16 Effects of Sugarcane Production in Southwestern Kenya on Income and Nutrition

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Introduction

In 1984, at the request of the Government of Kenya, IFPRI initiated 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 to sugarcane production, a deterioration in household-level food security and preschooler nutritional status was occurring.

The study was initiated in South Nyanza, a sugar-growing area, 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.

The study site was served by the South Nyanza Sugar Company (SONY), which, typical of most sugar factories in Kenya, is primarily government owned. Smallholder producers who join the sugarcane outgrowers program are under contract to the company to produce sugarcane at a price determined by the government. Inputs such as seed, fertilizer, and hired labor are provided to the farmers, as needed, for a fee. The total costs of the package of inputs plus interest are deducted from the payment to the farmer for the sugarcane crop. The SONY outgrowers' program is typical of the way sugarcane production is organized throughout Kenya.

The first stage of data collection took place from June 1984 to March 1985. The sample included a representative sample of 504 households from the community; this research is one of the few studies on commercial agriculture to include a representative sample of agricultural as well as nonagricultural households from within the community.

A follow-up study was initiated in the same project area in December 1985 to build upon the information collected in the 1984–85

portion of the research.[1] The two studies together provided the opportunity to collect information on socioeconomic conditions, food consumption, and health and nutritional status for a cohort of households (called new entrants) prior to and after their entry into a smallholder sugarcane outgrowers' scheme, as well as up to and after payment for their first sugarcane crop. The 1984–85 and the 1985–87 studies, combined, provided a rare opportunity in which (1) baseline economic and health information is available concerning households prior to cash cropping and (2) farmers can be followed up to and after payment has been received. Sugar farmers, who received at least one payment for the cane crop, were also included, as were nonsugar farmers, merchants, wage earners, and landless persons (Kennedy and Cogill 1987; Kennedy 1989).

Of the 504 households in the 1984–85 study, 462 (92 percent) remained in the follow-up study. The group of households that was in both the 1984–85 and 1985–87 studies is called the cohort households and is the focus of the results presented in this chapter.

Income Effects

The results from the 1984–85 study indicate that incomes of sugarcane farmers who have received at least one payment for the crop are significantly higher than incomes of nonsugarcane producers (table 16.1). Sugarcane contributes to most of the difference in incomes between these two groups. Incomes per capita of new entrants (KSh 1,956 per capita)[2] were virtually identical to that of nonsugarcane producers (KSh 1,924 per capita) in the 1984–85 study. Interestingly, in the follow-up study, incomes per capita (both nominal and real) of the same new entrant group were significantly higher than those of the nonsugar group, and both new entrants and sugar farmers had incomes per capita significantly higher than of nonsugarcane producers (table 16.1).

Part of the difference in incomes between the cohort sample of new entrants and nonsugarcane producers arises from differences in marketed agricultural income (table 16.1). However, other sources of income also contribute to the difference in incomes between the two types of households. In the 1984–85 study, sugarcane production contributed 73 percent of the difference in income between sugar and nonsugar producers. The higher incomes of the new entrants in the 1985–87 study

1. For a detailed description of the survey design and research protocol for both studies, see Kennedy and Cogill (1987) and Kennedy (1989).

2. US$1 = 20 Kenyan shillings in 1989.

TABLE 16.1 Mean annual income per capita per year, by source and activity group, study 1 compared to study 2, cohort group, South Nyanza, Kenya, 1984–1985 and 1985–1987

Activity Group	Agricultural Income: Used for Own Consumption Mean (KSh)	Agricultural Income: Used for Own Consumption Share (percent)	Agricultural Income: Marketed Mean (KSh)	Agricultural Income: Marketed Share (percent)	Nonagricultural Income Mean (KSh)	Nonagricultural Income Share (percent)	*N*	Mean Nominal Income/Capita (KSh)	Mean Real Income/Capita[a] (1984 Level) (KSh)
Study 1 (1984–85)									
New entrants	728	37	404	21	824	42	42	1,956	—
Sugar farmers	748	29	942[b]	36	901	35	139	2,591[c]	—
Nonsugar farmers	822	43	393	20	709	37	231	1,924	—
Merchants	51	2	17	1	2,141	97	29	2,209	—
Wage earners	171	8	45	2	1,821	90	18	2,037	—
Landless	163	13	48	4	1,079	83	43	1,290	—
Total sample mean	669	32	482	23	926	45	502	2,077	—
Study 2 (1985–87)									
New entrants	1,761[d,e]	46	791[d]	21	1,285	33	27	3,837[d]	3,070[d]
Sugar farmers	1,370[e]	40	625[e]	19	1,395[f]	41	146	3,390[f]	2,712[f]
Nonsugar farmers	1,302[d]	48	365[d,e]	14	1,041[f]	38	205	2.708[d,f]	2,166[d,f]
Merchants	571	11	49	<1	4,646[g]	88	15	5,265[g]	4,212[g]
Wage earners	972	30	233	7	2,017	63	14	3,222	2,578
Landless	841	36	162	7	1,336	57	33	2,338	1,870
Total sample mean	1,292	42	452	15	1,347	43	440	3,091	2,473

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

[a]1985/86 incomes adjusted to 1984 levels using GDP deflator. World Bank 1986, 1987.
[b]Sugar farmers have significantly ($p < 0.05$) higher marketed agricultural income per capita than all other groups.
[c]Sugar farmers have significantly ($p < 0.05$) higher income than nonsugar and landless groups.
[d]New entrants versus nonsugar farmers ($p < 0.05$).
[e]New entrants versus sugar farmers ($p < 0.05$).
[f]Sugar farmers versus nonsugar farmers ($p < 0.05$).
[g]Merchants have significantly ($p < 0.05$) higher income than all other groups.

came from more varied sources. The new entrant group increased the proportion of income earned from commercial agricultural income while at the same time it increased subsistence income—that is, agricultural production used for own consumption. Table 16.2 provides an explanation of how this occurred. The new entrant group has the highest mean area per capita devoted to food crops. Of the KSh 1,129 difference in nominal income per capita between the new entrant and nonsugar cohort groups in the 1985–87 study, 41 percent is contributed by commercial agricultural income, 38 percent by subsistence income, and the remaining 21 percent by higher nonfarm incomes in the new entrant group (table 16.1).

The profitability of sugarcane compared to maize for small farmers is due in large part to the pricing policy pursued by the government of Kenya. The price paid to sugarcane producers is set by the government. Since 1980, the producer price of sugarcane has increased both in nominal and real terms; had the government used the world price of sugar to set the producer price for sugarcane, incomes of farmers would have been negative. The government's pricing policy has protected the incomes of sugarcane producers.

TABLE 16.2 Characteristics of farming patterns for agricultural households, cohort group, South Nyanza, Kenya, 1984 and 1986

	1984[a]			1986[a]		
Characteristic	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
Farm area devoted to all crops (percent)	51.7	66.9	56.6	55.6	55.6	44.4
Farm area devoted to food crops (percent)	36.4	36.0	52.1	31.4	31.4	40.3
Mean area per capita devoted to food crops (hectares)	0.19	0.18	0.19	0.17	0.14	0.14

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

[a]Long rain seasons.

New entrants and sugar farmers put a larger proportion of their total land into production. The outgrowers' program, by providing factory labor to the sugarcane producers, has allowed farmers to cultivate more land. Subsistence food crop production has not been jeopardized by the entry into the sugarcane scheme.

Caloric Consumption of Households and Preschoolers

There were no significant differences in the caloric intake per adult-equivalent in the 1984–85 study across the different types of households. However, in the follow-up study, the daily per capita intake of 2,848 calories of new entrants was significantly higher than the 2,641 calories of nonsugar farmers and the 2,649 calories of sugar farmers (table 16.3).

More important than average energy consumption within the different activity groups is the distribution of caloric consumption within the groups. The households consuming 80 percent or less of their energy requirements are of particular concern, since it is unlikely that at this level of consumption these households have adapted successfully to low energy intake. The proportion of the new entrant sample that falls into this severely restricted group is only 24 percent compared to 30 percent of the nonsugar farmers and 27 percent of the sugar farmers in 1984–85.

TABLE 16.3 Comparison of household caloric intake for cohort and total sample, 1984–85 and 1985–86, South Nyanza, Kenya

	Kilocalories per Adult Equivalent per Day[a]		Households Consuming ≤ 80 Percent of Recommended Calories	
Activity Group	1984–85[b]	1985–86[b]	1984–85	1985–86
			(percent)	
New entrants	2,822	2,848[d,e]	24	30
Sugar farmers	2,689	2,649[d]	27	35
Nonsugar farmers	2,669	2,641[e]	30	33
Merchants	2,281	2,462	—	—
Wage earners	2,898	2,668	—	—
Landless	2,506	2,751	—	—
Mean	2,657	2,663	—	—

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

[a]For both studies, all-season average.

[b]No two groups significantly different at $p < 0.05$ level.

[c]All-round average.

[d]T-test for new entrant versus nonsugar group ($p < 0.05$).

[e]T-test for new entrant and sugar group ($p < 0.05$).

New entrant households not only had higher household energy consumption, on average, compared to the nonsugar farmer households, but a smaller proportion of new entrants fell below 80 percent of standard calorie consumption.

The household consumption function reported in table 16.4 indicates that total household income has a positive and significant effect on household caloric intake. Interestingly, different sources of income have different effects on household energy intake over and above the pure income effect. Nonfarm income has a negative effect on household caloric consumption. However, women's income has a beneficial effect on household caloric intake, holding overall income constant.

One major reason for the differential effects of various sources of income on energy consumption relates to control of income within the household. These data support 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 in influencing household-level food security.

Dietary patterns of preschoolers were also analyzed; the elasticity of household calories on a child's calories is 0.14, that is, for each 10 percent increase in household calories, there is a 1.4 percent increase in the child's calories.

TABLE 16.4 Household consumption function, 1985–87

Variable	β	*t*-Statistic	Sign
Women's income (percent)	18.6	2.69	0.007
Dummy Round 2[a]	−1,139	−2.89	0.037
Round 3	−1,975	−3.59	0.0003
Round 4	−1,824	−3.27	0.0011
Head of household schooling (in years)	−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
Nonfarm income (percent)	−31.4	−2.89	0.004
Relocated household[b] (1 = yes, 0 = no)	50	0.08	0.936
Sugarcane income (percent)	−5.974	−2.54	0.011
Constant	−665	−0.67	0.498
$R^2 = 0.62$			
Analysis of variance			
Regression 11 $F = 204$			
Residual 1,366 Sig $F = 0.0$			

SOURCE: Kennedy (1989).

NOTE: The dependent variable is total daily household caloric intake.

[a]Surveys were conducted in four rounds: round 2 = pre-long rains harvest; round 3 = harvesting; round 4 = post-long rains.

[b]Households that were relocated as a result of creation of the sugarcane factory.

Morbidity Patterns and Nutritional Status of Preschoolers and Women

The sugarcane scheme is one form of development assistance that 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 for the population, and, in particular, for vulnerable groups such as preschoolers and pregnant and lactating women.

For the cohort sample of women and preschoolers, there is no significant difference in total time ill or time ill with diarrhea (preschoolers only) across any of the household groups. In addition, for both women and preschoolers, there are no significant differences across income quartiles in the total percentage of time ill in the follow-up study (table 16.5). This is similar to findings from the 1984–85 baseline study, which indicated that increasing income was not associated with a decreasing prevalence of illness, at least in the time period covered by the study. There are also no differences for preschoolers across income quartiles in the total time ill with diarrhea.

Findings on the nutritional status of preschoolers and women parallel the morbidity findings. Table 16.6 presents the average Z-scores[3] for height-for-age, weight-for-age, and weight-for-height for preschoolers for both studies and the mean body mass index[4] for women from both studies. There are no significant differences across the different catego-

TABLE 16.5 Total time ill and time ill with diarrhea of preschoolers and women, stratified by income quartiles, South Nyanza, Kenya, 1985–87

	Income Per Capita Quartile			
Activity Group	1	2	3	4
Preschoolers				
Total time ill[a] (percent)	27.6	30.6	31.9	31.0
Number[b]	(399)	(398)	(311)	(388)
Time ill with diarrhea[a] (percent)	3.7	4.8	3.9	4.3
Number[b]	(403)	(405)	(316)	(391)
Women				
Total time ill[a] (percent)	21.4	25.6	26.1	22.8
Number[b]	(170)	(162)	(140)	(159)

[a]No significant difference among groups.
[b]Number of women or children.

3. Z-score is defined as $\frac{\text{(Actual measurement} - \text{Standard)}}{\text{Standard deviation of the standard}}$.

Standards are based on National Center for Health Statistics 50 percentile standards.

4. Body mass index (BMI) = weight (in kilograms)/height^2 (in meters).

TABLE 16.6 Z-scores for children, in 1984–85 study and 1985–86 study, South Nyanza, Kenya

Activity Group	1984–85 Z-Score[a]			1985–86 Z-Score[a]			Women's Body Mass Index (All-Round Average)
	Length/Age	Weight/Age	Weight/Length	Length/Age	Weight/Age	Weight/Length	
New entrants	−1.46	−1.13	−0.27	−1.74	−1.06	0.005	22.1
	(90)	(90)	(90)	(61)	(61)	(61)	(58)
Sugar farmers	−1.34	−1.03	−0.22	−1.67	−1.14	−0.15	22.3
	(356)	(356)	(356)	(243)	(243)	(241)	(305)
Nonsugar farmers	−1.50	−1.17	−0.31	−1.76	−1.10	−0.04	22.2
	(556)	(556)	(556)	(349)	(353)	(349)	(390)
Merchants	−0.99	−0.86	−0.27	−1.05	−0.89	−0.26	22.6
	(62)	(62)	(62)	(29)	(29)	(29)	(24)
Wage earners	−1.65	−1.49	−0.59	−1.87	−1.49	−0.51	21.1
	(30)	(30)	(30)	(24)	(24)	(24)	(15)
Landless	−1.45	−1.06	−0.18	−1.99	−1.36	−0.16	22.3
	(77)	(77)	(77)	(40)	(40)	(39)	(44)
Sample mean	−1.42	−1.11	−0.28	−1.72	−1.13	−0.10	57.3
	(1,171)	(1,171)	(1,171)	(746)	(749)	(743)	(1,015)

NOTES: No two groups are significantly different. Numbers in parentheses are sample sizes.
[a]All-round average for each Z-score.

either women or preschoolers. There is also no difference in the prevalence of stunting (less than 90 percent of height-for-age), wasting (less than 90 percent of weight-for-height), or weight-for-age of less than 80 percent for the cohort sample of preschoolers.

Determinants of Preschooler Morbidity and Nutritional Status

Multivariate analyses for morbidity and nutritional status substantiate much of what has been presented in the descriptive analyses.

Morbidity models were specified for preschoolers and women.[5] Results for both women and preschoolers indicate that income is not a significant determinant of illness. In addition, health expenditures per capita are not significantly associated with the prevalence of illness in either women or preschoolers, at least in the short run. Both these findings may seem counterintuitive until one looks at them more closely. Income in the household tends to be spent on a mix of goods and services that, at least in the short term, do not impart a health benefit to women or children. Sugar-producing households spend a slightly higher proportion of their income on nonfood expenditures compared to non-sugar-producing households. Increased income in sugarcane scheme participant households is spent on items such as improved housing and education, which may produce health benefits in the long term, but, in the short run, are not associated with changes in morbidity patterns.

Policymakers are concerned about short-run morbidity because the acutely ill have a higher risk of mortality. In the study area, better-nourished children are, in fact, less likely to be sick (Kennedy 1989). Similar results are seen for women. Women with a higher body mass index are significantly less likely to be ill.

The lack of an income-morbidity relationship in either women or preschoolers should not be used to argue that income is not important, but rather that, at least in the short term and possibly in the medium term, planning for income-generating schemes should be coordinated with other health and sanitation initiatives. 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.

Growth models for preschoolers were specified (table 16.7); one robust finding for all three Z-scores is the strong relationship between the baseline Z-score from the 1984–85 study and the anthropometric indicator from the 1985–87 study. Given that the time span between the

5. See Kennedy (1989) for model specification and empirical results.

TABLE 16.7 Regressions of preschooler Z-scores for height-for-age, weight-for-age, and weight-for-height, 1985–87 study

	Height-for-Age		Weight-for-Age		Weight-for-Height	
Independent Variables	β	t-Statistic	β	t-Statistic	β	t-Statistic
Head of household away	−0.134	−0.74	−0.137	−0.99	−0.03	−0.20
Household size	−0.012	−1.51	−4.28E-03	−0.70	1.44-03	0.216
Sex (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
Percent time with 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	0.025	8.10	0.01	6.21	1.27E-03	0.51
Constant	−5.60	−4.56	−2.03	−2.16	2.02	2.04
R^2	0.51		0.49		0.20	
Degree of freedom	512		514		512	
F-value	53.4		49.3		13.0	

SOURCE: Kennedy (1989).

baseline period and the end of the 1985–87 study is two and one-half years, an effect this strong might not be expected. However, an increase in the height-for-age Z-score of 1.0 in the baseline period is associated with a 0.61 increase in the 1985–87 height-for-age Z-score. The corresponding values for weight-for-age and weight-for-height are 0.55 and 0.39, respectively. This would indicate that children who were doing well in the 1984–85 baseline study had a high probability of doing well in the follow-up period. Conversely, children who were not doing well earlier had a high probability of continuing to have less than optimal nutritional status. These data also give credence to those who advocate growth faltering as a major criterion for identifying children who are at risk of long-term growth problems.

Preschooler caloric intake is a significant positive determinant of children's height and weight but not weight-for-height. Similarly, the percentage of time ill with diarrhea has a negative effect on height and weight but not weight-for-height. Finally, in general, as children get older, their Z-scores for height-for-age and weight-for-age improve.

Conclusions

The results from the two studies in Southwestern Kenya suggest some very positive impacts of commercial agriculture on household income. The sugarcane outgrowers' program, as it is implemented, is associated with a significant increment in income for both new entrants and sugar farmers. This income, in turn, produces some positive effects on household energy consumption of sugar farmers. However, this benefit at the household level does not appear to have had a dramatic influence on preschooler morbidity patterns or growth. There is a growing awareness that family-level factors may be poor predictors of a child's nutritional status.

Many governments and international agencies are putting increased emphasis on income-generating schemes as a way of achieving health and nutrition objectives. While income may be a necessary condition, increases in income, by themselves, may not be sufficient to alleviate malnutrition, at least in the short term.

Data from the 1984–85 study suggest that the health and sanitation environment had the greatest impact on preschoolers' growth. In the 1985–87 study, one of the major determinants of child growth is the growth pattern of this same child in the baseline study; this earlier growth of the child was influenced significantly and negatively by the preschooler's morbidity patterns and the health and sanitation environment. Children who were not doing well earlier continued to have inadequate growth, which suggests that without improvements in factors

that influence children's health, their growth will not be substantially improved. Greater emphasis needs to be placed on the health implications of agricultural policies and projects, with particular attention on ways to improve the health infrastructure in a given community.

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

To date, most of the farmers who joined the outgrowers' scheme have remained. It is naive to think, given the way the program now operates, that there will be a mass exodus back to food crop production. Farmers are making a profit and will probably remain in the scheme. Some fine tuning of the program will help maximize the potential impact of the increased income on household and preschooler nutritional status.