RESEARCH REPORT

79

EFFECTS OF AGRICULTURAL COMMERCIALIZATION ON LAND TENURE, HOUSEHOLD RESOURCE ALLOCATION, AND NUTRITION IN THE PHILIPPINES

Howarth E. Bouis
Lawrence J. Haddad

January 1990

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

In collaboration with the RESEARCH INSTITUTE FOR MINDANAO CULTURE

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FOREWORD

Over the past several years IFPRI has undertaken research on the production, consumption, and nutrition effects of agricultural commercialization in The Gambia, Guatemala, Kenya, the Philippines, and Rwanda. While it is widely recognized that the commercialization of agriculture is essential to overall economic development, various rural population groups adapt differently to the process of commercialization, depending on the resources available to them, economic and social conditions, and government policies. Many households benefit in the form of higher incomes; others may suffer a decline in income. A particular concern of policymakers has been the effect of commercialization on nutrition.

The purpose of these studies has been to analyze the process of commercialization in order to identify key factors that determine nutritional outcomes, with the objective of formulating policies to enhance the beneficial effects of commercialization and minimize the harmful effects.

The present report by Howarth E. Bouis and Lawrence J. Haddad presents the findings for the Philippine case study, located in an area on the southern island of Mindanao where a substantial number of households converted lands from corn to sugarcane production after construction of a sugar mill. The main effects of the introduction of export cropping in this area were a significant deterioration in access to land as smallholder corn tenant farms using primarily family labor were consolidated into larger sugar farms using primarily hired labor; an increase in incomes for households that grew sugarcane; a decline in women's participation in own-farm production; and very little improvement in nutritional status as a result of increased incomes from sugarcane production, primarily because of the high levels of preschooler sickness in the sugarcane-growing households.

The difficulty of generalizing as to the varied effects of agricultural commercialization is brought out by a comparison with the case study for Kenya (see IFPRI Research Report 63 by Eileen Kennedy and Bruce Cogill), where farmers also switched from maize to sugarcane production. In that African setting, where land is often relatively abundant and labor scarce compared with many situations in Asia, women increased their participation in own-farm production as sugarcane was introduced. Yet there are important similarities as well. As all of the commercialization studies have confirmed, poor health and sanitation conditions are a serious constraint to the improved nutrition that increases in income might otherwise have made possible.

John W. Mellor

Washington, D.C.
January 1990

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We are deeply grateful to Azucena Limbo of the Nutrition Foundation of the Philippines, who provided training for collection of our anthropometric and 24-hour food-recall data, no doubt the most difficult portion of our questionnaire to administer and code. Her competence and enthusiasm helped us through some difficult times.

We thank Joel Asentista, head of the Xavier University extension program in Bukidnon, and Roberto Montalvan, president of the Bukidnon planters association, for giving up so much of their personal time to familiarize us with the study area, as well as Father Antonio Ledesma and the graduate students of the Institute for Market Analysis at Xavier University, whose background knowledge of the area and logistical support were essential inputs into our survey work.

The help of Per Pinstrup-Andersen, whose efforts provided the initial impetus for many of the IFPRI commercialization studies, is gratefully acknowledged. For detailed comments on various drafts of the entire report, we would like to thank Romeo Bautista, Rodolfo Florentino, Yujiro Hayami, Francis Madigan, John Mellor, and Steve Vosti. For helpful comments on specific components of the study, we would like to thank Julie Anderson, Gelia Castillo, Reynaldo Martorell, Marc Nerlove, and Anne Peck. Any errors and omissions remaining in the report are, of course, our responsibility alone.

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Howarth E. Bouis
Lawrence J. Haddad

1

SUMMARY

The commercialization of agriculture, and in particular export cropping, has often been blamed as a cause of poor nutrition. Critics contend that if the resources used to produce agricultural exports were used instead to produce food for the local economy, the problem of malnutrition in many countries could be significantly reduced, or even eliminated. Proponents argue that by exploiting comparative advantage and generating faster growth for the overall economy, export cropping raises incomes and improves nutrition. In order to identify policy measures that can enhance positive and minimize harmful nutrition effects, IFPRI has undertaken research on the process of agricultural commercialization in five specific country contexts. This research report presents the findings for the Philippine case study.

Approximately 500 corn- and sugar-producing households were surveyed four times at four-month intervals during 1984 and 1985 in one province in Mindanao, Bukidnon, an area primarily engaged in semisubsistence corn production before the establishment of a sugar mill in 1977. The sample included smallholder landowner, tenant, and landless laborer households. Data were collected on landholdings, income sources, expenditure patterns, calorie intakes, and nutritional status.

An initial random sample of households, both far away from the sugar mill (households that did not have the opportunity of switching to sugar because of the high cost of transporting cane to the mill) and near to the mill, indicated a serious deterioration in land tenancy patterns as a result of the introduction of sugar. Whereas landless households accounted for less than 5 percent of households engaged primarily in corn production, nearly 50 percent of households employed in sugar production had no access to land. When households engaged in sugar production were asked to characterize their tenancy status before the introduction of sugar seven years earlier, the pattern of distribution that emerged between owner, share tenant, and landless laborer households was very similar to the present pattern for corn households. Several former corn tenant households had lost access to land when landlords who had decided to grow sugarcane chose to hire labor for the new crop rather than rent out land on a share-of-harvest basis, as had been the custom with corn.

The detailed survey data show that smallholder sugar landowners and renters who kept their land made substantially higher profits per hectare than their corn-household counterparts (an average of US$225 per hectare per year for sugar compared with US$100 for corn) despite the low prevailing world prices for sugar, which to some extent were transmitted to the domestic market. The higher profits for sugar are in part a reflection of the low and declining productivity of corn. The primarily migrant population reported that corn yields, because of declining soil fertility, were about half of what they had been when they first settled their land. Despite this, all sugar households with access to land continued to plant some land to corn and, on average, produced well in excess of their household needs.

On average, about two-thirds of the labor devoted to corn production is provided by the family and one-third is hired. These fractions between family and hired labor are reversed for sugar production. Women contributed 23 percent of the total labor for corn production, but only 11 percent of the total labor for sugar production.

Sugar households had higher incomes on average than corn households, due partly to higher profits from sugar and partly to larger landholdings, although for most households, sources of incomes were highly diversified, with 29 percent of all incomes coming from nonagricultural sources. The income elasticity for food expenditures at the mean for all sample households was estimated to be 0.65, so that food expenditures rose rapidly with income. However, because higher-priced calories were purchased by higher-income households, a doubling of income at mean income levels leads to only an 11 percent increase in calorie intakes at the household level. A substantial portion of the extra calories that were available at higher incomes went to adults, who were already meeting their recommended intakes of calories. Preschool children (once breastfeeding had been stopped) at all income levels consumed well below their recommended calorie intakes.

A strong association exists between income and height-for-age, a long-run measure of nutritional status, for children less than one year old. However, this association between income and height-for-age is weak for preschoolers at four years of age, which means that height-for-age deteriorates (relative to average heights for a reference, well-nourished population) much faster for higher-income children than lower-income children as they grow older. This aggregate pattern is more pronounced for the higher-income sugar households. Preschool children who are four years of age from households without access to land (corn and sugar landless laborer households) are significantly more stunted than children of the same age in households with access to land, reflecting in part the low availability of calories in these landless households, which spend more than three-fourths of their income on food.

Regressions show morbidity to be an important determinant of short-run nutritional status, weight-for-height. There appears to be little association between income and morbidity, although sugar-household children are sick more often than corn-household children, which is consistent with the more rapid deterioration in height-for-age for sugar-household children as they grow older.

Export cropping can significantly raise the incomes of smallholder producers. However, to prevent further consolidation of smallholder farms, the government needs first to make a conscious effort to encourage export cropping by smallholders by providing them with credit and know-how through extension and by actively promoting their access to processing and marketing facilities where necessary. Second, smallholder corn productivity needs to be improved. Both open-pollinated and hybrid varieties are available, but typically only larger landowners in Bukidnon are experimenting with the new corn technologies.

In the area of nutrition policy, providing landless households with access to land appears to be a sufficient condition for limited improvement in preschooler nutritional status. However, for households with access to land, preschooler nutrition does not seem to improve as income increases. Regressions show calorie intakes of preschoolers to be positively and significantly related to their nutritional status. Yet higher-income households choose to purchase nonfood items and higher-priced calories at the margin, while preschoolers continue to consume well below recommended intakes. Surely education has some role to play in convincing parents to adjust food-expenditure behavior and to distribute calories more equitably among household members. Even this, however, may not be sufficient given the high prevalence of preschooler sickness, even among high-income groups. Reducing illness may involve both education and improvement of community-level health and sanitary conditions.

2

RESEARCH OBJECTIVES AND POLICY SETTING

Specialization, development of markets, and trade, which characterize commercialization, are fundamental to economic growth. But how are higher *average* incomes distributed among various economic and social groups as commercialization takes place? Does a higher household income necessarily mean better nutrition for all household members? Because there are so many possible policy variations within the competing paradigms of specialization and self-sufficiency, because economic and social conditions vary so much across countries and regions, and finally because there are inevitably winners and losers in any process of change, it is unfortunately impossible to answer such crucial questions in any definitive way.

In order to provide some guidance for policy formulation in this area, however, what is possible is to study the *process* of commercialization in specific contexts and to identify key factors that appear to lead either to beneficial or detrimental outcomes in terms of nutrition. In designing and carrying out future projects and policies, then, the research goal would be for policymakers to find ways to enhance the beneficial factors, while minimizing the harmful ones.

Toward this end, the International Food Policy Research Institute (IFPRI) has conducted microlevel studies in five countries—The Gambia, Guatemala, Kenya, the Philippines, and Rwanda—in rural areas where farm households have recently undergone a switch from semisubsistence staple food production to production of crops primarily for sale in the market (Kennedy and Cogill 1987; von Braun and Kennedy 1986; von Braun, Puetz, and Webb 1989; von Braun, Hotchkiss, and Immink 1989; von Braun, de Haen, and Blanken forthcoming). This study, which constitutes Phase II of the Philippine Cash Cropping Project, summarizes the findings for the case study undertaken in Bukidnon Province on the southern island of Mindanao in the Philippines, an area primarily engaged in semisubsistence corn production until the establishment of a sugar mill in 1977, which led to a rapid expansion of sugarcane production. Phase I of the project consists of detailed case studies of 10 households in southern Bukidnon (Corpus et al. 1987). Phase III provides an overview of export crop production in Mindanao in the past 15 years and of the economic and political factors that led to this expansion (Lim 1987). These two phases were undertaken in collaboration with the Institute for Market Analysis at Xavier University, under the direction of Father Antonio Ledesma.

The Philippine Policy Setting

The Philippine economic crisis, precipitated in October of 1983 by the inability of the Marcos administration to meet its foreign debt obligations, resulted in a new focus on agriculture as the key sector in economic recovery. Discussion of agricultural policies during the last years of the Marcos regime and through the first year of the Aquino administration (which began in February 1986) centered on ridding the agricultural sector of monopolistic control by close associates of Marcos and on adjusting macroeconomic trade and fiscal policies so as not to be biased against agriculture.

Public attention to agriculture shifted dramatically to the issue of land reform in January of 1987, when several demonstrators for land reform were killed by security forces near the presidential palace. Land reform has since become the political litmus test of the ability of the Aquino administration to provide a better life for the rural poor. The implication is that agriculture is not only expected to generate much of the growth for the economy as a whole (and in the process contribute increased exports to help pay off the burdensome foreign debt), but also to accomplish this in the context of a significant redistribution of wealth through land reform.

The government investment strategy in rural areas is a crucial component in achieving sustained high agricultural growth rates. The term "investments" is used here in a very broad sense to include expenditures for agricultural research and extension as well as expenditures for irrigation, roads, and other physical infrastructure. Technological change is essential for raising agricultural productivity, the sine qua non of high agricultural growth rates where land is a constraint, as is the case in the Philippines. Perhaps because of the understandable desire to get government out of agriculture after the experience of the Marcos years, perhaps because available investment resources are very limited, and perhaps because of a preoccupation with generating short-run increases in exports to keep up with interest payments on the foreign debt, there has been relatively little discussion of the government investment strategy for agriculture.

Much of the growth in Philippine cereal and export crop production in the past decade has occurred in the southern region of Mindanao. Because of its relatively even distribution of rainfall throughout the year, its position outside of the path of typhoons, and its lower population densities, Mindanao is better situated than Luzon for realizing rapid increases in agricultural productivity.

Over the past 15 years rice yields in Mindanao have grown rapidly enough to now surpass average yields in Luzon, although corn is more widely grown than rice. Mindanao has also witnessed a rapid expansion of production of alternative export crops, including bananas, cacao, rubber, palm oil, coffee, and pineapples. Much of this expansion has taken place on large-scale operational units.

Not only will the growth of agriculture in Mindanao determine to a significant extent whether the high expectations for agriculture as a stimulant to economic recovery will be realized, but the policy choices to be made there are a microcosm of those confronting national agricultural policy. Now that a land constraint has been reached in Mindanao, should the government continue to promote the expansion of large-scale export crop production as a means to earn foreign exchange? Alternatively, if distributional objectives are given precedence by encouraging smallholder export crop production, how much growth, if any, would be sacrificed? A third strategy would be to emphasize increased production of rice and corn, which typically have been grown on smaller operational units and may need to be imported in larger and larger quantities in the years ahead (see Bouis 1989). Under any of these three options, what would be the consequences for income levels and the nutritional status of the poor?

Any complete evaluation of these three broad alternatives would require construction of a multisectoral economic model that could determine agricultural supply and demand responses to market-clearing prices, which is well beyond the scope of this study. However, what this report does provide is a detailed household-level and individual-level look at what happened to land tenure patterns, incomes, and nutrition in an area in Mindanao that was primarily engaged in semisubsistence corn production and then switched to export cropping, with the establishment of a sugar mill.

In the Philippines as a whole, over 3 million hectares of corn are harvested each year, about the same area as rice. Yet corn production and consumption patterns at the household level have been studied relatively little, just as Mindanao has been relatively neglected in the socioeconomic literature. Much has been said and written about the decline of the sugar industry in the Philippines in the wake of low world prices, especially with reference to Negros, where most of the nation's sugar is produced. This study provides some hard evidence on net returns to sugar production of smallholder producers and on their nutritional status in a nontraditional sugar-growing area with a more diversified agricultural economy than exists in most of Negros.

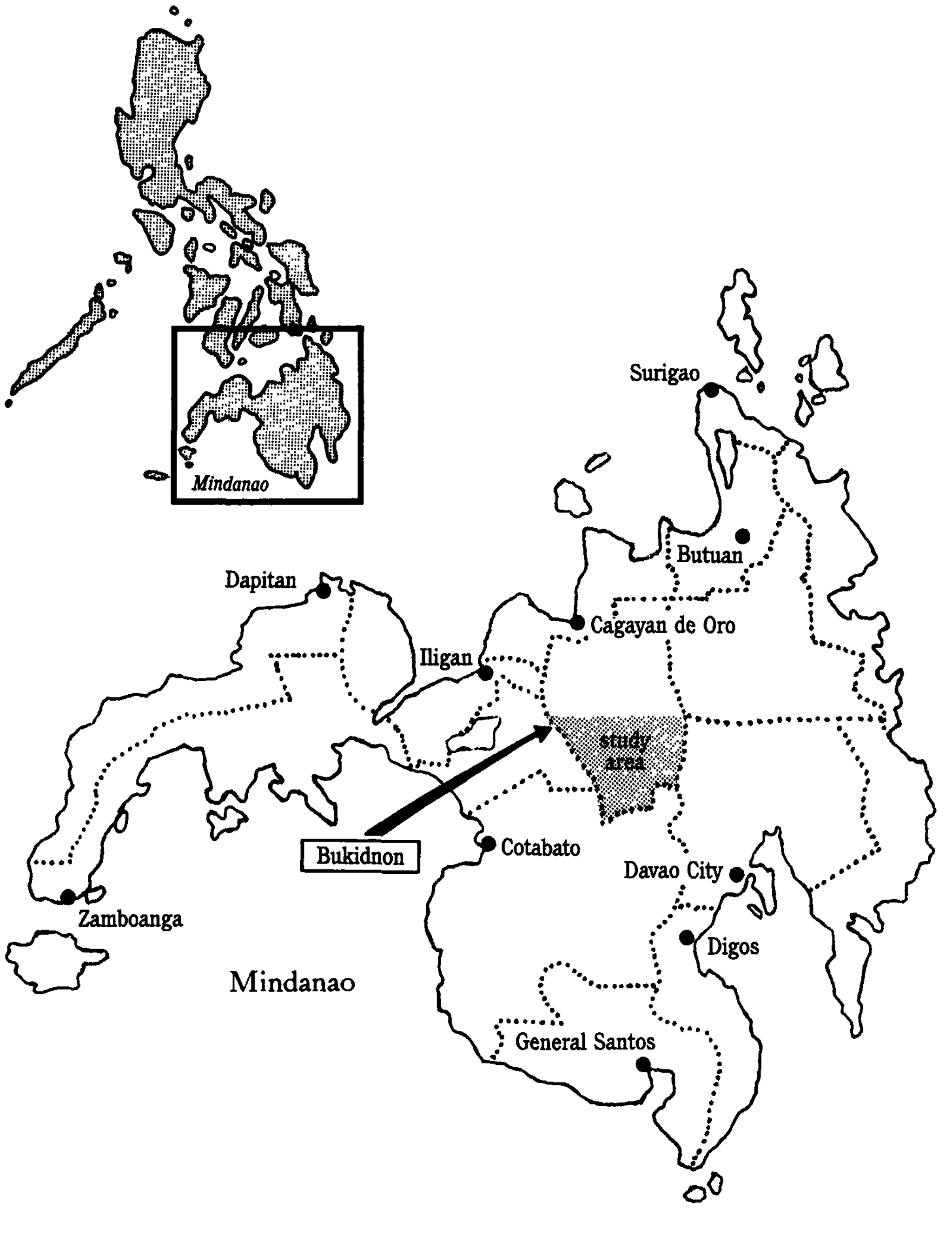
Study Area

The southern part of Bukidnon Province, where the study was conducted, lies about midway between two principal cities of Mindanao, Cagayan de Oro on the northern coast and Davao City on the southern coast (Figure 1). The study area is about a five-hour bus ride from Cagayan de Oro on a partially cemented road that runs through the provincial capital of Malaybalay. It is crisscrossed by a network of unimproved feeder roads, giving most farms relatively easy access to markets for their output.

By the mid-1970s, smallholder agriculture was almost exclusively devoted to corn and some upland rice farming, except for small areas of irrigated rice production. The Bukidnon Sugar Company (BUSCO) began operations in 1977, established in response to the high world sugar prices of a few years before. From the beginning, BUSCO was supplied primarily by sugarcane production from a few large haciendas located near the mill.

Cane production was sufficiently profitable that there was generally a high demand for contracts with the mill, and the mill's capacity was expanded in 1981. Contracts for as little as 1 and 2 hectares were given out. Members of the Sugar Planters Association numbered nearly 2,000 by the time of this survey, dominated by smallholders in absolute numbers but not in area planted or cane produced. Voting power in the association is proportional to contracted hectares and so is dominated by a relatively few large hacienda owners, many of whom also have business interests in the mill.

Figure 1—Map of the Philippines indicating study area



3

CONCEPTUAL FRAMEWORK AND RESEARCH DESIGN

After a review of the literature on the nutritional effects of the commercialization of agriculture, two major improvements over previous analyses were incorporated into the research design for the five country case studies noted in Chapter 2. First, it was clear that the optimal strategy would consist of surveying semisubsistence households before and at several intervals after the introduction of a new cash crop. The practical considerations of identifying an area that could be surveyed just before the introduction of a cash crop and the length of time involved in undertaking panel surveys precluded following this optimal strategy. However, an alternative strategy that could be followed consisted of cross-sectional comparisons of two groups—one that had switched to cash cropping and another that had remained in semisubsistence food production. This strategy required that care be taken to choose two groups as similar as possible in terms of resource bases and other factors that might determine the decision to adopt cash cropping and affect nutritional status. All previous studies had either looked only at the nutritional status of a single cash crop adopting group without reference to their nutritional status before adoption or had compared the nutritional status of two groups as suggested above, but groups living under different economic and social conditions.

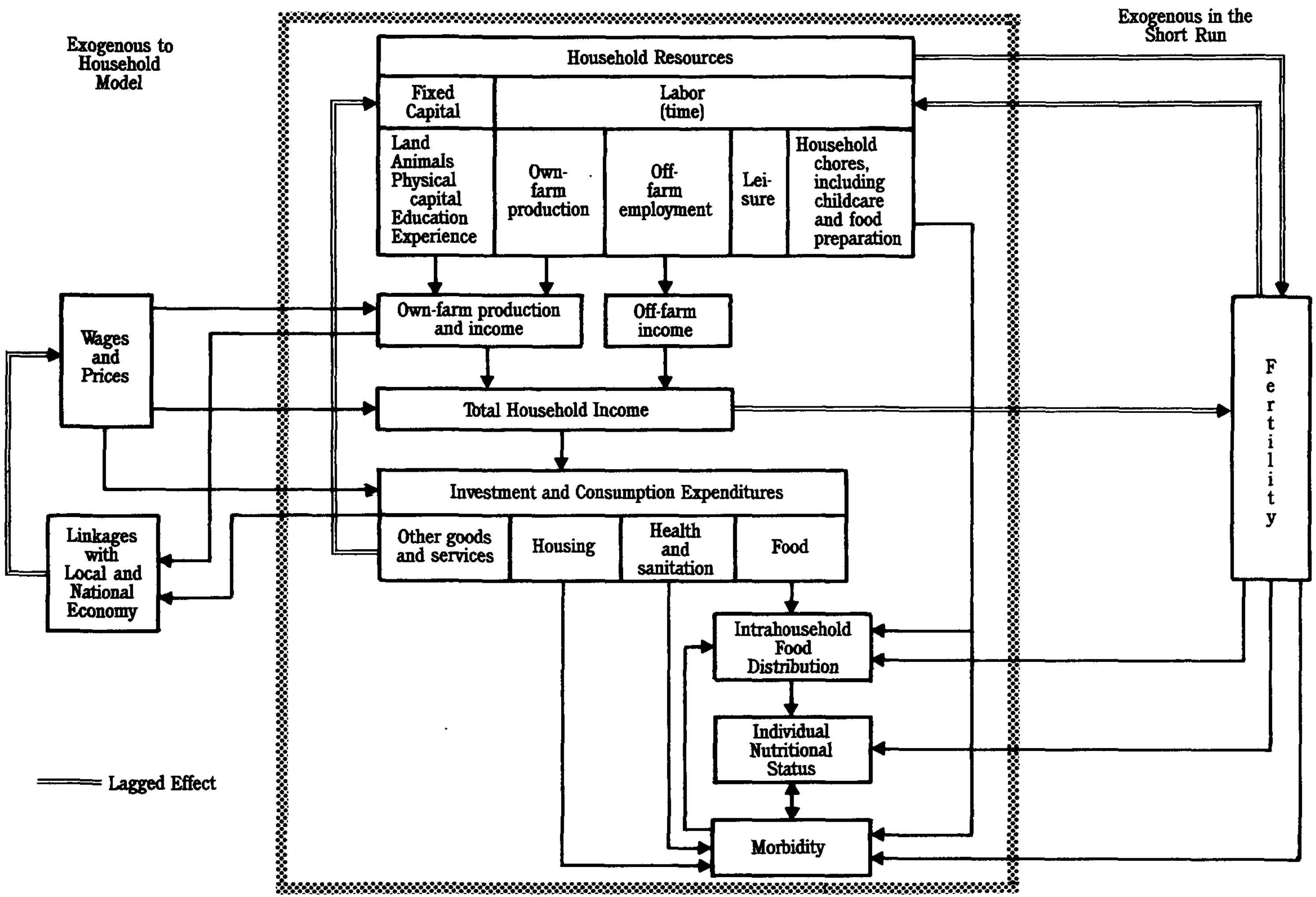
Second, previous studies had looked only at nutritional outcomes without looking at the process that had generated those outcomes, and without identifying the key factors mentioned above that changes in the production system had wrought to either improve or worsen nutrition. Thus, it was necessary to agree upon a conceptual framework for looking at this process at the household level (see Figure 2) before proceeding to collect data for various components of this framework.

The Household Model and Preschooler Nutrition

The theoretical underpinnings for the intuitive diagram in Figure 2 are provided by the literature on the new household economics (Behrman and Deolalikar 1988; Singh, Squire, and Strauss 1986; Pitt and Rosenzweig 1985; Haddad 1987). At the top of the diagram, the household has a fixed amount of time and capital that it must decide to allocate among various income-generating activities, given exogenous prices for consumer goods and production inputs and outputs, with the objective of maximizing well-being from some combination of consumption expenditures, leisure time, and better nutrition. Depending on how those resources are allocated to own-farm production activities and off-farm employment, a certain amount of cash and in-kind income is generated that can then be spent on various consumption items (or consumed). Because the particular interest here is nutritional outcomes, the focus is on food expenditures: how they increase with higher incomes, how many more calories these extra food expenditures generate at the household level, and how these calories are distributed among various household members. Finally, as shown at the bottom of Figure 2, calorie intakes are an important determinant of nutritional status.

However, as is evident from the richness and complexity of the household model, nutrient intakes are not the only link through which household allocation decisions

Figure 2—Household resource allocation and nutrition



affect nutrition. Morbidity is an important determinant of appetite and of how efficiently nutrients are absorbed by the body. The household that earns less income because it allocates more time to food preparation and child care could, conceivably at least, enjoy better nutrition because of reduced morbidity than if it had earned extra income and spent more for food.

Other more indirect links between production and nutrition could be added to the diagram and analyzed. The purpose of this discussion, however, is to limit the focus of research to those links just identified above. The research strategy, then, is to collect detailed household-level and individual-level information on income, production, consumption, time allocation, morbidity, and nutritional status for cash crop adopting and nonadopting household groups, to identify to what extent (if at all, controlling for income) these households allocate their resources differently, and to determine how these allocation decisions affect nutritional status (Bouis et al. 1984).

Estimating Equations

In household modeling, the usual practice is to treat all allocation decisions as simultaneous decisions. Econometrically, this leads to a set of reduced-form equations with endogenous outcomes as dependent variables, and exogenous variables such as prices as explanatory variables. However, this methodology does not permit any conclusions to be drawn as to the specific impact of crucial structural variables in the system at each particular link in Figure 2. Thus, in using this methodology, it is difficult to gain an understanding of the *process* through which nutrition is affected by changes in the production system, and so to identify the key factors that drive that process.

If, however, each step in the household decisionmaking process is not made simultaneously, a way out of this dilemma is provided by specifying the four-equation, recursive system below. At each stage in the system, variables on the right-hand side of each individual equation may be tested for simultaneity with the dependent variable (Hausman 1978). If the null hypothesis of exogeneity is rejected for any equation, an instrumental variables technique may be used to estimate that equation, which should give consistent estimates.

FOOD EXPENDITURES	$= f_1$	(INCOME, Prices, Demographics, Parents' Education)	(1)
HOUSEHOLD CALORIES	$= f_2$	(EXPENDITURES, Prices, Demographics, Parents' Education)	(2)
PRESCHOOLER CALORIES	$= f_3$	(HOUSEHOLD CALORIES, Demographics, Parents' Education, Parents' Calorie Intakes, Morbidity)	(3)
PRESCHOOLER NUTRITIONAL STATUS	$= f_4$	(PRESCHOOLER CALORIES, Morbidity, Demographics, Parents' Education, Father's Height, Mother's Height)	(4)

The above formulation is intended to be general. Additional variables to be used in each equation will be discussed more specifically later when the regression estimations are presented. For a detailed discussion of the recursive versus the simultaneous treatment of the model, see Appendix 1.

Sample Selection and Categorization of Households

Conceptually, the research strategy is simply to sample cash crop adopting (sugar) and nonadopting (corn) households, but in the Philippine context the situations of landowners, tenants, and landless laborers need to be compared and contrasted, both within and across crop groups. In selecting a sample, an additional consideration was bias due to adopter self-selection. In the hope of obtaining roughly comparable adopting and nonadopting groups, the survey area was extended beyond the vicinity of the mill to include households that did not have the opportunity to adopt sugar (due to prohibitive costs of transporting the sugarcane to the mill) but shared a common growing environment and cultural heritage with sugar-adopting households.

A short "presurvey" of 2,039 randomly selected households was undertaken, primarily to ask about present and previous occupations, crops being grown, and landholdings. This served two purposes. First, it gave a picture of present employment and land tenure patterns in the survey area and of how these patterns had changed since the sugar mill was built. Second, it provided a frame for choosing a stratified sample of 510 households consisting of landowner, tenant, and landless agricultural labor households within each crop group.

Only households (with at least one child under 60 months of age) that farmed less than 15 hectares were eligible for selection. Only households that characterized the primary occupation (including wage income) of the head of household as either corn or sugar production were eligible for selection (except for a small target group of nonfarm households). Later analysis of the detailed survey data indicated that the respondents' characterizations of their crop and tenure status were quite accurate.

Four detailed surveys were undertaken in these households at four-month intervals, beginning in August of 1984 and ending in August of 1985. Four hundred and forty-eight households remained by the end of round 4. The loss of respondent households was due primarily to out-migration. Table 1 shows the topics covered in each of the four survey rounds.

For purposes of analysis, households were divided into 10 groups. Any household cultivating an average of at least 1 hectare per round of any crop that produced any sugar at all was placed in one of three groups, "sugar owner," "sugar owner/renter (mixed)," or "sugar renter," depending on the proportion of total land cultivated that was owned and rented in. All other households cultivating an average of at least 1 hectare per round were placed in one of four groups, "corn owner," "corn owner/share tenant (mixed)," "corn share tenant," and "corn/other rent," depending on the proportion of total land cultivated that was owned, rented in on a share basis, or rented in on a fixed-rate or other type of arrangement. Typically, land rented for sugar production was rented in on a fixed-rate basis. For corn, the typical rental arrangement was for the tenant to pay a proportional share of the harvest to the landowner. The corn/other rent group includes households that rented in land primarily on a nonproportional basis, usually at a fixed rent.

The households in the remaining three groups, which cultivated less than 1 hectare of land, are characterized as "landless," although this is not strictly true for about half the households in these three groups. If income from nonagricultural sources was greater than agricultural wage income, households were placed in a group designated "other occupation." If agricultural wages were greater than nonagricultural income *and* income from sugar wages was greater than agricultural wages from all other crops, households were designated as "sugar laborer." The remaining "corn laborer" households had sugar wages that were less than half of total agricultural wages.

Table 1—List of topics covered by survey questionnaires, 1984/85

Block	Topic[a]	Explanation
A[b]	General household information	Demographics, education, migration
B	Parcels of land	Ownership, tenure relations
C	Agricultural production record	Steps in production, input use, output
D	Sugar producer's questionnaire	Postharvest processing, disposition
E	Corn producer's questionnaire	of output including revenues
F	Rice producer's questionnaire	from sales, loans, past
G	Other crop producer's questionnaire	production history
H	Agricultural wage labor	By crop, by task
I	Other sources of income	Nonagricultural employment and transfers
J	Backyard production	Livestock, fruits, vegetables
K	Assets (rounds 1 and 4)	Land, buildings, farm implements, consumer durables
L	Past income and assets (rounds 1 and 4)	By employment category; access to land
M[b]	Food expenditures	One-month recall
N	Nonfood expenditures	Four-month recall
O	Source of water and food preparation (round 1)	Primary, secondary; cooking fuel, storage
P[b]	Preschool feeding practices (round 2)	Breastfeeding, weaning practices
Q	Reproductive history (round 1)	Live births, miscarriages, causes of children's death
R	Health services and nutritional knowledge	Doctors, paramedics; based on quiz
S	Time allocation of wife	24-hour recall
T[b]	Anthropometry and morbidity	Measurement, two-week recall
U[b]	Individual food intake	24-hour recall
V	Perceptions of and reactions to technological change (round 4)	By crop; reasons for adoption, nonadoption; input use

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.
[a]All topics were covered in each of the four survey rounds unless otherwise indicated.
[b]Accomplished on first visit to households. Remaining blocks were covered during a second visit.

These criteria distributed the sample households so as to avoid cells with low numbers of observations, while taking into account the complexity of the land-tenure relationships that were found. Virtually all "sugar" households produced some corn, except for sugar laborer households that had no land at all.

Table 2 presents selected characteristics that can be compared across the 10 household groupings. The data show that the respondents are primarily a migrant population (typically from the Visayan Islands in the central Philippines). Those who own land tend to be older, to have migrated earlier, to have been married longer, and to have larger families than tenant/renter households. These same relationships hold when comparing tenant/renter households with landless households and, although the data are not shown in Table 2, when comparing large farms with small farms. The level of education is low, with respondents on average just having finished grade school.

As would be expected, incomes and expenditures of owner households are higher than for tenant/renter households and higher for tenant/renter households than for laborer households. At an exchange rate of P20 for US$1, per capita incomes of landless laborer households are roughly US$80 per year, those of corn owner households about US$130, and those of sugar owner households approximately US$195.

In a comparison of like tenure groups across crops, although demographic variables are quite similar, the one exceptional difference is that sugar farms are larger than corn farms. This presents a problem in terms of the research strategy outlined above, wherein it was deemed necessary to sample adopting and nonadopting groups with similar resource bases. If the nutritional status of preschoolers in sugar households is

Table 2—Selected data for respondent households, by crop-tenancy group, 1984/85

Crop-Tenancy Group	Number of Households	Average Age		Percent Born in Bukidnon		Average Years Since Migration to Bukidnon		Average Years of Education		Average Years Married[a]	Average Household Size[a]	Average Area Cultivated per Round[b]	Average per Capita Weekly Expenditure[b,c]	Average per Capita Weekly Income[b,c]	Average per Capita Net Worth[b,c]
		Husband	Wife[a]	Husband	Wife	Husband	Wife[a]	Husband	Wife						
		(years)									(persons)	(hectares)	(pesos)	(pesos)	(pesos)
Corn															
Owners	46	41.4	36.8	0.07	0.13	26	22	6.5	7.0	17	7.7	3.3	49.2	47.7	30,588
Owners/share tenants	44	38.0	34.0	0.11	0.07	25	20	5.8	6.2	15	7.4	3.7	46.6	46.4	18,698
Share tenants	91	34.7	31.3	0.14	0.22	22	19	5.6	6.2	12	6.4	2.0	40.0	28.4	9,744
Laborers	51	33.1	30.0	0.12	0.27	18	17	4.5	5.2	9	5.7	0.3	32.3	26.6	2,135
Sugar															
Owners	41	44.6	38.9	0.02	0.07	26	25	5.3	6.3	20	9.0	6.3	64.4	70.1	62,656
Owners/renters	30	37.4	34.0	0.10	0.03	22	22	6.6	6.8	14	7.1	7.6	89.9	83.3	87,932
Renters	31	37.0	32.3	0.06	0.06	21	20	6.0	6.6	14	7.3	3.0	43.5	43.0	13,079
Laborers	54	32.8	30.2	0.06	0.20	17	18	4.7	5.2	11	6.2	0.2	30.8	26.5	2,201
Corn/other rent[d]	18	34.5	30.6	0.17	0.28	22	20	6.4	7.3	12	5.7	1.9	44.4	35.2	13,324
Other occupation	42	35.6	31.9	0.10	0.26	18	19	6.8	7.2	11	6.0	0.3	43.2	39.1	7,975
Total sample	448	36.6	32.8	0.10	0.17	21	20	5.7	6.3	13	6.8	2.6	45.9	41.5	21,371

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.

[a] Responses in round 1, July 1984.

[b] Averages for all four rounds.

[c] Round 1 constant (July 1984) pesos; P20.00 = US$1.00.

[d] Corn growers who rent in land on fixed-rate or other types of arrangements.

better than the nutritional status of children in corn households, is the difference explained by having more access to land or by higher incomes that are possible from sugar production? This turns out not to be a problem, since sugar-household children are not taller and do not weigh more than corn-household children once they reach the age of four. This difference in resource bases only reinforces a conclusion that, while higher income may be a necessary condition for improving the nutritional status of preschoolers, it is not a sufficient condition.

4

CHANGES IN LAND TENURE PATTERNS

The introduction of sugarcane production in Bukidnon apparently led to a significant deterioration in the access to land. This is unfortunate for at least two reasons. First, because access to land is such an important determinant of income in rural areas in a land-constrained, labor-surplus country such as the Philippines (and the survey data to be reported on later bears this out), income distribution has been skewed and the plight of low-income groups has worsened. Second, if a larger proportion of the higher incomes possible from sugar production had gone to lower-income groups instead, the linkages with other sectors of the rural economy would have been stronger, stimulating more local business and service activities, and so generating higher regional employment and economic growth (see Hazell 1983; Johnston and Kilby 1975; Mellor 1976; Ranis and Stewart 1987).

1971 and 1980 Agricultural Censuses

The evidence that the expansion of sugar production has resulted to some extent from a consolidation of smaller operational units comes from three sources: two agricultural censuses conducted by the National Census and Statistics Office in 1971 and 1980 (National Economic and Development Authority 1974, 1985), the presurvey of a random sample of 2,039 households in the study area in 1984, and the four survey rounds. Table 3 shows the distribution of sugar and corn farms, by number of farms, area harvested, and size of farm, for 1971 and 1980 for the whole of Bukidnon Province. In 1971 sugar production was negligible, but it had expanded to more than 9,000 hectares by 1980. Two-thirds of total sugar area was accounted for by farms larger than 25 hectares, which constituted only 12 percent of all sugar farms.

By contrast, corn is a smallholder crop. In 1971 nearly three-fourths of corn farms were less than 5 hectares and accounted for 40 percent of all corn area. Between 1971 and 1980, corn area harvested increased by 51 percent and the number of corn farms by 68 percent, implying (assuming no change in the cropping intensity) a modest reduction in average corn-farm size and a rapid expansion of population. By 1980 nearly 50 percent of corn area was on farms of less than 5 hectares.

While these figures strongly suggest that smallholders participated only marginally in the sugar expansion, it is not clear to what extent the expansion resulted from a consolidation of smaller farms, if at all, or from the decision by large landowners to convert to sugar production lands that they already owned and were either cultivating themselves or leaving fallow. The census data show that there was apparently some expansion of total cropped area onto previously unused land during the 1970s. Unfortunately, the analysis that can be undertaken with the census is limited because data on operational farm size are not disaggregated by type of tenure; the census data refer to the entire province of Bukidnon, while the surveys focus on the southern half of the province; and the census data cover only the period up to 1980 before the expansion of the sugar mill's capacity. The presurvey of 1984 offers more precise evidence.

Table 3—Percentage distribution of sugar and corn farms and area harvested in Bukidnon Province, by farm size, 1971 and 1980

	Size of Farm							
Crop/ Year	Less Than 1.00 Hectare	1.00-2.99 Hectares	3.00-4.99 Hectares	5.00-10.00 Hectares	10.00-24.00 Hectares	More Than 25.00 Hectares	Total Percent	Total Absolute Number
	(percent of all farms)							(farms)
Sugar								
1971	...	...	...	...	...	...	...	21
1980	1.3	14.9	15.0	32.5	24.6	11.7	100.0	951
Corn								
1971	2.8	41.1	29.7	18.8	6.9	0.6	100.0	37,620
1980	4.9	41.1	22.5	23.9	6.8	0.8	100.0	63,239
	(percent of total area harvested)							(hectares)
Sugar								
1971	...	...	...	...	...	...	...	320
1980	0.1	2.3	2.6	10.0	17.0	68.1	100.0	9,365
Corn								
1971	0.3	16.1	24.4	28.2	21.8	9.2	100.0	162,607
1980	1.1	25.1	22.9	31.0	14.1	5.8	100.0	244,943

Sources: National Economic and Development Authority, *1971 Census of Agriculture* (Manila: NEDA, National Census and Statistics Office, 1974); and NEDA, *1980 Census of Agriculture* (Manila: National Census and Statistics Office, 1985).

Note: Parts may not add to totals because of rounding.

Presurvey of 2,039 Households

Table 4 presents the distribution of primary occupations of the heads of household recorded from the presurvey. Eighty percent of the respondents identified themselves as either landowners, tenants, or agricultural laborers. About 79 percent of these respondents directly employed in agriculture were engaged in corn production, while only 7 percent were primarily employed in sugar production. Laborer households accounted for less than 5 percent of households primarily engaged in corn or rice production, with the percentage of landowners and of tenants about equal for each of these cereals. Among sugar producers, laborers accounted for nearly half of the households, with a much lower percentage frequency for tenants and a somewhat lower percentage frequency for landowners compared with corn and rice producers. The implication is that if the same distribution of corn landowners, tenants, and laborers existed before the introduction of sugar as now, some former corn landowners, but especially former corn tenants, must have become sugar laborers.

Table 5, which presents data for the previous occupations of heads of households presently engaged in sugar production, shows that this is indeed the case. For a majority of households, land tenure status has not changed. However, 40 percent (21 out of 52) of households presently identified as sugar laborer households were corn owner or corn tenant households before the BUSCO sugar mill was built. Another 40 percent (22 out of 52) in-migrated to the area after BUSCO began operations (typically sugar laborers from the islands of Negros and Panay, who were recruited by the sugar hacienda owners). Thus only about 15 percent of present sugar laborers (8 out of 52) came from the preexisting pool of corn laborers.

Table 4—Present primary occupation of heads of households, all municipalities, April 1984

Occupation	Number of Household Heads	Percent of Household Heads	Percent of Total for Each Crop
Direct agricultural employment			
Corn	1,281	62.8	100.0
Landowner	670	32.9	52.3
Tenant	572	28.1	44.7
Laborer	39	1.9	3.0
Sugar	116	5.7	100.0
Landowner	44	2.3	37.9
Tenant	16	0.8	13.8
Laborer	56	2.7	48.3
Rice	171	8.4	100.0
Landowner	92	4.5	53.8
Tenant	71	3.5	41.5
Laborer	8	0.4	4.7
Other crop	59	2.9	100.0
Landowner	38	1.9	64.4
Tenant	8	0.4	13.6
Laborer	13	0.6	22.0
Subtotal	1,627	79.8	. . .
Transportation-related jobs	94	4.6	. . .
Skilled workers	62	3.0	. . .
Unskilled workers	46	2.3	. . .
Small business/trading	76	3.7	. . .
Other (professional, executive, police, technician, service, typist, clerk, jobless)—	134	6.6	. . .
Total	2,039	100.0	. . .

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture presurvey of randomly selected households in southern Bukidnon Province.

Note: Parts may not add to totals because of rounding.

Except for the in-migrants, almost all households that switched to sugar production had previously been involved in corn production. It is especially important to note that the *previous* tenure distribution of those who switched from corn to sugar production is very similar to the *present* tenure distribution of households primarily engaged in corn production.

Evidence from the Four Survey Rounds

In round 4 of the survey, respondents were asked detailed questions about changes in their tenure status since the establishment of the BUSCO sugar mill. Table 6 is constructed from these responses. All 448 of the round 4 households are included in Table 6, not only households presently engaged primarily in sugar production as in Table 5. For purposes of comparison with Table 5, the tenure categories used are those attributed by the households to themselves, not the categorizations used later in the report that are based on reported landholdings and sources of income.

Table 6 divides the respondents into four employment categories: those primarily engaged in corn production; those primarily engaged in sugar production; those primar-

Table 5—Sugar-producing households, by land tenure and previous occupation, April 1984

Previous Occupation in Agriculture	Present Occupation in Sugar Production: Three Municipalities Closest to BUSCO[a]				Seven Municipalities Farthest from BUSCO[a]				All Municipalities			
	Landowner	Tenant	Laborer	Total	Landowner	Tenant	Laborer	Total	Landowner	Tenant	Laborer	Total
Corn landowner	26	2	5	33	9	0	2	11	35	2	7	44
Corn tenant	2	10	8	20	0	3	6	9	2	13	14	29
Corn laborer	0	0	6	6	0	0	2	2	0	0	8	8
Rice landowner	1	0	0	1	1	0	0	1	2	0	0	2
Rice tenant	0	1	1	2	0	0	0	0	0	1	1	2
Rice laborer	0	0	0	0	0	0	0	0	0	0	0	0
Other crop landowner	1	0	0	1	2	0	0	2	3	0	0	3
Other crop tenant	0	0	0	0	0	0	0	0	0	0	0	0
Other crop laborer	0	0	10	10	0	0	12	12	0	0	22	22
Total	30	13	30	73	12	3	22	37	42	16	52	110

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture presurvey of households in southern Bukidnon Province, April 1984.

[a] Bukidnon Sugar Company, which began operation of a sugar mill in 1977.

Table 6—Household employment and land tenure status during round 4 of survey and before sugar mill operation, July 1985

Previous Status[a]	Present Status: Owner	Tenant	Laborer	Total
		Households Engaged Primarily in Corn Production		
Owner	55	5	0	60
Share tenant/renter	21	98	3	122
Laborer	2	2	5	9
Nonagricultural employment	1	0	0	1
New household[b]	11	44	8	63
Total	90	149	16	255
		Households Engaged Primarily in Sugar Production		
Owner	25	0	1	26
Share tenant/renter	3	8	7	18
Laborer	0	1	11	12
Nonagricultural employment	0	0	0	0
New household[b]	0	4	17	21
Total	28	13	36	77
		Households Engaged Primarily in Agricultural Production (No Crop Specified)		
Owner	36	2	2	40
Share tenant/renter	6	14	0	20
Laborer	0	2	6	8
Nonagricultural employment	0	0	0	0
New household[b]	4	4	4	12
Total	46	22	12	80
		Households Engaged Primarily in a Nonagricultural Occupation		
Owner	...	...	...	4
Share tenant/renter	...	...	...	10
Laborer	...	...	...	1
Nonagricultural employment	...	...	...	12
New household[b]	...	...	...	9
Total	...	...	...	36

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.
[a] Employment or land tenure status before the Bukidnon Sugar Company (BUSCO) mill began operations in 1977.
[b] In-migrants to area after BUSCO sugar mill was built.

ily engaged in agricultural production, but who declined to specify a particular crop as dominant; and those primarily engaged in nonagricultural employment. Comparing Tables 5 and 6, note that the percentage of present sugar laborers (who specified a tenure status as a corn producer when BUSCO was established) who lost access to land is nearly equal between the two tables (21 out of 52 in Table 5 and 8 out of 19 in Table 6). The percentages are also similar for present sugar landowners (2 out of 42 in Table 5 and 3 out of 28 in Table 6) and for present sugar renters (−2 out of 16 for Table 5 and 1 out of 9 for Table 6) who bettered their past tenure status.

Table 6 shows that 56 out of 64 households that became involved in corn production *after* the establishment of BUSCO were able to acquire access to land, so the overall tenure pattern remained stable over time (many older residents improved their status from tenant to landowner, while newly married or newly resident couples embarked on corn production in disproportionate numbers as tenants). For households primarily engaged in sugar production, however, only 4 out of 21 newly married or newly resident households got access to land, and none as landowners.

A high percentage of households presently engaged primarily in nonagricultural employment who were married Bukidnon residents when BUSCO was established (14 out of 27) had lost access to land. Only one household moved in the other direction, from nonagricultural employment to corn production. The survey data, then, also present a contrasting picture between sugarcane and corn production of relatively easy access to land for corn production and of a decline in access to land as sugarcane is adopted.

From Table 6, it is possible to identify 38 households whose tenancy status improved, 34 households whose tenancy worsened, and 236 households (with previous access to land) whose tenancy status remained the same. Sixty-seven newly in-migrant or newly formed households gained access to land. The remaining 73 households (including both old residents and new households) have never acquired access to land.

Analysis of the survey data by change in tenancy status shows that for households engaged in corn production the sizes of farms being converted to and taken out of corn production appear to be in rough equilibrium. The average area cultivated by households whose tenancy status was unchanged at 2.5 hectares is almost equal to the average area lost of the 25 households that reported a decline in tenancy status at 2.4 hectares and to the average 2.8 hectares cultivated by the 26 households whose tenancy status improved. The size of the average corn farm appears, however, to have been decreasing over time, as the farms of new households at 1.6 hectares are disproportionately tenant households, which tend to be smaller than owner corn farms.

The dynamics of change in farm size for sugar production appear to be quite different. The average area cultivated by adopting households was about 5.5 hectares—more than twice the area cultivated by the average corn household. The average area lost by households whose tenancy status declined and whose land was converted to sugar production was only a third that size at 1.8 hectares.

Finally, in each month in which wages from sugar production were earned, respondents were asked to identify a farm-size category in which this labor was performed, ranging from a score of 1 for farms larger than 50 hectares to a score of 5 for farms smaller than 5 hectares. An average score of about 4 was reported by the respondents, indicating that most of the off-farm sugar labor provided by our respondent households was hired in by farms of medium size relative to all farms, though small relative to those farms engaged primarily in sugar production.

Did sugar expansion occur on previously unused land? Certainly whatever expansion onto previously fallow land occurred on the largest sugar haciendas contributed little to the employment of local residents, who tended to be hired instead by relatively small sugar farmers.

Eighty of the sugar households who grew sugar during the survey (and had previous access to land) and whose tenancy status remained the same reported that in 1977 they grew mostly corn and that only about 10 percent of their land was left fallow, a percentage similar to that surveyed during 1984-85. Over the same period, these 80 households reported a 28 percent increase in the amount of land that they cultivated, an absolute increase of 1.3 hectares from 4.6 hectares in 1977. The farms of smallholder sugar adopters (small relative to all sugar adopters, large relative to the average corn-producing farm) increased in size as sugarcane *replaced* corn production. The evidence from households with access to land, then, supports a conclusion that there was some consolidation of existing operational farm units.

Conclusion

As already pointed out, land reform is central to the agricultural policy debate presently taking place in the Philippines. In the context studied here, a kind of land reform in reverse has taken place with the introduction of export cropping. This raises at least two important questions. The first is the empirical question (which is beyond the scope of the present study) of whether a similar deterioration in access to land has been occurring all over Mindanao, where various other export crops have been newly introduced.

Second, what are the forces driving this redistribution of land? The analysis that follows will show that these forces appear to be the declining productivity of corn lands, and the know-how and financial resources of the wealthier families, who are in a position to take advantage of a new income-earning opportunity.

5

COMPARISON OF THE CORN AND SUGAR PRODUCTION SYSTEMS

This chapter compares the relative profitability of corn and sugar production. An additional objective is to disaggregate total labor inputs, not only by hired and family labor, but also by labor performed by men, women, and children, in order to gain possible insights into changes in intrahousehold time allocation patterns that might be the result of a switch to sugar production.

The Corn Production System

During the postwar period up until the early 1970s, Bukidnon was a region of heavy in-migration. New settlers typically homesteaded recently cleared rain forest. Conversations with persons who migrated to Bukidnon before 1970 about past corn yields and agricultural wage rates invariably indicated a significantly declining trend in corn yields due to loss in soil fertility, and lower shares of harvest paid to hired laborers over time. An attempt was made to measure these two trends in the detailed household surveys.

According to the respondents, corn yields have fallen dramatically over the past two decades—more than 50 percent in an average of 13 years (Table 7). Similarly, shares paid to harvesters have declined significantly, from one sack in every five harvested in the mid-1960s to one sack in every eight by the time of the survey. The indicated trends, then, are very pessimistic: declining productivity and increasing land pressure.

Peak corn harvests occurred in July and December. The average growing cycle from plowing to harvest was 3.3 months, so there is ample time to grow three crops a year. However, producing a third crop depends on rainfall at the onset of the relatively dry months from March to May. Most of the respondents were able to produce two crops a year. A few households produced three crops. Average yields were highest for the first crop, an average of 0.9 metric ton of shelled corn per hectare.[1] Yields fell by 25 percent for the second crop.

The average labor input per hectare per crop was 51 days. About two-thirds of this labor input is provided by family labor and one-third by hired labor. There is a stronger tendency for the family labor input per hectare to increase as farm size decreases than for hired labor to decrease with farm size. Consequently, labor inputs per hectare are somewhat higher on small farms.

Tractors are used only on the largest farms, and these only sparingly. Land preparation (plowing, harrowing, furrowing) accounts for about 20 percent of total labor use, weeding (with carabao, by hand, or with sickle) almost 50 percent, harvesting about 20 percent, and planting and fertilizing the remaining 10 percent. The only striking differences in labor inputs across household groups within particular tasks occur for weeding by hand and weeding with a carabao, where there is an obvious possibility of substitution between the two types of inputs. There is some tendency for

[1] All tons in this report are metric tons.

Table 7—Comparison of past and present corn yields, by crop-tenancy group and farm size, 1984/85

Crop-Tenancy Group[a]	Sample Size	Average Hectares Cultivated per Round During Survey	Average Time Land Has Been Planted to Corn	Yield of Shelled Corn: Average Yield in First Few Years	Yield of Shelled Corn: Average Yield, 1984/85 Survey
			(years)	(50-kilogram sacks)	
Corn					
Owners	46	3.3	18.3	37.9	14.2
Large	32	4.1	19.0	40.0	14.5
Small	14	1.3	16.9	33.6	13.6
Owners/share tenants	44	3.7	11.3	32.7	16.8
Large	32	4.6	11.2	33.0	17.5
Small	12	1.5	11.3	30.8	15.1
Share tenants	91	2.0	11.2	35.6	14.9
Large	43	2.9	11.2	34.4	15.1
Small	48	1.2	11.3	36.8	14.8
Laborers	51	0.3	11.0	34.4	11.7
Land	32	0.5	...	...	...
No land	19	0.0	...	...	...
Sugar					
Owners	41	6.3	17.2	41.6	18.2
Owners/renters	30	7.6	13.1	31.8	22.5
Renters	31	3.0	13.1	40.0	18.0
Large	20	3.9	...	...	...
Small	11	1.2	...	...	...
Laborers	54	0.2	9.6	32.9	14.1
Land	26	0.4	...	...	...
No land	28	0.0	...	...	...
Corn/other rent[b]	18	1.9	6.3	25.4	15.3
Other occupation	42	0.3	11.6	31.7	14.4
Total sample	448	2.6	12.9	35.4	15.7

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.
[a] A "large" farm is any farm where more than an average of 2 hectares per round was cultivated.
[b] Corn growers who rent in land on fixed-rate or other types of arrangements.

smaller farms to weed more by hand, which accounts for the higher total family labor inputs just noted for smaller farms.

Table 8 shows that of the 32.6 days of family labor inputs per hectare for the total sample, about 15 percent are provided by women (typically the wife) and 25 percent by children. In the hired labor market, participation of children is very low. Women provide a quarter of hired labor inputs.

It is instructive to break down these participation rates by task. The basic pattern is for men to do almost all of the work for tasks associated with use of a carabao. The remaining tasks are shared by husband, wife, and (to the extent applicable) several children.

Fertilizer use is very low. An average of 5 kilograms of nitrogen per hectare per crop was applied. Even the heaviest-user groups (the sugar owner and sugar owner/renter households) applied only about twice the average amount of nitrogen. This is consistent with the low adoption rates of fertilizer-responsive technologies. Only 10 percent of the respondents reported planting improved varieties.

For all tasks except harvesting, the average wage rate received was around 17 pesos (P) per day (US$0.85). Harvesting received a substantially higher wage, about P28 per day. No notable differences were found across the crop, tenure, and size groups in the wages they paid to labor, or in prices they paid for various nonlabor inputs.

Table 8—Total labor inputs per corn crop, by family and hired labor, crop-tenancy group, and farm size, 1984/85

	Family Labor			Hired Labor		
Crop-Tenancy Group[a]	Men	Women	Children	Men	Women	Children
			(person-days/hectare)			
Corn						
Owners	19.8	4.3	5.6	16.9	5.2	1.3
Large	18.5	4.9	6.0	17.9	5.4	1.1
Small	22.9	2.9	4.9	14.3	4.8	1.7
Owners/share tenants	18.7	5.1	6.5	10.4	3.6	0.8
Large	15.3	5.1	4.3	11.7	3.8	0.7
Small	27.3	5.2	12.0	7.2	3.1	0.9
Share tenants	19.4	4.2	7.9	10.0	4.7	1.2
Large	16.9	3.5	9.1	9.1	4.8	1.2
Small	21.9	4.8	6.8	10.8	4.7	1.2
Laborers	24.7	10.3	11.3	6.0	3.3	0.3
Sugar						
Owners	15.7	2.7	11.7	12.8	5.0	1.5
Owners/renters	11.8	2.9	6.2	19.6	5.9	0.8
Renters	18.8	5.0	15.0	13.5	7.2	0.8
Laborers	20.5	6.9	16.5	9.0	2.3	2.5
Corn/other rent[b]	17.7	5.5	4.1	17.7	6.3	0.9
Other occupation	24.3	10.5	2.4	16.4	8.3	1.8
Total sample	19.1	5.2	8.3	12.5	4.9	1.1

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.
[a] A "large" farm is any farm where more than an average of 2 hectares per round was cultivated.
[b] Corn growers who rent in land on fixed-rate or other types of arrangements.

The average production cost per hectare was P650. Of this, about two-thirds was paid in cash and one-third in kind (mostly harvest wages, but in-kind payments also included meals for hired laborers engaged in other tasks). Wages (cash plus in-kind) accounted for about two-thirds of total expenses.

Per hectare in-kind wage payments did not vary a great deal across groups and farm sizes, so cash expenditures accounted for most of the differences across groups in total costs per hectare. Corn laborer and sugar laborer groups spent an average of less than P200 cash per hectare per crop. Sugar households (apart from the laborer group) invested the largest amounts of cash, an average of P600 per hectare per crop.

All sugar households continued to produce some corn. Per capita consumption of own-produced corn in sugar households (about 1.3 kilograms per capita per week) was much lower than in corn households (about 2.0 kilograms per capita per week), although sugar households produced sufficient corn to have consumption levels equal to those of corn households (Table 9). Sugar households preferred to purchase more rice in the market instead. For corn households, per capita consumption of home-produced corn on small farms was only marginally lower than on large farms, suggesting that households kept what they needed for home consumption and sold the remainder.

Labor for postharvest shelling, drying, and transport of corn for marketing or for milling into grits was provided primarily by the family and added an average of 3.5 days of total labor inputs per hectare. Analysis of marketing margins between farmgate and retail prices of corn and costs of having shelled corn milled into grits indicates that farmers who grow corn for own consumption save a premium of 25 percent (less storage losses and interest costs) compared with selling their output and buying corn grits in the retail market.

Table 9—Shelled corn production and consumption of own production, by crop-tenancy group and farm size, 1984/85

Crop-Tenancy Group[a]	Production	Production Net of In-Kind Cost	Consumption Out of Own Production	Share of Net Production Sold
	(kilograms/week/capita)			(percent)
Corn				
Owners	7.0	6.0	2.2	64
Large	8.1	7.1	2.4	67
Small	4.4	3.6	1.9	49
Owners/share tenants	10.7	8.6	1.9	77
Large	13.2	10.7	1.9	80
Small	3.9	2.8	1.8	36
Share tenants	8.4	4.9	1.9	63
Large	10.2	6.0	2.1	69
Small	6.9	4.0	1.8	49
Laborers	1.3	0.9	0.5	34
Sugar				
Owners	4.9	4.2	1.6	63
Owners/renters	6.0	4.7	1.3	74
Renters	5.2	3.7	1.0	72
Laborers	0.7	0.4	0.2	50
Corn/other rent[b]	7.8	6.2	1.7	62
Other occupation	1.1	0.8	0.5	29
Total sample	5.3	3.9	1.3	67

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.

[a] A "large" farm is any farm where more than an average of 2 hectares per round was cultivated.

[b] Corn growers who rent in land on fixed-rate or other types of arrangements.

Average returns to corn production are a dismal P1,023 per hectare per crop (US$51; partly in cash, partly in the form of own-produced corn consumption). Share tenants do worse than this average, since the share paid to their landlords has been subtracted.

The Sugar Production System

One of the primary differences between production of corn and of sugar is the way processing and marketing are organized. With corn, individual households may make independent decisions as to when to plant, harvest, and market their corn (subject, of course, to rainfall patterns). With sugar, production must be coordinated among several producers so that milling capacity is as fully utilized as possible without overproduction.

A second basic difference between production of the two crops is the length of the growing period, 3.3 months on average for corn for the sample households and 12.0 months for sugar. For sugar, 12.0 months is only the average time between harvests, not between plantings, since sugar may be ratooned. There are substantially higher input costs for the plant crop than for successive ratoons.

The sugar milling season begins in late October and ends in late July. The sugar content of the cane tends to be highest in March and April, when there is less rain. Most farmers would prefer to plan for harvesting then, but the mill prefers to process cane more or less evenly throughout the milling season.

The problem of coordinating the planting and harvesting of all contracted hectares is resolved ingeniously through a system that revolves around the *bagon* (wagon), or metal carrier, that sits on a truck bed and is lifted by cranes to dump the cane onto a conveyor belt at the mill. One *bagon* can service roughly 40 hectares if it is filled to capacity and delivered each day that the mill is in operation during the nine-month milling season. The mill assigns one *bagon* to each group of farmers with sugar contracts that total 40 hectares (operators of large farms would have several *bagons* at their disposal). Each group of smallholder farmers, then, must arrange a mutually agreeable schedule for utilization of that *bagon* capacity during each day of the milling season.

Several of the sugar household respondents had no contracts with the mill but worked out deals with growers who did not want to plant sugarcane up to the maximum of their contracted hectares ("deficit" producers).

A typical arrangement might be for a surplus grower to sell sugarcane to the deficit grower at a certain rate per truckload of cane. The deficit planter proceeds to the surplus grower's field with a truck and laborers, who cut and load the cane into the deficit planter's *bagon*. The deficit grower, who undertakes the expense of harvesting and hauling the cane, brings the cane to the mill as if it were his own production. This type of arrangement presents no particular problem for operation of the overall system just outlined.

When the cane is brought to the mill, it is weighed and a sample is taken to determine its sugar content. The grower is paid the National Sugar Trading Agency (NASUTRA, the government agency to which mills were required by law to sell their output) price for 60 percent of the sugar equivalent and the remaining 40 percent is retained by BUSCO. The grower is also paid a transportation rebate by the mill for the hauling of the mill's 40 percent of the cane. This rebate is paid on a kilometer and ton basis, so that farms farther away from the mill get a higher rebate. However, while contracts are given to farms outside of a 20-kilometer radius from the mill, rebates are paid only up to a maximum of 20 kilometers.

In the past growers were paid, usually within a month of depositing a truckload of cane at the mill, a single payment for both sugar and trucking rebate. Toward the end of the survey period, payments were delayed three months and more. Since a single grower may deliver several truckloads throughout the milling season, payments are staggered throughout the year. Some growers have large enough operations that it is more profitable to buy and use their own trucks to haul their cane. The growers in the sample were small enough that in all cases they hired private truckers to haul their cane.

Table 10 shows that average sugarcane yields were nearly identical across tenure groups. There was an almost uniform drop in yields across tenure groups between the two milling seasons recorded in the survey rounds.

The average total labor input per hectare was 109 days. The proportion of family labor in total labor for all groups was about one-third, with the exception of the sugar owner/renter group, which hired nearly 90 percent of its total labor inputs. Weeding accounted for 45 percent of all labor inputs and harvesting for 35 percent. Land preparation accounted for a low percentage of total labor inputs, partly because of the practice of ratooning, but also because tractor usage is much higher than for corn.

As indicated in Table 11, women contributed 9 percent of family labor and 11 percent of hired labor for sugar, lower percentages than for corn. As with family labor for corn, women are almost entirely excluded from tasks involving a carabao and participate, along with several children, in all other tasks except preparing the ratoon. In the hired

Table 10—Sugar yields, by crop-tenancy group and milling season, 1984/85

Crop-Tenancy Group	By Milling Season: 1983/84 Milling Season	1984/85 Milling Season	Two Milling Seasons Combined	Average Ratoon Number
	(metric tons of cane/hectare)			
Sugar owners	59.5	40.6	49.8	1.7
Sugar owners/renters	53.4	37.3	43.2	1.8
Sugar renters	67.8	35.7	48.3	1.6
Large[a]	82.0	38.5	54.8	1.6
Small	50.8	31.6	39.6	1.6
Total sample	59.1	38.3	47.2	1.7

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.
[a] A "large" farm is any farm where more than an average of 2 hectares per round was cultivated.

Table 11—Total labor inputs per sugar crop, by crop-tenancy group and family and hired labor, 1984/85

Crop-Tenancy Group	Family Labor: Men	Women	Children	Hired Labor: Men	Women	Children
	(person-days)					
Sugar owners	20.7	3.8	20.9	67.7	9.0	1.4
Sugar owners/renters	8.5	0.6	2.7	77.6	9.1	0.5
Sugar renters	19.5	3.5	5.4	52.5	6.3	0.4
Large[a]	15.1	4.2	5.5	53.1	5.9	0.8
Small	25.4	2.6	5.3	51.8	6.8	0.0
Total sample	16.5	2.7	11.9	68.2	8.6	0.9

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.
[a] A "large" farm is any farm where more than an average of 2 hectares per round was cultivated.

labor force, women's participation rates fall when compared with corn, primarily because they are excluded from harvesting.

Average fertilizer usage per hectare per crop is between two and three times higher for sugar than for corn, although the duration of the growing cycle is much longer for sugar. The sugar owner/renter group uses the most fertilizer, 16 kilograms of nitrogen per hectare, which in absolute terms is still quite low.

Wage levels for all tasks are similar to those paid to corn laborers. There are not any obvious patterns of wage differentials across tenancy groups. As with corn, the wage paid for harvesting is substantially higher than for other tasks and about equal to the wage paid to corn harvesters at P27 per day.

Average expenditure per hectare for all household groups was P2,200, virtually all of which was paid out in cash. Thus, not only are production expenses much higher per crop per hectare than for corn, but a much higher proportion is paid out in cash. As with corn, about two-thirds of total expenses are paid out as wages. Total expenditures for the sugar owner/renter group are somewhat higher than average. Total expenditures for the small sugar renter group are well below the average due to lower levels of nonlabor inputs.

Plant crop expenses are, on average, about P800 more per hectare than ratoon crop expenses. If fertilizer applications had been constant across plant and ratoon crops, this differential would have been larger.

The price paid for sugar changed three times during the two milling seasons. At the beginning of the 1983/84 milling season, the price per picul[2] of sugar stood at P85. Toward the end of the milling season, this price was raised to P96. By the beginning of the 1984/85 milling season this price had increased to P107, and at about the middle of the milling season the price increased sharply to P171 per picul (the result of a devaluation of the peso).

Average returns of P4,500 per hectare per crop for sugar were well above those for corn. As with corn, landowners do better than renters because of the variable cost-accounting method used. Economic returns to corn and sugar production are examined more closely in the following section.

Comparison of Profits and Labor Allocation Patterns

Table 12 shows net revenues for corn and sugar (calculated on a variable cost basis) and net profits per hectare after subtraction of imputed values for family labor, inputs for carabaos owned by the household, interest on cash inputs, and rents on owned land. Except for land prices, the introduction of sugar did not affect the local prices of these inputs, or the output price for corn. Before finally subtracting an imputed value for owned land, a subtotal is calculated in which imputed values for family labor, owned-carabao inputs, and interest on cash have been subtracted from net revenues.

For corn laborers this subtotal is negative. This implies that these households could have had a higher income by hiring out their family labor and carabaos on the labor and carabao rental markets rather than devoting these inputs to corn production—assuming that employment is readily available if desired. Corn share tenants barely do better than break even, compared with the alternative of employment in the labor market.

In general, corn production by sugar households earns the highest returns net of family labor, carabao inputs, and interest on cash. The corn mixed tenancy group does nearly as well, but the pure corn landowner group does less well. Net profits are higher for sugar relative to corn, compared with net revenues for sugar relative to corn, since family inputs are greater for corn.

The final calculation shown in Table 12 is to subtract imputed rental values on owned land. Several negative entries in the final column for corn indicate that these households would have done better to rent out their land at the assumed rate (and enter the labor market) rather than to have undertaken corn production. This is not to say that farmer behavior is economically irrational. Yields and prices obviously cannot be predicted with complete accuracy, and some value may be attached to working for oneself rather than for someone else. But the low average value (a net profit of only P93 per hectare per crop) for the total sample indicates what a marginal activity corn production has become over time for smallholders.

Net profits for corn and sugar for the sugar owner/renter and sugar owner groups are roughly equal after doubling corn profits to take account of the two crops per year that can be planted to corn. These households would appear to have done a good job of allocating resources between sugar and corn production so as to have equalized marginal returns in both activities. This does not appear to be the case, however, for

[2] One picul equals 60.477 kilograms.

Table 12—Corn and sugar production profits, by crop-tenancy group and farm size, 1984/85

Crop-Tenancy Group[a]	Corn					Sugar				
	Net Revenues per Hectare	Value Imputed to Family-Owned Inputs[b]	Sub-total	Rent on Owned Land	Net Profit per Hectare	Net Revenues per Hectare	Value Imputed to Family-Owned Inputs[b]	Sub-total	Rent on Owned Land	Net Profit per Hectare
	(pesos/hectare/crop)									
Corn										
Owners	1,038	720	318	447	−129	...	...	...	...	...
Large	1,057	716	341	447	−106	...	...	...	...	...
Small	993	728	265	447	−182	...	...	...	...	...
Owners/share tenants	1,390	688	702	292	410	...	...	...	...	...
Large	1,459	646	813	315	498	...	...	...	...	...
Small	1,215	810	405	233	172	...	...	...	...	...
Share tenants	774	698	76	...	76	...	...	...	...	...
Large	802	652	150	...	150	...	...	...	...	...
Small	748	742	6	...	6	...	...	...	...	...
Laborers	685	894	−209	231	−440	...	...	...	...	...
Sugar										
Owners	1,665	714	951	447	504	5,250	1,455	3,795	2,250	1,545
Owners/renters	1,315	620	698	92	606	3,727	1,096	2,631	1,625	1,006
Renters	1,041	840	201	...	201	2,853	1,226	1,627	75	1,552
Large	...	...	...	...	...	3,533	1,247	2,286	75	2,211
Small	...	...	...	...	...	1,970	1,198	772	75	697
Laborers	780	772	8	57	−49	...	...	...	...	...
Corn/other rent[c]	940	685	255	345	−90	...	...	...	...	...
Other occupation	818	792	26	249	−223	...	...	...	...	...
Total sample	1,023	728	295	202	93	4,570	1,298	3,274	1,910	1,364

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.

[a] A "large" farm is any farm where more than an average of 2 hectares per round was cultivated.

[b] Values imputed to family-owned inputs were for family labor, carabao inputs, and an assumed interest rate for cash inputs.

[c] Corn growers who rent in land on fixed-rate or other types of arrangements.

sugar renter households, which seem to have overinvested family labor in corn production.

Table 13 shows average labor inputs for corn and sugar production. The corn figures have been doubled to take account of the two corn crops that are harvested for each sugar crop. Corn and sugar production use almost identical amounts of total labor. As previously mentioned, however, the mixes of family and hired labor, and of men's, women's, and children's labor are quite different. While the substitution of hired for family labor in switching from corn to sugar production is perhaps marginally overstated in Table 13 due to the larger farm sizes of the sugar households, most of this substitution would appear to be related to the particular characteristics of the corn and sugar technologies themselves. As a proportion of total labor inputs, harvesting is about twice as important for sugar production as for corn production (both technologies use primarily hired labor for this step in the production process). This explains more than one-half of the increase in hired labor for sugar production. Tasks involving carabaos and postharvest processing explain more than one-half of the increase in family labor for corn production. Tractor use, which does not appear to be strongly related to farm size, is commonly used for land preparation in sugar production. Women's participation in household production declines dramatically with a switch from corn to sugar production, from 12.4 days per hectare for corn to only 2.7 days for sugar.

Other Sources of Income

The following chapters will analyze how incomes generated from the production of corn and sugar are spent and how time allocation and expenditure decisions affect the nutrition of preschoolers. Before proceeding, however, it is important to keep in mind that the sources of income for these households are very diverse, especially for households with access to land.

Table 14 shows the percentage distribution of various sources of income, disaggregated by expenditure quintile and by crop and tenure group. For corn households with

Table 13—Labor inputs for corn and sugar, by family and hired labor, 1984/85

Labor Group	Corn[a]	Sugar[b]
	(person-days/hectare)	
Family labor	70.0	31.0
Men	40.2	16.5
Women	12.4	2.7
Children	17.4	11.9
Hired labor	39.2	77.6
Men	26.0	68.2
Women	11.0	8.6
Children	2.2	0.9
Total labor	109.2	108.6
Men	66.2	84.7
Women	23.4	11.3
Children	19.6	12.8

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.
Note: Labor inputs shown are for the total survey sample and include postharvest processing.
[a] Corn figures are for two crops.
[b] Sugar figures are for one crop.

Table 14—Sources of income, by expenditure quintile and crop-tenancy group, 1984/85

Group	Farm Production Income						Off-Farm Income			
	Sugar	Corn	Rice	Other	Backyard	Sub-total	Agricultural Wages	Nonagricultural Wages, Business, Other	Sub-total	Total
						(percent)				
Expenditure quintile[a]										
1	2	22	3	2	23	52	31	17	49	100
2	3	16	3	3	18	43	39	19	58	100
3	7	21	4	3	18	53	28	20	48	100
4	10	18	3	6	18	54	20	27	47	100
5	25	18	7	4	10	64	2	35	37	100
All	16	18	5	4	14	57	15	29	44	100
Crop-tenancy group										
Corn	0	29	5	7	19	60	17	23	40	100
Owners	0	25	5	13	22	65	4	31	35	100
Owners/share tenants	0	44	9	8	16	77	8	16	24	100
Share tenants	0	33	4	3	20	60	16	24	40	100
Laborers	0	6	0	1	17	24	65	11	76	100
Sugar	33	10	6	2	10	61	13	27	40	100
Owners	42	12	5	3	9	71	3	26	29	100
Owners/renters	33	8	10	2	9	61	2	36	38	100
Renters	34	15	2	0	14	65	9	26	35	100
Laborers	0	3	1	0	13	17	76	7	83	100

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.

Note: Averages are weighted by absolute amount of income earned by individual households.

[a] Expenditure quintile 1 is the lowest rank and 5 the highest.

access to land, profits from corn production account for only about a third of total income. Sugar households with access to land derive about the same proportion of their income from sugar production.

For both crop groups with access to land, income from nonagricultural sources contributes a quarter of total income. Backyard livestock, vegetable, and fruit production is a more important component of income for corn households with access to land than for sugar households with access to land, partly because livestock production is a complementary activity to corn production.

Rice and corn production account for about 15 percent of income for sugar households with access to land. Crops other than sugar, rice, and corn do not figure prominently for these households. For corn households with access to land, rice and other crops provide significant proportions of income for owner and owner/renter households but not for share tenant households.

Landless laborer households, whether corn or sugar, are the most dependent on a single source of income, agricultural wages, which constitutes from two-thirds to three-fourths of total income. For these households, backyard production, at roughly 15 percent, is the second largest component of income.

6

FOOD EXPENDITURES AND CALORIE INTAKES

The links between income and food expenditures at the household level, between food expenditures and household calorie intakes, and between household calorie intakes and preschooler calorie intakes for corn and sugar families are examined in this chapter. For reasons developed at length elsewhere (Bouis and Haddad 1989), total expenditures and *calorie intakes* derived from the 24-hour recall of foods consumed by a family are believed to give the best indication of the effect of increases in purchasing power on improved calorie consumption at the household level. A commonly followed alternative would have been to estimate the relationship between *calorie availability* (derived from food-expenditure information) and *total expenditures*.

Appendix 2 contains a discussion of how data on incomes, expenditures, nutrient availability, and nutrient intakes were collected, which data are more reliable, and how these variables are related empirically. See Table 26 for estimates of the income elasticities based on the two-way relationship shown in Table 15. See Appendix 3 (Tables 27-29) for descriptive statistics of the variables used in the following analyses and for the results of various structural and exogeneity tests.

Food Expenditures as a Function of Income

Table 15 presents data for per capita income, total expenditures, food expenditures, per adult-equivalent calorie availability, and calorie intakes disaggregated by income quintile, total expenditure quintile, and crop-tenancy group. As expected, food budget shares decline and household calorie consumption increases with income.

Sugar households purchase an average of about 15 percent more of their food in the market than do corn households, with proportions between own-produced food and market purchases invariant with tenure status. Conversely, about 15 percent more of corn-household food purchases come from their own production. This is not invariant with tenure status, as households with access to more land produce a higher percentage of their own needs. Laborer households make up for a lower home production percentage with higher percentages of in-kind wages.

Much of the difference between corn and sugar households in the percentage distribution of market purchases can be explained by differences between the two groups in their purchases of rice and corn, the two main staples. As indicated previously, sugar-household purchases of rice in the market are higher than corn-household purchases. Prices paid for corn grits and rice do not vary by income group. An F-test indicates that the marginal propensity to consume rice out of income is significantly higher for sugar households than for corn households.

The results of estimating the relationship between income and food expenditures are given in Table 16. The coefficients on the income terms are positive and significant for all three samples (corn households, sugar households, and the combined sample). Out of each additional peso of income, the marginal propensities to spend for food are 49 centavos for the whole sample, 52 centavos for corn households, and 39 centavos for sugar households. In accordance with Engel's law, the higher-income sugar households

Table 15—Income, expenditures, and calorie availability and intake, by income and expenditure quintiles and crop-tenancy group, 1984/85

Group	Per Capita Income	Total Expendi-tures	Family Food Expendi-tures	Food Budget Share[a]	Calorie Avail-ability[b]	Calorie Intake[c]
		(pesos/week)[d]		(percent)	(per day)	
Income quintile[e]						
1	13.1	30.0	24.0	80	2,170	2,266
2	21.9	36.6	26.6	73	2,237	2,313
3	29.8	39.7	28.5	72	2,321	2,336
4	41.4	48.1	33.3	69	2,639	2,433
5	101.7	76.2	43.2	57	2,826	2,443
All	41.7	46.2	31.1	67	2,439	2,358
Expenditure quintile[e]						
1	21.9	21.8	17.2	79	1,790	2,108
2	25.4	29.8	23.4	79	2,143	2,288
3	28.5	38.0	28.8	76	2,411	2,384
4	45.8	50.0	34.8	70	2,666	2,439
5	87.6	91.9	51.7	56	3,193	2,575
All	41.7	46.2	31.1	67	2,439	2,358
Crop-tenancy group						
Corn	35.2	41.4	29.3	71	2,375	2,372
Owners	47.7	49.2	32.7	66	2,445	2,387
Owners/share tenants	46.4	46.6	30.4	65	2,368	2,329
Share tenants	28.4	40.0	29.6	74	2,405	2,412
Laborers	26.6	32.3	24.9	77	2,266	2,326
Sugar	52.2	53.5	33.7	63	2,534	2,343
Owners	70.1	64.4	39.3	61	2,655	2,386
Owners/renters	83.3	89.9	47.5	53	3,148	2,447
Renters	43.0	43.5	30.0	69	2,350	2,371
Laborers	26.5	30.8	24.0	78	2,208	2,237

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.
Note: Parts may not add to totals because of rounding.
[a] Food budget share = family food expenditures/total expenditures; shares are weighted by total expenditures for individual households.
[b] Per adult-equivalent, derived from food expenditures.
[c] Derived from 24-hour recall of foods consumed.
[d] 1984 pesos.
[e] Quintile 1 is the lowest rank and 5 the highest.

spend a lower proportion of their incremental income on food. However, the range of the corresponding elasticities, 0.65, 0.63, and 0.57, is smaller. Food expenditures rise rapidly with income.

The test for equality of coefficients across corn and sugar households gave an F-value of 4.26, which is above the critical value. Changes in demand for household labor between sugar and corn production, especially for women, changes in demand preferences for rice and corn, and differences in percentage of food purchased in the market could all account for this result.

Calorie Intakes as a Function of Food Expenditures

Calories purchased per peso decline with increasing income, reflecting the declining share of staples in the diet as higher-income households seek more variety in what they eat. The food-expenditure data indicate that households in the highest expenditure

Table 16—Regression results for the relationship between income and food expenditures

Variable	All Households		Corn Households		Sugar Households	
(Constant)	−25.15210	(−4.38)	−15.53920	(−2.04)	−28.45140	(−3.26)
LNY	20.38670	(16.90)*	18.49230	(9.74)*	19.08450	(13.14)*
MOTHED	0.91819	(5.08)*	0.66936	(2.86)*	1.29299	(4.57)*
FATHED	−0.41277	(−2.35)*	−0.71002	(−2.68)*	0.60185	(2.55)*
MOTHAGE	−0.32516	(−3.25)*	−0.52139	(−4.10)*	0.27850	(1.78)
FATHAGE	0.11586	(1.49)	0.18369	(1.87)	−0.17939	(−1.46)
NUTRSC1	−0.43354	(−3.02)*	−0.59274	(−3.19)*	−0.22091	(−0.96)
PRCORN	0.82957	(1.14)	−0.11026	(−0.13)	1.78659	(1.53)
PRRICE	−1.38213	(−2.41)*	−0.45116	(−0.62)	−3.53981	(−3.98)*
PCTHOME	0.00253	(0.15)	0.02339	(1.08)	−0.04679	(−1.82)
POPDEN	−0.02133	(−2.33)*	−0.01569	(−1.34)	−0.00951	(−0.64)
ADEQVHH	−0.39700	(−1.48)	−0.17440	(−0.45)	−0.81660	(−2.33)*
RD1	4.14243	(3.70)*	5.28186	(3.81)*	1.68067	(0.99)
RD2	0.79826	(0.64)	3.40079	(2.15)*	−3.40899	(−1.82)
RD3	1.59086	(1.30)	2.26638	(1.48)	0.54071	(0.29)
	R^2 =	0.362	R^2 =	0.280	R^2 =	0.476
	F =	65.32	F =	25.36	F =	36.88
	N =	1,624	N =	928	N =	624
Marginal propensity to spend for food		0.49		0.52		0.39
Food expenditure elasticity with respect to income		0.65		0.63		0.57

Notes: The dependent variable is food expenditures per capita per week. t-statistics are in parentheses.
*Significant at the 0.05 level.
Definitions of variables:
LNY = predicted natural logarithm of income, in pesos per capita per week;
MOTHED = years of formal education of the mother;
FATHED = years of formal education of the father;
MOTHAGE = age of mother in months;
FATHAGE = age of father in months;
NUTRSC1 = measure of the nutritional knowledge of the mother;
PRCORN = quality-adjusted real price of corn;
PRRICE = quality-adjusted real price of rice;
PCTHOME = percentage of food expenditures coming from own-farm production;
POPDEN = population density of the muncipality;
ADEQVHH = number of household members expressed in adult-equivalents; and
RD1,RD2,RD3 = zero-one dummy variables for round.

quintile spend 60 percent more than those in the lowest expenditure quintile for equal amounts of calories.

Table 17, which disaggregates food expenditures by five broad food groups, indicates the types of calorie-expensive foods the higher-income groups in the sample demand. Overwhelmingly, it is the meat category that increases its share with income as the staple share declines. The category of fruits, snacks, desserts, and beverages increases its share with income, although the percentage share remains low. The shares of the remaining two food groups remain nearly constant with rising income.

The regression results in Table 18 show that household calorie intakes increase positively and significantly as food expenditures increase. At mean food expenditure levels, each extra peso spent for food increased household calorie intake (per adult-equivalent) by only about 90 calories *at the margin* for the sample as a whole, compared

Table 17—Allocation of weekly per capita food expenditures, by food group, expenditure quintile, and crop-tenancy group, 1984/85

Group	Staples	Meat, Eggs/Fish	Vegetables, Legumes	Fruits, Snacks, Desserts, Beverages	Cooking Ingredients	All
			(percent)			
Expenditure quintile[a]						
1	61	20	5	7	7	100
2	56	25	5	8	7	100
3	52	27	5	9	8	100
4	45	31	5	11	8	100
5	37	39	6	12	7	100
All	48	30	5	10	7	100
Crop-tenancy group						
Corn	49	28	5	10	7	100
Owners	45	31	4	13	7	100
Owners/share tenants	47	31	5	9	8	100
Share tenants	50	29	5	9	8	100
Laborers	56	23	5	9	7	100
Sugar	46	31	5	10	7	100
Owners	42	35	5	11	7	100
Owners/renters	40	36	5	12	7	100
Renters	48	30	6	10	7	100
Laborers	56	24	5	9	7	100

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.
Note: Averages are weighted by food expenditures for individual households.
[a] Quintile 1 is the lowest rank and 5 the highest.

with more than 400 calories purchased *on average* by a peso spent on food. The estimated household calorie intake elasticities with respect to food expenditures are 0.17 for the sample as a whole and 0.15 and 0.21 for corn and sugar households, respectively. Testing for the equality of coefficients across corn and sugar groups, an F-value of 0.79 does not reject the null hypothesis.

Direct Estimation of the Calorie-Income Elasticity

Calorie-income elasticities for the entire sample of 1,624 observations have been directly estimated using four econometric techniques (ordinary least squares, instrumental variables, and two techniques designed to take account of unobserved household-specific effects; a detailed presentation is provided in Bouis and Haddad 1989). The instrumental variable technique gave a calorie-income elasticity estimate of 0.11, and the two fixed-effect techniques gave estimates of 0.06 and 0.05, using calorie intakes and total expenditures as dependent and explanatory variables, respectively. These estimates, then, are nearly identical to the 0.11 estimate derived using the two-step procedure outlined above (obtained by multiplying 0.65 and 0.17) and suggest that household unobserved effects are empirically relatively unimportant in this instance.

The expenditure behavior indicated by the regression results reveals a high degree of leakage between higher incomes and increases in calorie intakes at the household level. The striking conclusion is that as incomes double, household calorie intakes increase by only about 10 percent for both corn and sugar households (less than 10 percent if the panel estimates are used).

Table 18—Regression results for the relationship between calorie intakes and food expenditures

Variable	All Households		Corn Households		Sugar Households	
(Constant)	1,699.20348	(7.15)	1,572.79891	(4.65)	1,900.12249	(5.14)
LNFFEX	399.57051	(9.80)*	348.18092	(5.85)*	486.02863	(7.95)*
MOTHED	−6.55484	(−0.81)	4.39447	(0.38)	−17.99340	(−1.43)
FATHED	−10.29226	(−1.44)	−9.53054	(−0.90)	−13.14178	(−1.27)
MOTHAGE	−1.00478	(−0.24)	−0.71330	(−0.12)	−6.58987	(−0.97)
FATHAGE	−3.82640	(−1.11)	0.03981	(0.01)	−5.12551	(−0.96)
NUTRSC1	9.00880	(1.54)	9.91045	(1.28)	4.41642	(0.45)
PRCORN	−40.57495	(−1.27)	−7.10563	(−0.17)	−93.01054	(−1.81)
PRRICE	25.92191	(1.07)	22.96462	(0.67)	39.97245	(1.04)
PCTHOME	0.65529	(0.92)	0.73085	(0.71)	1.31968	(1.17)
POPDEN	−2.03446	(−5.05)*	−1.75213	(−3.06)*	−2.76975	(−4.25)*
ADEQVHH	−34.17901	(−2.95)*	−48.58973	(−2.69)*	−19.60127	(−1.28)
RD1	160.01210	(3.22)*	207.05062	(3.00)*	116.27610	(1.56)
RD2	5.53448	(0.10)	−47.53876	(−0.61)	83.46194	(1.01)
RD3	−117.68181	(−2.18)*	−139.32955	(−1.85)	−100.18397	(−1.23)
	R^2 =	0.125	R^2 =	0.117	R^2 =	0.176
	F =	16.43	F =	8.60	F =	9.27
	N =	1,624	N =	928	N =	624
Calories purchased for each additional peso spent on food		89.8		83.1		100.8
Household calorie intake elasticity with respect to food expenditures		0.17		0.15		0.21

Notes: The dependent variable is household calorie intake per adult-equivalent per day. t-statistics are in parentheses.

*Significant at the 0.05 level.

Definitions of variables:

- LNFFEX = natural logarithm of food expenditures, in pesos per capita per week;
- MOTHED = years of formal education of the mother;
- FATHED = years of formal education of the father;
- MOTHAGE = age of mother in months;
- FATHAGE = age of father in months;
- NUTRSC1 = measure of the nutritional knowledge of the mother;
- PRCORN = quality-adjusted real price of corn;
- PRRICE = quality-adjusted real price of rice;
- PCTHOME = percentage of food expenditures coming from own-farm production;
- POPDEN = population density of the muncipality;
- ADEQVHH = number of household members expressed in adult-equivalents; and
- RD1,RD2,RD3 = zero-one dummy variables for round.

Preschooler Calorie Intakes as a Function of Family Intakes

Table 19 presents average calorie adequacy ratios for various age groupings by expenditure group and crop-tenancy group. These ratios are computed by dividing actual calorie intakes (taken from the 24-hour recall of individual food intakes) by the recommended calorie intakes for the appropriate age and sex (Food and Nutrition Research Institute 1984). Only preschoolers for whom breastfeeding has already been stopped are included in the table, because data were not collected on calorie intakes from breast milk. Consequently, currently breastfed children were also excluded from the regressions reported on below and in the following chapter.

Table 19—Calorie adequacy, by family member, expenditure quintile, and crop-tenancy group, 1984/85

Group	Average Calorie Adequacy Ratio					Percent Below 80 Percent of Caloric Requirements				
	Preschoolers (0-4)	Children (5-14)	Adolescents (>14)	Mothers	Fathers	Preschoolers (0-4)	Children (5-14)	Adolescents (>14)	Mothers	Fathers
Expenditure quintile[a]										
1	0.69	0.71	0.84	1.03	0.98	56	66	41	24	28
2	0.75	0.74	0.83	1.08	1.06	47	61	41	23	21
3	0.74	0.79	0.84	1.15	1.08	54	56	41	18	19
4	0.77	0.77	0.91	1.12	1.10	53	56	37	19	21
5	0.83	0.87	0.92	1.21	1.14	47	46	29	14	15
All	0.75	0.77	0.87	1.12	1.07	52	58	38	19	21
Crop-tenancy group										
Corn	0.76	0.77	0.87	1.12	1.06	63	58	38	20	23
Owners	0.82	0.78	0.89	1.19	1.10	56	56	33	15	18
Owners/share tenants	0.73	0.77	0.82	1.15	1.05	67	57	46	23	24
Share tenants	0.77	0.76	0.89	1.11	1.05	61	58	36	19	22
Laborers	0.76	0.77	0.91	1.05	1.01	66	58	35	24	28
Sugar	0.72	0.75	0.89	1.10	1.10	66	59	37	20	18
Owners	0.74	0.80	0.91	1.13	1.12	65	56	33	18	17
Owners/renters	0.76	0.77	0.91	1.15	1.15	61	53	35	13	15
Renters	0.71	0.76	0.82	1.13	1.13	67	60	42	19	13
Laborers	0.71	0.70	0.75	1.03	1.04	66	63	53	26	23

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.

Note: Parts may not add to totals because of rounding.

[a] Quintile 1 is the lowest rank and 5 the highest.

Table 19 shows that preschoolers on average are consuming only about 75 percent of their recommended daily intakes, while adults are consuming slightly above their recommended levels. Comparing calorie adequacy ratios across the various crop-tenancy groups, preschoolers in corn households consume more calories than sugar-household preschoolers. While the difference is not large, it is still surprising in view of the higher incomes in sugar households.

Table 20 presents the regression estimates for preschooler calorie intakes as a function of household calorie intakes. For all three samples, the household calorie intake was found to be a positive and significant determinant of preschooler calorie intake. At the margin, calories are distributed more or less equally among household members, increasing the percentage of household calories going to preschoolers, who consume below average household levels. For the whole sample and subsamples of corn and

Table 20—Regression results for preschooler calorie intakes as a function of household calorie intakes

Variable	All Households		Corn Households		Sugar Households	
(Constant)	263.42399	(1.12)	530.87080	(1.69)	98.99475	(0.26)
HCALAEQ	0.82028	(30.86)*	0.84577	(25.52)*	0.77578	(16.68)*
RATIOPAR	−1,483.48814	(−14.01)*	−1,588.46312	(−11.22)*	−1,320.44308	(−7.57)*
MOTHED	16.79655	(2.26)*	17.66845	(1.93)	5.11738	(0.35)
MOTHAGE	1.03590	(3.37)*	1.02134	(2.68)*	0.79280	(1.46)
NUTRSC1	−3.42859	(−0.55)	−13.81724	(−1.86)	25.15519	(2.11)*
CHILDCRE	0.32042	(1.63)	0.51105	(2.04)*	0.05842	(0.18)
SICK	−81.70871	(−1.90)	−137.87299	(−2.57)*	38.38262	(0.51)
SEX	65.98609	(1.73)	45.64234	(0.96)	72.80922	(1.07)
ACCAGE	43.84393	(4.84)*	39.98655	(3.27)*	35.74011	(2.45)*
AGESQ	−0.54548	(−4.56)*	−0.52775	(−3.32)*	−0.35900	(−1.81)
ADEQVHH	49.24556	(3.61)*	60.88718	(3.35)*	34.94330	(1.62)
RD1	−2.93130	(−0.06)	−47.44410	(−0.71)	60.91730	(0.65)
RD2	−65.62428	(−1.23)	−94.31894	(−1.39)	−13.65748	(−0.15)
RD3	−110.98226	(−2.08)*	−110.95572	(−1.65)	−106.97079	(−1.17)
	R^2 =	0.769	R^2 =	0.792	R^2 =	0.567
	F =	99.08	F =	68.91	F =	30.90
	N =	975	N =	587	N =	345
Preschooler calorie intake elasticity with respect to household calorie intake		1.18		1.20		1.17

Notes: The dependent variable is preschooler calorie intake per adult-equivalent per day. t-statistics are in parentheses.

*Significant at the 0.05 level.

Definitions of variables:

HCALAEQ = household calorie intake per adult-equivalent per day;
RATIOPAR = ratio of average of father's and mother's calorie intake per adult-equivalent over the household calorie intake per adult-equivalent;
MOTHED = years of formal education of the mother;
MOTHAGE = mother's age in months;
CHILDCRE = minutes spent by mother in child care in previous 24 hours;
NUTRSC1 = measure of nutritional knowledge of the mother;
SICK = zero-one dummy for reporting sickness in previous two weeks;
SEX = 0 = female, 1 = male;
ACCAGE = age of preschooler in months;
AGESQ = age of preschooler squared;
ADEQVHH = number of household members expressed in adult-equivalents;
RD1,RD2,RD3 = zero-one dummy variables for round.

sugar households the estimated preschooler calorie-intake elasticities with respect to household calorie intakes are 1.18, 1.20, and 1.17, respectively.

The F-test for equality of coefficients between the corn and sugar households indicated that the coefficients were significantly different for the two subsamples. Discussion of the reasons for this particular result will be postponed until differences in mothers' time allocation patterns between corn and sugar households are discussed in Chapter 7.

Multiplying the calorie-income elasticities reported in the previous section by the cited elasticities of 1.18, 1.20, and 1.17 gives the percentage increase in preschooler intakes over the percentage increase in income, or 0.13, 0.11, and 0.14 for the whole sample, corn households, and sugar households, respectively. Because preschoolers start off so far below their recommended calorie intakes, though distribution is relatively equitable at the margin, even high-income households would have to realize substantial percentage increases in income for the calorie intakes of preschoolers to reach their recommended levels, given these low elasticity values.

7

HEIGHTS AND WEIGHTS OF PRESCHOOL CHILDREN

Anthropometric data on height and weight were collected in each of the four survey rounds for all individuals present in the household at the time of the interview. In this chapter the data for preschoolers are presented, and the effects of calorie intakes and several nonfood variables on their heights and weights are analyzed. The standards against which heights and weights are compared are the United States National Center for Health Statistics references for a healthy U.S. population.

Table 21 presents Z-scores for height-for-age, weight-for-age, and weight-for-height for all preschoolers, disaggregated by age and expenditure quintile. The height-for-age

Table 21—Z-scores for height-for-age, weight-for-age, and weight-for-height of preschoolers, by age and expenditure quintile, 1984/85

Expenditure Quintile[a]	Age of Preschoolers in Years					
	0	1	2	3	4	0-4
			Height-for-Age			
1	−2.08	−2.75	−2.62	−2.44	−2.69	−2.57
2	−1.24	−2.37	−2.26	−2.30	−2.46	−2.22
3	−1.20	−2.03	−2.04	−2.13	−2.17	−2.02
4	−0.91	−1.97	−1.86	−2.28	−2.30	−2.02
5	−0.82	−1.88	−1.76	−1.94	−1.91	−1.80
All	−1.31	−2.24	−2.15	−2.24	−2.34	−2.16
			Weight-for-Age			
1	−1.82	−2.15	−1.77	−1.53	−1.61	−1.75
2	−0.90	−2.06	−1.69	−1.62	−1.52	−1.62
3	−1.24	−1.76	−1.45	−1.42	−1.39	−1.47
4	−1.44	−1.71	−1.47	−1.45	−1.41	−1.49
5	−0.86	−1.60	−1.39	−1.30	−1.33	−1.35
All	−1.25	−1.88	−1.57	−1.48	−1.46	−1.55
			Weight-for-Height			
1	−0.47	−0.81	−0.73	−0.48	−0.50	−0.60
2	−0.07	−1.06	−0.82	−0.61	−0.40	−0.64
3	−0.46	−0.83	−0.62	−0.45	−0.40	−0.55
4	−0.92	−0.81	−0.77	−0.46	−0.51	−0.65
5	−0.47	−0.80	−0.66	−0.38	−0.42	−0.54
All	−0.43	−0.87	−0.72	−0.48	−0.45	−0.60

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.

Note: The heights and weights of preschoolers were measured in each round so that Z-scores for any one preschooler are typically included in the mean calculations for two columns. U.S. National Center for Health Statistics (NCHS) standards were used for ease of comparison with the other four IFPRI microlevel studies of commercialization. The Food and Nutrition Research Institute (FNRI) in the Philippines has recently issued a set of reference values based on a national sample of apparently healthy Filipino children. Healthy Filipino children are close to the NCHS standard during the first half of infancy, gradually deviating from it as age advances. Thus it may be expected that Z-scores based on the NCHS standards gradually decline with age.

[a] Quintile 1 is the lowest rank and 5 the highest.

scores for preschoolers less than one year old indicate a very strong association between height and income. Although data are not presented to substantiate such a conclusion, this pattern is probably a reflection of better maternal nutrition in high-income groups during pregnancy and breastfeeding (see Bouis and Kennedy 1989 for a discussion of this topic).

As age increases and children are weaned, height-for-age Z-scores for all expenditure quintiles decline. However, they decline more rapidly for higher-income quintiles so that by the age of four years, heights of higher-income children are only marginally better than heights of lower-income children. There appears to be little association between income and weight-for-height. Weight-for-age Z-scores show a pattern that is a mix of the patterns for height-for-age and weight-for-height scores.

Height-for-age Z-scores disaggregated by crop-tenancy group for preschoolers who have been completely weaned are given in Table 22. Note that children in the two highest-income crop-tenancy groups (sugar owner and sugar owner/renter households) in the first age tercile are significantly taller than preschoolers in any of the remaining six groups. However, having started out significantly taller, sugar owner and sugar owner/renter children are shorter on average than their corn-household counterparts by the time they reach the oldest age tercile (although the difference is not statistically significant) despite their larger farms, higher profits from sugar, and higher incomes. Corn laborer and sugar laborer children in the oldest age tercile are significantly more stunted than children in any of the remaining six groups, a result that might have been expected because of their low incomes.

Causal factors that could potentially influence the above patterns of nutritional status, particularly mothers' time allocation, preschooler morbidity, health and sanitation practices and facilities, and mothers' nutritional knowledge, are discussed in the following sections.

Table 22—Height-for-age Z-scores for preschoolers who no longer breast-feed, by crop-tenancy group and age tercile, 1984/85

Crop-Tenancy Group	All Ages	Age Tercile 1	2	3
Corn	−2.21	−2.17	−2.18	−2.29*
Owners	−2.18	−2.12	−2.37	−2.07
Owners/share tenants	−2.19	−2.22	−2.15	−2.18
Share tenants	−2.12	−2.13	−1.99	−2.23
Laborers	−2.41	−2.25	−2.38	−2.64*,**
Sugar	−2.17	−1.97	−2.27	−2.37*
Owners	−1.97	−1.77**	−1.83	−2.32*
Owners/renters	−2.00	−1.84**	−2.05	−2.11*
Renters	−2.16	−2.11	−2.16	−2.28
Laborers	−2.39	−2.04	−2.77	−2.62*,**

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.

* Significant difference at the 0.05 level between first and third age terciles within crop-tenancy group.

** Significantly different at the 0.10 level from all other crop-tenancy groups for the same age tercile; tests run only for first and third age terciles.

Time Allocation Patterns of Mothers

Mothers who are breastfeeding spend about 110 more minutes a day in child care than do nonbreastfeeding mothers. Less than half of this extra time is accounted for by breastfeeding itself. A comparison of like tenancy groups across crops (excluding the laborer groups) shows that breastfeeding time and other child-care time for children who are being breastfed is consistently higher for the sugar-household mothers than for the corn-household mothers. Once breastfeeding is stopped, child-care time is consistently lower for sugar-household mothers than for corn-household mothers (again excluding the laborer groups).

Such a result might have been predicted, given the assumptions underlying the economic theory of the household model, and given the reduced role of women in sugar production. Because the mother is relatively more tied to the house and baby during breastfeeding (for both corn and sugar households), the lower opportunity cost of women's time in sugar production will leave more time for child care for sugar-household mothers. Once breastfeeding is discontinued, however, sugar-household mothers have less incentive to stay at home, so child-care time will be reduced. This line of reasoning holds only for households with access to land. The pattern described above breaks down when comparing the corn laborer and sugar laborer mothers.

Table 23 shows that time in own-farm activities rises only marginally between breastfeeding mothers and mothers who have stopped breastfeeding for corn owner and corn owner/share tenant households, in contrast with sugar owner and sugar owner/renter mothers, who spend much less time in own-farm activities during breastfeeding than after. It can be presumed that time in own-farm activities of sugar owner and sugar owner/renter mothers, whose children get an especially good nutritional start, is similarly low during pregnancy as well (Bouis and Kennedy 1989).

Comparing like tenancy groups across crops (but excluding the laborer households), Table 23 shows that total time away from the house, which increases for all eight crop-tenancy groups once breastfeeding is stopped, is consistently lower for sugar-household mothers during breastfeeding, and consistently higher for sugar-household mothers once breastfeeding has been stopped. Most of these differences are statistically significant. Once breastfeeding has been stopped, corn-household mothers spend about one more hour each day away from the house than before they stopped, while sugar-household mothers spend about two more hours away from the house.

As noted earlier, corn-household preschoolers, after they have been weaned, are favored somewhat in the intrahousehold distribution of calories relative to their sugar-household counterparts. The dichotomy in mothers' time allocation patterns just discussed provides a plausible explanation for this statistically significant difference.

Preschooler Morbidity Patterns

Mothers were asked to provide information on the duration and symptoms of any type of illness that the preschooler may have suffered in the two weeks before the interview. Fever and diarrhea were the most frequently mentioned symptoms. After breastfeeding had been stopped, an average preschooler in the sample was sick once every six weeks (Table 24). The average duration of each reported sickness was about 4.5 days and did not vary much across expenditure or crop-tenancy groups.

Surprisingly, prevalence rates are higher for sugar households than for corn households. For sugar-household preschoolers, fever and diarrhea combined occur 25 percent

Table 23—Mothers' time away from the house, by breastfeeding status and crop-tenancy group, 1984/85

Crop-Tenancy Group	Time Away from House in Own-Farm Activities[a]			Time Away from House in Off-Farm Activities[b]			Total Time Away from House		
	Currently Breastfeeding	No Longer Breastfeeding	Net Change	Currently Breastfeeding	No Longer Breastfeeding	Net Change	Currently Breastfeeding	No Longer Breastfeeding	Net Change
					(minutes)				
Corn[c]	86**	118*,**	+32	105**	150*,**	+45	191**	269*,**	+78
Owners	108	130	+22	108	163	+55	215	292	+77
Owners/share tenants	108*	136	+28	96*,**	149*,**	+54	203**	285**	+82
Share tenants	91	107	+16	100*,**	150**	+50	191*,**	256**	+65
Laborers	58**	109*,**	+51	118	136*	+18	176**	245**	+69
Sugar[c]	69**	99*,**	+30	104**	196*,**	+92	172**	295*,**	+123
Owners	65**	118**	+53	102**	179**	+77	166**	297**	+131
Owners/renters	16*,**	101**	+85	165*	207*	+42	181**	309**	+128
Renters	84	113	+29	50*,**	182**	+132	134*,**	295**	+161
Laborers	79	69*	−10	109**	213*,**	+104	187**	282**	+95

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.

Note: Data are for the 24-hour period prior to the survey interview.

[a] Cultivating fields, pasturing and watering work animals, fetching water, gathering firewood.

[b] Agricultural and nonagricultural employment, marketing, meetings, church, fiesta, visiting friends.

[c] Weighted by number of observations; weights differ between mothers who are currently breastfeeding and those who are no longer breastfeeding.

* Significantly different at the 0.05 level, comparing like tenancy groups across crops.

** Significantly different at the 0.05 level, comparing like variables across breastfeeding and nonbreastfeeding mothers.

Table 24—Prevalence of sickness among breastfeeding and nonbreastfeeding preschoolers, by expenditure quintile and crop-tenancy group, 1984/85

	Currently Breastfed Preschoolers			Preschoolers Who Have Stopped Breastfeeding		
Group	Sickness	Fever	Diarrhea	Sickness	Fever	Diarrhea
			(percent)[a]			
Expenditure quintile						
1	31	21	03	24	17	03
2	29	21	04	27	19	04
3	34	16	07	29	14	05
4	39	28	02	30	20	03
5	41	21	07	32	21	03
All	35	21	05	28	18	04
Crop-tenancy group						
Corn	32	22	05	27	17	03
Owners	22	11	03	24	15	01
Owners/share tenants	38	32	05	28	16	03
Share tenants	33	21	05	29	18	04
Laborers	31	21	04	26	19	04
Sugar	36	22	05	30	20	05
Owners	32	21	03	28	20	02
Owners/renters	43	17	04	32	20	06
Renters	34	28	03	32	21	03
Laborers	37	22	07	30	20	07

Source: International Food Policy Research Institute-Research Institute for Mindanao Culture survey, 1984/85.
[a] Percentage of children sick in the two weeks preceding the survey interview.

more frequently than for corn-household preschoolers (after breastfeeding has been stopped). The pattern of sickness across the crop groups is consistent with the more rapidly declining height-for-age Z-scores for sugar-household preschoolers as they grow older. Sugar-household mothers spend less time in child care and more time away from the house, even though their preschoolers are sick more often.

Health and Sanitation

Increases in income are associated with improved primary water sources, water sources that are closer to the house, improved toilet facilities, and better housing as measured by flooring and roofing materials. On average, these mean better facilities for sugar households, which have higher incomes. Laborer households have the least-improved toilets and poorest-quality floor material. For none of the sanitation variables considered are poorer facilities consistently associated with sugar households (which could explain the higher morbidity rates among sugar-household preschoolers), nor do improved facilities for higher-income households seem to have resulted in lower morbidity for preschoolers in these higher-income households.

Forty-three percent of preschoolers were ever bottlefed, compared with 94 percent ever breastfed. The practice of bottlefeeding is positively associated with rising incomes. Sugar-household mothers bottlefeed more frequently than their corn-household counterparts. Laborer-household mothers bottlefeed least, reflecting their lower purchasing power. Sugar-household mothers delay the introduction of weaning foods longer than corn-household mothers, stopping both breastfeeding and bottlefeeding at older ages, which is indicative of the greater time availability of sugar-household mothers for child care. While studies have shown that bottlefeeding is associated with higher morbidity than breastfeeding, this does little to explain why sickness would be higher for sugar-household children who are three and four years old.

Mothers' Nutritional Knowledge

In each of the four survey rounds, mothers were given a quiz of 10 questions relating to nutrition. The purpose of this was to obtain an empirical measure of each mother's nutritional knowledge, which could then be entered in the regression estimations to test whether specific knowledge in the area of nutrition affected the efficient use of household resources, especially as compared with the effect of years of formal education.

From the total of 40 questions, 17 that split the correct and incorrect answers into two fairly even groups were selected. A nutritional knowledge score, equivalent to the number of correct answers given, was calculated for each mother. These scores ranged from 1 to 17 with an overall population mean of 7.5 and were highly correlated with mothers' education (see Table 2).

Z-Score Estimations

In the fourth and final link specified in Chapter 3, weight-for-height (a short-run measure of nutritional status) was regressed on preschooler calorie intakes (Table 25). Preschooler intakes were found to be a positive and significant determinant of weight-for-height for the whole sample and for the corn-household and sugar-household subsamples. While it should be pointed out that the magnitudes of Z-score elasticities are sensitive to population means, which can approach zero, the estimated elasticities calculated from the coefficients on preschooler calorie intakes are 0.39, 0.34, and 0.57 for the whole sample and corn-household and sugar-household subsamples, respectively. Greater calorie intakes mean better nutrition in the short run and presumably in the long run also if these intakes can be sustained over longer periods.

Morbidity, as represented by zero-one dummy variables for diarrhea and fever, is negatively and significantly associated with short-run nutritional status for the whole sample and for sugar households. If these occurrences of sickness continue repeatedly over the long run, the higher morbidity levels for sugar-household children are a major contributor to the more rapidly declining height-for-age Z-scores for sugar-household children as they grow older.

The F-statistic, computed to test the equality of the coefficients between the corn-household and sugar-household subsamples, was significant. This result was more or less expected, given the different morbidity rates between the groups and the more rapidly declining height-for-age Z-scores for sugar-household children.

Summary

With the analysis of all four links between income and nutritional status completed, as outlined in Chapter 3, it is possible to estimate the effect of changes in income on the

Table 25—Regression results for the relationship between preschoolers' calorie intake and weight-for-height

Variable	All Households		Corn Households		Sugar Households	
(Constant)	−2.80493	(−3.17)	−3.41129	(−2.82)	−1.06934	(−0.65)
PCALAEQ	1.0775×10^{-4}	(3.90)*	9.6935×10^{-5}	(2.62)*	1.5494×10^{-4}	(3.05)*
DIARR	−0.52031	(−3.62)*	−0.17917	(−0.90)	−0.79902	(−3.59)*
FEVER	−0.22818	(−3.44)*	−0.06216	(−0.68)	−0.33448	(−3.04)*
MNTHBFED	2.4400×10^{-3}	(0.77)	-5.844×10^{-3}	(−1.28)	0.01162	(2.28)*
BRTHSP1	-4.406×10^{-3}	(−3.62)*	-2.851×10^{-3}	(−1.89)	-7.761×10^{-3}	(−2.84)*
MOTHED	0.02909	(2.50)*	0.02247	(1.42)	0.05561	(2.77)*
FATHED	−0.01673	(−1.66)	−0.03022	(−2.02)*	-2.062×10^{-3}	(−0.13)
MOTHAGE	1.4876×10^{-3}	(4.45)*	1.1664×10^{-3}	(2.73)*	1.6346×10^{-3}	(2.64)*
NUTRSC1	-5.475×10^{-3}	(−0.65)	-4.256×10^{-3}	(−0.40)	−0.01784	(−1.16)
CHILDCRE	-4.263×10^{-4}	(−1.72)	-3.577×10^{-4}	(−1.10)	-7.576×10^{-4}	(−1.77)
SEX	−0.15879	(−3.13)*	−0.11764	(−1.73)	−0.26390	(−2.96)*
HTFATH	-2.294×10^{-3}	(−0.53)	2.8451×10^{-3}	(0.45)	-8.935×10^{-3}	(−1.28)
HTMOTH	0.01455	(3.97)*	0.01453	(3.60)*	8.4126×10^{-3}	(0.90)
RD1	−0.09839	(−1.40)	−0.07415	(−0.80)	−0.04898	(−0.40)
RD2	−0.14613	(−2.06)*	−0.16582	(−1.75)	−0.07918	(−0.67)
RD3	−0.06586	(−0.91)	−0.09738	(−1.02)	0.08283	(0.68)
	R^2 =	0.115	R^2 =	0.089	R^2 =	0.231
	F =	7.91	F =	3.07	F =	6.20
	N =	995	N =	522	N =	347

Notes: The dependent variable is weight-for-height. t-statistics are in parentheses.
*Significant at the 0.05 level.
Definitions of variables:

PCALAEQ	= preschooler calorie intake per adult-equivalent per day;
DIARR	= zero-one dummy for diarrhea reported in past two weeks;
FEVER	= zero-one dummy for fever reported in past two weeks;
MNTHBFED	= months that child was breastfed before stopping;
BRTHSP1	= months between births of present and previous child;
MOTHED	= years of formal education of the mother;
FATHED	= years of formal education of the father;
MOTHAGE	= age of the mother in months;
NUTRSC1	= measure of the nutritional knowledge of the mother;
CHILDCRE	= minutes spent in child care in previous 24 hours;
SEX	= 0 = female, 1 = male;
HTFATH	= height of the father in centimeters;
HTMOTH	= height of the mother in centimeters; and
RD1,RD2,RD3	= zero-one dummy variables for round.

short-run nutritional status of preschoolers via the higher calorie intakes that higher incomes make possible. The short-run nutritional status-income elasticity (that is, with respect to weight-for-height) for the whole sample may be estimated by multiplying the individual elasticities for each link: (0.65) (0.17) (1.18) (0.39) = 0.05, implying that a doubling of income improves weight-for-height by only 5 percent. This 5 percent difference for every 100 percent increase in income does not show up clearly across expenditure quintiles in Table 21 (see weight-for-height Z-scores for three- and four-year-olds) because of the confounding effect of higher morbidity rates of preschoolers in higher-income sugar households.

What benefit the extra calories provide at higher incomes is negated to some extent by these higher morbidity rates, so that (once breastfeeding has been stopped, on average after 14 months of age) the net effect of income on nutritional status in the short run is negligible in the two-way table.

Note in Table 21 that the height-for-age values in the lowest and highest expenditure quintiles remain almost unchanged for preschoolers aged one to four years. This implies that most of the improvement in height-for-age that is derived from income is realized before the preschooler's first birthday—most likely in the form of better maternal nutrition during pregnancy and breastfeeding. Weaning takes an especially high toll on the heights of higher-income preschoolers (relative to NCHS standards). After that, as preschoolers grow older, the relationship between income and height-for-age remains almost unchanged. This is consistent with the finding of a very low correlation between income and short-run nutritional status.

8

CONCLUSIONS

This research has had two objectives: examining the process of commercialization in order to generalize as to the key factors in favorable or unfavorable nutritional outcomes, and addressing policy concerns that are specific to the Philippines. Accordingly, some of the conclusions and policy recommendations that come out of this study are relatively narrow in focus, applying only to the Philippines, Mindanao, or perhaps only the study area itself. Others are more widely applicable, both in terms of methodologies that were tried and could possibly be replicated in other studies of nutrition policies, and in identification of the key factors mentioned above that may manifest themselves in similar ways in the other IFPRI commercialization studies.

Production Policies

The analysis of the profitability of corn production for a group of smallholder producers in a traditional corn-growing area shows that productivity is so low that in many instances corn tenants would realize higher incomes by working in the agricultural labor force (assuming employment were available) rather than on their farms. Corn landowners do only a little better than tenants because they do not pay a share of their harvest for rent.

Declining soil fertility is a major problem. There would appear to be high returns to developing low-cost technologies for improvement of soil fertility and to investing in extension programs for dissemination of these technologies to farmers. Adoption rates of hybrid varieties of corn are low, probably because of the risk involved and high input costs. Open-pollinated varieties that do not require such high input levels have been more widely adopted. Fertilizer is being used at levels well below those that would maximize profits.

Surprisingly, in view of a widespread perception of a failing sugar industry in the Philippines, sugar production in Bukidnon is more profitable than corn production. Smallholders who kept their land were able to raise their incomes by switching from corn to sugar production. Sugar looks highly profitable in part because it is being compared with corn. Average returns of P4,500 per hectare per year (US$225 on a variable cost basis without valuing family labor and without subtracting interest on loans) are not high in an absolute sense, considering the risks involved and the amounts of capital invested. If the peso had not been devalued by 50 percent in 1984, prices received by sugar producers would have been much lower in the 1984/85 milling seasons, substantially reducing net returns.

Because transportation costs are such an important determinant of profitability, it can be presumed that many sugar producers in Negros, whose farms are at some distance from the mills, have had to discontinue production with declining sugar prices, while those nearer to the mills are able to continue production at a profitable rate but using fewer inputs, including labor. Underemployed or laid-off workers must look for employment elsewhere, but where sugar is virtually the only industry, there is no other employment. This is not the case in Bukidnon, whose agricultural economy is much more diversified.

Despite the higher profits possible from sugar production, all sugar households continued to produce some corn, on average well above what was needed for home consumption. This is probably due to their unwillingness, in case the harvest should fail or they were not able to market their crop, to bear the risk of converting entirely to cash crop production. Because these unfavorable outcomes did not in fact materialize, they were left with large surpluses of corn that could then be marketed.

Nutrition Policy for Agricultural Households

Raising household incomes appears to be a necessary but not a sufficient condition for substantially improving preschooler nutrition. Regressions show calorie intakes of preschoolers to be positively and significantly related to their nutritional status. Yet higher-income households choose to purchase nonfood items and higher-priced calories at the margin, while preschoolers continue to consume well below recommended intakes. Surely education has some role to play in convincing parents to adjust food-expenditure behavior by purchasing less-expensive sources of calories and to distribute the extra calories more equitably among household members.

For the whole sample, after controlling for income or for variables highly correlated with income such as food expenditures and household calorie intakes, the number of years of formal education of the mother was positive and significant in three of the links in the four-step system that was estimated. However, on average, mothers had received only six years of primary school education. This suggests that investments in education at the secondary level could have an important lagged effect after students marry, apart from any benefits derived from the higher incomes that better education would generate.

At the crucial second link in the four-stage process, where much of the "leakage" occurs when increases in income are not translated into increases in preschooler calorie intakes, no measure of education, knowledge, or experience is significant. It is possible that mothers are targeting more-expensive nutrients such as proteins. It is important to point out, however, that relatively modest increases in *absolute* annual per capita income (US$185 between the lowest and highest expenditure quintiles in Table 15) result in substantial increases in household calorie intakes, a point that can easily be overlooked in focusing on the low calorie-income elasticity estimates.

Improvement of preschooler calorie intakes, however, is not a sufficient condition for substantially improving nutritional status because of the high prevalence of sickness, even among high-income groups. Reducing sickness may require both education and improved community-level health and sanitary conditions.

To the extent that the findings of low calorie intakes and sickness as the primary causes of preschooler malnutrition can be corroborated by other studies in rural areas—especially for households that appear to be able to purchase more calories without substantially increasing food expenditures—a priority area of action would be to introduce pilot nutrition education programs in an attempt to determine whether food expenditure behavior and intrahousehold distribution of calories could be altered by such programs. At the same time, the major determinants of sickness need to be identified so that effective policies for reducing morbidity can also be pilot-tested and then implemented on a wider scale.

Winners and Losers

Who benefited from the introduction of sugar? An important result of the study was to show that smallholders who kept their land and were able to switch to sugarcane production realized substantial increases in income by participating in export cropping. This was accomplished despite the absence of government extension programs to teach farmers how to grow sugar, of government credit programs to help farmers with the much higher fixed costs of initiating sugarcane production, and of a government program to ensure that smallholders got growing contracts with the mill.

Land values in the areas close to the mill rose, so that small landowners who held on to their land realized substantial increases in their net worth. Higher profits from sugar production meant that these households could eat more varied diets, provide a better education for their children, enjoy better housing, and gain many other benefits that usually accrue with higher income. Pregnant and lactating mothers were able to spend less time in agricultural production and more time with their children, resulting in better nutrition for younger preschoolers.

The one negative aspect for these households from a nutritional point of view was that as preschoolers got older, they were not able to sustain their initial height gains, so that by the time they reached four years of age they were no taller than their corn-household counterparts. Despite the higher incomes of their parents, sugar-household preschoolers were eating no better than corn-household children and were getting sick more often.

Unfortunately, the numbers indicate that for every two sugar owner and sugar renter households that benefited in the ways just mentioned, there was one household that lost access to land and consequently experienced a decline in income. Thus a substantial number of households were losers in the process of commercialization studied here. By the time they reached the age of four years, preschoolers in these households could be expected to be significantly more stunted than if the households had maintained their access to land and continued to grow corn.

Data from both the presurvey and the detailed household survey indicate that it was the smallholders with relatively large landholdings who were able to overcome the barriers to adoption and initiate sugarcane production. What were the underlying factors that caused the apparent deterioration in land-tenure patterns and a more skewed distribution of income?

First, declining corn productivity constitutes a force that in a sense "pushes" landowners and tenants off the land. Returns to household labor and other inputs are quite low, making the decision to leave the land much easier in times of financial hardship. Second, the better ability of the larger farm households to bear risk, their better access to credit facilities, and their generally better education, know-how, and access to important political and social institutions put these households in a much better position to take advantage of new agricultural production technologies when they become available. Especially if these new technologies have economies of scale, but also if they are neutral to scale, these advantages of the larger farm households constitute a force that "pulls" less well endowed households off the land.

Development Strategy for Mindanao Agriculture

There are several reasons why export cropping has expanded more rapidly in Mindanao than in other parts of the country. First, it is out of the path of typhoons.

Second, the relatively even year-round distribution of sunshine and rainfall found in Mindanao is more conducive to agricultural production throughout the year than the heavy monsoon rains followed by a relatively long dry season in Luzon. Third, Mindanao is one of the few regions of the country that contains relatively large areas of arable land at higher elevations. This elevation is important for the production of some export crops, such as some vegetables (which are shipped to Manila during the rainy season in Luzon) and coffee. Fourth, population densities are lower in Mindanao than in Luzon, so that in the past there was some open land for expansion. Mindanao is well situated, then, for generating the high agricultural growth rates that policymakers at the highest levels continue to insist will be the backbone of the economic recovery in the Philippines (Lim 1987). The question is the manner in which this potential will be tapped.

The introduction of sugar in southern Bukidnon provides some important lessons for how *not* to pursue development of export cropping in the future. From the outset, most of the milling capacity of BUSCO was met by sugarcane produced on large-scale haciendas. Small-scale producers entered the scheme relatively late, and in a marginal way in terms of the total mill output. About half of small-scale sugar producers surveyed had no grower contracts with the mill and so had to strike individual deals with those who had contracts, reducing their income from sugar. Because there were relatively few small-scale sugar producers, the increases in income that these households realized provided a relatively weak stimulus to the local economy. The decreased incomes of those households that lost access to land can be presumed to have had negative multiplier effects on the local economy.

What should be done instead? First, to help to prevent a further deterioration in land distribution patterns, smallholder corn productivity needs to be improved (Rosegrant et al. 1987).[3] Both open-pollinated and hybrid varieties are available, but typically only larger landowners in Bukidnon are experimenting with the new corn technologies. A corn technology dissemination program similar to the well-known Masagana 99 program for rice has been in effect for some time. However, it has not received nearly the resources or the attention that the rice program did in the 1970s. Such a program would assist not only households that traditionally grow corn as their primary crop, but smallholder export crop producers as well. The Bukidnon surveys revealed that no households were willing to completely forgo corn production.

Second, the government needs to make a conscious effort at the same time to develop the inevitable expansion of export cropping in Mindanao on a smallholder basis. This involves reducing the barriers to entry by providing smallholders with credit and know-how through extension and by actively promoting their access to processing and marketing facilities where necessary. Although such characteristics unfortunately do not always coincide with high output prices and low production costs, all else being equal the government should seek to promote export crops that are labor intensive, have diseconomies of scale in production, have low transportation costs in marketing, and can be stored for relatively long periods after harvesting.

[3] The analysis presented in this report supports such a policy conclusion based on distributional grounds, helping the rural poor. Rosegrant and Gonzales (Rosegrant et al. 1987) reach a similar policy conclusion taking a macro perspective—comparing costs and returns to production of various cereal and export crops in the Philippines using a domestic resource cost methodology. A strategy of promoting new corn technologies, therefore, could lead to higher growth and better distribution of income if steps were taken to overcome the barriers to adoption for smallholders.

APPENDIX 1

SHOULD THE MODEL BE TREATED AS SIMULTANEOUS OR RECURSIVE?

It is impossible to treat the four-equation model as a simultaneous system, because the data for the first two equations are specified at the household level and for the second two at the individual level. Assuming that all four equations were specified at the same level of disaggregation, it can be shown that each equation satisfies the order and rank conditions for identification of structural coefficients. Let the model be written as follows:

Equation	Y	FE	HC	PC	Z	M	F	MA	FA	NU	PK	PR	AD	PH	PD
1	b_{11}	1				a_{11}	a_{12}	a_{13}	a_{14}	a_{15}	a_{16}	a_{17}	a_{18}	a_{19}	a_{110}
2		b_{22}	1			a_{21}	a_{22}	a_{23}	a_{24}	a_{25}	a_{26}	a_{27}	a_{28}	a_{29}	a_{210}
3			b_{33}	1		a_{31}		a_{33}		a_{35}			a_{38}		
4				b_{44}	1	a_{41}	a_{42}	a_{43}		a_{45}					

Equation	CC	SK	SX	A	A^2	RP	HF	HM	D	FV	MB	BS
1												
2												
3	a_{311}	a_{312}	a_{313}	a_{314}	a_{315}	a_{316}						
4	a_{411}		a_{413}				a_{417}	a_{418}	a_{419}	a_{420}	a_{421}	a_{422}

where the correspondence to the codes in Appendix 3 is

Y = YPCPWK	NU = NUTRSC1	A = ACCAGE
FE = FFEXWKPC	PK = PRCORN	A^2 = AGESQ
HC = HCALAEQ	PR = PRRICE	RP = RATIOPAR
PC = PCALAEQ	AD = ADEQVHH	HF = HTFATH
Z = ZHA, ZWA, ZHA	PH = PCTHOME	HM = HTMOTH
M = MOTHED	PD = POPDEN	D = DIARR
F = FATHED	CC = CHILDCRE	FV = FEVER
MA = MOTHAGE	SK = SICK	MB = MNTHBFED
FA = FATHAGE	SX = SEX	BS = BRTHSP1

The coefficients on endogenous variables are denoted as b and those for predetermined variables are denoted as a.

Applying the *order* condition to each equation (comparing the number of predetermined variables excluded from the equation and the number of endogenous variables in the equation minus one), it can be seen that each equation is overidentified. The sufficient *rank* condition (is the matrix, constructed from the columns of the variables not included in the equation, of full rank?) also demonstrates overidentification of each equation.

An alternative is to break the model up into two simultaneous subsets that are recursive with respect to each other. The FE and HC equation pair would be one subset and the PC and Z equation pair the other. This would prove unsatisfactory, as the first subset would be underidentified, and even more arbitrary zero restrictions would have to be imposed on both the FE and HC equations.

A strong case can be made for recursive estimation in this situation. In relation to equation 1, a sufficient condition for the separability of production and consumption of semisubsistence households is that all markets exist for commodities that are both produced and consumed by the household, including leisure, with the household being a price-taker in each one. Evidence for the efficient functioning of the study area corn market is provided in Chapter 5, and there is some additional circumstantial evidence to suggest that market imperfections are not significant (Haddad and Bouis 1989). Thus income can be included as a right-hand side variable in the first equation without too much trepidation.

In relation to equations 3 and 4, it is unlikely that calorie intake and weight are simultaneously determined, simply because the body takes time to assimilate calories and other nutrients. For equation pairs 1 and 2, and 2 and 3, the theoretical arguments for recursiveness are weaker. Nevertheless, right-hand side exogeneity is tested for in all equations with a Hausman Test, and where necessary an equation-by-equation instrumental variable estimation is applied.

APPENDIX 2

TOTAL EXPENDITURES AND HOUSEHOLD CALORIE AVAILABILITY AS PROXIES FOR INCOME AND HOUSEHOLD CALORIE INTAKES

Table 15 in Chapter 6 presents data for income, total expenditures, food expenditures, calorie availability, and calorie intakes disaggregated by income quintile, total expenditure quintile, and crop and tenure group. While regression analysis is necessary to obtain more refined estimates that take account of a number of variables not shown, this two-way table nevertheless provides a rough indication of the magnitude of the relationship between income and household calorie intakes. In analyzing this relationship, a number of methodological issues need to be raised, which the two-way table helps to bring into focus.

The Relationship Between Income and Total Expenditures

While total expenditures plus savings should theoretically sum to income, how do the data for these two variables actually compare? On average for the total sample, per capita income is somewhat less than per capita total expenditures.

If savings are positive, income should be higher than expenditures. In calculating *income*, all agricultural production was valued at farmgate prices, whether sold or kept for home consumption. In calculating *food expenditures*, agricultural production consumed at home was valued at retail prices. Valuing consumption of own-produced food at retail prices instead of farmgate prices in the income calculation would have resulted in higher incomes. For example, implementing this alternative accounting system for a household earning two-thirds of its income from own-farm production, which kept half of its total production for home consumption, and where the markup between retail and farmgate prices was 25 percent (numbers not untypical for corn share tenant households) would give an estimate of income that was a minimum of 8 percent higher (profits go up by more than 25 percent, the percentage depending on the difference between the output price and production costs).

Comparing incomes and total expenditures for the various crop-tenancy groups given in Table 15, there is the expected strong association between the two variables, with savings indicated for the higher-income groups and accumulation of debts for the lower-income groups. While this pattern of savings and debts may actually have occurred over the particular survey period, the accumulation of debts obviously cannot occur indefinitely. An alternative interpretation is that certain socially obligatory income transfers to extended family members or other dependents are perhaps easy to pick up on the expenditure side, but not on the income side, for net "debtors" (low-income groups), and are picked up on the income side, but not on the expenditure side, for net "lenders" (high-income groups). If this is the case, both the income and expenditure data are biased, with income data underestimated at the low end of the distribution and expenditure data underestimated at the high end.

Using Income and Expenditures to Classify Households

In order to obtain a rough estimate of the income elasticity of household calorie consumption from Table 15 as an intuitive check against regression results presented in

Chapter 6, what is the dispersion in incomes and expenditures between low- and high-income groups? Disaggregating by *income* quintile in this two-way table, incomes increase by a factor of 7.7 from the first to fifth income quintile, while factors for total expenditures and food expenditures are only 2.5 and 2.0, respectively. Disaggregating by *expenditure* quintile, these three factors are 4.0, 4.1, and 3.0, respectively. In the second calculation, income dispersion goes down, while expenditure dispersion goes up. Which of these conflicting results is to be believed?

Any disaggregation of a continuous variable into equal groups by a monotonic ranking of *itself* will likely overstate the actual dispersion calculated as above. This is because randomly distributed overestimates of the variable tend to be filtered to one side of the distribution and underestimates to the opposite side.[4] This is a particular problem at the tails, while for middle groups overestimates and underestimates will tend to even out (note in Table 15 that for both the *third income* and *third expenditure* quintiles, estimates of income, total expenditures, and food expenditures are nearly identical). Despite this, economic data are often presented and analyzed in this manner; for example, total expenditure data by expenditure decile.

What is perhaps more common is the presentation and discussion of the dispersion of a second variable, which is correlated with and ranked using the first variable; for example, rice consumption by expenditure decile (assume that rice consumption data are collected independently of the total expenditure data and are not used in the calculation of total expenditures). The dispersion of the second variable (rice consumption) will be *understated* to the extent that there are errors in measuring the first variable.

To see this, assume that two data sets are available, one with perfectly measured estimates of total expenditure and rice consumption (which generate accurate estimates of rising rice consumption for each successively higher expenditure decile), and a second data set identical to the first, except that the expenditure data are replaced by numbers randomly generated from a normal distribution with the same mean and variance as the original expenditure data. Given a large enough sample, average rice consumption for all 10 expenditure deciles computed from this second data set should be equal. As observations are gradually added from the second data set to contaminate the first data set, the dispersion in rice consumption computed from the combined data set will gradually decline and give an estimate lower than the true value.

This example provides a framework, then, for an intuitive understanding of the different patterns of dispersions obtained above when disaggregating by income quintile and by expenditure quintile in Table 15. More important, however, some rules can be stated about the relative magnitudes of the biases introduced: (1) dispersion biases are smaller across classification groups in the middle of the distribution than across classification groups at the tails of the distribution; (2) dispersion biases are smaller for variables that can be measured more accurately; (3) after measuring the dispersions of two variables by stratifying by each of the variables, estimates can be obtained that "bracket" the true dispersion.

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[4] In econometrics, a well-known result is that errors in measuring a variable will lead to estimates that are biased toward zero. In computing elasticities from dispersions observed in two-way tables, the greater dispersion caused by measurement errors when a variable is classified by itself results in a larger denominator, which biases the elasticity estimate toward zero. As the discussion goes on to point out, this is reinforced by an understatement of the dispersion of the correlated variable, which appears in the numerator of the simple elasticity calculation.

By making use of rule 1 to illustrate the use of rule 3, ratios of income and total expenditures for the fourth and second income quintiles and the fourth and second expenditure quintiles are computed and shown in Table 26.

Between the second and fourth income/expenditure quintiles, then, incomes increase between 77 and 91 percent and total expenditures increase between 34 and 68 percent. Since expenditures can be measured more accurately than income, using rule 2, the income increase is closer to 77 percent than to 91 percent and the increase in expenditures is closer to 68 percent than to 35 percent.

Using estimates of 80 percent for the increase in income and 65 percent for the increase in total expenditures implies a marginal savings rate of about 20 centavos out of each extra peso of income. While such a marginal savings rate seems perhaps high, using percentage increases closer to those generated by the income quintile breakdown gives even higher marginal rates of saving. The expenditure quintile breakdown seems to give more reasonable estimates.

Calorie Availability Versus Calorie Intakes

In order to obtain an estimate of the numerator in the calculation of an income elasticity of household calorie consumption, what is the dispersion in household calorie consumption between the second and fourth income/expenditure quintiles? According to the rules above, the dispersion estimates of calorie availability or calorie intakes by income quintile or by expenditure quintile in Table 15 all understate the true dispersion. Nevertheless, since expenditure data are measured more accurately, expenditure quintiles should give a better indication.

Empirically, the selection between the two data sources for calories turns out to make much more difference than the selection of income or expenditure quintiles. The calorie availability data indicate percentage increases of 19.0 percent and 25.4 percent for income and expenditure quintiles, respectively, and the calorie intake data indicate percentage increases of only 4.7 percent and 5.4 percent for income and expenditure quintiles, respectively (see Table 26). Which data source is more accurate?

Table 26—Income elasticities of household calorie consumption implied by the two-way relationship between income and household calorie intakes

Categories Across Which Elasticities Are Calculated	Ratio of Incomes	Ratio of Total Expenditures	Ratio of Calorie Availability	Ratio of Calorie Intakes	Implied Elasticity: Income, Calorie Availability	Implied Elasticity: Income, Calorie Intake	Implied Elasticity: Total Expenditures, Calorie Availability	Implied Elasticity: Total Expenditures, Calorie Intake
Fourth and second income quintiles	1.890	1.314	1.180	1.052	0.20	0.06	0.57	0.17
Fourth and second expenditure quintiles	1.803	1.677	1.244	1.066	0.32	0.07	0.36	0.10
Corn-owner and corn-laborer households	1.793	1.523	1.079	1.026	0.10	0.03	0.15	0.05
Sugar-owner and sugar-laborer households	2.645	2.091	1.202	1.067	0.12	0.04	0.19	0.06

Note: The two-way relationship is presented in Table 15.

In a comparison of the two data sources for the eight crop-tenancy groups, for six of the groups calorie availability and calorie intakes are within 3 percent of each other. For the two highest-income crop-tenancy groups, sugar owners and sugar owner/renters, however, calorie availability exceeded calorie intakes by 11 percent and 29 percent, respectively. Food expenditures for family consumption for these households were apparently seriously overestimated, even though questions were asked about food given to guests and to hired laborers, which was subtracted from food expenditure and calorie availability estimates. Data not shown here indicate that the most serious discrepancies between calorie availability and intakes occurred in round 3 of the survey during the height of the sugar harvest. Thus, calorie intake data would appear to be more reliable than calorie availability data.

Finally, taking 5 percent (percentage increase in household calorie intakes between the second and fourth expenditure quintiles) as the numerator of the income elasticity of household calorie consumption, and either 80 percent (percentage increase in income) or 65 percent (percentage increase in expenditures) as the denominator, gives elasticity estimates below 0.10. At average income levels for the sample households, analysis of the data from Table 15 indicates that as permanent incomes double, household calorie consumption goes up less than 10 percent. This figure is consistent with regression estimates presented in Chapter 6.

Conclusion

The presentation here has been somewhat intuitive, but the same concepts have been developed more rigorously from an econometric perspective in Bouis and Haddad 1989. The regression analysis presented there gives very similar elasticity estimates to those developed in Table 26.

An important objective of this discussion has been to show that because total expenditures and calorie availability are both constructed from food-expenditure data, there is a strong potential for upwardly biased estimates of the relationship between total expenditures and calorie availability. Households that overestimate (underestimate) food expenditures necessarily overestimate (underestimate) total expenditures and calorie availability. Such overestimations and underestimations may be random in nature, or what is worse in the case of the data presented here, there may be a systematic bias associated with a particular income level.

The availability of income and calorie intake data, which are collected independently of food expenditures, allowed a check against the usual shortcut of using total expenditures and calorie availability. While the income and calorie intake data are admittedly difficult and expensive to collect, in this study these alternative data sources gave elasticity estimates that differed by a factor of four or five from estimates derived using calorie availability and total expenditure data.

APPENDIX 3
DESCRIPTIVE STATISTICS AND RESULTS OF F-TESTS AND TESTS FOR EXOGENEITY

Table 27—Descriptive statistics for variables used in regression analysis

Variable	Mean	Standard Deviation
Tables 16 and 18		
YPCPWK	41.72	42.30
FFEXWKPC	31.14	16.53
MOTHED	6.15	2.68
FATHED	5.59	2.94
MOTHAGE	32.94	7.40
FATHAGE	36.73	8.33
NUTRSC1	7.54	3.22
PRCORN	3.67	0.63
PRRICE	5.07	0.76
PCTHOME	38.73	25.49
POPDEN	150.04	44.89
ADEQVHH	5.25	2.12
RD1	0.25	0.43
RD2	0.25	0.43
RD3	0.25	0.43
AVNETWTH	22,651.22	46,061.88
CULTARPC	0.38	0.39
Number of observations	1,642	. . .
Table 20		
PCALAEQ	1,915.35	901.23
HCALAEQ	2,363.47	726.69
RATIOPAR	1.22	0.19
MOTHED	6.18	2.71
MOTHAGE	393.28	89.53
NUTRSC1	7.60	3.20
CHILDCRE	70.04	97.93
SICK	0.30	0.44
SEX	0.55	0.50
ACCAGE	39.16	11.92
AGESQ	1,703.12	898.67
ADEQVHH	5.22	2.06
RD1	0.27	0.44
RD2	0.24	0.43
RD3	0.24	0.43
FFEXWKPC	31.05	16.61
BRTHORDR	4.04	2.22
FATHED	5.66	2.82
Number of observations	995	. . .
Table 25		
ZHA	−2.16	1.18
ZWH	−.53	0.83
PCALAEQ	1,929.62	918.31
DIARR	0.03	0.17
FEVER	0.18	0.38
MNTHBFED	13.76	8.09
BRTHSP1	38.16	22.18
MOTHED	6.28	2.75
FATHED	5.70	2.96
MOTHAGE	398.09	82.74

(continued)

Table 27—(continued)

Variable	Mean	Standard Deviation
NUTRSC1	7.80	3.27
CHILDCRE	71.74	103.00
SEX	0.53	0.50
HTFATH	161.44	5.89
HTMOTH	150.40	6.95
RD1	0.27	0.44
RD2	0.25	0.44
RD3	0.24	0.43
FFEXWKPC	30.56	16.76
Number of observations	995	. . .

Definitions of variables:

YPCPWK	=	income per capita per week (LNY = ln[YPCPWK]);
FFEXWKPC	=	household food expenditures per capita per week (LNFFEX = ln[FFEXWKPC]);
MOTHED	=	years of formal education of the mother;
FATHED	=	years of formal education of the father;
MOTHAGE	=	age of the mother in months;
FATHAGE	=	age of the father in months;
NUTRSC1	=	measure of nutritional knowledge of the mother;
PRCORN	=	quality-adjusted real price of corn;
PRRICE	=	quality-adjusted real price of rice;
PCTHOME	=	percent of food expenditures coming from own-farm production;
POPDEN	=	population density of municipality;
ADEQVHH	=	number of household members expressed in adult-equivalents;
RD1,RD2,RD3	=	zero-one dummy variables for round;
AVNETWTH	=	average net worth of all household assets;
CULTARPC	=	average cultivated area per round;
PCALAEQ	=	preschooler calorie intake per adult-equivalent per day;
HCALAEQ	=	household calorie intake per adult-equivalent per day;
RATIOPAR	=	ratio of average of father's and mother's calorie intake per adult-equivalent over the household calorie intake per adult-equivalent;
CHILDCRE	=	minutes spent by mother in child care in previous 24 hours;
SICK	=	zero-one dummy for reporting sickness in previous two weeks;
SEX	=	0 = female, 1 = male;
ACCAGE	=	age of preschooler in months;
AGESQ	=	age of preschooler squared;
BRTHORDR	=	birth order;
ZHA	=	height-for-age;
ZWH	=	weight-for-height;
DIARR	=	zero-one dummy for diarrhea reported in past two weeks;
FEVER	=	zero-one dummy for fever reported in past two weeks;
MNTHBFED	=	months that child was breastfed before stopping;
BRTHSP1	=	months between births of present and previous child;
HTFATH	=	height of the father in centimeters; and
HTMOTH	=	height of the mother in centimeters.

Table 28—Results of testing for equality of coefficients between corn and sugar households

Table 16 (dependent variable = per capita food expenditures)

RSS for corn sample	=	135,249.30
RSS for sugar sample	=	121,713.60
RSS for combined sample	=	269,603.00
Number in corn sample	=	928
Number in sugar sample	=	624
Number of restrictions	=	14
F-statistic	=	5.35

Table 18 (dependent variable = household calorie intake per adult-equivalent)

As Estimated in Table 18			Adding Owned Area Cultivated as an Additional Regressor[a]		
RSS for corn sample	=	491,504,400.00	RSS for corn sample	=	491,493,500.00
RSS for sugar sample	=	259,865,900.00	RSS for sugar sample	=	256,795,800.00
RSS for combined sample	=	757,230,300.00	RSS for combined sample	=	754,399,700.00
Number in corn sample	=	928	Number in corn sample	=	928
Number in sugar sample	=	624	Number in sugar sample	=	624
Number of restrictions	=	14	Number of restrictions	=	15
F-statistic	=	0.85	F-statistic	=	0.83

Table 20 (dependent variable = preschooler calorie intake per adult equivalent)

RSS for corn sample	=	182,699,100.00
RSS for sugar sample	=	117,367,400.00
RSS for combined sample	=	308,102,400.00
Number in corn sample	=	587
Number in sugar sample	=	345
Number of restrictions	=	14
F-statistic	=	1.73

Table 25

(dependent variable = weight-for-height)			(dependent variable = height-for-age)		
RSS for corn sample	=	281.65	RSS for corn sample	=	559.32
RSS for sugar sample	=	200.88	RSS for sugar sample	=	343.42
RSS for combined sample	=	502.60	RSS for combined sample	=	948.37
Number in corn sample	=	522	Number in corn sample	=	522
Number in sugar sample	=	347	Number in sugar sample	=	347
Number of restrictions	=	16	Number of restrictions	=	16
F-statistic	=	2.18	F-statistic	=	2.64

Notes: RSS = residual sum of squares. Critical F-value for the various equations falls between 1.3 and 1.4 at the 0.01 level.

[a] To take account of overestimated food expenditures by sugar owner households and sugar owner/renter households.

Table 29—Results of Hausman tests for exogeneity of right-hand side variables

Table 16 (dependent variable = per capita food expenditures; tested independent variable = per capita income)

Sample Households	Identifying Variable(s)	t-Statistic for Fitted Value
All	CULTARPC, AVNETWTH	14.22
All	CULTARPC	12.67
All	AVNETWTH	12.06
Corn	CULTARPC, AVNETWTH	9.64
Corn	CULTARPC	8.06
Corn	AVNETWTH	7.13
Sugar	CULTARPC, AVNETWTH	7.20
Sugar	CULTARPC	6.73
Sugar	AVNETWTH	6.08

Table 18 (dependent variable = household calorie intake per adult-equivalent; tested independent variable = per capita food expenditures)

Sample Households	Identifying Variable(s)	Estimated as Shown in Table 18	Owned Area Cultivated Added as Explanatory Variable
All	CULTARPC, AVNETWTH	2.12	0.38
All	CULTARPC	1.42	−0.27
All	AVNETWTH	2.56	1.16
Corn	CULTARPC, AVNETWTH	−0.53	−0.55
Corn	CULTARPC	−0.62	−0.64
Corn	AVNETWTH	−0.16	−0.11
Sugar	CULTARPC, AVNETWTH	2.37	0.68
Sugar	CULTARPC	1.88	0.25
Sugar	AVNETWTH	2.47	1.01

Table 20 (dependent variable = preschooler calorie intake per adult-equivalent; tested independent variable = household calorie intake per adult-equivalent)

Sample Households	Identifying Variable(s)	t-Statistic for Fitted Value
All	FFEXWKPC	0.63
Corn	FFEXWKPC	−0.14
Sugar	FFEXWKPC	1.07
	Tested independent variable = ratio of parents' intake to household intake	
All	FATHED	1.02
Corn	FATHED	1.95
Sugar	FATHED	−1.04
	Tested independent variable = sickness of preschooler during past two weeks	
All	BRTHORDR	−0.22
Corn	BRTHORDR	0.22
Sugar	BRTHORDR	0.69

Table 25 (dependent variables = weight-for-height and height-for-age; tested independent variables = preschooler calorie intake per adult-equivalent)

Sample Households	Identifying Variable(s)	Dependent Variable Is Weight-for-Height	Dependent Variable Is Height-for-Age
All	FFEXWKPC	−0.16	2.17
Corn	FFEXWKPC	0.30	−0.71
Sugar	FFEXWKPC	−1.11	2.93

Note: Critical t-value for the various equations falls between 1.96 and 1.98 at the 0.05 level for a two-tailed test.

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