivalent[15] for the cohort sample in both studies. The overall level of intake per adult equivalent is similar for the two time periods—2,657 kilocalories for the baseline study compared with 2,663 for the follow-up study. Thus, the significant increase in yields for most major crops has not led to a concurrent increase in the average caloric intake for the study population largely because intake levels were close to the caloric requirement in both time periods, averaging about 93 to 95 percent for the sample. If households are at or close to "true" requirements, a dramatic increase in caloric requirements is not likely.

In the 1984/85 baseline study, there were no significant differences in caloric intakes per adult equivalents among the various types of households. In the baseline study, caloric intakes of the new entrants (2,822) and the nonsugar-producing households (2,669) were not significantly different. However, the caloric intake for the new entrants group is significantly higher than both the nonsugar and sugar producers in the follow-up study. For the cohort sample, the caloric intake for the new entrants group improved between the baseline and the follow-up study primarily because of a decrease in variation in the level of caloric consumption.

Although the 1984/85 study did not explicitly examine the consumption patterns of the relocated households, given that the majority of the relocated households are nonsugar producers, it was expected that their caloric intake would be the same as the nonsugar group. However, the caloric consumption of the relocated group (2,465 kilocalories) is lower (although not significantly lower) than that of the nonsugar group (see Table 21). This may be partly because the relocated have a significantly smaller number of hectares per capita on which to grow food.

What is more important than average calorie consumption within the different activity groups, however, is the distribution of caloric consumption within the groups. Table 22 looks at the percentage of households falling at or below 80 percent of energy requirements and between 81 and 100 percent of requirements. The proportion of households below 80 percent is of particular concern because, although some adaptation to low or inadequate caloric intakes is possible, it is unlikely that a household could successfully adapt to chronic caloric intakes below 80 percent of standard requirements.

[15] The following weights were used to calculate adult equivalent units (AEU): 2,850 kilocalories was the requirement for an adult male. Adult males were assigned a weight of 1.0 AEU and adult females 0.8 AEU. Children in the household (defined as those less than 15 years of age) were assigned weights of 0.33 to 0.75 AEUs, depending on age.

Table 21—Household calorie intake in 1984/85 compared with 1985/86, for cohort and total samples

Activity Group	1984/85[a]	1985/86[a]
	(kilocalories/adult equivalent/day)	
New entrants	2,822	2,848[b,c]
Sugar farmers	2,689	2,649[b]
Nonsugar farmers	2,669	2,641[c]
Merchants	2,281	2,462
Wage earners	2,898	2,668
Landless	2,506	2,751
Cohort sample mean	2,657	2,663
Relocated	n.a.	2,465
Sony	n.a.	2,760
Total sample mean	n.a.	2,631

Source: International Food Policy Research Institute (IFPRI), "Survey, 1984/85," South Nyanza, Kenya; and IFPRI, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Notes: An all-season average is devised for caloric intake per adult equivalent for each study. Sony employees and relocated households were not included in the baseline. n.a. means not applicable.
[a] No two groups are different at the 0.05 level of significance in either study.
[b] The t-test comparison of new entrants and nonsugar farmers indicates $p < 0.05$.
[c] The t-test comparison of new entrants and sugar farmers indicates $p < 0.05$.

One note of caution: the merchant group appears to have an artificially high prevalence of caloric deficiency. This is more likely due to lower energy needs of this group because of sedentary lifestyles than to "true" caloric inadequacy per se.

The proportion of the new entrants sample that falls into this severely restricted group is smaller than that in the nonsugar group for both studies. The new entrants not only have higher household calorie consumption, on average, than the nonsugar

Table 22—Percentage of calorie-deficient households, by activity group, in baseline and follow-up studies

Cohort Sample	Baseline Study: Households at or Below 80 Percent of Caloric Requirements	Baseline Study: Households Meeting 81 to 100 Percent of Caloric Requirements	Follow-up Study: Households at or Below 80 Percent of Caloric Requirements	Follow-up Study: Households Meeting 81 to 100 Percent of Caloric Requirements
	(percent)			
New entrants	17.9	33.3	20.0	25.0
Sugar farmers	30.7	24.1	28.1	36.3
Nonsugar farmers	30.0	28.5	28.7	30.1
Merchants	42.1	31.6	41.2	29.4
Wage earners	15.4	30.8	14.3	42.9
Landless	34.3	25.7	26.5	26.5
Cohort sample mean	29.6	27.5	27.6	31.6
Sony	n.a.	n.a.	23.0	37.0
Relocated	n.a.	n.a.	35.0	42.0

Sources: International Food Policy Research Institute (IFPRI), "Survey, 1984/85," South Nyanza, Kenya; and IFPRI, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Note: An energy standard of 2,850 kilocalories per adult equivalent unit is used. Sony and relocated households were not included in the baseline study. n.a. indicates not applicable.

households, but the proportion of new entrants falling below 80 percent of the standard is also smaller.

Here again, one might expect data for the relocated group, who are mostly nonsugarcane producers, to be very similar to data for the nonsugar households. However, the relocated group has a higher percentage of households below both 80 percent and 100 percent of requirements. This finding is partly explained in Table 23, which examines the effects of various sources of income on household calorie consumption.

The household consumption function in Table 23 indicates that total household income has a positive and significant effect on household caloric intake; therefore, the gains in income associated with sugarcane production translate, in part, into increases in household caloric intake. At the mean for caloric intake, the income elasticity of demand for calories is 0.15.

Different sources of income have different effects on household caloric intake, and these effects are above and beyond the pure income effect. The percent of nonfarm income has a significant, negative effect on household calorie consumption. Relocated households derive 55 percent of their income from nonfarm income, compared with 36 percent for nonsugarcane-producing households (see Table 14). The negative effect of nonfarm income could account for a 589-calorie difference in intake between the relocated and nonsugar groups.[16]

In addition, income from sugarcane production also has a substantial negative effect on household calorie consumption. This negative effect on consumption largely offsets the positive effects of higher household income. Payment for the sugarcane crop comes in one lump sum. Data from several studies have indicated that lump-sum payments tend to be spent on nonfood expenditures that are typically one-time purchases.[17] Qualitative data from this study indicate that income from sugarcane in South Nyanza tends to be spent on improved housing, school fees, and the acquisition of capital goods.

One major reason that various sources of income have different effects on energy consumption may relate to control of income within the household. Nonfarm income is earned and controlled primarily by men within the household. Sugarcane income is also overwhelmingly treated as men's income. Conversely, much of the agricultural production used for home consumption comes from female-controlled plots. Approximately 60 percent of the plots of land allocated to food crop production is controlled by women within the household. Data in Table 23 indicate that women-controlled income has a significant and positive effect on household food consumption.

Greer and Thorbecke (1986) also found that female-controlled income and income from agricultural production are more likely than other forms of income to be used to enhance household-level food security. The data from the present study also suggest that the impact of female-controlled income on household calorie intake is clearly positive. The data in Table 23 supports one of the early hypotheses of the study that it may not simply be total income but control of income and source of income that are important factors in influencing household-level food security.

One purpose of the study was to examine the link between sugarcane production/household-level food security and the food intake of children. The analysis of the dietary patterns of preschoolers was, however, complicated by two factors. First, many children,

[16] The figure of 589 calories was arrived at by taking the difference in nonfarm income between the nonsugar and relocated households (19 percent) and multiplying by the regression coefficient of −31 from Table 23.

[17] See von Braun and Kennedy 1986 for a review of some of the literature on this topic.

Table 23—Regression for household caloric consumption

Independent Variable	Total Daily Household Caloric Intake		
	β	t-Statistic	Coefficient
Women's income (percent)	18.6	2.69	0.007
Round 2	−1,139	−2.89	0.037
Round 3	−1,975	−3.59	0.0003
Round 4	−1,824	−3.27	0.0011
Schooling of head of household	−93	−1.7	0.08
Adult equivalent units	2,278	46.1	0.0000
Income per capita	2.2	6.2	0.0000
Income squared	−1.43E−04	−4.2	0.0000
Percent of nonfarm income	−31.4	−2.89	0.004
Relocated households	50	0.08	0.936
Percent of sugar income	−5,974	−2.54	0.011
Constant	−665	−0.67	0.498
R^2	0.62		
Analysis of variance			
Regression	11		
Residual	1,366		
F	204		
Sig F	0.0		

particularly those in the 6- to 12-month category, obtained a substantial amount of their caloric intake from breast milk. Since it was not possible to quantify the caloric contribution of breast milk in this study, children who were receiving any breast milk were eliminated from the dietary analysis.

Second, preschoolers are often fed from a common family dish. In these cases, the mothers or caretakers are unable to quantify the amount of food eaten by the child at a particular meal. Because data for this group of preschoolers is "incomplete," their energy consumption is underestimated. Although the missing data were equally distributed across the different types of households in the study—not biased toward a particular type of household—these preschoolers were also eliminated from the estimate of caloric intake because the data for them were known to be underestimated.

Table 24 presents data on average caloric intakes as a percentage of requirements met for preschoolers in households present in both the baseline and the follow-up studies.[18] In the 1984/85 baseline survey, the percentage of caloric adequacy of children from sugarcane-producing households was significantly higher than intakes of children from the merchant or landless households.

These findings on preschoolers' consumption from the 1984/85 baseline study are in contrast to data for households in the same study. Household caloric intake was similar across groups, but the baseline data on children alone indicated that preschoolers from sugar-producing households do better and in some cases significantly better than children from other types of households.

In the follow-up study, data on preschoolers from the cohort sample indicate that children from both sugar- and nonsugar-producing households come significantly closer to attaining caloric adequacy than do children from wage-earning households.

[18] A preschooler's caloric intake was obtained from a 24-hour recall of consumption, as reported by the main caretaker of the child.

Table 24—Comparison of preschoolers' caloric adequacy, by household activity group, 1984/85 and 1985-87

Activity Group	Preschoolers with Complete Data	
	Baseline Study—1984/85	Follow-up Study—1985-87
	(percent of requirements)	
New entrants	64	54
Sugar farmers	69[a]	66[b]
Nonsugar farmers	58	62[b]
Merchants	47	53
Wage earners	49	38[b]
Landless	46	46
Sample mean	60	61

Sources: International Food Policy Research Institute (IFPRI), "Survey, 1984/85," South Nyanza, Kenya; and IFPRI, "Follow-up Survey, 1985-87," South Nyanza, Kenya.

[a] The percentage of preschoolers from sugar scheme households who met standards of caloric adequacy was higher at the 0.05 level of significance than those from landless or merchant households.

[b] The percentage of children from sugar and nonsugar scheme households who met standards of caloric adequacy was higher at the 0.05 level of significance than those from wage earner households.

It is curious that even though the new entrants had a higher household caloric intake than the nonsugar households (Table 21), the children of the new entrants did no better, on average, than children from nonsugar households. It is possible that the benefits of higher caloric intakes at the household level are not shared proportionately among different household members.

A caloric consumption function for preschoolers is specified in Table 25. The elasticity of household calories with respect to child calories is 0.15—the same as the income elasticity for household calories. Therefore, even though preschoolers, on average, are more deficient in calories than households as a whole, preschoolers capture the same share of incremental calories.

As the number of meals a child receives increases, the caloric intake of the preschooler improves. This supports the notion that many small children are physically unable to eat large enough portions of bulky foods at one time to provide the calories they need; thus, more frequent meals improve caloric consumption. The implications of preschooler calorie consumption for nutritional status will be discussed further in Chapter 7.

Table 25—Regression of preschoolers' caloric intake

Independent Variable	Log of Preschoolers' Daily Calorie Consumption	
	β	t-Statistic
Birth order	−2.7E−04	−0.13
Round 2	−0.017	−1.20
Round 3	0.02	1.68
Round 4	0.014	0.95
Gender (1 = boy)	0.013	1.26
Ln household calorie consumption	0.15	4.83
Head of household away	8.4E−03	0.42
Meals (numbers)	0.10	14.37
Age (months)	3.7E−03	7.11
Female head of household (1 = yes)	−0.02	−1.00
Percent diarrhea	7.74E−04	2.45
Adult equivalent	−7.3E−03	−4.16
Child's weight (kilograms)	0.021	7.25
Constant	3.80	11.60
R^2	0.20	
Analysis of variance		
Regression	13	
Residual	3,904	
F	74.98	
Sig F	0.0	

6

MORBIDITY PATTERNS OF PRESCHOOLERS AND WOMEN

The sugarcane scheme was targeted to South Nyanza District with the expectation that the economic growth generated by the outgrowers' program would result in improved health and nutritional status, particularly for the vulnerable groups: preschool-aged children and pregnant and lactating women. The 1984/85 baseline study results indicate, however, that the income gains associated with participation in the outgrowers' program did not translate into improvement in the health status of preschoolers and women, at least in the short run. The 1985-87 follow-up study assesses whether, in the longer term, income changes are associated with decreases in morbidity in women and children. It has already been shown that in the cohort sample, the new entrants group attained significantly higher incomes and household energy consumption than the nonsugar farmers. This chapter examines the effects of increased household income and caloric consumption on the morbidity patterns of women and children.

Descriptive Analysis of Morbidity

Table 26 presents data on morbidity patterns for women and preschoolers for all four rounds combined. For the cohort sample, there is no significant difference in the total time ill or the time ill with diarrhea for preschoolers across any of the activity groups. The new entrants' significant gains in income have not translated into a decrease in the average time ill for preschoolers. These results are similar to those in the earlier baseline survey.

The total amount of time ill for preschoolers is similar to that in the 1984/85 baseline study, dispelling the view held by some that in a normal agricultural production year, prevalence of illness will decrease. As will be seen later, the causes of poor health are not related directly to agricultural production.

Table 26—Percentage of time ill, preschoolers and women, by activity group, cohort sample, 1985-87

	Preschoolers			Women	
Activity Group	Total Time Ill	Number of Children	Time Ill with Diarrhea	Total Time Ill	Number of Women
	(percent)		(percent)	(percent)	
New entrants	29.5	85	4.7	24.5	32
Sugar farmers	29.8	428	4.6	23.8	168
Nonsugar farmers	31.2	542	4.0	24.3	220
Merchants	20.8	45	2.0	21.8	16
Wage earners	31.6	30	4.5	31.9	14
Landless	31.6	62	3.8	21.8	31
Sample mean and size	30.3	1,192	4.2	24.1	481

Source: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Note: The time ill is based on an average of all rounds. No two groups are significantly different.

Table 27—Percentage of time ill, preschoolers and women, cohort sample, by per capita income quartile, 1985-87

Per Capita Income Quartile	Preschoolers				Women	
	Total Time Ill	Number of Children	Time Ill with Diarrhea	Number of Children	Total Time Ill	Number of Women
	(percent)		(percent)		(percent)	
1	27.6	399	3.7	403	21.4	170
2	30.6	398	4.8	405	25.6	162
3	31.9	311	3.9	316	26.1	140
4	31.0	388	4.3	391	22.8	159

Source: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Notes: There was no significant difference across income quartiles.

Morbidity patterns for women and preschoolers are analyzed according to income per capita quartiles. There are no significant differences across income quartiles in the total percentage of time ill for either women or preschoolers (Table 27). This again is similar to findings from the 1984/85 baseline study, which indicated that an increase in income was not associated with a decrease in the prevalence of illness. There are also no differences for preschoolers across income quartiles in the total time ill with diarrhea.

Prevalence of all illness in preschoolers is also stratified by age in Table 28, and by nutritional status classification in Table 29. Illness tends to be most pronounced in the 7-24-month-old children; this period corresponds to the time when most children are weaned—typically a time when morbidity escalates. Data in Table 28 suggest that once children survive the weaning period, overall morbidity tends to decrease slightly. Children classified as better nourished according to any of the three measures were sick less frequently, irrespective of differences in income (Table 29).

Morbidity Models

Morbidity models are specified for preschoolers and women. One problem encountered in formulating these models relates to the interrelationship between sickness and nutritional status. Better-nourished children and women are less likely to be sick, and, therefore, individuals who are less likely to be sick, will have better nutritional status. In order to avoid this circularity problem, predicted nutritional status for preschoolers and women is used in the respective morbidity models.[19]

Results for both women and preschoolers indicate that income is not a significant determinant of illness (Table 30). This corroborates the descriptive analyses presented earlier. In addition, health expenditures per capita are not significantly associated with the prevalence of illness in either women or preschoolers. Both of these findings might seem counterintuitive until one looks at the findings more closely. Household income is usually spent on a mix of goods and services, which, at least in the short term, do

[19] The predictive equation for the preschooler's weight-for-age is given in Chapter 7. The index of women's body mass was predicted using women's age, women's education, household size, landholding per capita, number of wives in the household, and number of children the woman had. Body Mass Index is defined as weight (in kilograms)/height^2 (in meters).

Table 28—Percentage of preschoolers' time ill with any illness, by age of child and activity group, 1985/86

Activity Group	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)	
New entrants	22.1	18	38.1	29	23.4	23	29.2	17	32.6	27
Sugar farmers	33.1	56	31.7	113	27.8	78	28.0	58	27.7	99
Nonsugar farmers	30.3	82	39.0	130	30.7	103	27.7	107	26.6	128
Merchants	35.3	4	23.8	15	10.9	7	21.8	10	16.3	9
Wage earners	22.6	6	32.1	8	53.2	6	11.3	3	28.8	7
Landless	27.7	10	37.5	15	37.5	9	26.8	15	30.9	13
Sample mean	30.1	176	35.2	312	29.2	226	27.2	210	27.5	285

Source: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Note: These figures represent averages of all four rounds of the survey.

not impart a health benefit to women or children. As discussed in Chapter 4, there is a tendency for the sugarcane-producing households to spend a slightly higher proportion of their income on nonfood expenditures. The effects of these new expenditure patterns will depend on the items purchased. Nonfood expenditures fall into two broad categories: first, those with no expected health or nutritional effects—consumer goods such as jewelry or radios, for example. The second category of expenditures includes those with a potential impact on health, but these can be further subdivided into short-term versus long-term effects. Some expenditures, like money spent for deworming or other preventive health items, might be expected to have an immediate impact that can be observed even in the very short run.

However, as shown in Chapter 4, increased income in households participating in the sugar scheme is spent on items like improved housing and education. While these

Table 29—Percentage of time ill with any illness for preschoolers aged 6 to 72 months, by indicators of nutritional status and income quartile, 1985-87

	Weight-for-Age		Weight-for-Length		Length-for-Age	
Income Quartile	Less than 75 Percent	75 Percent or More	Less than 90 Percent	90 Percent or More	Less than 90 Percent	90 Percent or More
1	36.1 (41)	26.8 (353)	28.1 (57)	28.2 (307)	30.9 (100)	27.0 (267)
2	40.8 (48)	29.1 (349)	35.8 (52)	29.7 (296)	35.2 (74)	29.4 (274)
3	43.1 (29)	31.0 (280)	32.2 (36)	31,3 (229)	36.5 (65)	29.7 (200)
4	40.0 (26)	30.2 (359)	41.0 (33)	31.4 (300)	35.2 (73)	31.6 (260)
Sample mean	39.8 (144)	29.2 (1,341)	33.6 (178)	30.1 (1,132)	34.1 (312)	29.4 (1,001)

Source: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Note: The numbers in parentheses are the number of children in the sample.

Table 30—Regressions for total time ill of preschoolers and women

Selected Independent Variables	Share of Time Ill	
	Preschoolers	Women
Income per capita	4.38E–04 (0.772)	–1.63E–04 (–0.276)
Z-score of predicted weight-for-age	–5.59 (–4.05)	. . .
Predicted body mass index	. . .	–5.79 (–2.03)
Gender (1 = boy)	1.09 (0.552)	. . .
Health expenditures per capita	–3.40E–03 (–0.74)	5.15 (1.28)
Percent of female income	0.04 (1.078)	–0.98 (–0.233)
Household size	–0.47 (–2.615)	–0.85 (–4.32)
Constant	27.56 (4.03)	162.7 (63.3)
R^2	0.057	0.057
Analysis of variance		
Regression	66	65
Residual	450	401
F	4.522	4.83
Sig F	0.0002	0.0003

Notes: The numbers in parentheses are t-statistics. The ellipses indicate a nil or negligible amount.

expenditure categories may produce health benefits in the long run, they are not associated with changes in morbidity patterns in the short run.

Policymakers are particularly concerned about short-run morbidity because the acutely ill have a higher risk of mortality. The Z-score for predicted weight-for-age has a significant, negative association with illness in preschoolers; better-nourished children are less likely to be sick. Similar results are shown for women. Women with a better nutritional status (as measured by a higher body mass index) are significantly less likely to be ill. Women and preschoolers from larger households are ill for shorter periods of time. The larger households in this community tend to be wealthier.

The lack of proof of a relationship between income and morbidity for either women or preschoolers should not be used to argue that income is not important. At least in the short run and possibly in the medium term, planning for income-generating schemes should be coordinated with other health and sanitation initiatives. The complementarities between increased income and an improved health and sanitation environment should be stressed, so that the potential effects of commercial agriculture on overall welfare can be enhanced.

7

NUTRITIONAL STATUS OF PRESCHOOLERS AND WOMEN

The area of Kenya where this research was conducted has the highest birth-to-two-year mortality rate—216 per 1,000—of any part of the country. In other parts of Kenya the comparable mortality rate is 90 deaths per 1,000 live births. There is also a high prevalence of preschooler malnutrition in South Nyanza. For example, 30 percent of preschoolers in South Nyanza district are stunted, compared with a national average of 16 percent for all districts in Kenya. The government hopes that one positive effect of the transition from semisubsistence to commercial agriculture will be an improvement in the general well-being, including an improvement in child health and mortality statistics.

Descriptive Analysis of Preschooler Growth

The Z-scores for length-for-age, weight-for-age, and weight-for-length, averaged for all four rounds, for both the baseline and follow-up study are given in Table 31. These

Table 31—Z-score for length-for-age, weight-for-age, and weight-for-length of children, by activity group, cohort sample only, 1984/85 and 1985-87

Activity Group	Z-Score: Study 1			Z-Score: Study 2		
	Length-for-Age	Weight-for-Age	Weight-for-Length	Length-for-Age	Weight-for-Age	Weight-for-Length
New entrants	−1.46 (90)	−1.13 (90)	−0.27 (90)	−1.74 (61)	−1.06 (61)	0.005 (61)
Sugar farmers	−1.34 (356)	−1.03 (356)	−0.22 (356)	−1.67 (243)	−1.14 (243)	−0.15 (241)
Nonsugar farmers	−1.50 (556)	−1.17 (556)	−0.31 (556)	−1.76 (349)	−1.10 (353)	−0.04 (349)
Merchants	−0.99 (62)	−0.86 (62)	−0.27 (62)	−1.05 (29)	−0.89 (29)	−0.26 (29)
Wage earners	−1.65 (30)	−1.49 (30)	−0.59 (30)	−1.87 (24)	−1.49 (24)	−0.51 (24)
Landless	−1.45 (77)	−1.06 (77)	−0.18 (77)	−1.99 (40)	−1.36 (40)	−0.16 (39)
Sample mean	−1.42 (1,171)	−1.11 (1,171)	−0.28 (1,171)	−1.72 (746)	−1.13 (749)	−0.10 (743)

Sources: International Food Policy Research Institute (IFPRI), "Survey, 1984/85," South Nyanza, Kenya; and IFPRI, "Follow-up Survey, 1985-87," South Nyanza, Kenya.

Notes: The numbers in parentheses are the number of children in each sample. No two groups are significantly different. Standards of the U.S. National Center for Health Statistics are used as the reference median for nutritional status indicators. The z-scores are averages of all four rounds of the survey.

The baseline survey data included children up to six years of age. The same children are of course older in the follow-up study.

data represent the cohort sample of the children up to six years of age who were present for the earlier survey. Each of these children has, of course, aged; in the follow-up survey they range from one through six years. In the baseline study, there were no significant differences in any of the three anthropometric indicators across any of the household groups. This was somewhat surprising given that the incomes of the sugar farmers were approximately 25 percent higher than the nonsugar farmers and new entrants groups. However, the same results emerge from the follow-up study: there are no significant differences in any of the three indicators across any of the households. Although the new entrants now have an income per capita that is 33 percent higher than nonsugar producers, the preschoolers from the new entrants and nonsugar households are, on average, no different with regard to nutritional status.

The results are the same if all children in the second study are compared with children from the first study (Table 32). This group of children is different from that in the first study because new children have been added to the sample as the result of new births, children below six months who now fall in the range of 6-72 months of age, and new children (usually extended family) who have joined the households. Here again, there are no significant differences across any of the groups.

The prevalence of stunting (length-for-age less than 90 percent of the standard), wasting (weight-for-length less than 90 percent), and weight-for-age less than 80 percent in the various types of households are shown in Table 33. There are no significant differences in the prevalence rates for any of the three indicators in preschoolers from agricultural households.

Table 34 shows the prevalence of stunting, wasting, and low weight-for-age for the cohort sample of preschoolers stratified by household income per capita. There is a tendency, although not significant, for preschoolers from the highest-income group to

Table 32—Z-scores for length-for-age, weight-for-age, and weight-for-length of all preschoolers in follow-up study, 1985-87

Activity Group	Z-Scores: Study 2		
	Length-for-Age	Weight-for-Age	Weight-for-Length
New entrants	−1.73 (98)	−1.11 (98)	−0.07 (98)
Sugar farmers	−1.60 (371)	−1.08 (376)	−0.13 (369)
Nonsugar farmers	−1.74 (498)	−1.05 (515)	0.02 (498)
Merchants	−1.25 (42)	−0.88 (42)	−0.08 (42)
Wage earners	−2.04 (28)	−1.51 (28)	−0.42 (28)
Landless	−1.92 (57)	−1.33 (59)	−0.20 (55)
Sample mean	−1.69 (1,094)	−1.09 (1,118)	−0.07 (1,090)

Source: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Notes: No significant differences are found across groups. This table includes new children who were added to the sample in the follow-up survey, as well as children in the cohort sample.

Table 33—Prevalence of stunting, wasting, and low weight-for-age in preschoolers aged 6 to 72 months, by activity group, 1985-87

Income/ Capita Quartile	Length-for-Age Adequacy		Weight-for-Age Adequacy		Weight-for-Length Adequacy	
	Sample Size	Less than 90 Percent	Sample Size	Less than 80 Percent	Sample Size	Less than 90 Percent
		(percent)		(percent)		(percent)
New entrants	25	25.5	25	25.5	13	13.3
Sugar farmers	94	25.3	74	19.7	48	13.0
Nonsugar farmers	128	25.7	124	24.1	70	14.1
Merchants	5	11.9	5	11.9	5	11.9
Wage earners	8	28.6	8	28.6	6	21.4
Landless	16	28.1	18	30.5	10	18.2

Source: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.

have less wasting than children in other income quartiles. There are no significant differences across the income quartiles in weight-for-age less than 80 percent or in the rate of stunting, however.

The general conclusion has to be that, on average, increased household income does not bring about a significant improvement in preschoolers' nutritional status that can be detected by descriptive analysis. This issue will need to be explored further using the multivariate analysis.

Descriptive Analyses of the Nutritional Status of Women

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

In the baseline study, there was no difference in weight in any of the four rounds nor in the all-round average weight for women in any of the groups. The results from the follow-up study using the cohort sample are similar (Table 35). No significant

Table 34—Prevalence of stunting, wasting, and low weight-for-age in preschoolers, cohort sample, by income per capita quartile, 1985-87

Income/ Capita Quartile	Length-for-Age Adequacy		Weight-for-Age Adequacy		Weight-for-Length Adequacy	
	Sample Size	Less than 90 Percent	Sample Size	Less than 80 Percent	Sample Size	Less than 90 Percent
		(percent)		(percent)		(percent)
1	100	27.9	80	22.0	55	15.5
2	75	22.3	80	23.3	49	14.6
3	66	25.1	55	20.2	32	12.2
4	75	23.8	72	22.3	28	8.9

Source: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.

Table 35—Nutritional status of women in the cohort sample, 1985-87

Activity Group	Weight				Weight (All-Round Average)	Body Mass Index (All-Round Average)
	Round 1	Round 2	Round 3	Round 4		
	(kilograms)					
New entrants	56.6 (32)	58.2 (55)	58.4 (47)	59.7 (55)	58.7 (62)	22.1 (58)
Sugar farmers	57.7 (223)	57.6 (303)	58.1 (296)	57.9 (307)	57.9 (375)	22.3 (305)
Nonsugar farmers	57.0 (302)	56.9 (403)	56.8 (384)	57.0 (377)	56.9 (484)	22.2 (390)
Merchants	60.1 (17)	61.7 (21)	63.4 (11)	61.7 (21)	61.6 (28)	22.6 (24)
Wage earners	54.6 (13)	54.5 (13)	54.4 (15)	53.9 (17)	54.3 (17)	21.1 (15)
Landless	55.7 (32)	56.2 (39)	55.8 (38)	56.5 (41)	56.0 (49)	22.3 (44)
Sample mean	57.2 (619)	57.2 (834)	57.4 (797)	57.6 (818)	57.3 (1,015)	22.2 (836)

Source: International Food Policy Research Institute, "Follow-up Survey, 1985-87," South Nyanza, Kenya.
Notes: No two groups are significantly different. Body mass index is defined as weight (in kilograms)/height^2 (in meters). Numbers in parentheses are the number of women in each sample.

differences could be found in weight by round, by average for all rounds, or average body mass index.

Determinants of Preschooler Nutritional Status

Table 36 presents the regressions for Z-scores for preschoolers' length-for-age, weight-for-age, and weight-for-length. The multivariate analyses substantiate much of what appeared in the descriptive analyses.

One robust finding for all three Z-scores is the strong relationship between the baseline Z-score from the earlier study and the anthropometric indicator from the follow-up study. Given that the time span between the baseline period and the end of the follow-up study is two-and-a-half years, one might not expect this effect to be as strong. However, an increase in the length-for-age Z-score of 1.00 in the baseline period is associated with a 0.61 increase in the follow-up length-for-age Z-score. The corresponding values for weight-for-age and weight-for-length are 0.55 and 0.39, respectively. This indicates that children who were doing well in the 1984/85 study have a high probability of doing well in the follow-up period. Conversely, children who were not doing well earlier are highly likely to continue to have less than optimal nutritional status.

These data also give credence to those who believe that faltering growth is a major criterion for identifying children who are at risk for long-term growth problems.

Caloric intake of a preschooler is a significant, positive determinant of the child's length and weight, but not of weight-for-length (wasting). Similarly, the percentage of time ill with diarrhea has a negative effect on length and weight but not on weight-for-length. Finally, in general, as children get older, their Z-scores for length- for-age and weight-for-age tend to improve.

Table 36—Regressions for preschoolers' Z-scores for length-for-age, weight-for-age, and weight-for-length, cohort sample, 1985-87

Independent Variables	Length-for-Age		Weight-for-Age		Weight-for-Length	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
Head of household	−0.134	−0.74	−0.137	−0.99	−0.03	−0.20
Household size	−0.012	−1.51	−4.28E−03	−0.70	1.44E−03	0.22
Gender (1 = boy)	0.090	1.09	0.03	0.40	−0.03	−0.47
Female head of household	−0.211	−1.45	−0.14	−1.29	−0.07	−0.54
Average Z-score, Study 1	0.605	20.67	0.55	20.09	0.39	10.64
Child's calories	2.42E−04	1.96	2.02E−04	2.13	1.10E−04	1.07
Diarrhea	−0.02	−3.36	−0.014	−3.03	−7.09E−03	−1.46
Mother's height	0.026	3.69	7.80E−03	1.46	−6.3E−03	1.09
Area (hectares)	2.98E−03	0.29	0.01	1.36	0.01	1.29
Age (months)	0.025	8.10	0.01	6.21	1.27E−03	0.51
Constant	−5.60	−4.56	−2.03	−2.16		
R^2		0.51		0.49		0.20
Analysis of variance						
Regression	10		10		10	
Residual	512		514		512	
F	53.4		49.3		13.0	
Sig F	0.0		0.0		0.0	

8

CONCLUSIONS AND POLICY IMPLICATIONS

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 commercialization as a means of increasing incomes of rural smallholders, providing employment for the landless, and stimulating growth linkages with other segments of the economy. It is also assumed that the resulting economic gains will improve the welfare of small farmers, including the health and well-being of household members.

Critics of programs to accelerate the production of export or cash crops argue that not only have the economic benefits not materialized, but in some cases the transition to commercial agriculture has had a negative influence on health and nutritional status.

This report presents the results of the follow-up survey in 1985-87, which was an extension of the earlier (1984/85) baseline study conducted to evaluate the income and nutritional effects of cash cropping in southwestern Kenya. This body of research was initiated because the government of Kenya was interested in determining the appropriate balance between cash crop and food crop production for domestic consumption. Because of the controversial nature of commercialization, there was some concern that in areas with increased cash cropping, particularly increased sugarcane production, the nutritional status of preschoolers may be deteriorating.

Only a few studies, besides these two, are based on a random sample of farmers in a commercial outgrowers' scheme. In addition, the design of this research is methodologically stronger than most studies of this type because baseline information was available on the new entrants group prior to their entry into the sugarcane outgrowers' scheme. They were then tracked up to and following the time of the first harvest. This allows strong inferences to be made about the actual impact of commercial agriculture.

In addition, this research provides a rare assessment of the range of effects of commercial agriculture on the entire community. One premise of the study is that some of the most dramatic effects of cash cropping occur in households not directly involved in the scheme—the landless and the merchants. Therefore, a sample of nonagricultural as well as agricultural households were included in the surveys.

The follow-up study also includes a random sample of relocated households in which the government is particularly interested. There is currently some discussion in the government about development of new smallholder sugarcane schemes, and information about the effects of such schemes on relocated households may be used to guide future projects.

The results of this study suggest that commercial agriculture has definite positive effects on household income. In the baseline 1984/85 study, incomes per capita of the new entrants and nonsugar producers were virtually identical. In the follow-up of the cohort sample, the average income per capita of the new entrants group was KSh 1,129 higher than that of the nonsugar group. Part of this increment in income per capita is due to differences in commercial agriculture income. The new entrants earned KSh 791 per capita from commercial agriculture (primarily sugarcane), compared with KSh 365 per capita for nonsugar producers. In the earlier study, incomes per capita from commercial agriculture for the new entrants and the nonsugar producers were almost

identical—KSh 404 and KSh 393, respectively. The entry into sugarcane production clearly increased incomes.

The data show that the proportion of land sown with food crops is substantially less for new entrants and sugar farmers, compared with nonsugar farmers. Nevertheless, household food security has not been jeopardized because the overall amount of land per capita under cultivation is similar. New entrants and sugar farmers have maintained food production while expanding commercial agricultural production.

The returns to land (gross margins) were superior for sugarcane compared with maize in drought years but not in nondrought years. However, the net returns to household labor were three times higher for sugarcane than for maize.

The superior profitability of sugar to maize per day of household labor is due in large part to the pricing policy pursued by the Kenyan government. The price paid for sugarcane in Kenya is established by the Office of the President, Government of Kenya. Since 1978, the producer price has increased both in nominal and real terms. If the government had used the world price of sugar, the situation would have been different. In three of the five years included in this study, average net income would have been negative if the price paid to outgrowers for cane had been based on world sugar prices. The pricing policy for sugar in Kenya has worked to the advantage of the small producer.

The higher incomes associated with sugarcane production have resulted in increases in caloric intake for households in the new entrant group. In addition, the higher caloric intakes in new entrant households has translated into increases in the caloric intakes of children in those households. However, the amount of additional calories transferred to children has not been large enough to fill the average caloric deficit in children.

Moreover, the increases in income associated with participation in the sugarcane scheme are not found to decrease child morbidity, at least in the short and medium terms captured by these studies. It may seem counterintuitive that very significant increases in income do not translate into a decrease in the prevalence of illness. One needs to be cautious in interpreting these data. There is a tendency for more commercialized households to spend a slightly higher proportion of their income on nonfood expenditures. Both the 1984/85 and 1985-87 studies show that increased income in households participating in the sugarcane scheme is largely spent on items like improved housing and education. Whereas these expenditure categories may produce health benefits in the long term, in the short term they are not associated with changes in morbidity patterns. One could envision a scenario where increased expenditures on education—particularly education of girls—might result in changes in fertility patterns in the longer term, which, in turn, would influence neonatal outcome and ultimately result in improved infant health. Because of the relatively short time frame of both of these studies, linkages of this type could not be identified.

It is worth repeating that at the study site, sanitation and health practices are poor, and infant mortality and malnutrition rates are high. Whereas, in the longer term, increases in income can be expected to bring about an improvement in overall health and welfare, in the short term, it appears that increases in income must be combined with an improvement in the health environment in order to have a significant effect on preschooler morbidity. This is not to argue that income is not important, but rather that in planning agricultural policies and programs, attention should be given simultaneously to health and sanitation conditions in rural areas. The complementarities between increased income and an improved health/sanitation environment should be stressed, so that the potential effects of commercial agriculture schemes on overall welfare can be enhanced.

The morbidity pattern found in preschoolers is the major determinant of child growth. As already discussed, increases in income as a result of the schemes have had a limited effect on decreasing illness in the short term, and thus there has also been little effect on malnutrition because growth and morbidity are closely linked in preschoolers.

Increased household incomes affect preschoolers' growth mainly through the linkages between incomes, caloric intake, and growth. The analysis indicates that increases in income result in improved caloric intake within the household and that a portion of this benefit is passed on to the child. However, even with a doubling of household income, results suggest only a modest increase in a preschooler's caloric consumption. This level of increased intake is not sufficient, on average, to fill the child's caloric deficit. Even in households where more food is available than is needed to meet caloric requirements, preschoolers often fall well below their apparent energy requirements.

The two Kenyan case studies do not address directly the reasons for inadequate preschooler caloric consumption in situations where income and household food supplies seem not to be constrained. However, one explanation is plausible. The area in which the commercial agriculture 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, since their children look like most other children in the community. If primary caretakers do not perceive a nutritional need, then there would be no reason to assume that the children need more food.

A second explanation is also possible. It is very likely that chronically sick preschoolers feel satiated before their "true" caloric needs have been met. It is also not surprising that a parent would assume that a child does not need more food if the child has indicated that he or she has had enough.

Two things happen to older children. First, they are less likely to be sick. This is shown by both the descriptive data and multivariate analyses. Therefore, the adverse effect of illness on appetite is less pronounced in the older children. Second, older children are probably more likely than younger children to ensure that they receive adequate food. For one thing, they are able to help themselves; unlike very young children, they do not depend totally on caretakers.

The sugarcane outgrowers' program, as it has been implemented, has not been associated with increased preschool malnutrition. Therefore, accusations that introduction of a cash cropping scheme is usually associated with a deterioration in nutritional status are not borne out by data from the two Kenyan studies.

Increased household incomes in rural areas, based on agricultural growth that also includes the smallest farmers and the landless, can make a major contribution to the solution of the hunger problem, but it does not in itself provide a complete solution to the problem of preschooler malnutrition.

Many governments and international agencies are putting increased emphasis on income-generating schemes as a way of achieving health and nutrition objectives. While additional income may be a necessary condition, increases in income, by themselves, may not be sufficient to alleviate malnutrition, at least in the short term. Health and sanitation conditions should be improved in tandem with agricultural policies and programs in order to maximize the nutritional effects of income-generating schemes.

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